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**Tabanini of Thailand
above the Isthmus of Kra
(Diptera: Tabanidae)**

John J. S. Burton

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by
John J.S. Burton
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Table of Contents

	Page
Acknowledgments	4
Background	4
Economic Importance	5
Some Collections of Tabanidae Made in Indochina	6
Thailand and Zoogeography	10
Superspecific Taxa of Tabanini with Reference to Thailand	13
The Species Concept	15
Field Procedures	15
Explanation of Species Accounts	16
Key to Females	17
Species Accounts	23
Other Species Involved or Implicated in the Indochina Area	148
References Cited	159
Taxonomic Index	163

Tabanini of Thailand above the Isthmus of Kra (Diptera: Tabanidae)

The Oriental tabanid fauna is unusually rich yet is almost certainly the least known of any zoogeographic region. The region remains a taxonomic frontier even in those countries which have been the subject of the longer papers.

In this study I have combined a knowledge of Thailand, gained originally from service as a U.S. Peace Corps malaria entomologist, with an earlier interest in Tabanidae. The great majority of specimens were collected by me or by collectors under my supervision. Historical material was studied in museums in London, Paris, and Washington, with loans from elsewhere.

The 31 species described as new and the 24 nominal taxa newly synonymized are easily found in the species account headings and synonymy. Lectotypes for the following species of *Tabanus* are designated: *bicallosus* Ric., *indianus* Ric., *kakhyenensis* S.-Wh., *rubicundulus* Aust., *rubidus* Wied., *soubirovi* Surc., *speciosus* Ric., *subcallosus* Ric. The following species of *Tabanus* are resurrected from earlier synonymy: *assamensis* (Bigot), *crassus* Walk., *dorsilinea* Wied., *fulvimedius* Walk., *infamis* Szil., *internus* Walk., *megalops* Walk., *monilifer* (Bigot), *nonoptatus* Ric., *salvazai* Surc., *vagus* Walk. The following new generic combinations are proposed: *Tabanus gilvellus* Philip to *Atylotus*, *Tabanus humillimus* Walker to *Atylotus*, *Tabanus pusillus* Macq. 1838 to *Atylotus*, *Tabanus subcallosus* Ric. returned to original combination.

Some of the more diverse aspects of the field investigations in Thailand are to be noted in a separate paper (Burton, in press).

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Background

Early accounts of travel in Southeast Asia often recorded tabanids as a scourge. Henri Mouhot, exploring northeast Thailand in 1861, reported assaults by "legions of ox-flies" (Pym 1966:143). Hornaday (1908:323), while hunting in Selangor, Malaya, in 1878, noted the following about a fresh-killed elephant:

"His back was thickly encrusted all over with a half-inch coating of dried mud, the wise provision of a sagacious animal against the attacks of a swarm of huge gad-flies which buzzed about him. They bit the blood out of us more than once, and annoyed us exceedingly while we were at work on the dead elephant."

Discussing his observations made during the 1880's, Pavie (1904:252) stated,

"En Indo-Chine les plus gros animaux, les éléphants même, sont mis en sang par les taons; j'en ai souvent beaucoup souffert dans certaines régions."

While surveying possible railway routes, Hallett (1890:179) noted the following in what is now Thailand's Chiang Rai Province:

"Large herds of cattle and buffaloes were feeding in the plain, waging ceaseless war with their tails against myriads of bloodthirsty gad and ele-

phant flies. The elephants were likewise greatly annoyed by these flying leeches, and carried leafy branches in their trunks to switch them off their bodies. No one who has seen elephants fanning themselves with great palmyra-leaves, switching at the flies, or scratching themselves with twigs, could consider man the sole tool-using animal."

I, too, have seen an elephant use a coconut frond for this purpose.

The amount of scientific literature on mainland Southeast Asian tabanids has not sufficed to reflect their economic importance or biological diversity. At least until recently this has been especially true of Thailand, perhaps largely due to its lack of colonial heritage. Ricardo's work (1911 plus a second article in the same journal

and year covering genera other than *Tabanus*) is the cornerstone of organized classification for the Oriental Region, but she said almost nothing about Thailand or the countries to the east. Scattered articles were written by a variety of researchers, mostly following colonial lines (e.g. on Burma and Malaya by Englishmen and on Laos, Cambodia, and Viet-Nam by Frenchmen). Until 1960, the only paper which took aim at Thailand was by Austen (1922a). Schuurmans Stekhoven's impressive monograph (1926) was not intended to include Thailand, though some records and descriptions were added. Philip's work (1960a, b) added a number of new species and summarized the species known from Thailand up to that date. He has since written other papers involving the Thai fauna. Stone (1975) has cataloged the Oriental species. Stone & Philip (1974) have taxonomically accounted the Oriental species of Haematopotini including the known Thai fauna.

Economic Importance

It was realized since the very early years of the century that tabanids were involved in the transmission of trypanosomiasis in the Orient, especially *Trypanosoma evansi*, causing a disease of livestock known as surra. This disease, especially virulent in equines, is mechanically transmitted by the feeding activity of biting flies, and tabanids have been proven as vectors many times over. It was once so important that commerce (and perhaps land settlement patterns) were affected. Senior-White (1922:103) stated, "Practically nothing is known of the Tabanidae of Upper Burma, where the disease is so rife that, according to Captain Enriquez, the trade route to Yunnan is closed for several months of the year, through the Chinese muleteers refusing to expose their animals to its ravages..." Surra seems to have received almost no new attention in the literature since the 1930's, however, and I presume that the problem has been mostly resolved through chemotherapy.

In some Holarctic areas, Tabanidae are capable of the mechanical transmission of the bacterial disease tularemia to man. In discussing World War 2 and under the heading "Deer flies and tabanids", Cushing (1957:87) stated of tularemia that "The disease...hospitalized a number of soldiers in China and Burma." I have tried at length to confirm his statement, but all of the tularemia records I have seen do not include China and come nowhere near Burma; hence I do not think it exists in Southeast Asia.

Various species of Indochinese Tabanidae are known to attack man, so the annoyance

factor and potential for disease transmission are present. Quantitatively, however, these do not seem to be serious at the present time. I have not experienced in Southeast Asia attacks by any Tabanidae which in any way compare with the discomfort of being surrounded by a population of North American *Chrysops*. And if given a choice between man and domestic livestock (as was essentially the case through most of my collecting), Indochinese tabanids seem to attack the livestock almost invariably.

I believe it is safe to say without any hesitation that the principal economic importance of these flies is the direct effect of their biting activity on livestock. This has apparently never been quantified in the Oriental Region, and should be a high priority item. Such a study would be sure to have the desirable result of calling attention to their great importance and might serve to stimulate further research. In some localities the *Tabanus* were so numerous that they almost seemed to cover the entire venter of animals observed, and must certainly have had a debilitating effect. At the village level, husbandry practices for draft and meat animals are such that an anti-fly campaign might be difficult and would, in the absence of convincing data, be regarded as an unnecessary expense. Several Thailand operations visited, including the Thai-Danish Dairy Farm in Saraburi Province and the Northeast Agricultural Center in Khon Kaen Province were successfully using chemical treatments on livestock. The great increase in biting activity during the last hour before darkness, seen at so many localities, suggests that a method of reducing the problem might be to shelter the livestock during that hour.

Some Collections of Tabanidae made in Indochina

This section has been compiled both as a tribute to the collectors and to provide fragmentary information on the circumstances of their

collecting. It is hoped that the result will be a better understanding of the species involved.

Pavie Indochina Collection, 1883-1888, described by Bigot (1890)

Monsieur Auguste Pavie was the French consul in Cambodia. His travels took him far and wide in Cambodia, Thailand, and Laos, and are thoroughly documented by himself (Pavie 1901). The total span of his dates in Indochina was from 1879-1895, but some of the interim years were spent back in France. He collected Tabanidae along with other insects in general, apparently concentrating on Coleoptera.

Bigot (1890) was able to describe 6 new tabanid species (and one nomen nudum) from Pavie's collection, in every case (except the nomen nudum) from a single specimen with type locality published as "Laos." It is not clear where Bigot got the idea that Laos was invariably the origin of the specimens. The chances are that they did not come to be data-labeled in their present form until after Bigot had completed his work. He was probably told (accurately) that the 1888 material had come from Laos, and, in the absence of labels to the contrary, simply presumed that the 1886 material had come from there also. This gave rise to a great deal of confusion in the literature, right up to the present.

It need not have been confusing. After all of the various natural history specimens brought home by Pavie had been researched and published by the experts, but before anything further had been published on tabanid species in question, Pavie himself compiled and edited all the published works concerning his expeditions, and republished them as collected results in several volumes. Bigot's (1890:203-207) tabanid work was faithfully reproduced (Bigot 1904:253-256), except for the fact that Pavie corrected and elaborated the type localities! The corrections were checked by me in the Paris Museum and found to be in agreement with the type data labels as they now stand. Thus, the following type localities are reported as accurate, succeeded by a partial list of inaccurate reports:

Tabanus leucosparsus Bigot: "MUSEUM PARIS/LUANG PRABANG/à THENG Pavie 1888". Not "Laos (Siam)" (Ricardo 1911:188); not "(Siam)" (Philip 1960b:56).

Atylotus laotianus Bigot [now *Tabanus*]: "MUSEUM PARIS/LUANG PRABANG/à THENG Pavie 1888". Not "India, Chargole Valley, Sylhet, Austen Fr. '91 Coll. BR.M." (Schuermans Stekhoven 1926:414). Since both the type locality and type depository are so drastically wrong here,

Stekhoven must certainly have confused the type data of some other species with *laotianus*.

Ballardia nigropecta Bigot [now *Tabanus*]: "MUSEUM PARIS/SIAM/Pavie 1886/Chantaboun à Battambang". Not "Laos" (Bigot 1890:204). The "Southern Siam" of Austen (1922a:437) and "So. Thailand" of Philip (1960b:53) are mildly misleading, though the correct locality can be gleaned from them by cross-reference to the following species.

Haematopota? cilipes Bigot: Same data and reporting as for *nigropecta* above. This type, together with those of *H. pachycera* and *H. cingulata*, was found in the Paris Museum stored not under genus *Haematopota* but under genus *Potisa*, which reflected the viewpoint of Surcouf and presumably also of Séguy. As a consequence of this storage, Stone & Philip did not see these types during their Oriental *Haematopota* monographic work. When told about them, Stone (personal communication) indicated that these species had probably been correctly understood.

Atylotus melanognathus Bigot [now *Tabanus*]: "MUSEUM PARIS/CAMBODGE/Pavie 1886". Not "Laos" (Bigot 1890:204); not "...this too could come from So. Thailand" (Philip 1960b:52).

Haematopota? pachycera Bigot: Same data as for *T. melanognathus*, above. Not "Laos" (Bigot 1890:207); not "Siam" (Philip 1960b:63).

Haematopota? macrocera: Bigot. No locality was mentioned, and the name was simply listed as "nom. in litteris" under *cingulata* Wiedemann by Surcouf (1921:32).

The species described as new by Bigot were not the only ones brought home by Pavie. In the Paris Museum, associated with *T. basalis*, I found 7 specimens (6 of which were double-mounted but which have now been remounted singly) which are in fact a new species, described elsewhere in this paper as *T. paviei*. This series is labeled "MUSEUM PARIS/LUANG PRABANG/à THENG Pavie 1888", thus matching the locality of 2 other species above.

All of the Pavie collection known to date was labeled to show only 3 collecting localities, which will now be explained.

"Siam...Chantaboun à Battambang...1886". Chantaboun is the present-day Thai town of Chanthaburi, located at 12°37'N 102°07'E. Battambang is a town located at 13°06'N 103°12'E which has kept its name intact, but which has changed countries since Pavié's time. Although ethnically Cambodian (Khmer), the province of Battambang was at that time part of Siam. It has long since been restored to Cambodia, Pavié's route between these 2 towns was very long and roundabout, going first SE to Trat (= "Krat"), Kas Kong (= "Kokong"), and Kompong Som (10°31'N 103°41'E), then N and NE to Battambang. Although Pavié was correct to label the route "Siam" at the time, the present placement of the international border is such that about 70% of his route now lies within Cambodia. I judge that there is a corresponding likelihood that the types of *T. nigrotectus* and *Haematopota cilipes* are, therefore, from present-day Cambodia rather than Thailand. There is another question involved with the labeling of these specimens. Pavié's (1901) expositional volume indicates that his journey over this route took place between late 1883 and early 1884, not in 1886. Therefore, although the labels clearly show the latter date, it should be rejected in favor of 1883-1884, as the text is clear and detailed on this point (1901:132, 152-158,

and contrast the map on p.80 with that on p.198).

"Cambodge...1886". This name is the French form of Cambodia. As just explained, its boundaries were smaller then than now. Thus, the types of *T. melanognathus* and *Haematopota pachycera* were collected within present day Cambodia but apparently not as far NW as Siem Reap and Angkor, which were then in Siamese possession.

"Luang Prabang à Theng...1888". Luang Prabang is the royal capital of Laos, situated at 19°52'N 102°09'E. Theng cannot be found on any modern maps, but according to Pavié's own textual exposition of his journeys, Theng was even then called Dien Bien Phu by the "Annamites," and this latter name has since entirely superseded Theng. The locality is just inside N. Viet-Nam from Laos at 20°23'N 103°01'E. (It came to have much historical significance to Pavié's countrymen.) He took several different routes between the 2 towns, but in any case the great majority of the distance lies within Laos, with only a fragment at the end within Viet-Nam. Thus it is most reasonable to say that the type locality for *T. leucosparsus*, *T. laotianus*, and *T. paviei* is Laos.

Vitalis de Salvaza Collection in Laos and Tonkin, 1917-1920, described by Surcouf in 1922

Monsieur R. Vitalis de Salvaza was a French entomologist whose principal concentrations were Lepidoptera and Coleoptera, though he was also broadly interested in all insects and made successful collecting trips into the hinterlands of Indochina. He published several works on the area, including "Essai d'un Traité d'Entomologie Indochinoise" in 1919. Surcouf once referred to him as "notre excellent collègue".

While many older collections suffer the disadvantage of having been labeled too generally (e.g., nothing more than the country of origin recorded), the Vitalis de Salvaza collection presents the opposite problem. That is, very localized collecting localities were recorded, without any further indication of how they might be traced. Hence I have been unable to find about half of them even after searching through both modern and older map sources. A complete chronological list of type series localities is presented as transcribed from the actual specimen labels in the Paris Museum as well as the original descriptions, in hopes that it may help to trace them eventually.

Date as recorded	Locality	<i>Tabanus</i> collected
juin 1917	Tonkin	<i>hypomacros</i> cotype ♀
11. 10. 1917	Dong-Van (Tonkin)	<i>ictericus</i> type ♀
27-III-1918	Nam Pik (Laos)	<i>cepuricus</i> type ♀
27-III-1918	Nam Pik (Laos)	<i>soubiroui</i> cotype ♀
13-IV-1918	Tong King (Laos)	<i>soubiroui</i> cotype ♀
14-IV-1918	Nam Tiene (Laos)	<i>soubiroui</i> types ♀ ♂ & cotypes 3♂♂
15-IV-1918	Nam Mat (Laos)	<i>euphanes</i> type ♀
15-IV-1918	Nam Mat (Laos)	<i>soubiroui</i> cotype ♀
29-IV-1918	Sang Ke (Laos)	<i>soubiroui</i> cotype ♀
30-IV-1918	Tong La (Laos)	<i>tonglai</i> type ♀ & cotype ♀
8-V-1920	Pang Hai (Laos)	<i>hypomacros</i> type ♀
8-V-1920	Pang Hai (Laos)	<i>salvazai</i> type ♀
10-V-1920	Muong Kofa (Laos)	<i>pseudopallidepectoratus</i> type ♀

Of this list, the following have been identified. Tonkin is now all of that part of N. Viet-Nam which lies above the Ma River, with the line straightened on a NW-SE diagonal which hits the

Date as recorded	Locality	<i>Tabanus</i> collected
juin 1917	Tonkin	<i>oknos</i> type ♀
juin 1917	Tonkin	<i>pallidepectoratus</i> var. <i>aurea</i> type ♀

seacoast immediately below the 20°N parallel. Dong-Van is a town at the uppermost tip of N. Viet-Nam at 23°08'N 105°20'E. Nam Mat is identified elsewhere in the discussion of *euphanes*. Nam Tiene is identified in the discussion of *soubiroi*. Nam Pik is tentatively identified at 19°23'N 102°54'E, not far south of Muong Soui on the SE edge of the Plain of Jars. At this site on the National Geographic Society 1967 map of "Viet Nam, Cambodia, Laos, and Thailand" there is a village shown as "Ban Nam Pit"; and at the same site on U.S. Army maps the village is shown as "Ban Nam Pih". Either of these alternates could have been transcribed as Pik for several reasons by Vitalis de Salvaza, and the site is also reasonable on the grounds that he is known to have been on the other side of the Tranninh Plateau (at Nam Tiene) just 18 days later. The remaining localities are untraced, though guesses at their general area are made in the discussion of some species.

Surcouf had apparently intended his brief, unillustrated descriptions only as preliminaries to a fancier work, as he stated in his introduction (1921(1922):285): "Nous avons l'intention de publier sur ces captures un mémoire illustré de nombreuses figures, qui paraîtra dans la *Revue entomologique de l'Indo-Chine française*." It remained an unfulfilled intention.

Mouhot Thailand Collection, 1859, described by Austen (1922a)

Monsieur Henri Mouhot was a Frenchman and an explorer of the first order whose travels in Indochina began in 1858 and ceased in 1861 when he lost his life to a fever-producing disease in the jungle just east of Luang Prabang, Laos. A new edition of his fascinating explorations has been compiled by Pym (1966), which is highly recommended to all who are interested in natural and human history in the area. Mouhot's writings reawakened the interest of the western world in the great ancient civilization of Angkor in Cambodia. His insect collection is known to include the syntypes of *T. rubicundulus* Austen (1922a: 442-444) and the "second specimen" of *T. barnesi* Austen (1922a:435-437), all of which were labeled as "Chantabun", the modern name of which is Chanthaburi, a town in the southeastern corner of Thailand at 12°37'N 102°07'E. He made this his base for side trips during the first 3 months

Barnes Thailand Collection, 1921, described by Austen (1922a)

Austen pointed out in his introduction (1922a:431) that Dr. M.E. Barnes was a member of the Rockefeller Foundation, New York. I can only add that his assignment in Thailand concerned hookworm (uncinariasis) control. He made collections in the Chiang Mai area in April-May

All specimens named above were seen in the Paris Museum except *ictericus* and *pseudopallidepektoratus*, which must be considered as lost.

Some other specimens from Vitalis de Salvaza's collection have also been seen which were not described by Surcouf, e.g. 1♀ of *monilifer* from Laos: "Xieng-Om/le 30-III-1920" (Paris Mus.), and 2♀♀ of *longibasalis* from Laos: "Luang Prabang./Muong You./25. v. 1919" (BMNH).

In an unfortunate bit of timing, Surcouf was working on the above material at the same time that Austen was working on a number of the same species collected in Thailand. The dates for the 3 resulting publications are:

Surcouf 1921(1922): published 13 January 1922

Surcouf 1922: published 11 February 1922
Austen 1922a: published 4 March 1922

Dates pertinent to Surcouf's papers were published in Bull. Soc. Ent. France 1921:323 and 1922:348; I obtained the Austen mailing date from Dr. A.H. Parker, Assistant Director, Commonwealth Institute of Entomology, London. Synonymy was thus created in the cases of 4 different species, and Austen's names for these become the junior synonyms.

of 1859 (Pym 1966:xiii-xiv). Chanthaburi itself is virtually at sea level, but Mouhot is known to have visited Khao Sa Bap, a mountain beginning just 8 km to the southeast which reaches a height of 900 m, and he could easily have labeled any specimens collected there simply as "Chantabun" also. If other localities are found to be represented, they can quite possibly be traced with the use of Pym's edition. Although Mouhot made no known field notes on specific localities as they related to tabanids, during May-June 1861 during the leg of his journey between Chaiyaphum (NE Thailand) and Paklay (Laos), he did mention assaults by "legions of ox-flies, which after sunset, attack human being as well as elephants" (Pym 1966: 143), which I take to mean tabanids.

The above specimens are in British Museum (Natural History) (BMNH).

1921, and in the Bangkok area in June and August 1921. Field notes concerning the specimens were provided by Barnes and duly quoted by Austen; in some cases, Austen transcribed the notes and affixed them to the specimen pins. Barnes's most important collecting locality was

"Doi Chom Chang, near Chiangmai." No mountain with the name of Chom Chang is shown on modern maps, but I have been told about it by Dr. Ernestine Thurman whose work made it an important locality in mosquito taxonomy. It is one of the separate summits of the Doi Suthep

massif to the west or northwest of Chiang Mai, and may perhaps more phonetically be spelled Chom Cheng. Barnes's other localities need no explanation.

This collection was given to BMNH.

Indochina Collection described by Toumanoff, 1941-1953

Monsieur Constantin Toumanoff was a French medical entomologist who spent many years in S. Viet-Nam and Cambodia as "Chef de Laboratoire d'Entomologie medicale aux Instituts Pasteur de l'Indochine". His publications on this area span at least the years 1928-1953 and cover a wide variety of subjects including malaria and anophelines, filariases, ticks, fleas, and flies. A partial list of his titles appears in Segal *et al.* (1968).

It can generally be assumed that Toumanoff himself collected the tabanid specimens which he described, as the introduction to his later series of 3 papers (1950a, 1950b, 1953) stated: "Au cours de ces dernières années j'ai recueilli en Indochine un certain nombre de Tabanidae." In the case of *T. nantae*, the species is named

after its 'communicator'. In several other cases (*T. flavioculatus*, *T. aublanti*) the fact that the types were not deposited in the Institut Pasteur de Paris is grounds to assume that Toumanoff did not collect them. His collection, in this institute, contains perhaps no more than 100 specimens, and only about 1/4 of these actually bear Toumanoff's determination labels. The institute does not use an acquisition log book system, so the data reported in Toumanoff's papers cannot be checked against the specimens at all, as the specimens do not bear any collecting data labels. He apparently kept this information only in personal notes. He died several years ago and no such notes have been found at the institute, according to Dr. P. Grenier, head of the medical entomology section. The present status of his type specimens is noted under separate accounts.

Thurman Thailand Collection, 1951-52, described by Philip in 1960

Mr. Deed C. and Mrs. Ernestine H.B. Thurman were sent to northern Thailand while serving as commissioned officers in the United States Public Health Service, detailed to the U.S. foreign aid mission. They served as malaria control advisers, and amassed a large miscellaneous collection of insects (including Tabanidae) coincidental to their studies on mosquitoes. After 2 years there, Mr. Thurman tragically joined the list of dedicated medical entomologists who have fallen fatal victims to the subject of their research. Mrs. Thurman later obtained her Ph.D. degree after writing a dissertation, "A Contribution to a Revision of the Culicidae of Northern Thailand" (Univ. of Maryland Agric. Exp. Sta. Bull. A-100, 1959). She has since married Dr. J.C. Swartzwelder, and serves with her husband on the staff of Louisiana State University Medical Center.

I have exchanged personal communications

with Dr. Thurman, and wish to thank her for clarification of several localities and other help. Most of the tabanid collecting localities of the Thurmans are straightforward and can be found with little difficulty on any modern map which covers northern Thailand. Those which are more difficult or are of special interest by virtue of being holotype localities, etc., are detailed under the headings of the species concerned. Dr. Thurman has stated to me that, "When Chiangmai is shown as the locality, the collection was made in town which included the airport and to the foot of Doi Sutep." Their "Chiangmai" locality thus encompasses the extremely important area which I have designated herein as "Huai Kaeo (~4 km NW of Chiang Mai)".

Type and most other specimens from their tabanid collection are in USNM.

Wharton Cambodia Collection, 1952, described by Philip in 1960

Charles H. Wharton was a graduate student in mammalogy at Cornell University. He obtained a grant from the Coolidge Foundation to study the kouprey, a rare wild bovine whose range is almost entirely limited to the wooded plains of northern Cambodia. The resulting publication (Wharton, 1957) was his Master's thesis. It con-

tains a wealth of environmental information in addition to the ecology of the kouprey.

Diptera and ticks were collected as part of the study. Almost all of the Tabanidae were collected at "Study Area B". The specimen labels for these show "40 [or 50] km WSW of Khong,

Cambodia" or some slight variation of it. This was ambiguous, as there is no "Khong" in Cambodia. Correspondence with the author confirmed that the locality was pegged to the town of Khong in southern Laos. The locality is just to the north of the Cambodian village of Chhep, and about 50 km from the southeastern corner of north-eastern Thailand, at approximately 13°45'N 105°24'E. The specimens were collected from elephants, domestic cattle, and possibly other animals, but apparently not from kouprey itself. Several specimens simply labeled "Khong Cambodia" were collected at Khong, Laos.

Howarth Laos Collection, 1968, treated herein

Francis G. Howarth and his wife Nancy are Americans who spent several years in Sayaboury, Laos, with a Washington-based organization named International Voluntary Services, engaged in public health and other development-

The specimens were deposited in USNM, with the lot number 53-2059 printed on the labels. The material was identified by USNM staff, the tabanids almost certainly by A. Stone, though he is not credited by name in Wharton's publication nor does his name appear on any determination labels. It was left to Philip (1960a) to describe the new species in the lot.

Dr. Wharton is now a professor of biology at Georgia State University, Atlanta. I wish to thank him for his clarifications.

related work. Frank was able to collect some Tabanidae in the provinces of Sayaboury and Vientiane before returning to the U.S., and the collection was placed in Cornell University. He is currently on the staff of B.P. Bishop Museum.

Thailand and Zoogeography

Thailand has a tropical monsoon climate. The 4 major topographic areas are the mountainous north, the northeastern plateau, the central plain, and the peninsular south. This paper is concerned with the first 3, which fall into the Indochinese Subregion, and species which occur both above and in the Isthmus of Kra (herein used interchangeably with southern Thailand, i.e. the entire southern peninsula, which falls into the Malayan Subregion) are accounted for the entire country. Some species which are thought to be strictly coastal breeders, generally representing northern extensions of Malayan Subregion elements, have not been included.

Thailand's natural features will not be further characterized here, as this information is readily available from many sources. Some of the most helpful references include Pendleton (1962); Nuttonson (1963); and Ogawa, Yoda & Kira (1961). For Laos (and hence the adjacent parts of Thailand), see the excellent study by Gressitt (1970); and for Cambodia see Wharton (1957, 1966). The Natural History Bulletin of the Siam Society is a continuing wealth of information. The study by Küchler & Sawyer 1967 (1968) is especially interesting because it accounts the environs of the single most important tabanid collecting locality for this paper. For the social science aspects of Thailand, see Smith *et al.* (1968). The U.S. Army Corps of Engineers/Army Map Service map Series L509, scale 1:250,000, was used (about 50 sheets cover Thailand). A good and readily available map of the area is the National Geographic Society's 1967 map of "Viet Nam, Cambodia, Laos, and Thailand".

Thailand is divided into 71 administrative provinces (Fig. 1). The place name transliterations used are based on the Royal Institute System, and agree with the U.S. Board on Geographic Names gazetteer. (Province names are sufficiently different that even when other systems are used there is not likely to be any confusion, except in the case of the juxtaposed provinces of Chiang Mai and Chiang Rai.)

Insofar as the individual species of Tabanini can now be said to be related to geographical or other environmental features, these are discussed under the separate accounts. As a whole, the Tabanini are abundant throughout Thailand, and are present as adults throughout the year though there is probably some inhibition in the mountainous areas during the "cold season". Localities with a greater diversity of habitats spawn a larger number of species. This is nowhere more dramatic than at the edge of the city of Chiang Mai at the Huai Kaeo locality, which is easily reached by even the most casual tourist. Here, a high number of plains species and mountain species converge on a virtual smorgasbord of hosts. Precisely at the ecotone there is both a zoological garden and a commercial dairy which serve as magnets to the flies.

In a further attempt to define this study more naturally than politically, the described species from adjacent parts of Laos and of Cambodia are also accounted. Most of the other described species from the remainder of Laos, Cambodia, and the Viet-Nams are given brief comment either under their Thailand relatives or under a separate heading.

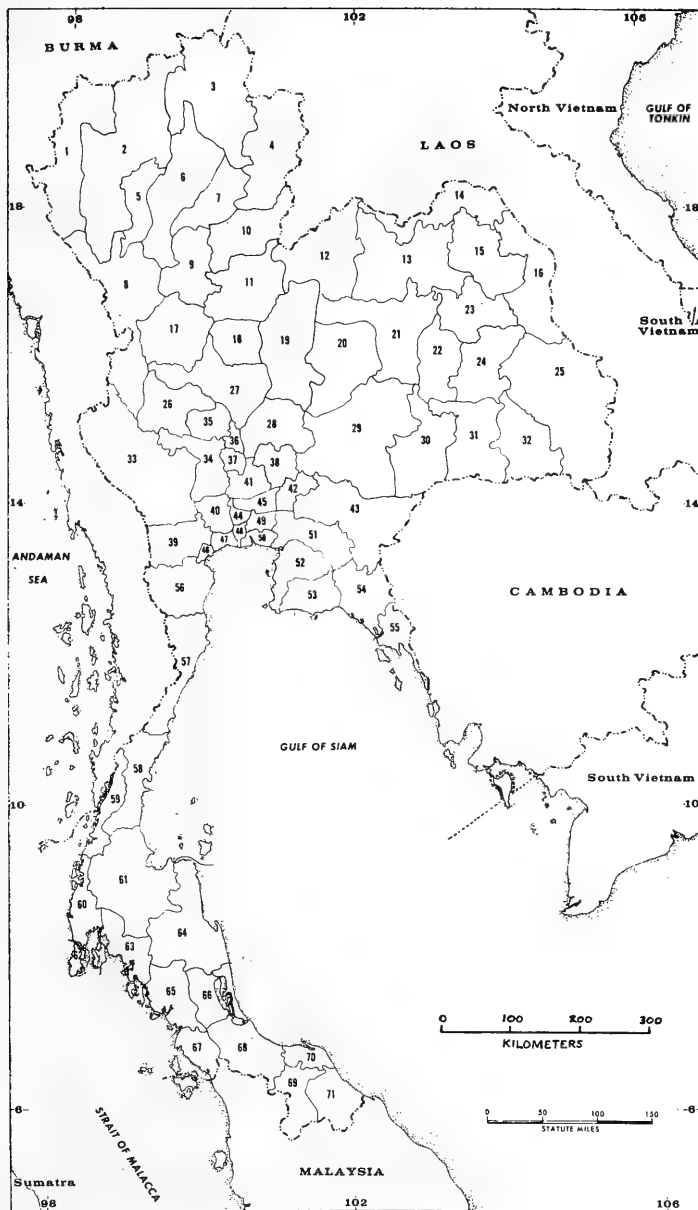


Fig. 1. Province map of Thailand. (From Smith *et al.*, 1968).

Provinces

(alphabetical)

37. Ang Thong
30. Buri Ram
51. Chachoengsao
35. Chai Nat
20. Chaiyaphum
54. Chanthaburi
 2. Chiang Mai
 3. Chiang Rai
52. Chon Buri
58. Chumphon
23. Kalasin
17. Kamphaeng Phet
33. Kanchanaburi
21. Khon Kaen
63. Krabi
 6. Lampang
 5. Lamphun
 12. Loei
28. Lop Buri
 1. Mae Hong Son
22. Maha Sarakham
42. Nakhon Nayok
40. Nakhon Pathom
16. Nakhon Phanom
29. Nakhon Ratchasima
27. Nakhon Sawan
64. Nakhon Si Thammarat
 4. Nan
71. Narathiwat
14. Nong Khai
44. Nonthaburi
45. Pathum Thani
70. Pattani
60. Phangnga
66. Phatthalung
56. Phetchaburi
19. Phetchabun
18. Phichit
11. Phitsanulok
 7. Phrae
49. Phra Nakhon
41. Phra Nakhon Si Ayutthaya
62. Phuket
43. Prachin Buri
57. Prachuap Khiri Khan
59. Ranong

39. Ratchaburi
53. Rayong
24. Roi Et
15. Sakon Nakhon
50. Samut Prakan
47. Samut Sakhon
46. Samut Songkhram
38. Sara Buri
67. Satun
36. Sing Buri
32. Si Sa Ket
68. Songkhla
 9. Sukhothai
34. Suphan Buri
61. Surat Thani
31. Surin
 8. Tak
48. Thon Buri
65. Trang
55. Trat
25. Ubon Ratchathani
13. Udon Thani
26. Uthai Thani
10. Uttaradit
69. Yala

Provinces

(numerical)

1. Mae Hong Son
2. Chiang Mai
3. Chiang Rai
4. Nan
5. Lamphun
6. Lampang
7. Phrae
8. Tak
9. Sukhothai
10. Uttaradit
11. Phitsanulok
12. Loei
13. Udon Thani
14. Nong Khai
15. Sakon Nakhon
16. Nakhon Phanom
17. Kamphaeng Phet
18. Phichit
19. Phetchabun
20. Chaiyaphum
21. Khon Kaen
22. Maha Sarakham
23. Kalasin

24. Roi Et
25. Ubon Ratchathani
26. Uthai Thani
27. Nakhon Sawan
28. Lop Buri
29. Nakhon Ratchasima
30. Buri Ram
31. Surin
32. Si Sa Ket
33. Kanchanaburi
34. Suphan Buri
35. Chai Nat
36. Sing Buri
37. Ang Thong
38. Sara Buri
39. Ratchaburi
40. Nakhon Pathom
41. Phra Nakhon Si Ayutthaya
42. Nakhon Nayok
43. Prachin Buri
44. Nonthaburi
45. Pathum Thani
46. Samut Songkhram
47. Samut Sakhon
48. Thon Buri
49. Phra Nakhon
50. Samut Prakan
51. Chachoengsao
52. Chon Buri
53. Rayong
54. Chanthaburi
55. Trat
56. Phetchaburi
57. Prachuap Khiri Khan
58. Chumphon
59. Ranong
60. Phangnga
61. Surat Thani
62. Phuket
63. Krabi
64. Nakhon Si Thammarat
65. Trang
66. Phatthalung
67. Satun
68. Songkhla
69. Yala
70. Pattani
71. Narathiwat

Superspecific Taxa of Tabanini with reference to Thailand

Tabanus

This genus contains the vast majority of species in the tribe Tabanini in Southeast Asia, and as a general rule, if a tabanid collected in Indochina is not an obvious chrysopsine or haematopotine, then in all probability it is a *Tabanus*. The single other taxon under Tabanini currently recognized as a full genus which is known to occur in Thailand is *Atylotus*, which constitutes an almost insignificantly small part of the total population.

Atylotus

This was originally described as a subgenus of *Tabanus* by Osten Sacken in 1876 in his "Prodrome of a Monograph of the Tabanidae of the United States." He included only 2 American and 2 European species. Use of the name as a full genus dates from 1878, when Osten Sacken, in his "Catalogue of the described Diptera of North America," placed it in the same bold face type as all other genera, without actually stating that it represented an elevation in rank. In 1900, Hine designated the Nearctic *Tabanus bicolor* Wiedemann as the type species of the genus *Atylotus*, and there is a consensus of opinion among modern authors that the genus should stand as valid.

I shall dispose first of the matter of this name as it was applied by Bigot in describing many Oriental species in 1890 and especially 1892. Authors have been agreed since the time of the first cataloguer/"reviser" (i.e., van der Wulp 1896) that Bigot's interpretation of the taxon was faulty, and these species were transferred to *Tabanus*. Van der Wulp (1896:62) stated, "Mr. Osten Sacken told me, that the signification of his genus *Atylotus*... is totally misunderstood by Bigot, and most, perhaps all the species, described by the latter in that genus, do not belong to it." It is in a way ironic that Bigot should have been thus trapped, as he had several times indicated his reluctance to accept *Atylotus* as a genus. After forcing himself to do so, he used only the criterion of absence of ocelli and ocelliferous tubercle to distinguish it from *Tabanus* and *Theriopectes* (1891b:419). It is no wonder that, out of 32 species described from west of Wallace's Line, 25 were placed in *Atylotus* and only 4 in *Tabanus* (as well as 3 in *Bellardia*). Another indication of Bigot's reluctance is shown by the fact that a number of the type labels, in his own handwriting, have the word *Atylotus* literally superimposed on the word *Tabanus*.

The modern interpretation of the taxon and placement of Oriental species in it is quite another matter. Ricardo (1911:112) indicated both a knowledge and an acceptance of *Atylotus* as a subgenus. But she believed that it was not applicable to species of the Oriental Region,

although a group of species, including several which she described as new, have since been recombined under it. In her opinion, none of the Oriental species possessed sufficiently pubescent eyes in either sex (in combination with lack of ocelligerous tubercle) to be included here.

Teskey's excellent work on immatures of North American Tabanidae brought new evidence to light. He stated (1969:58), "These genera [*Tabanus* and *Atylotus*] are treated together because of the absence of larval and pupal characters that readily distinguish all their members. Although this method is far from ideal, it has the advantage of emphasizing their close affinities." Attention is also called to his discussion on pp.120-121.

No single character used by authors for placing adults in the genus *Atylotus* is infallible or entirely exclusive with this taxon, and seems to me to be a subjective matter. Thus, even after examining specimens of the type species and several other species traditionally included here, I am still confronted with much the same dilemma faced by Bigot so long ago. After lengthy deliberation I am assigning several Thai species here. It is a placement with which I am not happy, but which conforms to the usage of recent workers on the Oriental fauna. Following Teskey, species in the two genera are herein treated together.

The generic placements used by Stone (1975) do not always conform to the characters exhibited by the species. In the interest of consistency such species as *T. humillimus* Walker from Celebes (type seen in BMNH) would have to be placed in *Atylotus* (new combination), and perhaps also several Schuurmans Stekhoven species assigned to *Ochrops* by Szilády (1926:9).

Hybomitra

This was described as a genus by Enderlein in 1922, with its type a species from western North America. For a time, authors treated it as a subgenus of *Tabanus*, but it has more recently come to be regarded as having full generic rank. Most of its species are Holarctic, but some Oriental elements have recently been assigned to it. With only two exceptions these are from Nepal and northern India, just as would be expected of a Palearctic group which has only recently entered the Oriental Region (indeed, the case could be made that the area of their occurrence is not Oriental but Palearctic). The two exceptions are what concern us here, as both are supposedly from near Thailand.

Tabanus latus was described by Szilády (1926:20). The first phrase of the description was all that Szilády said about the type data: "Rangun is given as habitat of a ♀ in Vienna

Museum..." There was no further taxonomic activity on this species until Stone (1975:50) simultaneously provided it with the new name *plauta* due to the 1832 preoccupation of *Tabanus latus* by Guérin-Méneville, listed it under the genus *Hybomitra*, and indicated the type locality as "Rangoon, Burma." It is understandable that the constraints of format in the Oriental Diptera Catalog prevented Stone from explaining his new generic combinations, but it is unfortunate that he assigned to this species both a new combination and a new name without recourse to the type. I think that Stone, as a matter of policy, assigned this species, as well as several of Ricardo, to *Hybomitra* because they were originally described in *Tabanus* subgenus *Theriopectes* by their authors. In the case of at least one species, *Tabanus subcallosus* Ricardo of India (types ♀ ♂ seen in BMNH), I believe that placement in *Hybomitra* is inaccurate. Although the species does possess hairy eyes, it otherwise resembles members of the *biannularis* group, discussed below under *Callotabanus*. In addition, although I have not seen the type of *T. latus* Szilády either, I have reason to doubt that its type locality "Rangun" is actually Rangoon, Burma. By 1926, Szilády had published several papers on Palearctic Tabanidae, and would not have been likely to assign this species to subgenus *Theriopectes* if it did not have the characteristics which more recent authors use to differentiate either *Theriopectes* or *Hybomitra* from *Tabanus*. If this is so, then Rangoon, situated in a low-latitude, monsoon lowland area, is a highly unlikely locality for such a species. I would encourage Palearctic workers to examine this type.

The second exception to the confined northern distribution of Oriental *Hybomitra* is *Tabanus rarus* Ricardo (seen in BMNH), reassigned to *Hybomitra* by Philip (1960b:60) on the grounds of its "distinct, though small, ocelligerous tubercle and microscopically hairy eyes". This species is highly distinctive in general appearance. The mountainous heartlands of Malaya develop sufficient altitude that they could be expected to harbor a fauna characteristic of much higher latitudes, but the distribution is not limited to the highlands. The type itself is labeled as collected at Kuala Lumpur, on the lush lowland plain of the west coast. Thus if correctly associated with *Hybomitra*, this species is remarkable indeed. It will suffice to state here that, despite very heavy collecting pressure on southernmost Thailand, none of this species was taken.

Thailand is thus free of records of *Hybomitra*, and none are expected to occur there. It is therefore unnecessary at this point to undertake a discussion of the relative merits and demerits of recognizing *Hybomitra* as having full generic rank, a topic which remains somewhat debatable among workers in the Holarctic.

Theriopectes

Present workers recognize this taxon as having full generic rank, with its distribution confined to the Palearctic. Those Oriental species which were originally described in subgenus *Theriopectes* have since been reassigned elsewhere (see *Hybomitra* above). None of these belong to the Thailand fauna or to that found further east or south.

Bellardia

Rondani proposed this name as a genus in 1863. Its type species is Neotropical. Despite earlier statements alternately accepting and then rejecting it as a valid genus, Bigot assigned 3 new Oriental species to it in 1890 and 1892: *nigrotecta* (whose range includes Thailand), *sinica*, and *annamita*. His assignment was based on the single criterion of closure of the 1st posterior cell of the wing. The taxon did not gain wide acceptance since it was realized that the principal character was highly variable. The species which Bigot assigned to both *Bellardia* and *Atylotus* in 1890 were immediately catalogued by Bigot himself (1891a:271-272) as true *Tabanus*; and those which he described in these 2 genera in 1892 were catalogued as *Tabanus* by Wulp (1896:62-63). Most subsequent authors have agreed on the recombinations. A notable exception was Enderlein, who even much later (1925:394) retained *Bellardia* as a valid genus (and Bellardiini as tribe) for *nigrotecta* and other species. *Bellardia* is currently considered a synonym of *Tabanus*.

Callotabanus

This taxon was originally proposed by Szilády (1926:10) as a subgenus of *Tabanus*. His criteria for inclusion were: frons with 2 separate calli, subcallus bare, abdominal markings transverse. Subsequent commentary on this taxon has been almost entirely in the hands of Philip, who in 1962 and after termed it the "*biannularis* group." Two changes of name should first be reviewed. *T. bicinctus* Ricardo 1911 was changed to *biannularis* Philip (1960a:12) due to the preoccupation of *bicinctus* by Fabricius in 1805. *T. flavicinctus* Ricardo 1911 was changed to *gertrudae* Philip (1960a:16) due to the preoccupation of *flavicinctus* by Bellardi in 1859.

One of Philip's initial statements on the name *Callotabanus* concisely reflected the situation (1960a:16): "To avoid ambiguity, *T. flavicinctus* Ricardo (= *T. gertrudae* n.n.) is hereby designated as subgenotype, though the need for systematic separation of this group is not apparent at present, since parallel treatment of other equally distinct elements such as *T. ceylonicus*, would also be needed." In the same paper (1960a:13) and in subsequent ones (1962:293; 1969:197), he accurately indicated that various Far Eastern species caused the group to be less than compact, and that

(1962:293): "The group characters of relatively narrow [sic: read broad] fronts, bare subcalli, and pale tibiae and scutelli are each polyphyletic in various combinations within the genus." On the grounds of the several intermediate species which he singled out (*pallidiscutum*, *cnemidotus*, *equicinctus*) as well as some others I have examined recently (e.g. *tuberculatus*, discussed elsewhere), I quite agree that *Callotabanus* is "untenable as a succinct entity", and herewith take the position that it does not deserve subgeneric rank. It is much more satisfactory to regard these related forms as a "species group", just as Philip has implied in his titles. It is surprising to note that he named the group *biannularis* rather than *gertrudae*, as it is the latter name that is currently valid for the species which he designated as "subgenotype".

For further information, see discussion of *gertrudae* Philip and *fulvicinctus* Ricardo.

Cydistomyia

This genus, originally described by Taylor

The Species Concept

An admirable discussion of the difficulties faced by the taxonomist in defining lower taxa was provided by Reid (1968:391-407). His treatment made special reference to the *Anopheles* of Southeast Asia, but the concepts and problems mentioned have much relevance to Tabanidae as well.

The interbreeding criterion for defining species is generally not available for scrutiny by tabanid workers. I know of no species to date which has been successfully mated in captivity, and relatively few species have been collected in copula. Therefore it is a matter of being reduced to an emphasis on morphological criteria by necessity and not necessarily by choice.

One of the commonest dilemmas is deciding between specific and subspecific rank for various populations. It is my understanding that criteria for subspecific placement are considerably more rigorous than those for a full species, and I have steered clear of the former. For example, a

in 1919 for a species in Australia, is placed by authors not in the tribe Tabanini but in Diachlorini. The following combination of characters serves to distinguish the latter tribe (Mackerras 1959:165): "Basicosta without strong setulae, contrasting with the costa. Fronts of females usually diverging towards the antennae, occasionally parallel; their palpi usually slender, tapering gently to a rounded end." I have seen no species from the area under consideration here that I would care to assign to Diachlorini, though Thailand falls between points in the Oriental Region from which recent authors have assigned species to *Cydistomyia* (Mackerras 1962: southern India; Philip 1970: Sikkim, Nepal, India (Assam, etc.); Mackerras various dates: eastern Indonesia and Pacific). The only suggestion I have seen published that any members of the Thailand fauna might be placed in *Cydistomyia* was that of Philip (1970:444), who wondered if *T. agnoscibilis* Austen might be one. He had seen the type in BMNH years earlier, but presumably did not investigate the question at that time. This species is seen as a true *Tabanus*, and *Cydistomyia* remains unknown in Thailand.

subspecies has a geographic basis. Much more collecting in Indochina will be necessary before ranges, and hence the desirability of infraspecific placement, can be determined with accuracy.

Trojan (1962) has written eloquently on the nature of the species concept in *Tabanus* throughout the taxonomic history of the genus. His analysis concentrated on European species, but since the great majority of Oriental tabanid work up until the 1950's was done by Europeans, the paper provides insight into Asian fly taxonomy as well. In some cases, the same authors (though never the same species) whom Trojan discussed were involved with the fauna of both regions: Fabricius, Walker, Szilády, Surcouf, Kröber, Oldroyd. None of these authors had firsthand knowledge of the Orient, and criteria available to them for application to the Oriental fauna were much more restricted than for that in Europe. Systematists in all groups of Diptera might benefit from a reading of at least the historical analysis by Trojan.

Field Procedures

A trip to Thailand was made in 1969 entirely to collect Tabanidae. I began collecting in mid-February and ended in early August, thus including parts of both dry and rainy seasons. Geographically and ecologically representative localities were chosen, and type localities of described species were visited. Local residents were hired and trained as collectors from the Provinces

of Songkhla (Aree Wachitnai), Chon Buri (Pie Chaemmanee), Chiang Mai (Kao Somporn), and Loei (Chusuk Dettongchai). The great majority of specimens were collected while they were attacking mammals, with the use of a collapsible pocket aerial net. The appropriate host was usually recorded, preceded by the word "about" (e.g., "about water buffalo"). This is a deliberate

ambiguity to avoid the necessity for determining whether each individual fly was actually imbibing blood, resting on but not biting an animal, or simply flying around it. These records are covered herein by a statement such as "Host interest is recorded in..." There is perhaps little or no true host specificity to be demonstrated; rather there is likely only a habitat phenomenon. For example, hill forest tabanids are far more

apt to have an elephant than a water buffalo available as host; the reverse is true of rice field tabanids. In most cases a time span during which specimens were collected was recorded, though this is sometimes too broad to be of significance. Specimens were killed in cyanide bottles, and most were pinned in the field. They were protected from ant damage with paradichlorobenzene.

Explanation of Species Accounts

I have tried to place obvious relatives together in the order of species accounts. I make no allegations for the arrangement. But however imperfect any such linear presentation may be, I consider it more satisfactory than alphabetical order.

The names of institutions have sometimes been abbreviated as follows:

ASRCT = Applied Scientific Research Corporation of Thailand

BMNH = British Museum (Natural History)

BPBM = Bernice P. Bishop Museum

CU = Cornell University

IPP = Institut Pasteur, Paris or "Pasteur Institute"

MNHN = Museum National d'Histoire Naturelle or "Paris Museum"

USNM = United States National Museum

When initials of individuals are used, I have tried to make their identity clear in the accompanying text. "JB" indicates the writer.

Individual species accounts are organized and explained as follows:

Synonymy. This listing includes synonyms and spelling lapses. References to all literature on a taxon are not listed here, but those of interest are mentioned elsewhere in the accounts.

Female. In the case of described species, the ♀ is redescribed as a composite of specimens (from all sources) at hand. This number is noted at the end of the redescription, and a "+" indicates that 1 or more additional specimens have been examined but are not at hand. In the case of new species, the holotype (invariably ♀) is described individually. This is followed by a composite mention of characters shown by the paratype ♀♀, insofar as they differ from the type.

In the case of all new species and of *T. abbasalis* Philip, it is the holotypes which have

been photographed for the figures. For the other species, an attempt was made to select properly representative specimens for this purpose.

Morphological terms generally follow standard usage, e.g. Bromley (1926). High quality specimens are always assumed in the descriptions and key. Rubbing or sometimes even a slight greasing of a specimen will alter its color. Some brief explanations of terms may be necessary to prevent misunderstandings. Total length is rounded to the nearest .5 mm. Colors given are based on a total impression, e.g. black integument overlain by white tomentum would probably cause a structure to appear gray and is so reported. On the head, the frons index is the ratio of the width between the basal angles of the eyes (generally measured between the ommatidial margins) to the height from the basal angles to the vertex (measured as a flat plane through the head). Characters of the "dorsal extension" are reported separately from those of the callosity; when these are entirely unconnected, the former is called the median callus. Reports on the color and the hairs of the palpus refer to the outer face of that structure, not the inner face unless so stated. For the thorax, mention of the dorsum covers the entire dorsal aspect down to the wing bases; the venter means the entire ventral aspect below the level of the wing bases (i.e., inclusive of the pleural plates), but the metepimeron which is appressed to the abdomen is not necessarily included. The scutum includes all of the notum and prescutellum but not the scutellum. Wing venation follows the dipterist's system, not Comstock-Needham. When an "appendix" is present near the base of the anterior branch of the 3rd longitudinal vein, it is called a spur vein; when it is not present, the point at which it would arise if present may be angulate or simply curved. On thorax and abdomen, a band is a transverse marking (left to right side of body), while a stripe is a longitudinal marking (cephalic to caudal). The "midline" or median is the longitudinal center of the body, and use of the term is by no means intended to imply a visible line. The division between sternites 1 and 2 is considered to be the row of pits transversing the area.

Male. Only brief mention is usually given to this sex. "The usual sexual differences" from

the ♀ include the holoptic condition, narrower antennae, rounder palpi, smaller average size, hairs on thoracic dorsum shaggier, etc.

Type series data or type data. This section gives an exact quotation of the data as it appears on the labels of described types when these have been seen, or from the literature when they have not. The notation "seen in..." indicates that I examined the type at its depository; "seen from..." indicates that I borrowed it and had it at hand while writing the final account. Other specimens in the original series are noted here or under "published records". In the case of new species, details of punctuation and spacing on the type labels are not rendered precisely herein. Whenever possible, some additional information is added about type localities.

Paratype depositories are not indicated herein for each new species. In general, the attempt was made to furnish those institutions whose names and initials are listed just above (except Institut Pasteur) with such material, as well as specimens of previously described species, insofar as such distribution was consistent with numbers available and with an accurate understanding of the species. A wider deposition of material may be accomplished at a later date. I have also personally retained material for comparative purposes.

Published records. Published distribution records are covered in general terms for widespread, common species, and in more detail for little known species. The accuracy of the records is assessed whenever possible. Records of junior synonyms are mentioned here even if the synonymy is new.

Since localities have throughout taxonomic history been expressed in terms of political boundaries, it may be helpful to note certain recent and older name changes for countries, a sort of

"synonymy" for states. First, "Indochina" is a convenient collective term for Laos, Cambodia, the Viet-Nams, Thailand, and usually Burma; the former French Indochina covered only the first 3. The following may be regarded as essentially interchangeable for the purpose of identifying localities: Siam = Thailand; Cambodia = Khmer Republic; Cochin China & lower Annam = S. Viet-Nam; Tonkin & part of upper Annam = N. Viet-Nam; Formosa = Taiwan = Republic of China; E. Bengal = E. Pakistan = Bangladesh; Malaya = W. Malaysia (=Malacca only in older usage, otherwise the latter is restricted); Dutch East Indies = Indonesia; Ceylon = Republic of Sri Lanka; Philippines = Pilipinas.

New records. Thai localities are herein delimited in order of descending administrative rank, i.e. Province: District: Canton (=village group): Village. The capital city of each province has the same name as the province, and each province has a "capital" district. If no other district is given for a locality, the capital district may be assumed. It is often unnecessary to give canton and village names when a locality can be pegged to a nearby populated place which is large enough to appear on a map of the country. Geographic coordinates are given for localities with which I am acquainted. The symbol "≈" means "approximately", but even in cases where it is used the coordinates are considered quite accurate for all practical purposes.

See also under published records above.

Taxonomy. This section gives comparative morphological notes, discusses any important vicissitudes of the taxon, and explains any new action taken. Relatives from other countries are sometimes discussed.

Biology. What little is known of the natural history of each species is summarized in this section.

Key to Females

[Good quality specimens are assumed. If specimens are rubbed or greasy their appearance may change and the user may be misled even at couplet 1. The ♀ of *A. givellus* is unknown.]

- | | | |
|-------|---|----|
| 1. | Subcallus bare and shining | 2 |
| | Subcallus covered with tomentum | 14 |
| 2(1). | Abdomen with distinct bands of pale tomentum on apices of at least tergites 3 and 4; frons broad, index not more than 1:6; independent median callus present; scutellum usually much paler than central part of scutum (<i>T. biannularis</i> group) | 3 |
| | No apical bands of pale tomentum on any tergites; frons narrow, index not less than 1:5.5 and usually above 1:6.0; callosity with linear dorsal extension; scutellum very dark, concolorous with scutum (<i>T. ceylonicus</i> group) | 11 |
| 3(2). | Overall coloration of thorax and abdomen gray/black and white; no conspicuous golden yellow hairs anywhere | 4 |
| | Dark area of tergites 1 and 2 mostly to entirely brown, or if blackened then much conspicuous bright yellow hair present on dorsum of thorax and abdomen | 7 |

4(3).	All femora black; frons usually relatively narrow, known index range 1:4.0-4.9; apex of tergite 2 known or presumed to lack pale band	5
	Middle and hind femora gray; apex of tergite 2 distinctly banded with pale tomentum and white hairs; frons usually relatively broad, known index range 1:3.2-4.0	6
5(3).	Apico-costal margin with a distinct brownish tint which fills marginal cell beyond stigma; most of scutellum white and in extreme contrast with blackened central area of scutum	<i>T. caduceus</i> , p.27
	Apico-costal margin hyaline; most of scutellum dark in dorsal view and essentially concolorous with gray scutum	<i>T. idulis</i> , p.26
6(4).	Fore femur black, and black haired except for a small patch of white hairs at apex; dark area of tergite 2 usually brown laterally (though not centrally); sternites 3 and 4 strongly blackened except for apical band	<i>T. gyruchus</i> , p.25
	Fore femur gray like other femora, and with abundant white hairs throughout its length; dark area of tergite 2 black throughout.....	<i>T. sexcinctus</i> , p.24
7(3).	Beard and hairs of thoracic venter snow white; apical bands on tergites 3 and 4 very broad, usually covering more than half the width of 4; antennal plate narrow; palpi grayish white to gray	8
	Not with the above combination of characters: if beard and hairs of thoracic venter are white, then pale hairs on thoracic dorsum are not brilliant golden yellow but just duller brownish yellow to white, and apical band of tergite 4 usually not covering half the width of the segment except at median triangle, antennal plate averages broader, and palpi not usually gray	9
8(7).	Pale hairs on sternites 3-6 bright yellow; wing distinctly tinted over basal and costal areas, marginal cell brownish beyond stigma	<i>T. rhinargus</i> , p.29
	Pale hairs on abdominal venter white, discordant with those of dorsum which are golden yellow; wing tint almost imperceptible, marginal cell essentially hyaline, stigma pale yellow	<i>T. discors</i> , p.30
9(7).	Length over 10 mm	10
	Tiny species, 8.0-8.75 mm; known from high altitude only; wing hyaline including costal cell; fore and middle femora black to brownish black	<i>T. zodiacus</i> , p.31
10(9).	Halter knob brown; abdominal pale hairs whitish to pale yellowish; scutellum essentially pale throughout	<i>T. tonglai</i> , p.32
	Halter knob yellow; abdominal pale hairs bright golden yellow; baso-central area of scutellum brownish when viewed from above	<i>T. orbis</i> , p.34
11(2).	Beard brown to black; body of thorax (and usually also of abdomen) lacking pale hairs; facial tomentum brown	12
	Beard white; whitish hairs evident on thorax and abdomen; facial tomentum pale grayish	<i>T. minimus</i> , p.36
12(11).	Frontoclypeus covered with tomentum	13
	Frontoclypeus with a single large black bare and shining area above, which is not simply attributable to antennal rubbing, tomentose below	<i>T. eurytopus</i> , p.40
13(12).	Wing tinted yellow in costal cell and over a larger area around stigma, tint usually dark enough to be seen by the naked eye	<i>T. ceylonicus</i> , p.38
	Wing essentially hyaline including costal cell, certainly not tinted enough to be seen with the naked eye	<i>T. mesogaeus</i> , p.41
14(1).	Wing with 1st posterior cell closed at or before hind margin and/or with a transverse pattern of infuscation	15
	Wing with 1st posterior cell open to hind margin; if infuscation is present it is not distinctly transverse.....	24
15(14).	Wing with 1st posterior cell closed or only very narrowly open at apex	16
	Wing with 1st posterior cell open; crossband occurs beneath stigma, wing hyaline beyond	23
16(15).	Scutellum whitish and hence in strong contrast to adjacent body areas	17
	Scutellum black, brown or gray when viewed with the naked eye from above, and not in strong contrast with adjacent body areas	21
17(16).	Abdominal tergites 1-4 essentially orange, 5-7 usually mostly blackened and with paler apical margins on 5 & 6; infuscation of wing includes apices of basal cells and base of discal cell	18
	Abdominal tergites 5-7 not greatly darker than 1-4; apices of basal cells and base of discal cell may be tinted but not distinctly infuscated	20

- 18(17). Dorsal extension of callosity relatively slender and distinguishable from callosity; palpus creamy white and almost always with predominantly pale hairs; wing infuscation usually rather light *T. toumanoffi*, p.47
- Dorsal extension of callosity relatively broad and its junction with callosity usually undefined; palpus yellowish brown or darker and with predominantly or entirely black hairs; wing infuscation usually relatively strong; antennal plate usually quite slender 19
- 19(18). Basal half of 1st posterior cell infuscated *T. geographicus*, p.46
- Most of basal half of 1st posterior cell hyaline or subhyaline *T. indosinensis*, p.47
- 20(17). Integument of abdomen black to brownish black; when present, pale hairs at apical corners of tergites are white *T. oknos*, p.43
- Integument of abdomen variable from orange to dark reddish black-brown; when present, pale hairs at apical corners of tergites are golden *T. granti*, p.45
- 21(16). Wing blackish brown overall; abdomen blackish and patternless *T. nigrotectus*, p.42
- Wing patterned with large areas of infuscation and subhyalinity; abdomen paler at least along segmental apices 22
- 22(21). Abdominal dorsum dark, not orange over tergites 1-4; wing infuscation relatively dark, basal cells rather strongly tinted *T. salvazai*, p.49
- Abdominal dorsum paler, tergites 1-4 more or less orange; wing infuscation rather light, basal cells rather lightly tinted *T. kakhyensis*, p.51
- 23(15). Legs mostly orange to orange brown; abdominal venter primarily orange *T. rufiscutellatus*, p.52
- Legs black; abdominal venter black and white banded *T. fascius*, p.53
- 24(14). Wing with costal margin infuscated or tinted such that the most darkened area includes part or all of the marginal cell and the apex but not the entirety of the 1st submarginal cell, remainder of wing contrastingly paler or hyaline 25
- Not as above, if wing is infuscated or tinted then the darkened area is not concentrated only along the costal margin 31
- 25(24). Species with thoracic and abdominal dorsums principally yellow to yellowish brown 26
- Species darker, dorsums mostly gray, brown, and/or black 29
- 26(25). Abdomen with a median stripe of yellow hairs; face pale; antennal plate elongate 27
- Abdomen unstriped; face orange, not pale; costal margin of wing weakly tinted; length under 13 mm *T. tamthaiorum*, p.65
- 27(26). Subcallus and frontoclypeus both similarly yellowish; body quite slender 28
- Subcallus orange and in rather strong contrast with the pale yellowish to whitish frontoclypeus; body not remarkably slender; abdominal dorsum brownish orange to brown with pale haired stripe indistinct *T. longibasalis*, p.66
- 28(27). Legs mostly brown to black; pale abdominal hairs brilliantly golden orange yellow; not in peninsular Thailand *T. helvinus*, p.67
- Legs mostly brownish yellow to orange brown; abdominal coloration including hairs usually more subdued than the above; peninsular Thailand and below *T. aurilineatus*, p.68
- 29(25). Abdomen with a very strong whitish median stripe crossing tergites 1-6 in sharp contrast with remainder, tergite 2 usually with a pale sublateral spot on each side *T. brunnipennis*, p.70
- Abdomen without connected stripe; fore tibia whitish basally and black apically 30
- 30(29). Abdomen banded, at least segments 3-5 paler apically than basally, the pale haired area generally expanding at dorsal midline to form triangles *T. anabates*, p.56
- Abdominal dorsum predominantly black with black hairs, midline of tergites 2-5 with slender and inconspicuous triangles of white hairs; wing visibly tinted throughout though more darkly so along costal margin *T. nyctops*, p.117
- 31(24). Abdominal venter at least predominantly black (occasionally blackish brown) to naked eye; and wing with a yellow to brown tint at least in costal cell and area below stigma 32
- Not with the above combination of characters, if wing tinted then abdominal venter not predominantly black (though it may be dark gray) 39
- 32(31). Entire ventral aspect of head and thorax, including head appendages and legs, black to dark brown; dorsum of body with some whitish but no orange areas 33
- Either tibiae or antenna (or both) paler; dorsum of thorax (and usually also part of abdomen) orange or brown 34
- 33(32). Entire abdomen blackened; wing tinted brown overall; thoracic dorsum mostly pale with a rather small dark central spot *T. euphanes*, p.115
- Abdomen with distinct white haired patches or bands on some tergites and sternites; wing tint pale, concentrated under stigma; thoracic dorsum mostly dark *T. unicus*, p.116

34(32).	Tergites 1 and 2 orange, 3 and beyond mostly to entirely blackened	35
	No extreme color contrast between tergites 2 and 3	37
35(34).	Tergites 3 and 4 with complete yellow apical bands; wing yellowed overall	
 <i>T. paviei</i> , p.63	
	Tergites 3 and 4 without complete apical band (though there may be median patches); wing with apico-costal area tinted brownish	36
36(35).	Abdomen lacks white hairs; face and frons orange	<i>T. admelanopygus</i> , p.60
	White apical fringes on sternites 2-5; face and frons dark brown	<i>T. abbasalis</i> , p.60
37(34).	Tibiae nearly all whitish and in strong contrast to body	<i>T. birmanicus</i> , p.58
	Tibiae not whitish	38
38(37).	Antennal plate large with forward projecting dorsal tooth; sternites 2-4 with white apical bands; wing yellowed overall	<i>T. praematurus</i> , p.64
	Antennal plate normal; abdomen lacks white markings; major color contrast between tergite 4 (orange) and 5 (mostly to entirely blackened); apico-costal area of wing tinted brownish	<i>T. thurmani</i> , p.61
39(31).	Medium sized to small species with abdomen predominantly brown to grayish brown, with or without pale median stripe but without other adornment such as bands, distinct triangles, sublateral pale marks, dark median, etc.	40
	Not as above, if abdomen brown then it is marked with bands, distinct triangles, sublateral pale spots, median dark spots, etc.	47
40(39).	Abdominal segment 7 and part of 6 laterally compressed; costal cell at least slightly yellowed; midline of abdomen may have some pale hairs but no pale tomentum	<i>T. oxybeles</i> , p.103
	Apical abdominal segments not laterally compressed	41
41(40).	Abdomen with a strong and sharply defined median stripe of pale tomentum and hairs, lateral area (from dorsal view) paler than the dark submedian area which flanks the stripe; antennal annuli not black	<i>T. fulvilinearis</i> , p.95
	Not as above, if abdomen striped then the stripe is not as sharply defined and the lateral area (from dorsal view) is colored the same as submedian area; annuli sometimes blackened	42
42(41).	Callosity and dorsal extension almost always form a single heavy columnar triangle; abdomen drab brownish to gray and usually with some evidence of a median stripe	<i>T. konis</i> , p.99
	Callosity and dorsal extension not forming a single remarkably broad triangle.....	43
43(42).	Abdomen, femora, and middle and hind tibiae with a reddish brown cast; no evidence of a median stripe; beard mostly brown; palpal hairs black	<i>T. ballmeri</i> , p.119
	Abdomen and legs not particularly reddish brown; abdomen either with evidence of a stripe or with apical tergites darkened (or both); beard pale; much or most palpal hair pale	44
44(43).	Antennal plate and at least the 3 basal annuli orange; apical tergites generally darkened	45
	Antennal plate mostly to entirely orange, annuli all black	46
45(44).	Costal cell usually yellowed; venation relatively pale; callosity brownish yellow; evidence of abdominal stripe present; known size range 10-13.5 mm	<i>T. agnoscibilis</i> , p.100
	Costal cell hyaline or nearly so; venation brown; callosity usually dark; abdominal stripe indistinct or lacking; known size range 12-16.5 mm	<i>T. pugiuunculus</i> , p.102
46(44).	Abdomen with median stripe of yellow tomentum and hairs, abdomen elsewhere rather unicolorous brown; tomentum of face and thoracic venter yellowish; frons apparently averages slightly more parallel sided above	<i>T. vernus</i> , p.96
	Abdomen may have median stripe of yellow tomentum and hairs, but usually the stripe is indistinct due to less pale tomentum even if pale hairs numerous, apical tergites may or may not show some darkening and median of tergite 2 may or may not have a darker underlay; tomentum of face and thoracic venter whitish	<i>T. diversifrons</i> , p.97
47(39).	Abdomen with a pale tomentose median stripe or series of connected pale tomentose median triangles which crosses parts of at least tergites 3-5, the pale median area flanked by darker submedian area such that the species cannot also be considered as banded; (for doubtful specimens marked with triangles, tergites 2 and 3 possess sublateral pale spots)	48
	Abdomen without stripe of pale tomentum crossing tergites 3-5, or if stripe present then it is not fully flanked by darker submedian area; (species with touching or very nearly touching median pale triangles have no longitudinal or oblique pale submedian spots on tergites 2 and 3)	63

- 48(47). Rather small species (below 14 mm) with a single smooth sided grayish white median stripe, dorsum otherwise entirely gray; wing tint if present restricted to costal cell and stigma 49
 Sublateral area of at least one tergite almost always marked with a pale spot or stripe, or if not then the size is not small and/or the wing is clearly tinted 51
- 49(48). Abdomen tapers to a point; costal cell yellow *T. systemus*, p.94
 Abdomen rounded apically 50
- 50(49). Callosity "normal", not unusually slender; costal cell hyaline *T. symmetrus*, p.92
 Callosity very slender; costal cell yellow *T. taeniellus*, p.95
- 51(48). Wing tinted over much or all of area; if sublateral area of abdomen has pale markings on more than a single tergite then the species is large and has a very strong median stripe and an essentially orange abdominal venter 52
 Sublateral area of abdomen pale spotted or striped on more than one tergite; wing hyaline or tinted but if tinted then not as above 54
- 52(51). Large species with strong median stripe crossing at least tergites 1-5; abdominal venter essentially orange; sublateral area of dorsum variable *T. firmus*, p.122
 Sublateral area of abdomen either unmarked or marked only on tergite 2; abdominal venter gray with a broad black haired median stripe 53
- 53(52). Median stripe of abdomen reduced to a more or less convex sided spot which crosses only tergites 3-5; pale sublateral spot present on tergite 2 *T. lentis*, p.91
 Median stripe of abdomen crosses tergite 2; sublateral area without pale markings; brown wing tint concentrated basally *T. subcanipus*, p.92
- 54(51). Callosity (basal callus) closely parallels or touches eye margin; relatively small species (up to 15.5 mm) with wing entirely hyaline including costal cell 55
 Callosity more triangular than rectangular; size variable but if relatively small then wing often tinted 58
- 55(54). Thoracic dorsum distinctly striped with the stripes clearly crossing the entire scutum and scutellum (hence the scutellum centrally dark and laterally pale) 56
 Scutum only indistinctly striped, with the scutellum not clearly carrying on the median pattern of the scutum 57
- 56(55). Callosity (basal callus) brownish black to black, large and rather protruding; sublateral pale stripe complete only on tergites 1 & 2 *T. jucundus*, p.77
 Basal callus yellowed and widely separated from median callus; sublateral pale stripe complete across tergite 3 *T. dorsilinea*, p.78
- 57(55). Midline of tergite 2 not crossed by a stripe of pale tomentum and hairs; dark abdominal stripes generally quite black *T. striatus*, p.71
 Midline of tergite 2 crossed by a stripe of pale tomentum and hairs (in unrubbed specimens); dark abdominal stripes generally a lighter shade of black to brown *T. megalops*, p.74
- 58(54). Tergites 3-5 almost always with very large white triangles at midline; dark parts of tergites 2 & 3 usually somewhat brownish 59
 Tergites 3-5 striped or with triangles at midline, but if with triangles then these are not unusually broad; dark parts of tergites 2 & 3 brown to black 60
- 59(58). Triangles on tergites 2-5 very sharply defined; wing distinctly tinted in costal cell and usually elsewhere as well; abdominal venter with a broad median stripe of black hairs *T. quadrifocus*, p.89
 Triangles (plus pale marking on tergite 2, which may or may not be clearly triangular) usually somewhat less precisely defined; wing essentially hyaline (costal cell sometimes with a yellowish tint); sternites 1-5 pale haired, no median stripe of black hairs present *T. rusticatus*, p.88
- 60(58). Abdominal dorsum black and white, with very distinct median stripe due to coincidence of pale tomentum and white hairs (stripe may be smooth or serrated); pale submedian stripes on scutum also more distinct than in related species, as is the broad black haired median stripe on abdominal venter *T. fontinalis*, p.86
 Dark parts of abdominal dorsum may be black but more commonly they are gray to brown, median pale markings variable from distinct to very dilute and may be a stripe or a series of triangles; striping on scutum indistinct or absent; abdominal venter with or without median stripe 61
- 61(60). Callosity relatively robust, triangulate; pale median stripe of abdominal dorsum rather well defined; known length range 11.5-16 mm; probable coastal breeder *T. virgulatus*, p.83
 Callosity relatively more slender; pale median abdominal markings highly variable but often not in the form of a well defined stripe; known length range 13-19.5 mm; widespread species 62

- 62(61). Abdominal dorsum predominantly reddish brown; abdominal venter generally without any easily discernible broad dark median stripe; antennal plate not narrow, color variable *T. pristinus*, p.84
- Dark areas of abdominal dorsum highly variable from brown to blackish but commonly grayish; sternites 2-5 with a variable amount of black hairs present on median which sometimes form a discernible stripe; antennal plate relatively narrower, at least apical 1/3 of plate blackened *T. rubidus*, p.80
- 63(47). Rather small species (known range 10-13 mm) with brown to black abdomens and very narrow apical bands on tergites 2-5 which generally expand slightly at midline 64
- Otherwise, if apical bands present on tergites then size larger and/or abdomen not brown to black 67
- 64(63). Abdominal dorsum mostly black; thoracic dorsum gray; wing hyaline; callosity large and rectangular, touching eye margin at least basally *T. equicinctus*, p.35
- Abdominal dorsum mostly brown; thoracic dorsum brown; wing tinted or hyaline; callosity not touching eye margin 65
- 65(64). Frons relatively narrow, known index 1:6.3-6.9; apical segment of palpus with white hairs at least basally if not entirely; wing hyaline *T. zoster*, p.109
- Frons broader, known index 1:3.5-5.0; palpal hairs largely to entirely black; wing yellowed at least in costal cell if not elsewhere also 66
- 66(65). Blackened spot present above small pale triangle at midline of tergite 2; midline at junction of tergites 1 and 2 not with a very conspicuous pale spot *T. cepuricus*, p.107
- Tergite 2 not noticeably blackened above small pale median triangle; junction of tergites 1 and 2 marked with a very conspicuous pale spot at midline *T. thermarum*, p.108
- 67(63). Tergites 2-5 clearly marked with median triangles of pale tomentum and hairs, pale apical bands may or may not be present; tergites 3-5 similar in color 68
- Not as above, if midline has pale triangles then they are not present on all four tergites, or they are formed only from pale hairs and not pale tomentum, or tergites 3-5 distinctly differ in color 72
- 68(67). Pale median triangles large and conspicuous; dorsum of thorax and abdomen usually predominantly gray to black but sometimes with a reddish cast; abdominal venter not appearing yellow to orange to the naked eye 69
- Pale median triangles small; dorsum of thorax and abdomen various shades of brown to orange brown; at least part of abdominal venter commonly appearing rather yellow to orange to the naked eye 71
- 69(68). Dorsal extension of callosity linear; no parts of tibiae whitish; wing distinctly tinted, and spur vein present; abdominal dorsum black to dark reddish *T. hypomacrus*, p.113
- Dorsal extension of callosity broad, elliptical to lanceolate; tibiae whitish basally; wing nearly all hyaline, no spur vein 70
- 70(69). Distinct brown horizontal band present at level of antennal bases; antennal scape blackened; median triangle on tergite 2 crosses half the segment *T. larvatus*, p.112
- Tomentum lateral to antennal bases may be whitish yellow but not brown; antennal scape not blackened; median triangle on tergite 2 more dilute, sometimes crossing entire segment *T. crassus*, p.110
- 71(68). Known length range 16-18.5 mm; spur vein present; apical palpal segment brown; blackened spot present above pale median triangle on tergite 2 *T. monilifer*, p.104
- Known length range 12.5-15.5 mm; spur vein usually absent; apical palpal segment creamy yellowish; no black spot above pale median triangle on tergite 2 *T. rubicundus*, p.106
- 72(67). Abdominal dorsum and legs nearly unicolorous yellow, orange, or reddish 73
- Abdominal dorsum not unicolorous, gray or black markings or areas present in some form 75
- 73(72). Large species (known range 18.5-21 mm) with reddish orange abdomen and legs *T. jeanae*, p.117
- Species below 15 mm 74
- 74(73). Medium sized (known specimen 13.5 mm); much of wing with a slight yellowish tint; eye (relaxed) with 3 reddish purple bands across green field *T. xanthochrus*, p.120
- Small (known range 8-9.25 mm); wing hyaline; eye unbanded *A. cryptotaxis*, p.125
- 75(72). Small (known range 7-10 mm); body gray and yellow; wing hyaline; callosity (basal callus) not vertically oriented and with no dorsal extension *A. lotus*, p.126
- Size above 10 mm; wing at least slightly tinted in costal cell if not more extensively and distinctly so; callosity "normal" and dorsal extension present or represented at least by a keel 76

- 76(75). Darker parts of abdominal dorsum usually at least partially with a longitudinal orientation such that the median and/or submedian area is usually darker than the sublateral area of some tergites; known size range 15.5-21.5 mm77
Abdominal dorsum with median/submedian area nearly always as pale or paler than sublateral area, apical tergites often distinctly darker than basal tergites; known size range 11-18.5 mm78
- 77(75). Antennal plate large with a forward-projecting dorsal tooth; dark median spots present, that on tergite 2 least dilute; wing tinted yellowish brown; size large *T. borealoriens*, p.118
Dorsal tooth of antenna not projecting forward; median/submedian area usually (but not always) dilute grayish and hence a little darker than brownish sublateral area on some tergites, midline may or may not be overlain with traces of pale tomentum and hairs; femora principally gray *T. griseilineis*, p.124
- 78(76). Wing with an apico-costal brown tint which becomes paler toward the hind margin; tergite 5 and beyond usually abruptly blackened *T. thurmani*, p.61
Wing tinted yellowish, or if brownish then not over such an extensive apical area; tergite 5 variable, but if blackened then the contrast with 4 generally not so extreme 79
- 79(78). Abdominal dorsum with a median stripe of yellow tomentum and yellow hairs crossing tergites 1-5 and sometimes 6, narrow yellow apical bands present on 3-5 and usually 6 (variable on 2); thoracic dorsum grayish (occasionally brownish) *T. soubiroui*, p.120
No stripe of yellow tomentum traceable across tergites 1-3; thoracic dorsum yellow, orange, or brown, not gray 80
- 80(79). Callosity a broad triangle which closely approaches eye margins at base; subcallus and face principally dark orange to orange brown; tergites 5-7 dark gray but with no black *T. tamthaiorum*, p.65
Callosity not approaching eye margins; subcallus and face paler (yellow to whitish yellow); apical tergites variable but the area usually with some blackened spots if not more extensively blackened 81
- 81(80). Thoracic dorsum appears yellow to naked eye; tergites 4-6 with basal sublateral dark spots which are often semicircular; middle and hind femora orange to gray *T. alumnus*, p.54
Thoracic dorsum appears brown to naked eye; tergites 5 & 6 variable but sometimes extensively blackened; all femora blackened *T. siamensis*, p.55

Tabanus biannularis group

This group has received perhaps more attention than any other such group of phylogenetically related species of Oriental Tabanini, yet there is a great deal more remaining to be understood about it. It is instructive to note that, of the 9 species herein recognized as valid from Thailand above Isthmus of Kra and from adjacent parts of Laos and Cambodia, 6 are described as new. All of these new species are known only from very short series which are almost always the result of extremely limited collecting in the type localities. This strongly suggests that there are many more species to be discovered. The limits of intraspecific variability are very incompletely known due to the shortness of the series of most species, old and new. Quite possibly the group as a whole suffered from taxonomic lumping among the early workers, giving rise to some disjunct and highly improbable records.

Understanding is further hampered by wide

dispersal of type specimens. *T. tenasserimi* Szilády might reasonably be expected to occur on the Thailand side of the border. The Vienna Museum declined to loan this syntype series and other material, and I do not recognize *tenasserimi* from Philip's characterization (1969:197) among material at hand.

As a whole, the group can be said to be characteristic of mountain jungle areas. The physiography and agricultural patterns of Thailand are such that the Thai species are concentrated in the north, though this is by no means a phenomenon of latitude alone because the group is well represented in Indonesia.

For further information including a discussion of the demerits of recognizing the group at the subgeneric level, see under *Callotabanus*.

Tabanus sexcinctus Ricardo Fig. 2*Tabanus sexcinctus* Ricardo, 1911, Rec. Indian Mus. 4(6):133.

Female. Length 9-10.5 mm. **Head.** Frons slightly divergent above, index 1:3.7-4.0; tomentum pale brownish to pale gray below median callus, medium to dark brown lateral to it, and highly variable from dark brown to pale gray above it, a dark and rather shining rounded spot at or near vertex; hairs below median callus mixed black and white, lateral to and above it almost entirely black. Calli black, usually separated but may be connected at midline; basal callus square overall to rounded above and jagged below, median callus irregular and variable, distinctly smaller than basal callus. Eye (relaxed) with 2 dark blue bands on green field. Subcallus bare and shining, brownish black, sometimes orange brown at midline. Upper cheek corner with brown tomentum and some brown hairs, remainder of face with grayish white to white tomentum and white hairs including beard. Basal segment of palpus pale gray with white hairs; apical segment pale gray becoming creamy yellow at tip, with white hairs basally and mixed white and black hairs beyond the tip. Antenna with scape mostly black haired above and white haired below, sometimes a few short orange hairs at dorsal apex; plate orange, slightly to rather distinctly elongate and with a low, obtuse dorsal tooth; 3 basal annuli usually essentially colorous with plate, apical annulus darkened. **Thorax.** Scutum with surface facing occiput gray with white hairs; large central area on both sides of the transverse suture very dark grayish brown with black hairs; a wide, curved band of brownish black tomentum next to but not including the hind margin; prescutellum dark gray with black hairs; hind margin of scutum from wing base to scutellum pale tomentose and white haired; scutellum with whitish gray tomentum and mixed black and white hairs. Venter and coxae pale gray with white hairs; femora gray except yellow at extreme apices, with white hairs except some black hairs on fore femur; fore tibia white with white hairs over approximately basal 4/5, apex black with black hairs; other tibiae white, narrowly brownish black to brown at apices; tarsi black. Wing essentially hyaline, stigma yellow, much or most venation yellowish; 1st P cell open; no spur veins; halter stem brownish yellow, base of knob dark brown, apex of knob pale brown. **Abdomen.** Tergite 1 with a broad area of grayish white tomentum and white hairs at side, central area black with black hairs; 2 much more narrowly grayish white and white haired at side; 2-6 black with black hairs, each with a narrow but very conspicuous apical band of grayish white tomentum and white hairs, with a minute expansion right at the midline of 2-4 which causes a naked-eye impression of a tiny extra touch of white; 7 with pale tomentum at apex but no pale hairs. Sternites 1 and 2 gray with white hairs; 3 and 4 mostly gray with white

hairs, but blackened and with some black hairs at base at least centrally; 5 blackened and black haired basally, gray with white hairs apically; 6 and 7 blackened and black haired, with apical bands of pale tomentum and white hairs. (4+).

Male unknown.

Type data (♀): "LUSHAI HILLS/CAPT. E. C. MACLEOD" and "Pres by/Dr Kertesz./May 1909." (Seen in BMNH.) Note that the type labels do not stipulate country of origin. This locality has, from the time of the original description to the present, been interpreted as lying in Burma. But "Lushai Hills" is the name given to that part of the border range which falls in Assam, India; on the Burmese side it is called the Chin Hills. Therefore I recommend that the type locality be regarded as India. The Lushai Hills lie in the southern spur of Assam, i.e. 22-24°N 92°30'-93°30'E.

Published records. Several localities in Taiwan by Ricardo (1913b:168) and Shiraki (1918:239). There have been no published reports of direct examination of Taiwan material since these records, and I strongly suspect they are the result of early lumping. Shiraki's color figure (Plate 5 Fig. 2) does nothing to lessen this doubt, and Philip (1962:297) has expressed similar doubts. Four specimens from "Masuri", 21 May-29 June 1920, reported by Senior-White (1922:104). This is a very cryptic record, as the only further locality explanation is that most of the specimens in his paper were collected by others "mainly in the Western Himalaya and Burma" (p.103). I can find no such locality in either Burma or India. Sen & Fletcher (1962:156) have interpreted it as "Mussoorie", i.e. the resort town north of Dehra Dun in northern India, and this may well be right. Tienmushan, Chekiang Province, China, 1♀ reported by Ouchi (1943:521-522, 551). This is at 30°21'N 119°29'E, and very far "out of range."

New records. "Lower Burma:/Insein./1932./ J. Smith./M.R.C.V.S.", 1♀ in BMNH. "N. THAILAND:/Lampang./ex. elephant./12. X. 1970./H. Wetzel", 2♀♀ in BMNH. In a subsequent examination for me, Mr. Oldroyd noted that, in the 2 BMNH Thailand ♀♀, the frons appears darker than that of the type, and the sternites beyond 4 are more grayish. THAILAND: Chiang Mai Prov.: Huai Kao (~4 km NW of Chiang Mai) 18°48'N 98°57'E: 4♀♀, date range from 10 May-10 June 1969, K. Somporn.

Taxonomy. This species has the character of multiple pale abdominal bands (on tergite

apices) in common with *subcallosus* (see discussion elsewhere) and with *gyruchus*. There is no problem of separating it from *subcallosus* in Thailand, as the latter is not part of the Thai fauna. It is very close to *gyruchus*, however, and the 2 occur in the same geographic area. See under *gyruchus* for taxonomic distinctions.

Tabanus gyruchus new species Fig. 3

Holotype female. Length 11.5 mm. **Head.**

Frons slightly divergent above, index 1:3.3; tomentum pale grayish brown below median callus, brownish at sides of median callus and gray above it, a large black and rather shining area at vertex; hairs below median callus mixed black and pale, lateral to, on, and above it black. Calli black, not connected; basal callus essentially square but uneven above and below; median callus also rather square and of similar size, with a median extension upward. Eye in life patterned as follows, in layers from top to bottom: dark (field) + green (band) + dark (field) + reddish green. Subcallus bare and shining, brownish black, paler brown at midline. Upper cheek corner with brown tomentum and some dark hairs; remainder of face with white to grayish white tomentum and white hairs including beard. Palpus grayish white, basal segment white haired, apical segment mostly with long white hairs at the base and mixed white and black hairs beyond the base, tip pointed. Antenna with scape black haired above and white haired elsewhere; plate orange, rather slender, with a low, obtuse dorsal tooth; annuli orange, negligibly to slightly darker than plate.

Thorax. Scutum gray over entire area anterior to transverse suture and also part of the area posterior to it, with white hairs over area facing occiput, then mixed black and pale hairs including some which are tinted yellowish white, then black hairs; a wide, curved band of brownish black tomentum between the wing bases and next to but not including the hind margin of scutum; prescutellum blackened and with black hairs; hind margin of scutum from wing base to scutellum with paler (mostly gray) tomentum and white hairs; scutellum gray with white hairs, a small baso-central area darker gray with a few black hairs. Venter and coxae gray, almost entirely white haired, except hind coxa with mixed white and black hairs; femur black and black haired, a patch of white hairs form part of the outer fringe at apex only; other femora covered with gray tomentum except yellow at extreme apices, mostly white haired; fore tibia white and white haired over approximately basal 3/4, apex black and black haired; other tibiae white, narrowly brownish black to brown at apices; tarsi black. Wing essentially hyaline, some slight yellowish tinting basally, stigma pale yellow, most venation yellowish; 1st P cell open; no spur vein or angulation; halter stem yellow brown, base of knob dark brown, apex paler brown. **Abdomen.** Tergite 1 with a broad area of grayish white to creamy white

Biology. All Thailand records are from the north, above 18°N. The Chiang Mai locality was at about 350 m altitude; the Lampang locality may have been somewhat lower. Apparently both the seasons of increasing and of decreasing rainfall are represented. The only recorded host to date is elephant.

tomentum and white hairs at side, central area black with black hairs; 2 much more narrowly creamy yellowish to pale grayish and with white hairs at side, dark area of 2 black haired, with the ground color brown at the side becoming black over central area; 3-7 black and black haired; 2-6 with rather narrow but conspicuous apical bands of white to grayish white tomentum and white to off-white hairs, those bands on 2, 4, and 5 with some black hairs mixed in with the white, thus causing the band on 3 to appear a bit more conspicuous, each band remarkably constant in width throughout its length; 7 black and black haired with some pale tomentum apically. Sternite 1 dull yellow laterally and gray centrally, with white hairs; 2 gray with basal corner dull yellow, hairs mostly white with a few black hairs scattered about midline; 3-6 black and black haired, with conspicuous apical bands of white to grayish white tomentum and white hairs; 7 black with a trace of paler tomentum apically.

Paratypes (4♀♀). Length 10-11.5 mm. Frons index 1:3.2-3.6. Tomentum of frons may be almost entirely gray, and black area at vertex may be rather subdued by gray tomentum. Basal callus often wider than high; median callus highly variable from rounded to quite tall and rectangular. Annuli may be distinctly darker than plate of antenna. The yellowish white tinted hairs on scutum may be confined to the pocket of the transverse suture or absent. Wing may have a very light yellowish brown tint in anal and part of axillary cells. Sternite 2 may be entirely gray and with entirely white hairs. The dark lateral area of tergite 2 remains blackened in the Chiang Dao paratype.

Male unknown.

Type series data. Holotype ♀: THAILAND: Chiang Mai Prov.: Doi Pui (a Maeo vill.) Alt. 1450-1650 m 18°49-50'N ~98°53'E: 3 May 1969 about horses John J.S. Burton 1600-1900 hrs. (In Cornell University.) See under *zodiacus* for a further note on this locality. Paratypes: 3♀♀, exactly the same collecting data as holotype; 1♀, Chiang Mai Prov.: Chiang Dao Dist. (~5 km NW of Chiang Dao) 19°23'N 98°56'E: 6 May 1969 JB.

Taxonomy. At first sorting, I had placed this taxon together with *sexinctus*, and the BMNH material (including the type of *sexinctus*) was

examined at a time when I did not yet appreciate the distinction. I have since sent Mr. Oldroyd a list of the characters of each of the 2 species, and he has assured me that the present interpretation of *sexincinctus* (as given below) agrees with its type. The 2 are strikingly close in overall appearance, but are quickly distinguished under the microscope. In *gyruchus*, the fore femur is black in contrast to the other femora which are gray; in *sexincinctus* all femora are gray. In *gyruchus*, the fore femur is black haired except for an apical patch of white hairs in the fringe; in *sexincinctus*, the fore femur has white hairs abundant throughout its length. In *gyruchus*, when the venter is viewed with the naked eye there is a color transition from gray to black at the junction of sternites 2 and 3; in *sexincinctus* the venter remains

predominantly gray from 1-4. In *gyruchus*, the dark area at the side of tergite 2 is essentially brown in topotype series (not black). The median callus is usually about as large as, or larger than, the basal callus (not distinctly smaller than basal callus). There are other differences including lack of even a slight expansion at the midline of apical bands on tergites, eye banding pattern, and frons index average.

Biology. The species is known from only 2 localities visited in early May in northern Thailand, with an altitude range from about 425 m up to a possible 1650 m. Both were essentially mountainous jungle habitats. All 5 specimens were taken between 1600-1900 hours. Host interest was recorded in horses and cattle.

Tabanus idulis new species Fig. 4

Holotype female. Length 11 mm. **Head.** Frons slightly divergent above, index 1:4.8; tomentum whitish gray below, becoming darker gray above especially at sides of median callus, with a very large somewhat triangular blackened area at vertex; hairs between calli mostly pale yellow, those at sides of and above median callus black. Calli connected at midline; basal callus somewhat rectangular, lower half brown and upper half black; median callus tall, elliptical, black. Subcallus brown, bare and shining; face pale gray, facial hairs including beard white, dense, a few dark hairs and some light brownish tomentum at upper cheek corner only. Antenna with scape black haired above and mostly white haired below; plate broad, orange, with an obtuse rounded dorsal tooth; all annuli quite evenly darker than plate. Palpus with basal segment gray, white haired; apical segment creamy white except grayish at base, hairs predominantly white but with a few scattered black hairs. **Thorax.** Scutum with surface facing occiput gray and with scattered pale hairs, antalar pale with mixed black and white hairs, a tuft of white hair mesad to the wing base and a large patch between wing base and scutellum, but essentially all the remainder of the scutum blackish gray to brownish gray and with black hairs. Most of scutellum essentially matches scutum when viewed from above with the naked eye, hind margin paler with whitish hairs. Venter and coxae whitish gray, white haired except some black hairs on coxae and on plate just anterior to middle pair; all femora black except yellow at extreme apices; fore tibia white and white haired over approximately basal 2/3 of area, black and black haired over apical 1/3, remaining tibiae similar except proportion is about 4/5 white and 1/5 or less black. Wing essentially hyaline except for some pale brownish tint in some cells at base, stigma pale brownish; 1st P cell open; anterior branch of 3rd vein very strongly curved, almost angulate; calypter tinted brown; halter stem and extreme apical face of knob pale brown, remainder of knob dark brown.

Abdomen. Side of tergite 1 pale gray with white hairs, remainder bluish gray with black hairs which are especially dense at midline; tergites 2-4 blackened basally and with black hairs, apically with paler bands of bluish gray to whitish gray tomentum, white hairs present widely over apical corner of 2 and at least over the lateral area of the apical pale bands on 3 and 4 [these 3 tergites mechanically rubbed in such a way that the hair coloration of their central areas cannot be appreciated, but at least an apical fringe of white hairs crosses 4, probably (but not certainly) crosses 3, and probably (but not certainly) does not cross 2]; 5-7 black with narrow apical bands of pale tomentum, 6 and 7 with some white hairs forming a very sparse apical fringe [which is apparently absent on 5 but this is not certain due to rubbing]. Sternite 1 brownish to grayish laterally and white at midline, white haired; 2 gray with mixed white and black hairs across the base and more broadly at midline, whitish with white hairs apically; 3-7 blackish brown to black or dark gray and with black hairs, with apical bands of whitish tomentum and white hairs, the bands on 3 and 4 wider than those on 5-7.

Paratypes (2♀). Length 10-10.5 mm. Frons index 1:4.3-4.9. Calli may or may not be connected at midline. Apical annulus of antenna may be darker than others, and apical area of plate may be somewhat darker than base, thus removing the color break between plate and annuli. Black hairs on sternite 2 inconspicuous. [Abdominal dorsum rubbed as in holotype, so total pattern remains uncertain.]

Male unknown.

Type series data. Holotype ♀: "LAOS/Mg. Vang Vieng/Vientiane Prov./15 March 1968/250 m./F. G. Howarth". (In Cornell University.) Paratypes: 1♀, exactly the same collecting data as holotype; 1♀, same but 18 Mar. 1968. The town [=Muong or "Mg."] of Vang Vieng is located

half way between Vientiane and Luang Prabang at $18^{\circ}55'N$ $102^{\circ}27'E$.

Taxonomy. This species is most similar in appearance to *T. sexcinctus* Ricardo due to its size, clear wings, and basic black, gray and white coloration, including the fact that the anterior area of the scutum remains dark and is therefore not in highly conspicuous contrast with the central area of the scutum. *T. idulis* differs in various aspects, including: (1) most of the area of the scutellum remains dark like the scutum when viewed with the naked eye from above; (2) it does not possess the strong, white haired

apical band on tergite 2 [though knowledge of its condition at and near the midline is incomplete]; (3) the area and height of the median callus is very distinctly greater than that of the basal callus; (4) the antennal plate is much broader.

The name assigned to this new species concerns the exact collection date of the holotype. It is formed from the Latin word *idus*, and refers to the monthly basis of the Roman calendar. The Ides of March were made famous by the death of Julius Caesar.

Tabanus caduceus new species Fig. 5

Holotype female. Length 11 mm. **Head.** Frons very slightly divergent above, index 1:4.9; tomentum below median callus whitish gray, along sides of median callus brown, and above it brownish gray but remaining pale gray along a very narrow strip along eye margin, a rather shiny blackened area at vertex; hairs below median callus mixed white and black, sparse; hairs at sides of and above median callus black, dense. Calli black, not connected; basal callus essentially rectangular but excavated above and jagged below; median callus ovate-lanceolate. Eye in life with one light green stripe through middle of dark field. Subcallus bare and shining, blackish brown to black. Upper cheek corner of face with brown tomentum and brown and black hairs, remainder of face with grayish white tomentum and white hairs including beard, except that the upper cheek has a quantity of black hairs below the brown tomentose area. Palpus with both segments strongly gray, basal segment mostly with long white hairs but a few black hairs apically, apical segment mostly white haired at base, beyond the base with mixed white and black hairs throughout. Antenna with scape mostly black haired, some white hairs below; plate orange, narrow, with a very low obtuse dorsal tooth; annuli evenly orange brown, darker than plate. **Thorax.** Scutum anterior to transverse suture gray over a large anterior area, antelare paler brownish white, and central area becoming dark brown posteriorly; with recumbent off-white hairs, more erect white hairs anteriorly and black hairs posteriorly; scutum posterior to transverse suture blackish brown with black hairs, hind margin between wing base and scutellum with pale tomentum and white hairs, the hind margin centrally (i.e. the prescutellum) remaining dark; scutellum with white tomentum and hairs except for a rather small anterior central strip (adjacent to prescutellum) which has brown tomentum and a few black hairs. Venter almost entirely whitish gray with white hairs; coxae whitish gray; femora black; fore tibia white with white hairs over outer face of approximately basal 7/10 of length, apex black with black hairs, other tibiae similar except approximately basal 7/8 white; tarsi black. Wing with costal cell tinted

light brown; apico-costal area tinted brown to wing tip, relatively strong in marginal cell and dilute in 1st submarginal cell except at apex (where it remains strong along costa); remainder of wing nearly hyaline; 1st P cell open; anterior branch of 3rd vein curved to slightly angulate; halter stem yellow, knob brown. **Abdomen.** Tergite 1 black with black hairs, widely whitish gray with white hairs at side; 2 black with black hairs and only narrowly whitish gray with white hairs at side and on apical corner; 3 and 4 black with black hairs, with narrow but conspicuous apical bands of grayish white tomentum and white hairs which expand toward the midline; 5 black with black hairs, and although there is a trace of pale tomentum along extreme apex, it is obscured by black hairs; 6 black with black hairs, a narrow, even band of grayish white tomentum and white hairs along apex; 7 black. Sternites 1 and 2 with whitish gray tomentum and almost entirely white hairs; 3 and 4 black with black hairs basally, grayish white with white hairs apically; 5 mostly black with black hairs, with an apical band of gray tomentum which is also mostly black haired, and an apical fringe of white hairs; 6 black, with a very narrow apical band of gray tomentum and white hairs; 7 black, with only a faint suggestion of gray tomentum at apex.

Paratypes (6♀). Length 10-11.5 mm. Frons index 1:4.0-4.8. Basal callus brownish below in Viet-Nam specimens. White portion of tibiae may be even greater than that shown for holotype. Tergite 7 may have gray tomentum narrowly along apex. White hair fringe sometimes incomplete on sternite 5 (and also incomplete on 6 in Viet-Nam specimens); a few white hairs may be present at apical corners of sternite 7.

Male unknown.

Type series data. Holotype ♀: THAILAND: Chiang Mai Prov.: Ban Bon Doi Suthep (vill. on mtn.) Alt. 1000 m $18^{\circ}48'N$ $98^{\circ}56'E$: 3 May 1969 manbiting John J.S. Burton 1215 hrs. (In Cornell University.) The locality was a small village at the base of the stairway to a famous Buddhist

temple, on the road climbing Doi (=Mountain) Suthep. Paratypes: Chiang Mai Prov.: Doi Pui (a Maeo vill.) 18°49-50'N ~98°53'E: 2♀♀, 3 May 1969 JB; Chiang Mai Prov.: Huai Kao (~4 km NW of Chiang Mai) 18°48'N 98°57'E: 1♀, 18 July 1969 Kao Somporn; S. VIET-NAM: "20 km/N. of Pleiku/650m. 9.V.1960/S. Quate/Collector", 3♀♀ (in Bishop Museum and Philip collection).

Taxonomy. This species has 2 very close relatives in *biannularis* Philip (new name for *bicinctus* Ricardo, not *2cinctus* [= *bicinctus*] Fabricius) and in *griseipalpis* Schuurmans Stekhoven.

The type of *bicinctus/biannularis* was seen by me in BMNH. The type locality is in N. Kanara district, which is adjacent to but west and south of Goa Province in SW India. The species, under one or the other name, has been widely reported outside of India from the Far East, including Malaya (Ricardo 1911:132; Stekhoven 1926:310; Philip 1960b:42), Taiwan (Ricardo 1914a:64; Shiraki 1918:245), Indonesia (de Meijere 1924:203), Chiang Mai, Thailand (Philip 1960a:13), and S. Viet-Nam (Philip 1962:297). I have had little or no occasion to check the specimens on which these records are based, but am strongly inclined to suggest that most of these records are the result of excessive lumping. In BMNH I have seen 1 specimen each from East and West Malaysia whose conspecificity with the type of *bicinctus/biannularis* I cannot now argue against; but many of the rest of these southern records may well be *griseipalpis* Schuurmans Stekhoven or other species. Indeed, Philip (1962:296-297) formally reduced *griseipalpis* to the status of a "variety" under *biannularis*; I believe the former to be a good, full species (see below). As for the Viet-Nam record, it may prove to be the same as the new species under consideration here, since it was taken only about 160 km from the Viet-Nam paratype locality and in physiographically related circumstances. Also, Philip has formerly determined as *biannularis* the 3 Viet-Nam specimens now being used as paratypes. As for the Chiang Mai record, it is even more likely to be *caduceus*, since it is just down the mountain from the type locality and essentially the same as a paratype locality; but I am inclined to disregard this record completely, because, in the same sentence that it is reported, Chiang Mai is identified as the type locality of *griseipalpis* (instead of Sumatra). Of greatest significance, I have neither collected nor seen any specimens from anywhere in Thailand which are conspecific with the *bicinctus/biannularis* type, and do not now regard the species as a member of the Thailand fauna.

The 2 species differ as follows. (1) In *caduceus*, the mesopleurite is entirely white haired. In *biannularis*, the large heavy pile of the posterior (caudal) edge of the mesopleurite is dark brown,

thus appearing to continue the pale/dark color dividing line on the scutum far down on the pleuron (I consider this character very important). (2) In *caduceus*, sternites 5 and 6 bear narrow but easily visible apical pale bands. In *biannularis*, the venter beyond sternite 4 is black, with only a faint trace of pale apical tomentum on sternite 5. The same distinction can be made for the apex of tergite 6. (3) In *caduceus*, the brown tint in the 1st submarginal cell is quite dilute, especially along the lower border. In *biannularis*, the brown tint is strong in, and entirely fills, the 1st submarginal cell (this last differentiation may prove variable).

The type of *T. griseipalpis* was described by Stekhoven (1926:312-313) from Sumatra. Dr. T. van Leeuwen of Zoologisch Museum, Amsterdam, has informed me that that institution has the specimen labeled as type by Stekhoven. The Siam paratype from Khao Luang, Nakhon Si Thammarat Province, is in BMNH; and 2♀♀ which he subsequently published (1928:443) from Trang Province are in USNM. These last 2 are probably not conspecific with each other. Only 1 of them is labeled "*griseipalpis* SCH. STEKH" in handwriting which I presume to be Stekhoven's. Working from this specimen and from the original description, the taxon clearly merits full specific rank and is distinct from *biannularis* and *caduceus*. In addition to the geographic consideration (no *griseipalpis* has been taken above 9°N nor west of 99°E), the species may be distinguished as follows. Both *caduceus* and *griseipalpis* have all white haired mesopleurites, unlike *biannularis*. *T. griseipalpis* has a considerable amount of yellow hair on both the anterior portion and the hind margin of the scutum, which is not possessed by *caduceus* (and probably not by *biannularis* either, though I neglected to make notes on this.) The blackish brown pattern of the scutum of *griseipalpis* does not carry over onto the base of the scutellum, as it does in *caduceus*. Other differences are seen but their value cannot now be assessed.

I have found no reason to exclude the Viet-Nam specimens from the paratype series of *caduceus*, though their presence does add a slight touch of heterogeneity as noted.

Biology. *T. caduceus* is known to occur at altitudes from about 350 m up to a possible 1650 m, these extremes reached at the base and toward the summit of the same massif, with the type locality in between. It is probably safe to characterize it as a mountain jungle species. Known flight range is from 3 May to 18 July, clearly artificially short. It is known to be active at midday as well as in later afternoon or evening. It is thought appropriate to name this known manbiting species after the symbol of the medical profession. Host interest has also been observed in horses and cattle.

Tabanus rhinargus Philip Fig. 6

Tabanus rhinargus Philip, 1962, Pacif. Ins. 4(2):299-300.

Female. Length 10-12 mm. **Head.** Frons divergent above to nearly parallel-sided, sometimes bowed outward into rather convex sides, index 1:3.4-4.7; tomentum grayish white below basal callus and grayish white to rather yellowish and yellow haired above it, patches lateral to median callus brown, tomentum above median callus gray to brown, blackened over apical patch which may be in the shape of a triangle and with black hairs. Basal callus essentially square, its sides parallel to, and closely approaching but not touching, the eye margins. Median callus oval, elliptical, or an irregular variant of these, which may or may not be connected with basal callus by a narrow strip at the midline. Eye in life with 2 diagonal green stripes across dark field, the upper stripe at about the middle of the eye extending out from the level of the basal callus, the lower stripe near lower eye margin. Subcallus bare, brownish orange to blackish brown; facial tomentum white except brownish near upper cheek angle, facial hair including beard white. Antenna with scape mostly black haired above and with long white hairs elsewhere; flagellum unicolorous orange, dorsal tooth of plate obtuse and low. Palpus variable from whitish gray to silvery gray, basal segment with long white hairs and occasionally some black hairs, apical segment with mixed white and black hairs. **Thorax.** Dorsum with anterior portion relatively pale-tomentose and predominantly golden yellow haired, central portion blackish brown and black haired over a wide convex-convex band between the wing bases, posterior portion including hind margin of scutum and entire scutellum almost entirely whitish- to yellowish-tomentose and predominantly golden yellow haired, with a tuft of white hair between wing base and scutellum. Venter and fore coxae gray to grayish white and almost entirely white haired; all femora black to brown with matching hairs; tibiae white and white haired, except apical 1/4 to 1/3 of fore tibia black and black haired, and apices of remaining tibiae yellowish brown with some black hairs; tarsi black to brown. Wing with costal cell tinted yellowish brown and remainder of costal margin tinted brown, remainder of wing with a light to moderate yellowish to brownish tint, fading to nearly hyaline along hind margin; calypter brown; 1st P cell open; spur vein usually present but occasionally reduced to an angulation of the 3rd vein; halter stem and knob yellow to brown. **Abdomen.** Tergites 1 and 2 dark brown with black hair, 1 broadly yellowish to grayish at sides with golden yellow to white hairs over this pale area, 2 similar but pale area much smaller; 3 and 4 dark brown to blackish basally and with black hairs, yellow tomentose and golden yellow haired apically, the pale band occupying about 2/5 to 1/2 of the breadth of 3 and 2/5 up to 3/4 of the breadth of 4, the pale

bands gradually expanded toward the midline; 5 and 6 blackish brown and black haired with narrow pale bands of yellow tomentum which also possess a variable amount of golden yellow hairs, these pale hairs sometimes reduced to a sparse fringe. Sternites 1 and 2 principally yellow to grayish yellow (infrequently gray), with yellow to white hairs; 3 and 4 variable, 3 occasionally remaining pale and pale yellow haired throughout but usually darkened basally at least toward the midline, 4 pale apically and darkened basally but never as dark tergite 4, the hairs on both these sternites generally reflecting the underlying color; 5 and 6 similar to tergites 5 and 6. (33).

Male unknown.

Type data (♀): "VIET NAM. 20 km/N. of Pleiku/650m. 9.V.1960/L. W. Quate/Collector". (Seen from Bishop Museum.) Coordinates of this locality are about 14°11'N 107°57'E. Pleiku is shown as Gia Lai on older maps.

Published records. Known only from the type and 1♀ paratype, said to have the same data.

New records. VIET-NAM: "Fyan/2. VIII. 1961/Malaise trap/N.R. Spencer", 1♀ from BPBM. Fyan is west of Da Lat at 11°53'N 108°12'E. "BanMeThuot 500m/16-18.V.1960/S. Quate/Collector", 1♀ from BPBM, a paratype of *nigrinus* Philip. This locality is at 12°40'N 108°03'E, and the town's alternate name is Lac Giao. LAOS: "Muong Sing/NW of Luang Prabang/650m, 6-10.VI.1960/S. Quate & L. Quate/Collectors", 1♀ from BPBM. Muong Sing is near the China border at 21°11'N 101°10'E. THAILAND (all 1969): Chiang Mai Prov.: Huai Kao (~4 km NW of Chiang Mai) 18°48'N 98°57'E: 1♀, 10 May JB; 21♀, 10-28 May Kao Somporn: 1♀, 18 July KS; Loei Prov.: Dan Sai Dist.: Dan Sai & vic. 17°16'N 101°09'E: 2♀, 22 May JB; 1♀, 9 June C. Dettongchai (plus a longer series with same data in which the condition is too poor to identify with certainty); Nakhon Ratchasima Prov.: Pak Chong Dist.: Mu Si Canton: Pong-ta-long [14°25-37'N 102°20-37'E]: 4♀, 20 May G.R. Ballmer.

Taxonomy. The type of *rhinargus* has a brownish orange subcallus. All other specimens seen by me including those from Viet-Nam have brown to blackish brown subcalli, though a few approach orange at the midline of the subcallus. This color difference is not now considered significant, and consequently cannot be used to differentiate this species from *nigrinus* Philip. The characters of the *nigrinus* holotype (seen from Bishop Museum) almost all fall within the range of variation of my *rhinargus* series, and I

might have synonymized the 2 species if it were not for a difference in the wing coloration. The *nigrinus* type has the costal cell only slightly yellowed, and the tint anywhere else in the wing is so slight that it is essentially imperceptible to the naked eye. In the *rhinargus* series, a yellowish to brownish tint can be seen with the naked eye in the basal and apico-costal areas of the wing. It should also be noted that the pale apical bands on tergites 3 and 4 are not as wide in the *nigrinus* type as in almost all *rhinargus*. Philip (1962:300) named 9 specimens from Viet-Nam as paratypes of *nigrinus*. I have seen only 2 of these (from Bishop Museum). One of them has wings tinted like *rhinargus* and is therefore identified as the latter; the other is pale, but even so the tint is slightly stronger than in the *nigrinus* type. Philip also discussed 3 specimens from Thailand under *nigrinus* but noted that they "are not included in type series." But a paratype designation label was affixed by him to at least one of these specimens in Bishop Museum. The Thai specimen seen by me is not conspecific with either the *nigrinus* or the *rhinargus* types.

There are 2 specimens in Bishop Museum from "LAOS: Phou-kow-kuei" [=Khouai Mountain; Vientiane Prov.] which are related to *rhinargus* but differ from it in smaller size

(9.5 mm), narrower frons with more vertically proportioned calli and with darker tomentum, much larger area of brown tomentum on upper cheeks, hair tuft between wing base and scutellum golden yellow (not white), pale tomentum of apical band on tergite 4 could be said to cross the entire tergite at the midline. These Laotian specimens may well prove to be *T. leucocnematus* (Bigot); but since they were not given a direct type comparison, and since the type of *leucocnematus* is headless and in otherwise bad condition, I do not now wish to state that this misunderstood species is a known member of the Thailand/Laos fauna. It will suffice to say that the species bears a resemblance to *rhinargus*, distinguished at the least by smaller total size and broader apical band on tergite 4.

Biology. *T. rhinargus* seems to prefer jungly areas at middle altitudes. It is known to occur from about 350-650 m. Known seasonal range is 9 May-2 August, both extremes from south central Viet-Nam but very similar to the range in Thailand. Host interest is recorded in cattle and water buffalo, and it has also been taken at lights at night and in Malaise trap. Ballmer noted that his specimens were taken biting the ankle area of cattle. They are known to be active in early afternoon as well as later in the day.

Tabanus discors new species Fig. 7

Holotype female. Length 11.5 mm. **Head.** Frons divergent above, index 1:5.2; tomentum whitish gray and hairs mostly yellow below level of median callus, tomentum brown and hairs black lateral to and above median callus, a median area of gray tomentum near vertex. Calli black; basal callus approximately square, slightly taller than broad; median callus approximately elliptical, connected to basal callus by a keel which is nearly grown over by tomentum. Subcallus bare and shining, orange brown at midline and dark brown laterally; face whitish gray to gray, hairs including beard white, upper cheek corner with brown tomentum and some dark hairs. Antenna with scape mostly black haired, white haired below; flagellum unicolorous orange, plate slender with a low obtuse dorsal tooth. Palpi with both segments pale gray, basal segment white haired, apical segment predominantly white haired but with black hairs mixed in beyond the base. **Thorax.** Scutum with area anterior to the transverse suture mostly with various shades of gray tomentum and with golden yellow hairs, tomentum of antealare mostly pinkish yellow; a broad convex-convex blackish brown, black haired band extends between wing bases; entire hind margin of scutum and all of scutellum covered with pale (off-white) tomentum and yellow to golden yellow hairs. Venter pale gray, almost entirely white haired; coxae also pale gray, fore coxa white haired except black haired at apex, hind coxa mostly black haired; all femora black except

pale at extreme apices, hairs black except some scattered white hairs; fore tibia white and white haired over approximately basal 3/4 of area, apical 1/4 black and black haired, remaining tibiae white and white haired over about 9/10 of area, only extreme apices brown and with black hairs; all tarsi dark. Wing essentially hyaline, 1st costal cell slightly yellowed, stigma and apex of subcostal cell yellow; veins yellowish brown, relatively pale; 1st P cell open; anterior branch of 3rd vein with an unusually long and slightly curved spur vein; halter stem yellow, knob brown. **Abdomen.** Tergite 1 widely pale tomentose and with white and golden yellow hairs at side, central area blackened and with black hairs; 2 also pale tomentose laterally and over apical corner, with white and golden yellow hairs, remainder brown to black with black hairs; 3 and 4 black with black hairs basally, apically with broad pale bands of yellow tomentum and golden yellow hairs which expand gradually toward the midline; 5 and 6 similar but apical pale (yellow) bands quite narrow and not expanded at midline; 7 black, apex with only a suggestion of pale tomentum and a few scattered yellow hairs. Sternites 1 and 2 covered with pale tomentum and with white hairs, only a few inconspicuous black hairs near midline of 2; 3 and 4 blackened and with black hairs basally, apically with pale bands of whitish tomentum and white hairs which are narrower toward the midline; 5 and 6 similar but apical pale (whitish) bands much narrower.

Paratypes (4♀♀). Length 10-11 mm. Frons index 1:4.7-4.8. Tomentum of frons lateral to and above median callus brown to gray; calli may or may not be connected at midline. Subcallus may be entirely blackish brown. Antennal scape may be white haired laterally. Tuft of hair between wing base and scutellum white to yellow. Costal cell and some area beyond and below it may sometimes be considered as tinted slightly yellow. Sternite 2 may be entirely white haired or may have a few black hairs near the midline.

Male unknown.

Type series data. Holotype ♀: THAILAND: Chiang Mai Prov.: Huai Kaeo (~4 km NW of Chiang Mai) 18°48'N 98°57'E: 27 May 1969 Kaeo Somporn. (In Cornell University.) The type locality was the environs of a zoological garden at the foot of Doi Suthep, at ~350 m altitude. Paratypes: 2♀♀, same locality and collector as holotype, but 10 June 1969; 1♀, same locality as holotype but 15 July 1969, Pie Chaemmanee; Chiang Rai Prov.: Mae Sai Dist.: Mae Sai & vic.

Tabanus zodiacus new species Fig. 8

Holotype female. Length 8.75 mm. **Head.** Frons slightly divergent above, index 1:3.3; tomentum pale grayish yellow, brownish at the sides of median callus, dark brown triangular area at vertex; hairs mostly yellow below median callus, black at the sides and above it. Both calli black, connected at midline; basal callus a wide irregular square; median callus large, broad at base and narrowing above. Eye in life with single green stripe through middle of dark field. Subcallus bare and shining, orange. Small area of upper cheek corner bare, brown. Facial tomentum pale yellow, slightly darker on upper cheek; hairs including beard orange yellow, a few dark hairs on upper cheek. Antennal scape mostly black haired with some pale hairs below; plate orange, broad, with an obtuse dorsal tooth, basal annulus concolorous orange, apical annulus slightly to moderately darker. Palpi with basal segment orange to grayish with hairs almost entirely orange yellow, apical segment dull orange with mixed black and orange yellow hairs. **Thorax.** Dorsum with that portion anterior to the transverse suture yellow and orange yellow haired at sides, becoming gray anteriorly and brown at middle, midline with a darker brown very narrow stripe, hairs sparse orange yellow; broad band between wing bases blackish brown with matching hairs; entire hind margin of scutum and all of scutellum pale yellow to grayish yellow with orange yellow hairs. Venter and coxae mostly gray, some yellow, hair almost entirely orange yellow; femora black except yellow to orange at apices, fore femur black haired, others with much orange yellow hair as well as black; fore tibia yellowish white with concolorous hairs over approximately basal 3/5 of area, remainder

20°26'N 99°53'E: 1♀, 17 July 1969 JB.

Taxonomy. This species is easily separated from other known Thailand and Laos members of the group by the fact that the pale hairs of the entire dorsal aspect of the insect are almost all golden yellow, while those of the entire ventral aspect are almost all white. The wings do not show a brownish tint; they do have a long spur vein.

I have seen 1♀ specimen from Lampang in BMNH which may belong here, but which differs from the type series in having only a short spur vein in the left wing and none in the right wing, some pale hairs on the abdominal venter yellow, and tomentum of frons lateral to and above median callus blackened.

Biology. Known seasonal range is 27 May to 17 July; altitudes from approximately 350-400 m. Host interest includes at least water buffalo and cattle. The Mae Sai specimen was collected between 1200-1600 hrs.

blackened and with black hairs, other tibiae whitish with white to yellow hairs over at least 4/5 of area, only the apices brown. Wing essentially hyaline except for a slight yellow tint at base; 1st P cell open; 3rd longitudinal vein very slightly (left wing) to rather distinctly angulate; halter stem and apex of knob brown, base of knob darker brown. **Abdomen.** Tergites 1 and 2 yellow and orange yellow haired at sides, becoming brown with black hairs mesad and brownish black with black hairs over a broad area at the middle. The tomentum along the apex of 2 is paler, but the tergite should not be considered as banded. Tergites 3-7 each black and black haired, with apical bands of pale yellow tomentum and golden yellow hairs, the band on 3 occupies an average of about 2/5 the width of the tergite, with each succeeding band progressively narrower, the bands on 3 and 4 slightly expanded at midline and sides. Sternites 1 and 2 yellow with minor yellowish gray areas, and with yellow hairs; 3 and 4 mostly yellow haired, with pale yellow apical bands and basally with pale tomentum overlying dark integument; 5-7 with apical bands of pale yellow tomentum and yellow hairs, basally black with black hairs.

Paratypes (6♀♀). Length 8.0-8.75 mm. Frons index 1:3.3-3.8, slightly divergent above to essentially parallel-sided. Calli variable, sometimes unconnected, basal callus may be undulant above and below, median callus sometimes tapering to nearly a point above. All antennal annuli sometimes darker than plate. Outer face (not venter) of apical segment of palpus commonly almost all black haired. Hind femur may be brown (not black),

fore tibia may be up to nearly half blackened, or all tibial apices may be paler than in type. Short spur vein sometimes present on 3rd vein; halter may be pale brown, yellowish at tip. Sternite 3 sometimes about as pale yellow as 1 and 2.

Male unknown.

Type series data. Holotype ♀: THAILAND: Chiang Mai Prov.: Doi Pui (a Maeo vill.) Alt. 1450-1650 m 18°49-50'N ~98°53'E: 3 May 1969 about horses John J.S. Burton 1600-1900 hrs. (In Cornell University.) All paratypes with exactly the same collecting data as holotype. Doi Pui (=Pui Mountain) is just to the NW of, and part of the same massif as, Doi Suthep. These lie just NW of the city of Chiang Mai. The collection was made at a Maeo (=Miao) hill tribe village accessible by car.

Taxonomy. I have at hand 10 specimens with precisely the same collecting data as the above type series and which show only one consistent difference from the series: all of the pale hairs over the entire insect are whitish yellow in color, not orange (golden) yellow as in *zodiacus*. In view of the fact that the 2 series were collected only at the same unique locality and at the same time, it is possible that they are conspecific; on the other hand since there is no overlap in pale hair coloration (out of a total of 17 specimens), it is possible that the 2nd series represents yet another new species. I consider it prudent to refrain from taking decisive action until further evidence is gathered.

Tabanus tonglai Surcouf Fig. 9

Tabanus Tong-Lai Surcouf, 1922, Bull. Soc. Ent. France 1922(1):13.

Tabanus insidiator Austen, 1922a, Bull. Ent. Res. 12(4):437-440. (New synonym.)

Female. Length 10.5-12.5 mm. **Head.** Frons divergent to very slightly divergent above, index 1:3.9-5.0; tomentum pale yellow to yellowish brown, dark brown lateral to and just above median callus, blackened or at least dark brown over large and fairly shiny area at vertex; hairs mostly to entirely pale yellow between calli, mostly to entirely black haired lateral to median callus, variable above from mixed yellow and black to almost entirely black haired, black haired over blackened area at vertex. Calli usually with a linear connection at midline; basal callus hexagonal to square or rectangular but may be jagged above and below, yellowish brown below to entirely black; median callus black, highly variable in both size and shape from very large and lanceolate or spindle shaped to small and irregular. Eye (in life or relaxed) with a single light green stripe across darker field. Subcallus bare and

T. zodiacus has a relative in *gertrudae* Philip (=flavocinctus Ricardo, not flavocinctus Bellardi) of India (Ricardo material seen in BMNH). *T. gertrudae* is distinguished from it by possessing a yellowed costal cell (not hyaline), and sternites 1-6 are yellow, not mostly darkened over apical sternites.

The new species has similarities with *bicoloratus* Philip from Da Lat, S. Viet-Nam (type seen from Bishop Museum), which is another higher altitude species. But they are immediately distinguishable by the color of the femora, which are orange yellow in *bicoloratus* and blackened in *zodiacus*. The same distinction can be made between *zodiacus* and *albiscutellus* Philip (=albivittatus Schuurmans Stekhoven, not Macquart), a Malayan Subregion species. *T. cestus* Philip, another S. Viet-Nam species (type seen from Bishop Museum), differs in having the costal cell slightly yellowed and palpi gray. There are several other specimens in Bishop Museum from Laos and Thailand, including the specimen inaccurately bearing a *nigrinus* paratype designation label which have only a superficial resemblance here; but clarifying their relationship should await fresh material since their condition is poor and/or they are ambiguously labeled.

Biology. The species is known from a single unusual locality. The terrain on Doi Pui is steep and forested, with agricultural clearings. A small stream was present near the collecting site. All specimens were taken about horses. It is suggested but not confirmed that there may be more flight activity in mid-afternoon than in the hour before nightfall.

shining, variable from yellow to brown. Upper cheek corner with brown tomentum and some darkened hairs; remainder of face white with some gray ventrally, hairs including beard white to whitish yellow. Both palpal segments highly variable from creamy yellow to gray, basal segment with whitish to whitish yellow hairs and commonly with some black hairs, apical segment extremely variable from almost entirely pale haired to almost entirely black haired. Antenna with scape black haired above and pale haired below; plate with an obtuse to right angled dorsal tooth; flagellum color variable from nearly unicolorous orange throughout to orange at base of plate and darker apically, or a color break may occur between plate and basal annulus, apical annulus almost always darker than remainder. **Thorax.** Scutum anterior to transverse suture gray anteriorly becoming dark brown centrally and pale

whitish brown (tan) at sides including antealear, with recumbent brownish yellow to pale yellow hairs widely over median and mixed pale and black hairs over brown area and on antealear; scutum posterior to transverse suture blackish brown to brown and with black hairs, hind margin of scutum and all of scutellum with pale (off-white) tomentum and white to pale yellowish hairs. Venter mostly gray, paler whitish brown at sides, almost all hairs pale yellow to white; femora black to brown except pale at extreme apex; fore tibia white and white to pale yellow haired over approximately 2/3 of area at the base, black and black haired apically, other tibiae similar but 4/5 or more of area white; tarsi dark. Wing variable, from essentially hyaline except for a faint suggestion of brownish tint along costa beyond its junction with the 1st vein, to more extensively tinted brownish especially in the marginal and 1st submarginal cells, costal cell hyaline to slightly tinted yellow; 1st P cell open; spur vein present and distinct but variable from short to very long and curved. Halter stem yellow to brown, knob dark brown. **Abdomen.** Tergite 1 with yellowish white to white tomentum and hairs over a broad area laterally, central area brown with black hairs; 2 brown with black hairs except with yellowish white to white tomentum and hairs at lateral margin and over apical corner; 3 and 4 black haired basally but underlying color highly variable from brown to black, hence a transition from brown to black may occur at the junction of 2 and 3, or of 3 and 4, or both tergites may be brown and concolorous with 2, or either may show intermediate coloration; 3 and 4 with apical bands of yellowish white to white tomentum and hairs which expand gradually toward the midline, usually forming low, broad based triangles; 5-7 black to brownish black and with black hairs, each with a narrow to very narrow apical band of yellowish white to white tomentum, 6 and (almost always) 7 with a variable pale hair fringe, 5 often also with a similar pale hair fringe, but this may be reduced to nonexistent, in which case the apex of 5 may be very inconspicuous. Sternites 1 and 2 essentially yellow, with pale tomentum and yellowish white to white hairs; 3 and 4 highly variable from yellow to blackish brown basally and with black hairs, with pale tomentum and hairs over apical area; 5 orange brown to black basally, 6 and 7 almost always black and black haired basally, 5-7 with bands of pale tomentum and hairs apically. (17+)

Male unknown.

Type data (♀): "Laos/Tong La/le 30-IV 1918/R.Vitalis de Salvaza". (Seen in Paris Museum.) Despite extensive seaching through both recent and older map sources, I cannot find this locality. It is possibly the same as the village of Ban La at 19°59'N 103°50'E, hence in the same general area where Vitalis de Salvaza collected earlier the same month (see discussion of

his collection); or possibly it is the town of Muong La at 20°53'N 102°07'E, thus much farther to the northwest; these are merely guesses.

Published records. 1♀ "cotype" of *tonglai*, also in Paris Museum, bears exactly the same collecting data. Holotype ♀ and all 4♀♀ paratypes of *insidiator* (seen in BMNH) show the same data: "N. Siam./Doi Chom Chang./nr. Chiangmai./Alt.5,000 ft./16.iv.1921./Dr. M.E. Barnes./1921. 393." Stone (1975:61) added Laos to the *insidiator* records without further comment.

New records. THAILAND (all 1969): Chiang Mai Prov.: Chiang Dao Dist. (~5 km NW of Chiang Dao) 19°23'N 98°56'E: 7♀♀, 6 May JB; 3♀♀, 7 May JB or P. Chaemmanee; Chiang Mai Prov.: Doi Pui (a Maeo village) 18°49-50'N ~98°53'E: 6♀♀, 3 May JB; Chiang Mai Prov.: Huai Kaeo (~4 km NW of Chiang Mai) 18°48'N 98°57'E: 1♀, 10-15 May K. Somporn.

Taxonomy. The type and cotype of *tonglai* are in good agreement with the series diagnosed above, and I have no hesitation calling them conspecific with the Chiang Dao population (from which the Doi Pui population diverges slightly as noted below). I consider the *insidiator* type to be the same and herewith synonymize it under *tonglai*, though in this case I am doing so with hesitation. The name *insidiator* was published only 3 weeks after *tonglai*, and Austen made a comparison of them very shortly thereafter, which was subsequently published by Schuurmans Stekhoven (1926:315). I think the differences he noted as well as others explored by me are the result of short series. Some have already been found to fall within the range of variation, and I expect the remainder will fall there in the future. Color of the palpal tomentum and hairs, as well as palpal shape, is seen as highly variable. I saw no particular distinction in width of abdominal bands; the dark spot on tergite 2 of the *insidiator* type is not regarded as taxonomically significant; amount of wing tint is variable. On the average, the *insidiator* type may agree more with the Doi Pui population, which was similarly collected at an upper altitude. They tend to have the darker palpal tomentum and greater proportion of black palpal hairs, the wing tint tends to be more distinct and/or more extensive. The higher altitude may have given rise to a partial phenotypic distinction, which is not in need of nomenclatorial recognition. Again, I hesitate to create the new synonymy since there is a lingering doubt, especially over the unusually dark, black haired palpi, but it seems to me the best case at this time. Furthermore, any distinction in range is eliminated, as "good" *tonglai* is found near the *insidiator* type locality. The *insidiator* type is aberrant in possessing an asymmetrically developed median callus, present only on the left side of the midline, and hence is not the specimen illustrated in the original description.

The closest relative known to me is *orbis*, which see for comparative notes.

Biology. The species is known from upper latitudes (not below Chiang Mai) and upper altitudes (not below 350 m and up to a possible 1650 m) in Thailand and Laos. The localities are

all in or adjacent to mountain jungles. Known seasonal distribution is from 16 April to 15 May, thus during the dry season. Flight activity is known to take place throughout the day, from morning up to and probably during the last hour before dark. Host interest includes horses, cattle, and man.

Tabanus orbis new species Fig. 10

Holotype female. Length 11.5 mm. **Head.**

Frons slightly divergent above, index 1:4.9; tomentum brownish yellow below median callus and dark brown lateral to and above it, with a fairly shiny brownish black area just below vertex; hairs below median callus mixed yellow and black, lateral to and above median callus almost entirely black. Calli widely separated, though a median keel is present beneath the tomentum; basal callus orange yellow below becoming blackened above, essentially rectangular, taller than wide, jagged above and below; median callus black, rather elliptical but ill-defined above as the tomentum encroaches irregularly on it. Subcallus bare and shining, dark yellow. Upper cheek corner with brown tomentum and hairs, and some dark hairs also scattered outward along adjacent eye margin; remainder of face with yellowish white tomentum and whitish yellow hairs. Palpus with basal segment yellow, basal hairs yellow and apical hairs mostly black; apical segment yellow basally and dorsally, becoming brownish to grayish laterally, some yellow hairs basally and ventrally, otherwise entirely black haired over outer aspect. Antenna with scape mostly black haired, some pale hairs below; plate orange, with a low obtuse to right angled dorsal tooth; annuli darker orange. **Thorax.** Scutum anterior to transverse suture gray, becoming dark brown centrally and pale whitish brown (tan) at sides including anteaalare, with recumbent yellow hairs and more erect pale yellow hairs over gray and pale areas, and some mixed black hairs on brown area and on anteaalare; scutum posterior to transverse suture brown to blackish brown and with black hairs; hind margin of scutum and all of scutellum with rather pale tomentum and whitish to yellow hairs, but a large basocentral area of the scutellum appears brown when viewed at an angle from the front or from above. Venter gray centrally but widely pale grayish yellow peripherally, almost all hairs pale yellow; fore femur brownish black, paler at apex; middle femur yellow to orange, with black hairs over anterior (outer) face and yellow hairs over posterior (inner) face; hind femur grayish brown basally and orange apically; fore tibia white to yellow with matching hairs over approximately basal 2/3, apical 1/3 black and black haired; other tibiae pale over basal 4/5 or more, brown with black hairs apically. Wing with a narrow and very diffuse brownish tint along costal margin, costal cell pale yellow, area of stigma yellow; 1st P cell open; spur vein present. Halter stem and knob yellow. **Abdomen.** Tergite 1 with

pale yellow tomentum and yellow hairs over broad lateral area, becoming brown with black hairs over median area; 2 brown with black hairs except with pale yellow tomentum and yellow hairs at lateral margin and over apical corner; 3 and 4 mostly blackened and with black hairs, apices with bands of pale yellow tomentum and yellow hairs which expand moderately toward the midline; 5 black with black hairs, some pale tomentum narrowly along apices but no pale hairs; 6 and 7 black with black hairs, and narrow bands of pale tomentum and yellow hair fringes along apices. Sternites 1 and 2 yellow with yellow hairs; 3 orange basally and with mostly black hairs, apically with yellow tomentum and hairs; 4 blackened basally and with mostly black hairs, apically with yellow tomentum and hairs; 5 and 6 black with black hairs, apices with narrow bands of yellow tomentum and hairs.

Paratypes (5♀♀). Length 10.5-11.5 mm.

Frons index 1:4.0-5.4. Calli may have a linear connection at midline; median callus variable in size, and in shape from lanceolate to elliptical. Face may be entirely pale haired, with dark hairs absent even from upper cheek corner. Basal segment of palpus may be entirely yellow haired, and may have some grayish area; apical segment may be gray except for a narrow yellow area at base. Antennal scape may be almost entirely pale haired below, and dorsal apex may have a few short orange hairs; dorsal tooth of plate may be low but acute; annuli may be concolorous with orange plate. Fore femur may be brown and hind femur orange. Wing commonly shows a very indistinct brownish to yellowish tint over a wider area in addition to the diffuse but more conspicuous brownish tint along costal margin. Tergite 5 may have some yellow hairs along apex laterally (but not forming a complete fringe); sternite 3 may be strongly darkened basally.

Male unknown.

Type series data. Holotype ♀: "LAOS: 30 Km N./Vang Vieng/12 March 1968/F. G. Howarth/El. 400 m./on horse..." (In Cornell University.) Paratypes: 4♀♀, exactly the same collecting data as holotype; 1♀, also "30 km. N./Mg. Vang Vieng", but "15 March 1968/700 m./Ban Ky Sok", same collector. A locality 30 km north of the town of Vang Vieng along the road to Luang Prabang would place it at approximately 19°08'N 102°20'E.

Taxonomy. This species is indeed very close to *tonglai*, and may eventually be found to be conspecific with it. But there are enough differences in the series at hand to justify the establishment of a new taxon at this time. The most consistent differences found are: in *orbis*, halter knob yellow (not brown); abdominal pale hairs with a distinct golden yellow hue throughout (not simply whitish to pale yellowish); baso-

central area of scutellum brownish when viewed from above (not remaining nearly the same pale shade throughout). In addition, other characters which tend to set *orbis* apart from *tonglai* but which may overlap with it are: darker palpi with more exclusively black hairs on lateral face; at least middle and hind femora paler; costal cell more yellowish.

Tabanus equicinctus Schuurmans Stekhoven Fig. 11

Tabanus equicinctus Schuurmans Stekhoven, 1926, Treubia 6, Suppl.: 282-283, Plate 10 Fig. 4.
Tabanus aequicinctus Szilády, 1926, Biologica Hung. 1(7):10. (Emendation.) [*aequicinctus*: Philip, 1960b:46; Stone, 1975:57—lapsus for Szilády's emendation.]

Female. Length 11.5-12.5 mm. **Head.** Frons parallel sided, index 1:4.0-4.6; tomentum dull yellowish to yellowish gray below and gray at vertex, with a dark brown patch on each side of dorsal extension of callosity which is conspicuous when viewed from below but may disappear when viewed from above; hairs black, sometimes mixed with white hairs. Callosity variable, orange brown to black, often brown below and black above, swollen, rectangular and entirely filling lower frons to the eye margins or moderately tapered in from the eye margins above; dorsal extension black to dark brown, distinctly elliptical to rather linear, connected to callosity by a narrow keel or entirely disjunct; a variable bare spot present near vertex. Subcallus with dull yellow tomentum, sometimes becoming gray above; face grayish white with white hairs including beard. Antenna with scape black haired above and white haired below; flagellum variable from almost entirely brownish orange to orange at base of plate and blackish brown elsewhere, dorsal tooth of plate low but obtuse or acute. Palpus with basal segment grayish white and long white hairs; apical segment mostly whitish gray becoming dull yellow at tip, hairs predominantly white but with scattered black hairs. **Thorax.** Dorsum shows various shades of gray, scutellum essentially concolorous with scutum; hairs black, but with white and sometimes yellow hairs both scattered and in conspicuous tufts around the periphery. Venter whitish gray with white hairs, coxae similar but hind coxa also with black hairs and fore coxa with some dark hairs at apex of inner face; fore femur blackish gray, middle and hind femora gray to brownish gray; fore tibia white and white haired over basal 3/4 to 4/5 of area, black and black haired over apical 1/4 to 1/5, middle and hind tibiae white and white haired over basal 4/5, brown to black with similar hair over apical 1/5; all tarsi dark. Wing hyaline, stigma brownish yellow; 1st P cell open; anterior branch of 3rd longitudinal vein curved to slightly angulate, no spur vein; halter stem and knob brown. **Abdomen.**

Dorsum black with black hairs, tergites 1 and 2 pale at sides, 2 and sometimes 3 brownish laterally, 2-6 banded at apices with whitish gray tomentum and white hairs, bands narrow, with each successive band slightly diminishing in width, bands expand slightly at the midline. Venter very similar to dorsum, except that sternites 1 and 2 are mostly or entirely gray tomentose and white haired; when viewed from the rear, darker patches usually appear at the midline of sternites; pale bands on 3-6 not expanded at midline. (5)

Male unknown.

Type data (♀): "Siam Peninsular[,] Nakon Sri Tamarat, Khao Rama Kam, 1200 Feet 23.2.'22, l Xavier" (quoted from original description). Type not seen by me. I cannot locate any "Khao Rama Kam" on my map sources; but the southern province of Nakhon Si Thammarat contains the great Khao Luang massif which rises above the stipulated altitude in a number of spots, so the name was probably locally used for one of them.

Published records. THAILAND: 1♀ [paratype], "Khao Tong 300 Ft. 21.2.'22, Xavier". 1♀, "[N]akon Sri Tamarat, Khao Ram, Siam 750 ft., 24.2.1922." (by Stekhoven 1928:443). As with the type, the localities given for these 2♀♀ are probably local names for spots in the Khao Luang massif (and note the date sequence). 2♀♀, "KhowSai/Dow1000ft/TrongLrSiam/Jan-Feb 1899/Collector/WLAbbott" (by Stekhoven 1928:443) (seen from USNM). Again, I cannot pinpoint the locality. Trang Province is on the west side of the southern peninsula, just southwest of Nakhon Si Thammarat Province. 1♀, "Chiangmai/Thailand 289/III-2-1952/DC&EBThurman" (by Philip 1960b:46) (seen from Philip collection). 1♀, "Doi Suthep, Thailand, 29. II. 1958 (Ikoma)" (by Sasakawa 1961:448). Doi Suthep is the mountain just NW of Chiang Mai. **VIET-NAM:** 1♀, "Annam/Asia/Sept-05/Vassal" (by Stone 1975:

57 as "Viet Nam") (seen from USNM). Annam was roughly that part of Viet-Nam which lies between 12°-20°N.

New records. "LAOS: 100 m./Uekinak,nr./PakKading/22. IV. 1965/J.L. Gressitt/Collector" (seen from Bishop Museum). Pakkading is located at 18°19'N 104°00'E just across the Mekong River from eastern Nong Khai Province.

Taxonomy. The type and [paratype] were originally shown by Stekhoven to be in the Raffles Museum, Singapore; the other Nakhon Si Thammarat specimen was shown to be in the Federated Malay States Museum, Kuala Lumpur. Mr. Oldroyd of BMNH has inquired about these collections for me, and has informed me that the type series "ought, presumably, to have come [to BMNH] in the postwar period." I found no specimens of *equicinctus* in BMNH. There is a remote chance that any of the 3 may still exist in Kuala Lumpur or Singapore, but it is probable that they are lost. Both of the Trang Province specimens are still in USNM, and would be available for neotype selection if the need arose. They would make good choices since Stekhoven himself published them, and since their source is not far from the type locality. I am refraining from establishing a neotype here because it is not yet certain that the original specimens are lost, and because I believe the situation does not satisfy Article 75a of the International Code of Zoological Nomenclature, which states that a neotype is not to be designated unless it is "essential for solving a complex zoological problem, such as the confused or doubtful identities

of closely similar species..." Several authors have contrasted *equicinctus* with other species from Thailand, Philippines, and India, but I do not now see any confusion whatsoever as to its identity.

Its black and white banded abdomen and strongly bicolored legs associate it at first glance with the *biannularis* group. But its subcallus is tomentose unlike the members of this group, and it lacks the strongly bicolored thoracic dorsum common to almost all members of the group. Thus it is technically not included in the group, and I have seen no particularly close relatives.

Stekhoven has figured the species in color in connection with the original description.

Biology. As sometimes happens with "rare" species, the sparse data presents an incongruous picture. All Thailand collecting localities are in or adjacent to hills (altitudes from 90-365+ m), but one source area is in the south (7°-9°N) and the other at about the same longitude but 1100 km away in the north (18°45-50'N). I was unable to collect any fresh specimens despite attempts in both these areas and many spots in between. All precisely stated Thailand/Laos dates fall between 21 February-22 April, but I regard this narrow range as coincidence, since the climates of the northern and southern areas are very different during this period as they are the year round. The Viet-Nam specimen, if accurately labeled, provides evidence of wider distribution and seasonal range, and causes the apparent rarity of the species to be all the more startling.

Tabanus ceylonicus group

This group contains a number of small, black to gray or brown species with bare and shining subcallus, body lacking strong color contrasts but with strongly bicolored (black and white) legs. The subcallus and leg characters, as well as the eye banding in life, may be said to "relate" this group to the *biannularis* group, but the 2 really do not have much in common (see key).

The *ceylonicus* group members characteris-

tically appear to be coastal breeders, though some species may tolerate a variety of conditions while others are probably restricted. Some are said to have a wide distribution. The Oriental tabanid fauna is generally so precinctive that I admit to some skepticism over the reported distribution of some species. These "little black flies" are generally so distinctive as a group that some classificational "lumping" may have occurred with some of its members.

Tabanus minimus van der Wulp Fig. 12

Tabanus minimus van der Wulp, 1881, Midden-Sumatra Exped. Diptera: 18, Plate 1 Fig. 11, 11a.

Female. Length 7.5-10.5 mm. **Head.** Frons slightly to very slightly divergent above, index 1:6.8-8.3; tomentum grayish below and yellowish to pale brownish above, with a darker gray spot at vertex which is usually rather shining; hairs black, uncommonly with some pale hairs below;

callosity black to brown, usually rather rectangular, excavated or with pockets below, variable above from square to excavated or dome shaped; dorsal extension black, finely linear, its keel sometimes grown over with tomentum below. Eye in life with 3 green bands across purple field.

Subcallus bare and shining, black to dark brown; face (including upper area of frontoclypeus) covered with whitish gray to yellowish gray tomentum; facial hairs including beard white to pale yellowish, sometimes with mixed dark hairs on frontoclypeus. Antenna with scape black haired; plate orange, slender and generally elongate, the dorsal tooth rounded to distinct but small; annuli usually orange with the apical annulus partly or entirely darkened, but all annuli may be somewhat darkened. Palpus variable from pinkish gray to blackish, basal segment with whitish hairs (rarely with a few black hairs apically), apical segment commonly with mixed white and black hairs, but may be highly variable from almost entirely white haired to almost entirely black haired. **Thorax.** Scutum with anterior surface (facing occiput) pale gray with pale hairs, remainder of scutum and scutellum mostly grayish black with recumbent whitish to yellowish hairs and more erect black hairs, the periphery with paler areas and longer pale hairs. Venter gray with whitish hairs; coxae gray with white and black hairs; fore femur black with black hairs, other femora grayish black to brownish with extensive pale hairs, all femora yellowed at apex; fore tibia with outer face whitish and white haired over basal 2/3 to 3/4 of area, apex and tarsus black with black hairs, other tibiae whitish with white hairs, apices yellowed; other tarsi with basal segment mostly pale, remainder brown to black. Wing hyaline, 1st P cell open, 3rd vein curved or sometimes angulate; halter stem yellow to brown, knob yellow. **Abdomen.** Tergite 1 variable from gray to grayish black, black haired except pale haired over a broad area laterally and with a patch of pale hairs at the midline apically, sometimes with an apical fringe of pale hairs; other tergites grayish black, black haired except with pale (white to yellowish white) hairs laterally and as an apical fringe which usually expands into an inconspicuous pale-haired triangle at the midline of 2-5; dorsum of abdomen (and thorax alike) seen to be covered with yellowish gray to gray tomentum when viewed at a low angle from the rear. Venter essentially grayish black, sternite 1 with pale hairs at least at midline, other sternites highly variable from mostly pale haired to mostly black haired, but pale hairs are usually present at least as an apical fringe on most sternites. (109)

Male. Despite the fact that this species has been mentioned fairly often in the literature, it is widespread and not uncommon, and has even been used as an object of disease research, there seems to be no record at all of any ♂. I collected none in Thailand.

Type data (♀). Given in original description as Soeroelangoen (Sumatra), with an August collecting date. Stekhoven (1926:426) added that the year of collection was 1878. This Indonesian locality is situated 300 km WNW of Palembang in Sumatera Selatan Province at 2°37'S 102°45'E,

and its contemporary spelling is Surulangun. Type in Rijksmuseum, Leiden (not seen by me).

Published records. MALAYSIA: Several lowland and highland localities in States of Selangor and Kedah, by Philip (1960b:52). Some earlier Malayan records of Fraser were questioned by Stekhoven. INDONESIA: Reported widespread over Sumatra in both inland and coastal localities, listed by Stekhoven (1926:426-429); Ambarawa, (northeastern) Java (*ibid.*); Martapoera, (southeastern) Borneo and another Borneo locality (*ibid.*). Two localities on the southern coast of Indonesian New Guinea were reported (with a species diagnosis) by de Meijere, and this is no doubt the source of the record reported by Stone (1975:64); but Stekhoven (1926:431, 440) identified de Meijere's diagnosis as *ceylonicus*, so New Guinea must be disregarded (other authors have already done so).

New records. THAILAND (all 1969 except as noted); Chiang Mai Prov.: Huai Kao (~4 km NW of Chiang Mai) 18°48'N 98°57'E: 1♀, 2 May JB; 2♀♀, 10-23 May K. Somporn; Nakhon Sawan Prov. (~10 km S of Nakhon Sawan) 15°36-38'N 100°07-08'E: 2♀♀, 27 June JB; Chanthaburi Prov.: Chanthaburi 12°37'N 102°07'E: 1♀, 20 Feb. JB; Chanthaburi Prov. (~2 km S of Chanthaburi) 12°36'N 102°07'E: 3♀♀, 19 Feb. JB; 28♀♀, 21 Feb. JB; 2♀♀, 19 June JB; Chumphon Prov.: Tha Yang Canton (~5 km SE of Chumphon) 10°28'N 99°13'E: 1♀, 3 Aug. A. Wanchitnai; 1♀, 1 Oct. AW; Nakhon Si Thammarat Prov.: Thung Song Dist. (~8 km E of town) 08°09'N 99°45'E: 1♀, 1 Apr. AW; Phangnga Prov. (vic. of Amphoe Muang Phangnga town) 08°28-29'N 98°32'E: 1♀, 6 June JB; Krabi Prov. (vic. N of Krabi) 08°04'N 98°55'E: 1♀, 4 June JB; Satun Prov.: Satun & vic. 06°38'N 100°04'E: 15♀♀, 7 & 8 Mar. JB or P. Chaemmanee; 2♀♀, 7 & 8 Apr. AW; 2♀♀, 12 & 14 May AW; 5♀♀, 13 & 15 July AW; 1♀, 27 Aug. AW; 1♀, 5 Nov. AW; 1♀, 16 Feb. 1970 AW; 1♀, 4 Mar. 1970 AW; Satun Prov. (~3-6 km NE of Satun) 06°40'N 100°05'E: 6♀♀, 7 Mar. JB.

Taxonomy. Although I have not seen the *minimus* type, this species is almost certainly correctly understood because the population at hand (1) generally agrees with the original description (as translated from Dutch in Ricardo (1911:221-222)); (2) it agrees with the diagnosis of Stekhoven (1926:430-431), who made a type comparison; and (3) it agrees with a specimen at hand (from Philip collection) which Philip has compared with the type.

T. minimus is fairly easily differentiated from other members of the *ceylonicus* group in the area by a combination of the complete covering of tomentum on the frontoclypeus, the white beard and other whitish hairs of face, thorax, and abdomen, wing including costal cell hyaline.

Ricardo (1911:221) placed this species as a junior synonym under "*simplicissimus*" [sic: *simplicissimus*] Walker. It was correctly resurrected again as a full species by Stekhoven, and has been treated as such ever since.

In a later record, Stekhoven (1932:89) assigned *minimus* to "*Neotabanus*", a taxon which had been established by Ricardo for an entirely unrelated species. This was the same error mentioned herein under *ceylonicus*.

Philip (1960b:52) listed *T. infamis* Szilády from Borneo as a questionable synonym under *minimus*, and Stone (1975:64) chose to repeat the listing. I can see no reason at all to presume that the 2 are synonyms, and, on another page, Philip himself (1960b:50) argued more persuasively against the synonymy than in favor of it. The type (in Vienna Museum) will indeed have to be studied for an accurate understanding.

Biology. *T. minimus* occurs in both inland and coastal situations. In Thailand there seemed to be a distinct preference for coastal areas. But its occurrence northward to Chiang Mai illustrates its wide tolerances. The type locality is far into the interior of Sumatra, and the species has been

reported from above 900 m in the State of Kedah, W. Malaysia. There seems to be a seasonal peak in February-March at the Chanthaburi and peninsular west coasts, thus during the driest season, though it appears that a low level of adult emergence may occur throughout the year. Host interest in Thailand included water buffalo, cattle, and elephant. The species was also taken by Malaise trap (with and without dry ice as bait), and resting on trees. In one case, a specimen (Chanthaburi, 20 February), was taken in a Steiner's trap baited with Trimedlure. These traps are used in Hawaii for fruit fly (Tephritidae) control (see J. Econ. Ent. 50(4):508-509, 1957), and a trap was kindly furnished to me by Mr. Kiichi Ohinata of USDA, Honolulu. This was the only tabanid ever taken in the trap despite one earlier and many subsequent usages; therefore I do not exclude the possibility that this solitary apparent capture might have been a prank. The species was found to be active during morning and afternoon as well as during the last hour before darkness. Nieschulz found the species to be capable of transmitting surra in Sumatra. (Earlier experimentation in Malaya also showed positive results, but the species identification of this earlier work has since been questioned.) Nieschulz (1931) has described the pupa of *minimus*.

Tabanus ceylonicus Schiner Fig. 13

Tabanus ceylonicus Schiner, 1868, Reise Novara, Diptera: 93. (*ceylanicus*: Bigot, 1891a:271—*lapsus*.)

Tabanus nitidulus Bigot, 1892, Mém. Soc. Zool. France 5:679 (presumed *lapsus*).

Tabanus nitidulus: van der Wulp, 1896, Cat. Desc. Diptera S. Asia: 63 (and subsequent authors; emendation).

Tabanus kershawi Ricardo, 1917, Ann. Mag. Nat. Hist. (8)19:221-222.

Female. Length 10-13 mm. **Head.** Frons slightly divergent above to nearly parallel sided, index 1:6.7-9.0; tomentum gray below and brown above, with a dark and rather shining area at vertex; hairs black. Callosity black, rectangular, commonly filling lower frons but often tapering slightly away from eye margins above, often with small inconspicuous pockets of tomentum below; dorsal extension black, usually finely linear, its keel sometimes grown over with tomentum at the bottom. Eye in life with 3 multicolored bands which alternate with 2 purple layers, and with green field at top and bottom [from notes on 2 specimens only], or (relaxed) with 3 predominantly green stripes across dark field. Subcallus bare and shining, black to reddish black; anterior aspect of face thinly covered with brown tomentum, though when viewed at some angles this may appear to be absent, especially along eye margin; facial hairs brown to black, beard blackened; ventral aspect of face (from which beard arises) black when viewed at most angles. Antenna with scape black haired; flagellum generally orange but may be unicolorous, or with annuli darker

than plate, or apical annulus or its tip darkened, or apical area of plate darkened, or a combination of these, plate quite slender, the dorsal tooth very low and rounded, or distinct but very small. Palpus black with black hairs. **Thorax.** Dorsum, venter, and coxae brownish black to black, sometimes with small areas of paler (medium brown) coloration; hairs black to brownish black. Femora also black and black haired, but extreme apices pale (dark yellow to whitish), and at least hind femur with some pale hairs at apex; tibiae mainly white with white hairs, apex of fore tibia blackened and with mixed white and black hairs, apices of other tibiae more narrowly yellowed; fore tarsus black, other tarsi with basal segment mostly white to yellow, darkened beyond. Wing with costal cell, apex of subcostal cell, and stigma almost always strongly yellowed, a less intense yellowing also continues below, at least in the vicinity of the stigma, then soon fades out below; 1st P cell open; anterior branch of 3rd vein variable from curved to distinctly angulate, rarely with a budlike spur vein; halter stem and base of knob yellow to brownish yellow, remainder of

knob generally whitish yellow. **Abdomen.** Color of segments 1-5 quite variable from medium brown to black, if basal segments are mostly brown then tergite 2 is generally darker at midline; at least segments 6 and 7 almost always black; all segments (like thorax) rather shiny throughout, but seen to have a sparse covering of grayish to brownish tomentum when viewed at a low angle from the rear; hairs black. (35)

Although this diagnosis is written only from Thailand specimens, I have at hand (from Pechuman collection) specimens from Manus and Guadalcanal Islands and Papua which would fit into the above with little difficulty. One of these (from Papua) was determined by Mackerras. But his recent diagnosis of Australian "*ceylonicus*" (1971:23-24) is not in very good agreement with either the Papuan, the insular, or the Thailand material before me, and I cannot help but wonder if the same species is being discussed. Thailand is a very great deal closer than Queensland to the type locality, but I am not confident that either of us has correctly deduced the true identity of *ceylonicus*. The characters that Mackerras published which disagree with all those at hand include: dense appressed dull yellow hairs present on scutum and scutellum; dull creamy yellow hairs present above and behind wing-root; a narrow inconspicuous fringe of cream hairs present at apices of tergites; wings unmarked.

Male. Several diagnoses of the ♂ have been given in the literature, including those by Ricardo (1911:224) and Stekhoven (1926:440). This sex is said to be easily associated with the ♀, though of course it is subject to all of the same misinterpretations and even more. I did not collect any in Thailand.

Type data (♀). Given only as "Ceylon" in original description and never elaborated. Type in Vienna Museum (not seen by me).

Published records. Reported extremely widely, from Ceylon (type locality and western extreme of known range) eastward to Philippines, coast of northeast Queensland, and Solomon Islands. In area of present consideration, there have been no records from Laos or Viet-Nam; 1♀ recorded from north central Cambodia by Wharton (1957:102). THAILAND: "Dinding", by Ricardo (1911:223) (I cannot find this locality); "S.E. Klong Yai, Dec. 1914", 1♀ by Stekhoven (1928:445) (this is probably the town of Klong Yai, Trat Province, at 11°46'N 102°54'E); "Chiangmai, Pann, 5.iii.1952 (D.C. and E.B. Thurman) 'in hot spring'", 3♂♂ by Philip (1960b: 44) (this locality is corrected to Phan, Chiang Rai Province, at 19°30'N 99°45'E: for clarification see under *T. zoster* type data).

New records. THAILAND: Chiang Mai Prov.: Huai Kaeo (~4 km NW of Chiang Mai) 18°48'N 98°57'E: 2♀♀, 18 May & 16 July 1969

K. Somporn; Nakhon Ratchasima Prov.: Pak Chong Dist.: Mu Si Canton: Pong-ta-long [14°25'-37'N 102°20'-37'E]: 1♀, 20 May 1969 G.R. Ballmer; Chanthaburi Prov.: Tha Mai Dist. (23 km NW of Chanthaburi) 12°43'N 101°59'E: 3♀♀, 20 June 1969 JB; 2♀♀, 22 June 1969 A. Wanchitnai; Nakhon Si Thammarat Prov.: Phrom Lok Canton (20-24 km NW of Nakhon) ~08°31'N ~99°48'E: 1♀, 2 Apr. 1969 JB; Phangnga Prov. (vic. of Amphoe Muang Phangnga town) 08°28'-29'N 98°32'E: 6 June 1969 JB; Krabi Prov. (vic. N of Krabi) 08°04'N 98°55'E: 4 June 1969 JB; Songkhla Prov.: Rattaphum Dist.: Tha Chamuang Canton ~06°58'N 100°08'E: 1♀, 6 May 1969 A. Wanchitnai; 1♀, 10 July; 1♀, 15 Aug.; 1♀, 23 Dec. (all A.W. in 1969); 1♀, 2 Jan.; 2♀♀, 3 & 6 Feb.; 9♀♀, 23-28 Feb.; 8♀♀, 13-21 Mar. (all A.W. in 1970).

Taxonomy. The original description of *ceylonicus* was based on 2♀♀ cotypes, as Schiner stated, "Zwei Weibchen aus Ceylon." This fact was duly translated and recorded by Ricardo (1911: 224). In the very extensive literature on this species, apparently the only mention ever published of a reexamination of the type material was by Mackerras (1959:162) and reiterated by him (1971:23). Even in this singular case, it was not Mackerras but Dr. M. Beier, Orthopterist at the Vienna Museum, who made the comparison (with a single ♀ from Queensland). And even Mackerras had lost sight of the fact that there were 2 original specimens (cotypes), as the comparison was reportedly made with only 1 of these, and Mackerras referred to this first (1959) as the "Type" and later (1971) as the "Holotype". Reassessment of the original material of this important species by a tabanid worker is clearly long overdue.

T. nitidulus was described by Bigot from Java. The first subsequent mention was by van der Wulp (1896:63) in his catalog, in which he listed the name as *nitidulus* without comment. This would seem to be a justified emendation, and has been so spelled ever since. But it is nevertheless quite remarkable that the original spelling has apparently never been mentioned in the literature from the original description to the present. *T. nitidulus* was made a junior subjective synonym of *ceylonicus* by Ricardo (1911:223). Later, Stekhoven (1926:437) retained it as a "variety" of *ceylonicus*. His "variety" was clearly not the equivalent of the modern subspecies concept, as he noted that the 2 mostly occur "in the same localities side by side". He also noted of *nitidulus* that the body color was less than wholly black, and "thorax covered with short buttermilk and black hairs". Though a percentage of the population at hand from Thailand is brownish bodied, none has pale thoracic hairs. If the *ceylonicus* and *nitidulus* type material is indeed truly synonymous, then possibly the population with yellow thoracic hairs which Stekhoven called "var. *nitidulus*" was some-

thing different. Unfortunately I overlooked the Bigot type in BMNH and so missed an opportunity; I understand that it is arranged under a "*Ceylonicus*" heading.

T. kershawi was described by Ricardo from northern Queensland, Australia. Its type is in the National Museum of Victoria, Melbourne. The original description contained no mention of *ceylonicus* or any other species, though of course Ricardo was well familiar with *ceylonicus* and, by that date, knew it to occur as far east as the south central coast of New Guinea. Just the same, her justification for describing a new species without mentioning its obvious relatives appears to be geographic, as the group was not before known from Australia. *T. kershawi* was first published as a synonym of *ceylonicus* by Oldroyd (1948(1949):329), where it has remained since.

Stekhoven was misled into thinking that Ricardo was making a new generic assignment when she described *Neotabanus ceylonicus*, as reflected in an installation of his later records (1932:89). Philip (1959:572) was correct in pointing out that Ricardo's description was for an entirely different insect. This latter has since

been placed in genus *Cydistomyia*, subgenus *Lissimodes*, of the Diachlorini.

As noted above, I have strong reservations about our understanding of *T. ceylonicus*.

Biology. This species appears to have a preference for coastal lowland situations, though it is by no means restricted to them. Most previously recorded distribution involves coastlines. In Thailand, most specimens were taken inland, but this is considered an artifact of collecting pressure. The following comments refer only to Thailand. Altitude represented ranges from sea level to about 350 m. A distinct flight season may someday be found in the north, but in the southern uplands low level emergence seems to go on for most of the year, with a peak in the driest season (February-March) and an interruption in the wettest (September-December). Host interest was recorded in water buffalo, cattle, and horses; man has been recorded from elsewhere. Flight activity was observed morning, afternoon, and pre-darkness. Nieschulz (1931) described and figured the pupal stage from Sumatra, and the same author had earlier proven the species to be capable of surra transmission.

Tabanus eurytopus new species Fig. 14

Holotype female. Length 8 mm. **Head.** Frons nearly parallel sided, (very slightly convex), index 1:6.4; tomentum above callosity gray, becoming brown over upper half, and with a shining black central area at vertex; hairs black. Callosity brownish black to black, with tiny pockets of tomentum below but otherwise essentially filling the frons at bottom, the raised portion tapering above into the black linear median callus, but the unraised upper lateral area is also black and shining thus creating a rather rectangular effect. Eye (relaxed) with 3 green bands across purple field. Subcallus bare and shining, essentially black. A large upper area of frontoclypeus bare and shining, black; remainder of anterior portion of face with dark brown tomentum, though it is very sparse along eye margin and may appear to be lacking there when viewed at certain angles; ventral aspect (the area from which the beard arises) black when viewed from most angles; anterior facial hairs brown, beard brownish black. Antenna with scape black haired; flagellum unicolorous orange with only the extreme tip of apical annulus darkened; plate narrow, the dorsal tooth very small. Palpus black, with black to brownish black hairs. **Thorax.** Dorsum, venter, and coxae black to brownish black, with black to brownish black hairs; femora same but extreme apices yellow and with at least a few yellow hairs; tibiae white and white haired, fore tibia brownish yellow apically and other tibiae only lightly yellowed over a narrower area; fore tarsus brownish yellow to light brown, other tarsi white

to yellow. Wing almost imperceptibly tinted over a large area, and for all practical purposes could be considered essentially hyaline; 1st P cell open; anterior branch of 3rd vein very slightly angulate; halter stem yellow, knob whitish. **Abdomen.** Dorsum and venter black to brownish black, with black to brownish black hairs, shining when viewed perpendicularly but seen to be covered with gray tomentum when viewed at a low angle from the rear.

Paratypes (11♀). Length 8.5-10 mm. Frons nearly parallel sided to very slightly divergent above, index 1:6.0-7.2. Fore tibial apex and fore tarsus variable from yellowish brown to yellow; hairs on apical segment of palpus variable from black to brown; shining blackened area at vertex of frons may or may not reach eye margins.

Other specimens (10♀♀). Frons as wide as 1:5.7 (in the Laos specimen); fore tibia may be dark brown apically and fore tarsus blackened (in Chiang Mai and Laos specimens); apical annulus of antenna may be entirely orange; callosity sometimes rectangular with no suggestion of tapering smoothly upward into the dorsal extension; southern specimens (Nakhon Si Thammarat and Songkhla Provinces) have paler (more brownish) abdomens, at least on parts of segments 1 and 2.

Male unknown.

Type series data. Holotype ♀: THAILAND: Chanthaburi Prov.: Makham Dist. (vicinity of Makham) 12°40'N 102°12'E: 20 February 1969 Malaise trap + CO₂ John J.S. Burton 1200-1800 hrs. (In Cornell University.) The area contained both agricultural (rice, rubber, orchard) and jungle situations, with a very slow flowing stream. Paratypes: 3♀♀, exactly the same collecting data as holotype; Chanthaburi Prov. (~2 km S of Chanthaburi) 12°36'N 102°07'E: 1♀, 19 Feb. 1969 JB; Chanthaburi Prov.: Tha Mai Dist. (23 km NW of Chanthaburi) 12°43'N 101°59'E: 6♀♀, 19 Feb. 1969 JB; Chon Buri Prov.: Si Racha Dist.: Bang Phra Canton 13°13'N 100°57'E: 1♀, 14 Feb. 1969 P. Chaemmanee.

Other (non-paratype) specimens: LAOS: Muong Sayaboury: 1♀, 14 Apr. 1968 F.G. Howarth. THAILAND: Chiang Mai Prov.: Huai Kaeo (~4 km NW of Chiang Mai) 18°48'N 98°57'E: 1♀, 10-15 May 1969 K. Somporn; Nakhon Si Thammarat Prov.: Phrom Lok Canton (20-24 km NW of Nakhon) ~08°31'N 99°48'E: 2♀♀, 3 Apr. 1969 JB; Nakhon Si Thammarat Prov.: Thung Song Dist.: (~8 km E of town) 08°09'N 99°45'E: 2♀♀, 1 Apr. 1969 A. Wanchitnai; Trang Prov.: Na Tham Nua Canton (~13 km N of Trang) 07°40'N 99°35'E: 1♀, 11 Mar. 1969 JB; Songkhla Prov.: Rattaphum Dist.: Tha Chamuang Canton ~06°58'N 100°08'E: 1♀, 6 Mar. 1969 JB; 2♀♀, 11 & 14 Mar. 1969 A. Wanchitnai.

Taxonomy. *T. eurytopus* is a member of the *ceylonicus* group, and can be separated from other Thailand members of the group by a combination of the bare and shining black area on upper part of frontoclypeus, blackened beard and body with entirely dark hairs, essentially hyaline

wing, and bicolorous tomentum on frons (gray below and brown above).

Biology. In view of the fact that the morphological limits of the species are poorly known, I thought it prudent to restrict the paratype series to those specimens which came from southeastern Thailand. The northern and southern groups both diverge from the type series in their own way, but as nearly as I can tell at present they are conspecific.

It is not known to me whether there was any brackish water within flight range of the type locality. It is possible that the Chanthaburi Canal exerts a brackish influence as far upstream as Makham, but I saw no signs of it during collecting. At least 2 of the 3 paratype localities (other than the type locality) are within immediate flight range of brackish water; none of the non-type localities are anywhere near brackish water (Phrom Lok Canton at the eastern base of Khao Luang Mountain, Nakhon Si Thammarat Province, comes closest). Thus, in addition to a widespread distribution in Thailand, it is possible that this species breeds in several kinds of aquatic situations, and its name is intended to reflect this latitude. Altitudes represented range from sea level (at Chanthaburi) to about 350 m (Chiang Mai). Known seasonal range includes only 14 February to 15 May, which probably has no significance in view of the climatic differences occurring at the same time in the different localities. Recorded host interest includes horses, water buffalo, and cattle, and all those obtained at the type locality were taken from the netting of a Malaise trap which was baited with dry ice. Flight activity apparently occurs throughout the heat of the day.

Tabanus mesogaeus new species Fig. 15

Holotype female. Length 8 mm. **Head.** Frons slightly wider above than below, but sides somewhat convex, index 1:7.5. Tomentum yellowish gray beside and above callosity, becoming brown over upper half, somewhat darker and more shining at vertex; hairs black, rather sparse; callosity black, essentially rectangular; dorsal extension black, very finely linear. Eye in life with 3 green bands across purple field. Subcallus bare and shining, black. Face entirely covered with tomentum, which ranges from gray to brown; facial hairs brown, except beard which is blackened. Antenna with scape mostly black haired; flagellum orange except apical annulus which is largely blackened, plate narrow, dorsal tooth reduced to a very low angle. Palpus black with black hairs. **Thorax.** Dorsum, venter, and coxae black to brownish black throughout, and with black to brown hairs; femora black and black haired, except yellow to orange at extreme apices, middle and hind femur also with some pale hairs

apically; tibiae white (fore tibia darker on inner face only) and white haired, apex of fore tibia blackened, of other tibiae yellow; fore tarsus black, middle and hind tarsi with basal segment mostly white, other segments mostly to entirely yellowish brown. Wing essentially hyaline, veins yellow; 1st P cell open; 3rd vein with very slight angulation in left wing but simply curved in right wing; halter stem and base of knob dark yellow, most of knob yellowish white. **Abdomen.** Dorsum and venter black to brownish black throughout, and shining when viewed perpendicularly, but (like thorax) seen to have a covering of grayish tomentum when viewed at a low angle from the rear; hairs black except for some paler brownish hairs scattered along the lateral apices of the tergites, and only a very few on several of the apices centrally [though there may have been more in the wild condition].

Paratypes (5♀♀). Length 8.75-10.5 mm.

Frons index 1:6.3-7.4. Callosity may have pockets of tomentum below; convexity of frons sides may be hardly perceptible. Facial hairs may all appear black. Angulation of 3rd wing vein may be distinct, but all specimens lack spur vein. Paler hairs are sometimes seen to form a complete but inconspicuous fringe along the apices of tergites 2-6.

Male unknown.

Type series data. Holotype ♀: THAILAND: Loei Prov.: Loei & vicinity 17°29'N 101°44'E: 16 April 1969 about water buffalo John J.S. Burton 1230-1430 hrs. (In Cornell University.) This locality is part of the Loei River plain, at 250 m altitude. There were man-dug water reservoirs close by. Land use was agriculture and human habitation, with wooded hills several kilometers away. Paratypes: 4♀, same collecting locality as holotype but 23 Apr., 25 Apr., 17 May, and 1 June, all by C. Dettongchai in 1969; 1♀, Khon Kaen Prov. (Univ. campus NW of Khon

Kaen) 16°27'N 102°49'E: 4 July 1969 JB.

Taxonomy. *T. mesogaeus* is a member of the *ceylonicus* group, and can be separated from other Thailand members of the group by a combination of the entirely tomentose fronto-clypeus, the blackened beard, and the hyaline wing. It seems closest in overall appearance to *eurytopus*.

Biology. This is the only Thailand species of the group which apparently lacks representation in coastal lowland situations. Its known distribution (only 2 localities) is confined to upland plains, in the Mekong River drainage of the Khorat Plateau. Its name has been formulated to reflect this distinction (from Greek "mesogaioi" = inland, interior). Known seasonal range is 16 April to 4 July, thus primarily in the dry season, though future collecting may show that the range is much longer. It is known to be active both about midday and during the last hour or so before darkness. Host interest is recorded in water buffalo and horses.

Tabanus nigrotectus (Bigot) Fig. 16

Bellardia Nigrotecta Bigot, 1890, *Nouv. Arch. Mus. Hist. Nat., Paris*, (3):204.

Female. Length 17.5-21 mm. **Head.** Frons narrowly divergent above, index 1:8.0-9.0; tomentum yellowish-brown, hairs black (sometimes with scattered pale hairs), and usually with a very narrow vertical bare spot at apex. Callosity and dorsal extension usually narrow and linear. Subcallus concolorous with frons, and face also concolorous or slightly darker; face including beard black haired. Basal segments on antenna black haired; plate very broad and with a distinct black haired tooth 1/3 to about 1/2 of the way out from its base, usually with a few scattered black hairs on outer surface of plate; entire flagellum yellow to orange, annuli the same shade as, or moderately darker than plate. Palpus pointed, brown to black and black haired. **Thorax.** Body entirely dark brown tomentose and black haired, sometimes slightly paler on surface facing occiput. Legs entirely dark brown to black and black haired. Wing and calypter rather uniformly blackish brown; distinct spur vein present; 1st P cell closed and petiolate; halter stem and base of knob blackish, remainder of knob whitish or occasionally gray. **Abdomen.** All aspects almost uniformly black and rather shining, except for inconspicuous patches of white hairs laterally on tergites 1 and 2, and sometimes also on 3. (90+)

Male. Similar except for usual sexual differences. (7)

Some specimens from various localities display hyaline areas in centers of wing cells, a condition which it seems cannot be dismissed

as teneral, as some of these are known to have been collected not sweeping but attacking hosts and at light.

Type data (♀): "Chantaboun à Battambang/ MUSEUM PARIS/SIAM/Pavie 1886". (Seen in Paris Museum.) See discussion of Pavie's collection for clarification of type locality. The labels transcribed here may have been affixed subsequent to Bigot's work, as the original description as well as the type-designation label in Bigot's own handwriting show "Laos."

Published records. 1♀, "Cambodia/1909/ John Surcouf", by Austen (1922a:437) (seen in BMNH). "Cambodge (Battambang)", by Hervé-Bazin (1919:291). [North central] Cambodia, 1 specimen reported by Wharton (1957:102). "Thailand: ♂ Chiangmai, viii. 1952 (D.C. & E.B. Thurman)", by Philip (1960b:53). "♀♀ in USNM seen from Cambodia and Borneo", by Philip (1960b:53). The data seen on the only Cambodia specimen in USNM reads "40km WSW Khong Cambodia VI-10-52 CWWharton". But the Borneo record must be withdrawn, as it is far out of range, and I found no specimens from there in USNM; however, there is a specimen from Burma associated under this species which Philip had probably intended to report instead. It is discussed further below.

New records. S. VIET-NAM: "COCHIN-CHINE/MONT. DE CHAUDOC/HARMAND 1877" [presumably near Chau Doc, former name

for present town of Chau Phu, just inside S. Viet-Nam from Cambodia at $10^{\circ}42'N$ $105^{\circ}07'E$]: 1♀ (Paris Museum). CAMBODIA: "CAMBODGE/HARMAND 1875": 1♀, 1♂ (Paris Museum). LAOS: Luang Prabang Prov. (vic. E of Luang Prabang) $\sim 19^{\circ}53'N$ $102^{\circ}10'E$: 3♀♀, 2 & 3 Aug. 1969 JB. Muong Sayaboury and several localities in Vientiane Province: 7♀♀, 5♂♂, date range from 14 May to 28 Aug., 1966 and 1967 F.G. Howarth. THAILAND (all 1969 except student collections): Chon Buri Prov.: Si Racha Dist.: Bang Phra Canton $13^{\circ}13'N$ $100^{\circ}57'E$: 1♀, 26 Mar. P. Chaemmanee; 49♀♀, date range from 4-13 July PC. Chumphon Prov.: Tha Yang Canton (~ 5 km SE of Chumphon) $10^{\circ}28'N$ $99^{\circ}13'E$: 4♀♀, 2 & 3 Aug. and 1 Oct., A. Wanchitnai. Loei Prov.: Loei & vic. $17^{\circ}29'N$ $101^{\circ}44'E$: 1♀, 28 Apr. C. Dettongchai; 1♂, 4 May CD; 1♀, 2 June CD; 1♀, 25 June CD. Loei Prov.: Dan Sai & vic. $17^{\circ}16'N$ $101^{\circ}09'E$: 1♀, 10 June CD. Ubon Ratchathani Prov.: Phibun Mangsahan Dist.: town & vic. $15^{\circ}14'N$ $105^{\circ}13'14'E$: 22♀♀, 1♂, date range from 22-25 July JB or P. Chaemmanee. Ubon Ratchathani Prov.: Warin Chamrap Dist. (town) $15^{\circ}12'N$ $104^{\circ}52'E$: 1♀, 25 July PC. Thai student collections, most taken not far N, E, and SE of Bangkok and with a date range from 22 June to 25 Sep., except 1♀ shows Chiang Rai 20 May: 10♀♀ in USNM.

Taxonomy. This large black species is not at all likely to be confused with any other one described from the area. It bears some resemblance to *perakiensis* Ricardo, but the latter is strictly a southern species (ranges not now known to overlap assuming Shiraki's record of it from Formosa is disregarded) with narrower body, 1st P cell wide open, no spur vein, with long and

narrow antennal plate, and grayish venter. Coher (1971:326) has suggested that *nigrotectus* might belong to what he called the *caerulescens* group. The antennal plate of *nigrotectus* is very broad and definitely not elongate, thus failing to satisfy 1 of his principal criteria for inclusion. *T. perakiensis*, which he included in the group, is indeed related to *caerulescens* and does possess elongate antennal plates. I have serious doubts about the conspecificity of the Burma specimen in USNM (Mandalay, 7 Sept. 1951, H.M. Smith) mentioned above in the published records. Its abdomen is more slender and tapered and with more conspicuous white lateral hairs, and its antennae are blackened (not orange). It may be a new species. Therefore neither Burma nor Borneo are yet known to be part of the range of true *nigrotectus*. See *Bellardia* discussion for further comment.

Biology. The known seasonal range of *nigrotectus* (except in the peninsula) is 26 March at Bang Phra (Chon Buri) to 28 August at Sayaboury (Laos), and possibly 25 September at Chiang Rai (student coll.), peaking during the rainy season in July. Distribution seems to be spotty throughout the country except in the south (not yet taken below Chumphon), with perhaps the greater concentrations around the Cambodian periphery. The collecting localities seem generally to be lowland plains and valley floors, but with some diversity of "cover" available in the vicinity. Altitudinal range is from sea level (Bang Phra and Tha Yang) to at least 375 m (Dan Sai). The great majority of new specimens were taken attacking water buffalo, but cattle and horses were also attacked. Both sexes were attracted to light at night, and 1♂ was taken resting on a tree.

Tabanus oknos Surcouf Fig. 17

Tabanus oknos Surcouf, 1921(1922), Bull. Soc. Ent. France 1921(19):287. (*okhos*: Toumanoff, 1941—*lapsus*.)

Tabanus barnesi Austen, 1922a, Bull. Ent. Res. 12(4):435-437. (New synonym.)

Female. Length 13-17.5 mm. **Head.** Frons slightly divergent above, index 1:6.9-8.7 (selected sample); tomentum brown to brownish yellow; hairs mostly black above and usually mostly pale below. Callosity dark brown or occasionally blackened, small and slender, generally elliptical to convex-linear; dorsal extension blackened, linear. Subcallus brownish orange to orange brown; face brown, often with coppery tomentum and sometimes with gray areas, hairs including beard brownish black to black. Antenna with scape black haired; flagellum bright orange to drab orange, apical annulus commonly darkened, plate variable in shape from quite slender and with a rounded low tooth to medium breadth and with a rather strong obtuse tooth. Palpus with both segments black haired, basal segment dark brown,

frequently; scutellum with narrow basal margin dark brown like scutum, elsewhere entirely whitish with white hairs, hence in extreme contrast with the remainder of the body. Venter and coxae very dark brown with black hairs, legs beyond coxae brownish black to black, black haired. Wing with costal and subcostal cells and stigma tinted medium brownish, 1st basal cell usually tinted paler and 2nd basal cell still paler; a strong cloud of infuscation covers the area of the marginal, 1st submarginal, and 1st P cells beyond the level of the junction of the subcostal vein with the costal vein, similarly infuscated are the apical segment dark to medium brown. **Thorax.** Dorsum except scutellum very dark brown, some pale hairs facing occiput but otherwise black haired, pale hairs scattered elsewhere only in-

base of the 2nd submarginal cell out to the level of the closure of the 1st P cell (and sometimes also along anterior branch of 3rd vein), the apex of the discal cell, most or all of the 2nd and 3rd P cells, and much of the central area (at least) of the 4th P cell, the whole cloud becoming paler from the costal toward the hind margin; 1st P cell usually closed and petiolate but occasionally slightly open; anterior branch of 3rd vein curved or angulate, often with a short spur; halter stem brown to brownish yellow, knob pale brownish white to white. **Abdomen.** Dorsum and venter entirely blackish brown to black, patternless; venter black haired (very rarely a few white hairs); dorsum usually black haired with distinct patches of white hairs at apical corners of tergites 1-5 and sometimes 6, but variable from almost entirely black haired overall to lateral areas rather extensively white haired and infrequently even a few white hairs along tergite apices centrally and/or a small patch at midline. (120)

Male. Easily associated with ♀, but in addition to usual sexual differences the abdomen is entirely dark haired, and the 1st P cells of all specimens at hand are narrowly open. (4)

Type data (♀): "Tonkin/Juin 17", plus a determination label handwritten by Surcouf, plus a label showing "TYPE". (Seen in Paris Museum.) This specimen is 1 of those collected by Vitalis de Salvaza; see discussion of his collection for delimitation of "Tonkin".

Published records. Toumanoff (1941:1078) showed "Laos", but this was an error in reporting the type locality. Toumanoff (1950a:376) reported "Cay-Gao près de Trang-Bom, dans la province de Bienhoa" [in S. Viet-Nam], and "Mimot" [in Cambodia]. "N. Siam:/Chiangmai./ 10. v. 1921/Dr.M.E.Barnes/1921.393." 1♀, the type of *barnesi* (seen in BMNH). Austen (1922a: 437) discussed a second specimen from "Siam:/Chantabun." which he originally regarded as a variety of *barnesi* and labeled it accordingly (seen in BMNH); it is herewith redetermined as *granti*.

New records. LAOS: Vientiane Prov.: Vientiane: 1♀, 8 Aug. 1968 (Bishop Mus.); THAILAND (all 1969 unless shown otherwise): Chiang Mai Prov.: Huai Kao (~4 km NW of Chiang Mai) 18°48'N 98°57'E: 1♀, 31 May K. Somporn; 4♀♀, 2-5 June KS; 6♀♀, 11-17 June KS; 2♀, 18 July KS; Tak Prov.: Mae Sot Dist.: (~5 km E of Mae Sot) 16°43'N 98°37'E: 1♀, 10 July JB; Tak Prov.: Mae Sot Dist.: Huai Muang Canton 16°40'N 98°31'E: 29♀♀, 9 July JB; 75♀♀, 11 July JB; Loei Prov.: Loei & vic. 17°29'N 101°44'E: 1♀, 9 May C. Dettongchai; "Kanchanaburi": 4♂♂, 31 May 1962 [Thai student colls. (USNM)]. Also in USNM in a tray labeled *barnesi* are Thai student-collected specimens from Kanchanaburi, Saraburi, and Nakhon Ratchasima Provinces; I did not reexamine these after seeing the related types,

so placement here is tentative.

Taxonomy. *T. oknos* is very closely related to *granti*, and the separation boils down to color characters: *oknos* occupies the slightly disjunct highly melanistic end of a broad color spectrum presented by the 2 species, metaphorically like the dot at the bottom of an exclamation mark. The type of *granti* is near the opposite, orange-abdomen end of the spectrum and hence in great contrast to *oknos*; but *granti* exhibits continuous variation in predominant abdominal color from orange to very dark reddish black-brown, with these darker specimens closer in superficial appearance to *oknos* than to their own type. A gap is perceived, however, preserving the separate identity of the 2 species. A second character is the color of the pale hairs (when present), especially those at the apical corners of the tergites. In *oknos*, these are white; in *granti* they are golden. It remains to mention a certain few specimens (including several from Vientiane Prov., Laos, F.G. Howarth coll.) which have blackened abdomens but which show some golden hairs, and hence do not fall into the characterizations of either species, nor do they suffice to suggest that the 2 nominal species are less than specifically distinct.

The types of *oknos* and *barnesi* were easily determined as conspecific through comparisons of each with recent material. Austen made a direct comparison of the 2 types very soon after the original descriptions appeared. He concluded that they were synonyms and placed a label on both types accordingly. This synonymy was never published, so I herewith formalize it. Stone (1972: 639) discussed the issue but refrained from declaring them synonyms due to a question about pale abdominal hairs. In fact the *oknos* type possesses white hairs at the apical corners of the tergites; but even if absent (as in a few recent specimens), the identity would still be clear. As noted by both Austen and Stone, the wing infuscation of the *barnesi* type is faint, interrupted by pale streaks in some cells. This condition is not infrequently observed among infuscated species, and is present in some of the *oknos* specimens at hand. It is not involved in the issue of synonymy.

Biology. The *oknos* collecting localities known to me present no clear picture of habitat requirements for the species. It appears that it likes jungle areas but within flight range of domestic livestock. Localities are few and widespread in the northeast, north, and west, with a confirmable altitude range from about 200-350 m. The Huai Muang (Mae Sot) locality where the species was so common is immediately adjacent to the Mae Moei River separating Thailand from Burma. All seasonal records for Thailand and adjacent Laos cover the range 9 May to 8 August, hence from the beginning into the midst of the rainy season. Recorded host interest includes

water buffalo, elephant, and cattle; 1 specimen was Malaise trapped. This is one of the most positively crepuscular species known. On 11 July 1969 at the Huai Muang locality, I began collecting tabanids from a water buffalo at 1730

hours. *T. oknos* did not begin to attack until 1850, but after that time swarmed in until 1930 when darkness made it impossible to see to collect any longer.

Tabanus granti Tomanoff Fig. 18

Tabanus granti Tomanoff, 1950a, Bull. Soc. Path. Exot. 43(5-6):377-379, Pl. 3 Fig. 2, Pl. 5 Fig. 6.

Female. Length 14-18 mm. **Head.** Frons slightly divergent above, index 1:7.7-10.1 (from selected sample); tomentum dull yellowish to orange, hairs black at vertex and variable but usually mostly pale below. Callosity brown, slender and usually rather linear; dorsal extension brown to black, linear; a median shiny spot usually present at vertex. Subcallus yellowish orange to brownish orange; eye margin of cheek brownish orange to brown, remainder of face with variable areas of yellow to yellowish brown and dull grayish yellow to gray; facial hairs including beard usually brown to brownish black but variable to mostly yellow. Antenna with scape black haired and usually a few orange hairs at dorsal apex, flagellum orange, apical annulus usually darkened, dorsal tooth of plate obtuse to acute. Palpus with basal segment usually brown to dark gray with brownish black hairs, but variable to yellow and pale gray with yellow hairs; apical segment usually brown with black hairs, but variable to yellow with mostly yellow hairs. **Thorax.** Scutum with variable shades of brown to gray, anterior area usually grayish and prescutellum very dark brown, scutum commonly mostly black haired with patches of pale (yellow to white) hairs near wing base and scattered elsewhere; scutellum with narrow basal margin brown, the remainder white and hence in strong contrast with rest of body, hairs of scutellum white to yellow. Venter and coxae highly variable from blackish brown with black hairs to rather pale yellowish gray with mostly yellowish hairs; fore femur black with black hairs, other femora often like fore femur but sometimes grayish black or brownish black with mixed yellow and black hairs; tibiae brown to black with black hairs, apices often darker than bases (especially fore tibia), paler specimens with some yellow hairs basally. All details of wing the same as given for *oknos*, though coloration apparently averages paler in *granti*. Halter stem yellow to brown, knob usually yellowish white. **Abdomen.** Tergites usually orange brown and essentially patternless, though the lateral margins are commonly darkened and the abdominal apex may be darker, but predominant color of dorsum may be variable from orange to brown; T2 (and uncommonly other tergites) sometimes with a dark spot at midline; hairs of dorsum commonly black with some golden hairs laterally, but variable from almost entirely golden haired to almost entirely black haired, golden hairs sometimes form

lateral and median triangles. Venter even more variable, commonly brown but may range from orange to blackish brown, with the apical sternites and lateral margins of others generally blackened, hairs variable from yellow or golden over all but apical sternites to black throughout. (121+)

Male. Single specimen seen has coloration of wing much paler than ♀, with 1st P cell open but narrow at apex; legs blackish brown with black hairs; abdomen predominantly orange with black and dark brown hairs. Longer series would be expected to show much of the same variability as ♀. (1)

Type series data. Holotype (♀) has only the following labels: "*Tabanus granti* n.sp." and "Type—", both labels handwritten, the latter on red paper (seen in Pasteur Institute, Paris). The paratype (♀) shows "INDOCHINA" as locality (seen in BMNH); Tomanoff (1950a:379) stated that, "Cette espèce...a été capturée au Cambodge (région de Mimot)," and it must be assumed that this applies to both original specimens. Mimot is a town in Kampong Cham Province, Cambodia, close to the border with Viet-Nam, at 11°49'N 106°11'E.

Published records. The only subsequent record was by Wharton (1957:78, 102), who collected 11 specimens in northern Cambodia and called the species "relatively common". His specimens were identified by USNM staff, probably by Stone. The 8 Wharton specimens which were found in USNM in a tray labeled *granti* are reconfirmed. They are from 2 localities in the vicinity of Chhep, Cambodia, about 60 km from the corner of northeastern Thailand. Date range shown is 9-14 June 1952.

New records. LAOS: Vientiane Prov.: Vientiane: 1♀, 8 Aug. 1968 (BPBM); Vientiane Prov.: "Ban Na FENG/11 Km. W. Ban Keun": 1♀, 21 May 1968 F.G. Howarth. THAILAND: "Chiang-mai": 1♂, 7 May (USNM) [Thai student coll.]; Tak Prov.: Mae Sot Dist.: Huai Muang Canton 16° 40'N 98°31'E: 2♀♀, 9&11 July 1969 JB; Ubon Ratchathani Prov.: Phibun Mangsahan Dist.: town & vic. 15°14-15'N 105°13-14'E: 1♀, 22 July 1969 JB; 3♀♀, 25 July 1969 P. Chaemmanee; "Chantabun" [=Chanthaburi]: 1♀, [Jan.-Mar. 1859] H. Mouhot (BMNH); Chumphon Prov.: Tha Sae Dist.:

(area ~15 km NW of Chumphon) 10°34-37'N 99°05-07'E: 2♀, 12&13 June 1969 JB; Songkhla Prov.: Rattaphum Dist.: Tha Chamuang Canton 06°58'N 100°08'E: 3♀, 22-25 Mar. 1969 A. Wanchitnai; 2♀, 6 Apr. 1969 AW; 5♀, 11-14 Apr. 1969 AW; 2♀, 19 Apr. 1969 AW; 35♀, 22-30 Apr. 1969 AW; 10♀, 1-9 May 1969 AW; 3♀, 15-18 May 1969 AW; 9♀, 26-28 Feb. 1970 AW; 14♀, 11-20 Mar. 1970 AW; Satun Prov.: Satun & vic. 06°38'N 100°04'E: 19♀, 8-10 Apr. 1969 AW; 7♀, 11-14 May 1969 AW; 2♀, 8 Mar. 1970 AW.

Taxonomy. This attractive species exhibits unusual variability, with the type and paratype near the pale end of the color range. The variability is not a geographic phenomenon, as it may be seen in full scope at a single locality. *T. granti* has a close relative in *oknos*, which see for comparative notes.

T. aurisetosus Toumanoff from Bien Hoa Province, S. Viet-Nam, is close to, if not the same

as, *granti*. The type of *aurisetosus* is in Pasteur Institute, Paris. During my visit there I lacked both the time and sufficiently diverse comparative specimens of *granti* to properly assess the closeness of the relationship of the 2 nominal species.

Biology. Known localities for *granti* are widespread in Thailand and Cambodia, though the species is not common and is not known to occur above 350 m altitude. Plains and low hills as well as coastal situations are represented. Inland and coastal localities in the deep south near the Malaysian border showed a distinct flight season from the end of February to the middle of May, a period of low to sharply rising rainfall there. Inland localities above Bangkok latitude showed a range of early May to early August, hence at the beginning and into the midst of the rainy season. Host interest is recorded in water buffalo, cattle, and elephant; 1 was taken at light at night. Unlike *oknos*, the diurnal flight of *granti* is apparently unrestricted, as it has been taken while attacking hosts during the morning and afternoon as well as during the last hour before darkness.

Tabanus geographicus new species Fig. 19

Holotype female. Length 17 mm. **Head.** Frons slightly divergent above, index 1:6.4; tomentum pale gray, hairs black above and mostly pale below. Callosity and dorsal extension essentially undifferentiated from each other, black, truncate below, the whole forming a strong column which is tapered (or partially parallel sided) throughout, pointed above; a bare and shining dark area crosses entire vertex. Subcallus orange gray; face whitish gray with mostly black to brown hairs but also some pale hairs, beard with mostly dark hairs in front and pale hairs in rear. Antenna with scape black haired; plate orange, very slender, dorsal tooth very low, right angled (right) to obtuse and rounded (left), annuli orange except tip of apical annulus dark. Palpus with basal segment pale grayish brown, mostly black haired but also a few pale hairs; apical segment brown, heavily clothed with black hairs.

Thorax. Scutum various shades of gray to brownish gray, antealar whitish gray, hairs mixed black and pale overall but with patches of pale hairs at sides; scutellum with narrow basal margin gray, the remainder whitish and hence in rather strong contrast to adjacent body areas. Venter pale to medium gray, hairs mostly yellowish white but with some black haired median areas; coxae gray with mostly black hairs; fore femur black with black hairs, other femora black to blackish brown with predominantly black hairs; all tibiae black haired, fore tibia brownish black, black apically, other tibiae brown. Wing infuscated or at least strongly tinted brown over extensive areas, leaving the following hyaline or subhyaline: most of 2nd basal cell except along veins at apex, most of axillary cell (anal cell and base of marginal cell

lightly tinted), a large oval hyaline spot occupies central area of discal cell and may be said to rise to 4th vein, and a rather triangular hyaline spot occupies most of the basal area of the 1st submarginal cell and that part of the marginal cell which lies below the central area of the stigma, apical area of 2nd submarginal cell also hyaline with the proximal border of the hyaline area a broad arc which meets the "petiole" below but does not touch the anterior branch of the 3rd vein above, coloration of the 2nd to 5th P cells much paler at apex than at base; 1st P cell infuscated throughout, closed and petiolate; anterior branch of 3rd vein with a rather long spur; halter stem yellow, knob yellowish white. **Abdomen.** Tergites 1-4 orange with almost exclusively orange hairs, a small gray area on 1 under scutellum; 5 mostly blackened but with a basolateral area on each side remaining dark orange and with apical margin yellow, hairs mixed black and orange; 6 black with black hairs except narrowly pale with pale hairs along apical margin; 7 black with black hairs. Venter almost identical to dorsum but sternite 1 and anterior area of 2 with whitish yellow hairs at midline, 5 with basomedian area remaining dark orange and apical margin more narrowly pale, pale hairs of 5 confined to apical margin, 6 only inconspicuously paler at apex and black haired throughout.

Paratypes (581♀). Length 12.5-18 mm. Frons slightly divergent above to essentially parallel sided, index 1:4.5-8.0 (from selected sample). Callosity black to brown and sometimes slightly narrowed above to suggest a differentiation from dorsal extension, the latter often coarsely

defined and not necessarily tapered above. Subcallus gray with tints of yellow, orange, or brown; facial hairs including beard highly variable from almost entirely dark to almost entirely pale; hairs of basal segment of palpus similarly highly variable, apical segment of palpus variable from yellowish brown to blackish brown, hairs usually black but sometimes with some pale hairs basally. Dorsal tooth of antennal plate sometimes represented only by a low convexity; apical annulus sometimes black and all annuli sometimes somewhat darkened. All femora often entirely black haired, fore tibia often entirely black. Wing infuscation with all the variation expected in infuscated species, including some with the normally hyaline areas (most notably that in the marginal and 1st submarginal cells) strongly tinted or variable in size, and some having almost all cells with hyaline centers (though even if this is true of the 1st P cell, its basal area remains infuscated); spur vein usually rather long but sometimes short. Abdominal segment 5 variable in extent of black versus orange and yellow integument and hairs.

Male unknown.

Type series data. Holotype ♀: THAILAND: Chiang Mai Prov.: Huai Kao (≈4 km NW of Chiang Mai) 18°48'N 98°57'E: 15 May 1969 about cattle John J.S. Burton. (In Cornell University.) The precise type locality was a dairy farm at the foot of Doi Suthep, at about 350 m altitude. Paratypes: total of 581♀♀, all also from Huai Kao though almost entirely from zoological garden, with dates, hosts, and collectors varying as follows (all 1969 unless shown otherwise): 2♀♀, 9&10 May JB; 16♀♀, 10-15 May K. Somporn; 1♀, 15 May JB; 30♀♀, 18-20 May KS; 83♀♀, 21-25 May KS; 146♀♀, 26-31 May KS; 127♀♀, 1-5 June KS; 83♀♀, 6-10 June KS; 69♀♀, 11-15 June KS; 18♀♀, 16-17 June KS; 5♀♀, 20 May 1973 H. Bänziger. Also, "Chiengmai.": 1♀, Apr. 1928 Dr. & Mrs. J.W. McKean (BMNH), this specimen quite likely from the type locality, as Huai Kao is a suburb of Chiang Mai.

Taxonomy. This species has an extremely close relative in *indosinensis* Toumanoff, and the only consistent difference which I have found between them is the extent of infuscation in the central area of the wing. In *geographicus*, the base

of the 1st P cell is entirely or almost entirely infuscated, thus creating 2 central fenestrations; in *indosinensis* the base of the 1st P cell is subhyaline, thus the central area has a single large fenestration. In *geographicus* the hyaline spot in the discal cell is at least slightly separated from the 5th vein; in *indosinensis* the hyaline spot reaches down to the vein. Someone may eventually decide that these are distinct at an infra-specific level, but this will require much more evidence than is now available. *T. indosinensis* (type seen in Pasteur Institute of Paris and paratype seen in BMNH) is known only from the type locality of "région de Mimot" (Toumanoff 1950a:377) in Cambodia near the Viet-Nam border, and from the area of Chhep in north central Cambodia (Wharton 1957:102). This latter locality is reconfirmed on the basis of 2 of the 3 original specimens in USNM; it is only about 60 km from the lower corner of northeastern Thailand, and is almost surely only a matter of time before Thai specimens are collected. The Chiang Mai area, where all known specimens of *geographicus* were taken, is about 860 km away from the nearest known *indosinensis* locality. *T. geographicus* is related to *toumanoffi* Philip, but these are easily separated by the distinctly broader callosity/extension in *geographicus*, as well as the darker palpi and more extensive and darker wing infuscation. This new species is named for the National Geographic Society, Washington, D.C., in honor of the Society's majority share in supporting the field collecting on which this work is based.

Biology. It seems very peculiar that this species is known only from the type locality in view of its abundance there. Agricultural lowland and mountain jungle meet at the type locality. Known seasonal range is from April through mid-June (when collecting was suspended); it no doubt occurs somewhat later, but was entirely absent during several days of collecting in mid-July and it may not withstand the increasing rainfall of that season. Host interest was recorded in elephant and cattle, and a few were taken at light at night. Almost nothing is known of its daily activity pattern. Dr. H. Bänziger, a Swiss lepidopterist, collected 5 specimens in a night at 2200 hours from elephant. He considered their activity as natural and not the result of attraction to his light.

Tabanus toumanoffi Philip Fig. 20

Tabanus toumanoffi Philip, 1960a, Stud. Inst. Med. Res. Malaya 29:25.

Female. Length 13.5-18 mm (1 paratype is 11.5 mm). **Head.** Frons very slightly divergent above to parallel sided, index 1:5.5-7.7 (from selected sample); tomentum pale gray, usually brownish to yellowish gray centrally; hairs mostly pale below and black above. Callosity black to

brown, small and variable from elliptical to narrowly triangular or narrowly drop shaped, dorsal extension black and essentially linear. Subcallus dull yellowish to pale gray. Face whitish yellow to pale gray, hairs including beard yellowish white, often with some dark hairs at upper cheek

corner. Antenna with scape black haired but often with scattered pale hairs; plate orange with acute to obtuse dorsal tooth, annuli commonly entirely blackened but sometimes remaining orange except for blackened tip of apical annulus. Palpus with basal segment yellowish white to grayish white, pale haired; apical segment creamy white, hairs pale with some scattered black hairs or almost entirely pale. **Thorax.** Scutum dark grayish brown, antelare paler, hairs mixed black and yellow, yellowish white between wing base and scutellum; scutellum with narrow basal margin blackish brown to gray, becoming light brownish to yellowish and then whitish over almost entire area and hence in strong contrast to adjacent body areas, hairs pale except along anterior margin. Venter and coxae grayish yellow to gray, hairs yellowish white except some dark hairs on coxae; legs beyond coxae black or nearly so, tibial bases may be dark brown, foreleg black haired, at least middle femur with some pale hairs. Wing tinted brown in costal and subcostal cells and stigma, a much paler tint in basal and anal cells, and with a highly variable pattern of infuscation which takes the general form of a relatively slender, uneven central crossband which runs from the 2nd vein down to the 6th vein at the level of the apices of the basal cells, and a much broader subapical crossband the top of which generally fills the marginal and 1st submarginal cells beyond the junction of the 1st vein with the costa, which then generally tapers strongly inward below such that the base of the 2nd submarginal cell and the apical half of the 1st P cell are infuscated as well as at least the bases of the 2nd and 3rd P cells, the apex of the discal cell, and that part of the 4th P cell which lies across from the posterior cross vein; both crossbands are quite variable in extent and intensity, and may occasionally even be joined below through coloration of the 4th P cell; 1st P cell closed and petiolate; spur vein present on anterior branch of 3rd vein; halter stem yellow to yellowish brown, knob yellow to yellowish white. **Abdomen.** Tergite 1 narrowly dark gray around scutellum and orange elsewhere; 2-4 variable from entirely patternless bright orange to darker orange (even brownish orange) basally and with yellow apices, hairs generally black basally and centrally, and generally orange laterally and apically, occasionally a dark streak or spot at midline; 5 and 6 blackened, apices yellow with yellow to orange hairs; 7 black with a pale apical margin. Venter similar to dorsum, but paler and with much less black hair on sternites 1-4 and usually much less pale hair on 5 and 6. (201+)

Male unknown.

Type data (♀): "50km WSW/Khong Cambodia VI-14-52/53-2059CWharton". (Seen in

USNM.) For explanation of locality, see discussion of Wharton collection.

Published records. I have at hand 3 of the 4 paratypes (from USNM and Philip collection), the collecting locality of which was "40km WSW...", i.e., 10 km from the type locality; the dates are 5 & 10 June 1952. A 4th paratype is in Pasteur Institute of Paris and was taken in the same locality and date range as the other type series members.

New records. S. VIET-NAM: "BanMeThuot 500m": 1♀, 16-18 May 1960 S. Quate (BPBM). THAILAND (all 1969): Chiang Mai Prov.: Huai Kao (~4 km NW of Chiang Mai) 18°48'N 98°57'E: 3♀♀, 10 May JB; 7♀♀, 10-15 May K. Somporn; 8♀♀, 18&20 May KS; 1♀, 22-23 May KS; 5♀♀, 26 May KS; 7♀♀, 3-5 June KS; 23♀♀, 6-10 June KS; 78♀♀, 11-15 June KS; 38♀♀, 16-17 June KS; 1♀, 15 July P. Chaemmanee; 26♀♀, 16-18 July KS.

Taxonomy. The Huai Kao (Chiang Mai) specimens on which the above diagnosis is based are determined as *toumanoffi* with some reluctance, as the averages for these specimens show larger body, paler abdomen, and wing infuscation more extensive than the Cambodian type series. But in view of the variation among the Thai specimens and among the type series specimens, sufficient overlap is seen to consider it best to call them all conspecific.

The nearest known Thailand relative is *geographicus*, which is common at the same Chiang Mai locality. See under *geographicus* and in key for comparative notes.

A Thai student-collected specimen from Saraburi (in USNM) appears to be *toumanoffi* but has the anal cell of the wing broadly and distinctly infuscated along both sections of the 5th vein.

Biology. Assuming that the Chiang Mai population is really *toumanoffi*, it is very peculiar that specimens were not taken at intermediate localities, especially in the northeast. Altitude range represented is from about 140 m at the type locality to 500 m in the central highlands of S. Viet-Nam. Known seasonal range is 10 May to 18 July, both extremes attained at Huai Kao (Chiang Mai), where the final date reflects only the cessation of collecting efforts and the beginning date falls very close to the commencement of collecting there. Thus the natural season is surely more extended. The known range covers the first half of the rainy season. Host interest was recorded in elephant, cattle, water buffalo, and serow; several were taken at lights at night.

Tabanus nephodes complex

This complex is here defined as that portion of the Oriental species group with closed 1st P cells and strongly infuscated crossbands in the wing which also possesses a scutellum that is essentially concolorous with, or only slightly paler than, the scutum, thus distinct from the remaining species in the group which have scutellums much paler (usually whitish) than the scutum. I now consider 3 species to be involved in the complex, though the figure could easily change as more information becomes available, especially in the form of additional collecting in Burma. The species are *nephodes* (Bigot), *salvazai* Surcouf, and *kakhyenensis* Senior-White. Under the present interpretation, the last two occur in Thailand.

T. nephodes was originally described in genus *Atylotus* by Bigot (1892:656), for which placement in *Tabanus* was quickly substituted by van der Wulp (1896:63). All subsequent authors

have subscribed to van der Wulp's placement with the exception of Enderlein (1925:394), who placed it in Rondani's artificial genus *Bellardia* on the basis of the closed 1st P cell. The geographic distribution of *nephodes* was recently given by Stone (1975:64) as "India [Assam], Laos, Malaya, Thailand." The India (Assam) material includes the holotype (from Naga Hills) and, at present, 3 other ♀♀ in BMNH. As explained below, I am resurrecting *T. salvazai* Surcouf from synonymy under *nephodes*. The Laos record of "*nephodes*" is simply the holotype of *salvazai*. Stone's Thailand record is based on a specimen in USNM which he compared with the type of *nephodes* in 1971; it is actually a specimen of *salvazai*. The Malaya record came from Philip (1960b:52), who identified 4♀♀ from Langkawi Island as *nephodes*. I have seen 2 of these specimens (in BMNH and Philip collection), and they too are *salvazai*; presumably the other 2 agree with them. Therefore the known range of true *nephodes* Bigot is restricted to the Assam area.

Tabanus salvazai Surcouf Fig. 21

Tabanus Salvazai Surcouf, 1921(1922), Bull. Soc. Ent. France 1921(19):286-287. (*salvazei*: Tomanoff, 1950a:375-lapsus.)

Tabanus cneucus Philip, 1974, J. Med. Ent. 11(4):395. (New synonym.)

Female. Length 13-17.5 mm. **Head.** Frons very slightly divergent above, index 1:7.8-10.0; tomentum brown, gray at vertex; hairs black. Callosity orange brown to black, slender, and tapering smoothly into dark, linear dorsal extension; a small, rounded "tubercle vestige" spot near vertex. Subcallus and upper cheeks with brown tomentum, concolorous with frons; remainder of face with grayish white tomentum and mostly white hairs including beard. Antenna with basal segments black haired; plate dark orange or occasionally brown, with a subacute black haired dorsal tooth about 2/5 of the way out from the base; annuli darker. Palpus brownish gray; basal segment with long white hairs and some black hairs apically, apical segment with coarse black hairs and sometimes a few scattered pale hairs basally. **Thorax.** Scutum gray to naked eye, scutellum slightly paler to almost concolorous; with suberect black hairs predominating overall, and sparse recumbent pale hairs; pale haired tufts beyond wing base. Venter and coxae gray with white hairs, often a few black hairs on mesopleurite; foreleg with femur black and tibia brown to black; middle and hind femora and tibiae brown to black. Wing infuscated in the form of 2 crossbands, or, if the hind margin including all of the 5th P cell is darkened, then only a fenestration in and above the discal cell may remain hyaline, though the apical area of the 2nd

SM cell and the axillary area commonly remain rather clear; 1st P cell closed and petiolate; spur vein present. Halter stem yellow to brown, knob yellow to orange. **Abdomen.** Dorsum usually appears purplish black to naked eye, with pale tomentose, white haired triangles at the midline of the apices of tergites 2-4 or 5; otherwise mostly black haired except white haired at apical corners; when viewed at a low angle from the rear, the entirety of 1 & 2 and the apices of 3-5 are grayish white tomentose, much paler than the remainder. Venter with sternite 1 possessing an inconspicuous white spot at the midline; 2-5 with white tomentum and hairs apically, elsewhere similar to dorsum. (29+)

The Chiang Mai (Huai Kaeo) specimen associated here is larger at 18.5 mm with sternites 1-3 orange and tergites 1-4 brown.

Male unknown.

Type data (♀): "LAOS/Pang Hai/le 8-V-1920/R.Vitalis de Salvaza". (Seen in Paris Museum.) See discussion of Vitalis de Salvaza's collection for notes on his localities. See taxonomy section below for other labels attached to type.

Published records. No records of *salvazai*

other than the type have ever been published. However, several specimens published as *nephodes* are being reassigned here (see discussion of *nephodes* above), including those from Langkawi Island, Malaya. Holotype of *cnecus* from "THAILAND: S./Banna, Nakhon/108m. V-5-10-'58" [=Ban Na of Nakhon Si Thammarat Prov., at 07°59'N 99°38'E]. (Seen from BPBM.)

New records. LAOS: Mg. Sayaboury, 10 km S.: 1♀, 28 May 1967 F.G. Howarth. THAILAND: Chiang Mai Prov.: Huai Kaeo (~4 km NW of Chiang Mai) 18°48'N 98°57'E: 1♀, 18 May 1969 K. Somporn. Kanchanaburi: 2♀♀, 31 May 1962 [student colls.], Loei Prov.: Dan Sai Dist.: Dan Sai & vic. 17°16'N 101°09'E: 1♀, 10 June 1969 C. Dettongchai. Songkhla Prov.: Rattaphum Dist.: Tha Chamuang Canton ~06°58'N 100°08'E: 24♀♀, 16 Apr.-8 May 1969 A. Wanchitnai.

Taxonomy. *T. salvazai* came to be synonymized under *nephodes* in a strangely round-about fashion. Almost immediately after the publication of *salvazai* by Surcouf, Austen made a trip to the Paris Museum. As a result, Austen placed the following note in the *nephodes* section of the BMNH collection: "*Tabanus salvazai*, Surcouf...=*T. nephodes*, Big., var. (basal cells of wings infuscated). E.E. Austen det., 1.iv.1922, by comparison of types." Similarly, the type of *salvazai* in Paris Museum has the following note attached to it: "*T. nephodes*, Big., Var. E.E. Austen det., 1.iv.1922—by comparison with type." Thus Austen expressed his viewpoint at an early date, but it was left to Senior-White (1927:45) to publish it. The latter did this by listing *salvazai* as "[var]" under the heading of *nephodes*, with no mention of Austen. Then Stone (1975:64) listed *salvazai* as a full synonym of *nephodes*, with no trinomial rank or further explanation.

With all evidence considered, I cannot now agree with this synonymy, and herewith resurrect *salvazai* to specific rank. The morphological evidence rests on the infuscation of the wings. In *salvazai*, the 1st B cell is as heavily infuscated as the subapical crossband; and the 2nd B cell, although generally lighter than the 1st, is nevertheless to be considered as infuscated. Also, the principal fenestration is essentially hyaline. By contrast, the *nephodes* type as well as 3 other specimens from Assam (in BMNH) do not have the basal cells infuscated, though they are yellowed; and the area corresponding to the fenestration in *salvazai* (i.e., the central part of the discal cell and above) also shows some yellowing. Other distinguishing characters were sought but none was found so consistent among all specimens of both species, including those *salvazai* from disjunct localities.

In the original description, Surcouf failed to make the obvious comparison of *salvazai* with *nephodes*, and instead compared it with 2 other species which were part of Ricardo's Group 5. This happened because he thought *salvazai* was a member of Group 5, while Ricardo had instead placed *nephodes* in her highly artificial Group 6. The comparison also eluded Toumanoff (1950a:375) for the same reason, whose characterization of "*salvazei*" (sic) is a slightly inaccurate quotation of the original description.

T. salvazai is quickly distinguished from *kakhyenensis* in having the abdominal dorsum dark, not orange over tergites 1-4; and the wing infuscation is distinctly darker throughout, especially the basal cells.

In addition to the collecting data label and Austen's note quoted above, the Paris Museum specimen has a label showing "TYPE" in red ink. There is no indication on the specimen pin stating which species it is. But the box-bottom label next to the specimen shows "*T. nephodes* Bigot/var. *Salvazai* Surcouf". The collecting data matches the original description perfectly, and only a single specimen is involved. Therefore I have added a label to the specimen pin stating that it must be the type of *salvazai* Surcouf, and have so considered it here.

Philip (1974) has just described *cnecus* as new, without allusion to *nephodes*. The type of *cnecus* (at hand, 1975) clearly agrees with material listed above from elsewhere in southern Thailand as well as with a specimen (also at hand) on which his (1960b) record of *nephodes* is based. I saw no reason earlier to keep the southern population distinct from the remainder, and still see no reason to do so, therefore the name *cnecus* is placed as a junior synonym. If future information, especially in the form of more good specimens from upper Thailand and Laos, shows these populations to differ sufficiently, then the name *cnecus* is available for the southern one.

Biology. The type locality in northern Laos is thought to be the northernmost record, and Langkawi Island, northwest Malaya, the southernmost. The climatic range that these localities represent is made all the more surprising by the apparent uncommonness of the species. (Species with wide geographic ranges and climatic tolerances are most often common as well.) In view of this range, the compactness of the known flight season, 16 April-10 June, is quite amazing, with the northern and southern populations not asynchronous. Known altitudes represented range from near sea level to about 375 m. Known host interest is recorded in water buffalo. It was taken attacking from before 1000 hours until nightfall at Tha Chamuang.

Tabanus kakhayensis Senior-White Fig. 22

Tabanus kakhayensis Senior-White, 1922, Mem. Dept. Agr. India, Ent. Ser. 7(9):143-145, 104, Plate 12.

Female. Length 13-16.5 mm. **Head.** Frons slightly divergent above, index 1:8.2-8.3; tomentum dull yellowish brown below becoming darker above and gray at vertex; hairs mostly black. Callosity orange brown, quite small and slender, smoothly drawn up into the very tall linear and raised dorsal extension which is darker. Tomentum of subcallus and upper cheek area brownish orange; remainder of face with yellowish to grayish white tomentum and with hairs variable from brownish yellow to white. Antenna with basal segments mostly black haired; plate orange, elongate but rather broad, with an obtuse black haired dorsal tooth about 2/5 of the way out from the base; annuli a darker shade of orange than the plate, apical annulus may be further darkened. Palpus gray to yellowish brown, basal segment with hairs variable from almost entirely dark to whitish at base of the segment and black at apex, apical segment with coarse black hairs and a variable amount of pale hairs. **Thorax.** Dorsum dark gray to naked eye, due to pale tomentum overlying mostly darker integument, color of scutellum not significantly different from scutum; hairs mixed black and whitish to golden. Venter and coxae gray to naked eye, with whitish hairs and tomentum; all femora dark brown to black; fore tibia orange basally and blackened apically; other tibiae variable, orange to brown. Wing with 1st P cell closed and petiolate; spur vein present; a broad infuscated apical crossband present, costal cell also infuscated and 1st B cell lightly so over apical half; remainder of wing mostly yellowed. Halter stem and knob yellow to orange. **Abdomen.** Tergites 1-4 orange except with a small gray area on 1 around the scutellum, 5 mostly dark orange but black at sides, 6 mostly black; 1 mostly golden haired, 2-4 with golden haired triangles apically at the midline and sometimes also golden haired apical fringes and corners; dorsum otherwise mostly black haired. Sternites 1 & 2 orange, sometimes with gray basally on 1; 3-5 highly variable, from orange like preceding sternites (as in Kanchanaburi ♀) to darkened like succeeding ones (as in type ♀ and the ♀ topotypic cotype in BMNH); 6 & 7 darkened. Hairs on venter also variable in extent and color, from sternites 1 & 2 white haired overall and 3 & 4 with white haired apices (as in type ♀), to entire area of 1-4 golden haired (Kanchanaburi ♀). (3+).

Male known from 1 cotype of Senior-White, in BMNH. He observed that it "differs considerably from the type female, but is obviously conspecific with one Yanaungmyin female..."

Type data (♀): "For.Zool. Coll./Mohnyin Res./Katha Burma/19-v-1919/at light/C.F.C. Beeson/1923.209." (Seen in BMNH.) Katha, the

town near the type locality, is at 24°10'N 96°20'E.

Published records. The type series of 6♀ and 1♂ were all from Burma. The type and 2 other ♀♀ were collected from Mohnyin Reserve, 15 & 19 May 1919; 1♀ & 1♂, Pyonchaung, South Toungoo, 22 May 1918; 2♀♀, Yanaungmyin, Pyinmana, 3 & 9 June 1918; all by C.F.C. Beeson. The latter 2 localities are between 18°30'-20'N and 95°40'-96°40'E. Other than the type series, the only record of this species is by Stone (1975:62) who included Thailand in the distribution without further elaboration. This record has been traced to a specimen in USNM which both of us have now compared with the type, from Kanchanaburi, 31 May 1962, [student coll.].

New records. BURMA: "Mt. Victoria/Chin Hills/500m VII.38/leg.G. Heinrich/Brit.Mus./1939-186.", 1♀ in BMNH; "?Tammu/1945/Sgt. Mortimer", 2♀♀ in BMNH, first determined by Senior-White. THAILAND: Tak Prov.: Mae Sot Dist. (~5 km E of Mae Sot) 16°43'N 98°37'E: 1♀, 10 July 1969 JB.

Taxonomy. The original description begins with a ♂ symbol, though it is immediately obvious that this is not the sex being considered; the description is essentially a composite of the series of 6♀♀. One of these was regarded by Senior-White as the type, but his text does not narrow down his selection any further than to show that it is one of the 3♀♀ from Mohnyin Reserve. The single ♂ is then discussed in a separate paragraph, without actually utilizing the word "type" in connection with it; perhaps the author took this for granted, or perhaps the designation was not intended. In any case, as they stand today in BMNH, 1♀ has the red-rimmed disc which is the hallmark of a BMNH type; while the ♂ has an ordinary label on which is written "Type of description of ♂" (rechecked since my visit by BMNH staff). In order to remove all of these ambiguities, the ♀ specimen bearing the type designation label in BMNH is herewith designated as lectotype (data label transcribed above under "Type data (♀)"). Under slightly different circumstances, this formality would not be necessary.

The species is distinguished from all others in Thailand except *salvazai* by possessing a scutellum which is not distinctly paler than the scutum in addition to an infuscated wing crossband and a closed and petiolate 1st P cell. For comparative notes with *salvazai*, see under the latter.

Biology. The records show fairly widely

separated localities in Burma, which my lack of experience there does not permit me to characterize. The 2 Thailand records are both from provinces abutting Burma. The Mae Sot locality was rather wet, hilly and forested; the whole area is in the Salween River drainage.

Tabanus rufiscutellatus Schuurmans Stekhoven Fig. 23

Tabanus rufiscutellatus Schuurmans Stekhoven, 1926, Treubia 6, Suppl.: 539-541, Plate 17 Fig. 6.

Female. Length 13.5-16.5 mm. **Head.** Frons slightly convergent above to parallel sided or convex, index 1:3.2-4.2 (from selected sample); tomentum orange, hairs mixed, predominantly orange below and commonly mostly black above. Callosity orange to orange brown, triangular to oval; dorsal extension orange brown to brown, linear and usually quite slender, sometimes mostly grown over with tomentum. Eyes (relaxed) green. Subcallus and face orange to yellow, facial hairs including beard orange to yellow. Antenna with scape mostly pale haired, some black hairs at least at dorsal apex; plate orange, broad and short, dorsal tooth large and acute or sometimes right angled, plate rather angulate below, annuli highly variable from orange to blackened. Palpus orange to yellow with orange to yellow hairs, apical segment usually with some scattered black hairs. **Thorax.** Dorsum orange to orange brown, hairs mixed orange to yellow and black. Venter and coxae orange to grayish yellow with orange to yellow hairs, fore coxa (and sometimes also hind coxa) with some black hairs apically; femora generally orange brown to dark yellow with mostly pale (orange to yellow) hairs and a variable amount of black hairs (nearly absent on hind femur); fore tibia orange to brown basally with orange hairs and blackened apically with black hairs, other tibiae usually orange with mostly orange hairs, apex with black hairs; fore tarsus black. Wing patterned, apex of subcostal cell and stigma brown, thence brown below in a cloud which extends downward and inward to the upper areas of the 2nd to 5th P cells, cloud becomes paler below, outer margin curved, coarse and indefinite; proximal area of wing from base outward to brown cloud tinted yellow, including costal downward through anal cell; anterior branch of 3rd vein curved, rarely angulate or with budlike spur; 1st P cell open; halter stem and knob yellow. **Abdomen.** Dorsum orange, unpatterned but often darkening to orange brown apically; hairs orange to yellow with a variable amount of black scattered primarily around midline and widely on apical tergites. Venter usually predominantly orange with yellow to orange hairs, sternite apices slightly paler with yellow tomentum, 2-5 with median patches of black hairs, 6 and 7 similar but black hairs commonly more extensive. (96+)

Kanchanaburi is both the name of a large province in west central Thailand whose western reaches are quite moist, and also the name of its lowland provincial capital, which is one of the driest spots in the entire country. The Mae Sot specimen was taken about cattle.

This species has green blood which is sometimes manifested as green antennae, knee joints, wing veins, halter knobs, etc.

Male. Easily associated with ♀. Subcallus, face, and palpus yellow, Thai specimen with venter similar to ♀ but paler (yellow), dorsum of thorax and abdomen more extensively black haired than in ♀. Java paratype ♂ with thoracic dorsum orange haired (no black hairs), abdominal dorsum coppery brown haired (apparently no truly black hairs except on exerted terminalia beyond tergite 7), and abdominal venter orange haired (no black hairs). (2)

Type data (♀): Given in original description as "Isle Java, Rangkas Dengklok, Krawang, Res. Batavia on buffalo 30.11.'21". Krawang is east of Jakarta at 06°19'S 107°17'E. The original type depositary was Veterinary State Laboratories, Bogor, and most such material was later sent to museums in the Netherlands. I have inquired about this type at the Zoölogisch Museum, Amsterdam, and at the Rijksmuseum, Leiden. Neither institution claims to have it, and it is presumed lost. The only specimens said to be present in either institution are 1♀ and 1♂ (both paratypes), kindly loaned to me by Dr. T. van Leeuwen, Amsterdam. These are the last 2 Java specimens listed by Stekhoven (1926:539).

Published records. The type series was from Java and Djambi, Sumatra. Toumanoff (1950a: 375-376) reported this species from near "Trang-Bom", Bien Hoa Prov., S. Viet-Nam. Although the key characters which he assigned to it (1950a: 374) seem satisfactory, the record requires reconfirmation. In Pasteur Institute (Paris) I found 2 specimens, 1 bearing his *rufiscutellatus* label and the other associated, but which are actually specimens of *fasciatus*. They bear no data labels and are likely not the specimens he reported, but doubt is cast on his understanding of the species. Philip (1960b:56) reported 5♀♀ from Thailand. I have on loan from Philip 2 of these specimens; they are from Bang Khen, Bangkok, and I reconfirm the determination.

New records. LAOS: Vientiane Prov.: 9 km N Vientiane: 1♀, 11 May 1968 F.G. Howarth.

THAILAND (all 1969 unless shown otherwise): Chiang Mai Prov.: Huai Kaeo (~4 km NW of Chiang Mai) 18°48'N 98°57'E: 2♀, 13-14 June K. Somporn; Loei Prov.: Loei & vic. 17°29'N 101°44'E: 3♀, 17 Apr. JB; 10♀, 19-29 Apr. C. Dettongchai; 1♀, 1 May CD; 10♀, 6-19 May CD; 16♀, 25&26 May CD; 1♀, 31 May CD; 4♀, 1-7 June CD; 4♀, 13-27 June CD; 4♀, 1&5 July CD; Loei Prov.: Dan Sai Dist.: Dan Sai & vic. 17°16'N 101°09'E: 1♀, 9-11 June CD; Nakhon Sawan Prov. (~10 km S of Nakhon Sawan) 15°36-38'N 100°07-18'E: 3♀, 27 June JB; Phra Nakhon Prov.: Bangkok: 1♂, 3 Feb. 1963 A. Nagatomi; Phra Nakhon Prov.: Bang Khen Dist.: 2♀; Chon Buri Prov.: Si Racha Dist.: Bang Phra Canton 13°13'N 100°57'E: 5♀, 12&13 Feb. JB; 15♀, 14-17 Feb. P. Chaemmanee; 11♀, 25-29 Mar. PC; 1♀, 13 July PC. Also student collected specimens from Bangkok and Chiang Mai. INDONESIA: Sumatra: "Goenong Soegi, Lampong": 1♀, Oct.-Nov. 1901 A.C. Harrison & H.M. Miller.

Taxonomy. Determination of Thailand material is based on comparison with the 2 Java paratypes noted above. It is very peculiar that representatives have not been collected in southern Thailand or Malaya. I found the Indonesian and Thai ♀♀ inseparable, though the 2♂♂ differed as noted. It may eventually be found that the geographic and ♂ distinctions have more significance than I can now attach to them. The tomentum and hairs of head and thoracic venter

averaged more strongly orange in the northern and northeastern Thai specimens (as in the Indonesian specimens), while those of the central Thai specimens averaged paler yellow.

The species is a member of the *optatus* group. The only relative now known to occur in Thailand is *fascius*, from which *rufiscutellatus* is immediately distinguished by its mostly orange to orange brown legs (black in *fascius*), and primarily orange abdominal venter (black and white banded in *fascius*). The Cambodian *melanognathus* may eventually be found in Thailand (see separate account). These are very close relatives, and the short series compared revealed only the following subjective distinctions: in *rufiscutellatus* the middle and hind legs are similar in color to the thoracic and abdominal venter, while in *melanognathus* the legs are darker brown and hence in greater contrast to the body. In *melanognathus* the abdominal venter tends to be a little more brownish and has whitish tomentose, whitish haired sternite apices, thus creating more of a banded impression than in *rufiscutellatus*. The relationship of these species should be assessed further.

Biology. In Thailand *rufiscutellatus* is known from near sea level up to 375 m at Dan Sai, and is considered a plains species. It has not yet been taken in the Isthmus of Kra. Confirmed seasonal range covers February to July and may be much longer. Host interest is recorded in water buffalo and cattle, 1 was taken by Malaise trap.

Tabanus fascius Philip Fig. 24

Tabanus fascius Philip, 1960a, Stud. Inst. Med. Res. Malaya 29:14, 13.

Female. Length 16.5-19.5 mm. **Head.** Frons slightly convergent above to parallel sided, index 1:3.7-4.5; tomentum yellow to orange, hairs mostly yellow below and with a few to many black hairs at vertex. Callosity orange brown to brown, hemi-hexagonal below to drop shaped; dorsal extension orange brown to dark brown, linear, sometimes fine or even grown over with tomentum. Subcallus and face deep yellow to pale yellow, facial hairs including beard yellow to whitish yellow. Antenna with hairs on scape variable but usually mostly black; plate orange, dorsal tooth large and acute, annuli variable from orange to blackened. Palpus yellow with yellow hairs, apical segment with scattered black hairs. **Thorax.** Dorsum yellow brown with yellow and black hairs. Venter yellow with yellow hairs, coxae similar but partly black haired, remainder of all legs black to dark brown with black hairs. Wing patterned, most of area tinted brown from wing base outward to apex of stigma and from costal margin downward to upper part of 2nd through 5th P cells and including anal cell and

base of axillary cell, stigma and adjacent areas above and below tinted darkest; halter stem and knob yellow. **Abdomen.** Dorsum orange basally and gradually becoming more brown to the apex of tergite 6, 7 gray; 1 with orange and sometimes a few black hairs, 2-4 usually black haired with orange hairs along apices and often expanding into triangles at midline, but sometimes more extensively orange haired, 5 black haired with a variable amount of orange hairs on apex but usually not forming a complete fringe, 6 black haired with patches of apical pale hair, 7 black haired, 1-4 also with orange and whitish hairs laterally. Venter with sternite 1 and the basal part of 2 orange with white and some black hairs, 2 beyond transverse row of pits and 3-6 blackened (or browned) with black hairs, 2-6 with white, white haired apical margins which may occupy from about 1/4 to 2/5 the width of 3 and from about 1/3 to over 1/2 that of 4 and 5. (19+)

Male unknown.

Type data (♀): "40kmWSW/Khong Cambodia VI-5-52/53-2059CWharton". (Seen in USNM.) The type locality is Wharton's study area near Chhep, Cambodia. See discussion of Wharton collection.

Published records. Holotype only.

New records. THAILAND (all 1969): Chiang Mai Prov.: Huai Kao (~4 km NW of Chiang Mai) 18°48'N 98°57'E: 1♀, 6 June K. Somporn; 4♀♀, 12 June KS; 2♀♀, 13-14 June KS; 1♀, 17 June KS; 1♀, 16 July KS; 2♀♀, 17 July KS; 5♀♀, 18 July KS; 1♀, 19 July KS. Also 2♀♀ from IPP, 1 of which is labeled *T. rufiscutellatus* by Toumanoff, are identified here. These bear no data labels, but are probably from S. Viet-Nam or eastern Cambodia.

Taxonomy. The holotype has broader white apical bands on the sternites than the Thai

specimens, but this is not now seen as significant especially since the 2 Toumanoff specimens (above) have the narrower bands and are probably from the opposite side of the type locality. A specimen at hand from BMNH, labeled "CHINA/Foochow/1935-6/M.S. Yang" is very close indeed to this species but all of the pale hairs of the abdominal venter are deep yellow (not white), and Foochow (=Fu-chou) at 26°05'N 119°18'E, is very far out of the present range. The known relative in the present area is *rufiscutellatus*, which see for comparative notes.

Biology. The known distribution of *fascius* is only Cambodia and northern Thailand, and it is surprising that none were taken in north-eastern Thailand. The type locality is a lowland plain and the Huai Kao (Chiang Mai) locality is at about 350 m. Known seasonal range is 6 June to 19 July (when collecting efforts ceased at Huai Kao). Host interest is recorded in elephant and cattle.

Tabanus alumnus new species Fig. 25

Holotype female. Length 15.5 mm. **Head.** Frons very slightly divergent above, index 1:5.8; tomentum yellow orange below becoming orange above, a small pale gray spot below vertex; hairs yellow throughout with a few scattered black ones. Callosity yellowish brown, inverted U-shaped and truncate below; dorsal extension brown, essentially linear but slightly expanded above. Subcallus and upper cheek area yellow, remainder of face paler whitish yellow; facial hairs including beard whitish yellow. Antennal scape with scattered black hairs, short orange hairs at dorsal apex and on inner face, some pale hairs below; pedicel black haired on outer face and orange haired on inner face; plate orange, with a squared dorsal tooth, annuli somewhat darker orange than plate, apical annulus rather blackened. Palpus pale yellow, basal segment entirely whitish yellow haired, apical segment also whitish yellow haired but with a few scattered black hairs. **Thorax.** Dorsum yellow to grayish yellow, with recumbent yellow hairs and more erect black hairs. Venter and coxae grayish yellow, with entirely whitish yellow hairs; all femora orange [but see paratypes below]; fore tibia orange, but paler and with orange hairs basally vs. darker and with black hairs apically, other tibiae orange. Wing yellowed in costal and subcostal cells, tinted yellowish to pale brownish over remainder of costal and apical area, gradually fading until only the faintest perceptible tint occurs in hind area; 1st P cell open; budlike spur vein present; halter stem yellow, knob whitish yellow. **Abdomen.** Tergites 1-3 entirely orange and orange haired except for a few black hairs laterally on 3; 4-6 also orange but with a roughly semicircular spot on both sides of the midline basally on each segment which is only slightly darker orange on 4, dark orange on 5, and rather blackened on 6, 4-6 orange

haired except black haired over the semicircular darker areas described which accentuates them; 7 slightly blackened but with orange apex, hairs black except orange apical fringe. Sternites 1-3 orange yellow with colorous hairs except 2 has a few scattered black hairs on center, and 3 also with some scattered black hairs which are concentrated along the base about the midline; 4-6 progressively darker with darkened, black haired areas which expand out from the midline at the base, but each segment with at least an orange and pale haired apical and lateral periphery; 7 rather blackened and black haired except at apical corners.

Paratypes (16♀♀). Length 14.0-16.5 mm. Frons index 1:5.2-6.8. Callosity sometimes slender and rectangular, dorsal extension may be slightly to entirely grown over with tomentum leaving only a keel. Inner face of antennal pedicel sometimes with some black hairs, dorsal tooth on plate squared to obtuse, 3 basal annuli may be colorous with orange plate and the apical annulus only moderately darker. Black hairs on palpus variable from very few to nearly predominating. Thoracic venter gray to grayish yellow. Femora highly variable: fore femur black to orange (that of the type is the palest of all; 2 paratopotypes slightly darker, the third blackened over most of area; paratype from Phibun Mangsahan moderately darker than type; those from Huai Kao (Chiang Mai) blackened); middle and hind femora variable from orange to gray. Anterior branch of 3rd wing vein variable from curved to distinctly spurred. Extent of black hairs on abdomen and intensity of dark pigmentation variable, though the position of the dark spots on the tergites remains constant and is a good diagnostic character.

Male unknown.

Type series data. Holotype ♀: THAILAND: Khon Kaen Prov. (Univ. campus NW of Khon Kaen) 16°27'N 102°49'E: 4 July 1969 about hours 1730-1900 hrs. John J.S. Burton. (In Cornell University.) The type locality was the animal pens on the campus of Khon Kaen University (suggesting the species name), on the outskirts of the town. Paratypes (all 1969): 3♀♀, data precisely identical to holotype; Chiang Mai Prov.: Huai Kao (≈4 km NW of Chiang Mai) 18°48'N 98°57'E: 1♀, 25 May Kao Somporn; 1♀, 29 May KS; 1♀, 31 May KS; 2♀♀, 2 June KS; 1♀, 6 June KS; 2♀♀, 13-14 June KS, 2♀♀, 17 June KS; 2♀♀, 18 July KS; Ubon Ratchathani Prov.: Phibun Mangsahan Dist.: town & vic. 15°14'-15°N 105°13'-14'E: 1♀, 22 July JB.

Taxonomy. This species is distinguishable at a glance from all others known from the area. I consider its closest relative to be *siamensis*, which see for comparative notes.

The difference in femoral coloration among members of the type series is surprising. I had thought this might be a geographic phenomenon but find that much of the diversity (though

certainly not its full range) occurred even at the type locality, hence it is not believed to represent a subspecific difference. However, the Chiang Mai Province specimens do possess the darkest femora and average narrower fronses. I have seen some specimens (e.g., 2 in USNM from Wharton's collection in northern Cambodia) which, although quickly appearing to be properly associated here, on closer examination show too great a divergence (e.g., in size and frons characters) from my concept of this species to be included in it at present.

Biology. This species is not only related to *siamensis* taxonomically but ecologically as well. Both were collected in the same date range from the 2 Thailand localities from which *siamensis* is known, though the latter was not taken during the brief collecting effort at the *alumnus* type locality. *T. alumnus* is likewise thought to be a plains species, and its type locality certainly substantiates this impression. Known seasonal range is 25 May-22 July. It may also be crepuscular, since my afternoon collections at both northeastern localities failed to produce it; it was present only in my collections made during the last 1 1/2 hours before darkness. Recorded host interest includes horses, elephant, and water buffalo.

Tabanus siamensis Ricardo Fig. 26

Tabanus siamensis Ricardo, 1911, Rec. Indian Mus. 4(6):212.

Female. Length 14.5-17.0 mm. **Head.** Frons very slightly divergent above, index 1:6.0-7.5; tomentum yellow below becoming orange above and usually pale gray at vertex; hairs mixed black and yellow, more concentrated black at vertex. Callosity reddish brown, parallel sided to oval and widely separated from eye margins; dorsal extension linear, reddish brown to black. Subcallus and upper cheek corners yellow to orange yellow, remainder of face yellow; facial hair variable from almost entirely pale yellow to largely tinted brownish especially along eye margins and blackish on frontoclypeus, beard yellow (rarely with some brownish tint). Antenna with scape black haired, usually some short orange hairs at dorsal apex and sometimes also on inner face; plate orange, dorsal tooth acute to square, black haired; annuli usually concolorous with plate, except apical annulus which is usually but not always darkened at tip. Palpus pale yellow; hairs on basal segment highly variable, most often pale haired basally and with black hairs apically; apical segment with mixed black and pale hairs, the black hairs variable from predominant to very sparse. **Thorax.** Dorsum brown, with some recumbent yellow to orange hairs and more erect black hairs. Venter and coxae yellowish gray to gray, fore coxae may be blackened apically, hairs of venter mostly yellow, with some brown to black hairs; all

femora blackened; fore tibia orange basally gradually becoming black apically, other tibiae orange. Wing tinted brownish yellow, strongest in costal cell and along costal margin, then fading to light touches along some veins, hind area hyaline or essentially so; 1st P cell open; anterior branch of 3rd vein curved to moderately angulate, rarely with a budlike spur vein; halter stem and knob yellow. **Abdomen.** Tergites 1-4 essentially orange, 5 darker but variable in extent and intensity, 6 and 7 black; hairs mostly black but 2-4 with yellow haired triangles at the midline which diminish in size, 3-5 and sometimes also 2 and 6 with yellow haired apical fringes; 3-6 with narrow apical bands of yellow tomentum which, together with the integumental color, usually expands at the midline of 5 to create a triangular pattern on this segment as well. Venter variable but essentially similar to dorsum except that there are no triangles, and sternite 5 is distinctly blackened (more so than tergite 5). (14)

It is necessary to have an entirely unribbed specimen to appreciate the abdominal triangles, though the integument itself may manifest the pattern. With some imagination, this can be said of the type, which Austen (1922a:434) has already noted.

Male unknown.

Type data (♀): "Siam, June, 1906, W. Palmer/ Recd from T. B. Bell, /Bombay, /per H. E. Andrews." (Seen from BMNH.)

Published records. The original series included the type and another ♀ with exactly the same data. Ricardo did not apply the term "paratype" to the second specimen, nor did it bear any such designation on the pin. But since there is no doubt about its identity, I have placed a paratype label on it in BMNH. The only subsequent specimen reported was by Coher (1962(1963):161), from Laos, "40 miles E. of Vientiane..." I have not seen Coher's specimen, but judging from the color characters he attributed to it, I think it is probably not *siamensis* under the present interpretation, but perhaps *thurmani* instead.

New records. LAOS: Khong: 2♀♀, 24 May 1952 C. Wharton (USNM). CAMBODIA: [vic. of Chhep]: 2♀♀, 5&14 June 1952 CW (BMNH & Pechuman collection). THAILAND (all 1969): Chiang Mai Prov.: Huai Kaeo (~4 km NW of Chiang Mai) 18°48'N 98°57'E: 1♀, 28 May Kaeo Somporn; 1♀, 4 June KS; 2♀♀, 8 June KS; Ubon Ratchathani Prov.: Phibun Mangsahan Dist.: town & vic. 15°14-15'N 105°13-14'E: 3♀♀, 22 July JB; 2♀♀, 25 July Pie Chaemmanee.

Taxonomy. The original description is very misleading in the sense that the color characters displayed by the type and paratype in their badly rubbed condition are essentially presented as the natural condition. Austen (1922a:455) called attention to this. I examined the 2 specimens in BMNH and found them in good agreement with each other, but association with my fresh material was another question. Then, after thoroughly examining the type of *thurmani* in USNM, I realized the question remained unresolved and requested on loan the *siamensis* type for further comparison. In the mails this latter type worked loose from its inverted-needle stage mount and is now in worse condition. The broken appendages were salvaged from the mailing box and have been glued on a separate slip of card. Association of the appendages with the type is correct, as it was the only specimen being mailed. The type has been remounted on a standard pin.

At a glance, the rubbed *siamensis* type

looks rather more like a fresh specimen of *thurmani* than like fresh *siamensis*. But thorough examination has, I believe, produced the correct association. The 2 species are almost always very quickly distinguishable when in good condition. In *siamensis*, even the costal margin of the wing is merely tinted and not infuscated; sternites 2-4 show various shades of orange, not progressively blackened; antennal plate relatively wider at the tooth level; tomentum of subcallus yellow like face, not strongly orange. I consider the closest relative of *siamensis* to be *alumnus*, the 2 of which have duplicate geographic and seasonal ranges at Chiang Mai and Phibun Mangsahan. *T. siamensis* is darker overall, with dorsum of thorax appearing brown to the naked eye (not yellow), tergite 5 and sternite 5 mostly blackened, femora of all legs blackened.

The type of *T. pallidepektoratus* (Bigot) from Saigon, S. Viet-Nam was seen in BMNH. It is related to *siamensis*, but the 2 are quickly distinguished by Bigot's type being larger and more robust (18 mm), its callosity much more linear, subcallus orange tomentose but face grayish yellow, apical segment of palpus entirely black haired, fore tibia strongly bicolored including white hairs over basal area, sternites 2-4 with dark median patches; the abdomen is rubbed so no distinct hair pattern can be seen though it may have been patterned originally; tergite 5 and beyond darkened (only lightly so on 5). Surcouf (1922:15) described *pallidepektoratus* var. *aurea*. A specimen so labeled was seen in Paris Museum. It was described from "Tonkin", and matches nothing known from Thailand. The name of this "variety" must be rendered *aureus*, as it is adjectival and must agree accordingly.

Biology. I infer from the localities represented that *siamensis* is essentially a plains species. I have no explanation why it was not taken in other flatland localities, as the Thailand localities are far apart. The type itself might have come from the Chiang Mai area, as this has always been a popular destination for Europeans. Known seasonal range is from 28 May to 25 July, thus apparently commencing with the rainy season, and may eventually be found to extend more deeply into it. Known host interest includes water buffalo and cattle. The species may well have a crepuscular habit. The 3 specimens I collected were all taken between 1830-1900 hours, with none taken throughout that afternoon's attempts.

Tabanus anabates Philip Fig. 27

Tabanus anabates Philip, 1960a, Stud. Inst. Med. Res. Malaya 29:9-10.

Female. Length 11-15 mm. **Head.** Frons slightly divergent above, index 1:4.5-6.3 (from selected sample); tomentum yellow to yellowish brown but commonly orange, sometimes partly

gray at vertex, hairs usually mostly black and sometimes entirely so. Callosity orange to brown, quite variable from spindle shaped to oval to rectangular, the lower corners often irregular,

dorsal extension black to orange, essentially linear but variable in width. Subcallus and upper cheek corners generally concolorous with frons, upper part of frontoclypeus sometimes tinted, upper cheek corners with some dark hairs, face elsewhere white with white hairs including beard. Antenna with scape black haired; plate orange, rather elongate, dorsal tooth obtuse to acute but low and near base, annuli orange, apical annulus (occasionally all annuli) may be darkened, annuli may number 4 or apparently only 3. Palpus creamy white, basal segment white haired, apical segment mostly to entirely white haired basally becoming mostly to entirely black haired beyond.

Thorax. Dorsum brown with mixed yellow and black hairs. Venter and coxae grayish white with white hairs; fore femur black with black hairs, outer face sometimes grayish black and with a quantity of white hairs, other femora mostly various shades of gray to blackish with variable amounts of white and black hairs; fore tibia with approximately basal 1/2 to 2/3 whitish with white hairs, the remainder becoming black with black hairs, other tibiae whitish with mostly white hairs, apices brown to black with black hairs. Wing with a strip of costal infuscation which covers the costal, subcostal, and marginal cells, apex of 1st submarginal cell and part of area along 2nd vein (sometimes all of area beyond level of furcation of 3rd vein), and top corner of 2nd submarginal cell, remainder of wing hyaline or nearly so; 1st P cell open; anterior branch of 3rd vein curved, angulate, or with a spur vein; halter stem dull yellow to brown, knob brown.

Abdomen. Dorsum principally orange to brown basally becoming darker apically, tergite 5 at least partly dark basally, 6 mostly dark and 7 nearly all dark (grayish black to black), tergites 3-5 with apical bands of orange yellow hairs and yellow tomentum which expand into triangles at midline, similar pale median hairs also present on 1 and 2 though pale haired apical bands may or may not be present, 6 with some apical pale tomentum but few or no pale hairs, lateral area of 1 broadly covered with yellow and white hairs, 2 more narrowly so. Sternites 1 and 2 with white tomentum and hairs, 3-5 also with whitish tomentum and hairs but with a basal band or horizontal patch of relatively darker area and mostly black hairs (usually darkest on 5, and this segment often more than half blackened), some of the pale hairs at sides of 3-5 often becoming yellow, 6 and 7 blackened with mostly to entirely black hairs, 6 commonly and 7 sometimes grayish apically. (875+)

Male unknown.

Type data (♀): "Thailand, Lam-/pang, Tern./ 22 July 1952/D.C. Thurman/In passenger bus", plus a label with only the collection number "978". (Seen in USNM.) Thoen (= "Tern") is a district town in southern Lampang Province at 17°36'N 99°12'E.

Published records. Holotype only.

New records. LAOS: Houa Khong Prov.: Muong Sing: 1♀, 6-10 June 1960 S. Quate; Sayaboury Prov.: Sayaboury: 13♀♀, 25-27 May 1967 F.G. Howarth; Sayaboury Prov.: Muong Phiang: 1♀, 3 June 1967 FGH; 1♀, 20 Aug. 1967 FGH; Vientiane Prov.: "Ban Na Pheng/11 Km. W. Ban Keun": 4♀♀, 21 May 1968 FGH; Vientiane Prov.: "Phou-kou-kuei": 1♀, 19-31 May 1968; Vientiane Prov.: Vientiane: 1♀, 31 May-3 June 1960 S.&L. Quate. THAILAND (all 1969 unless shown otherwise): Chiang Rai Prov.: Mae Sai Dist.: Mae Sai & vic. 20°26'N 99°53'E: 65♀♀, 17 July JB; Chiang Rai Prov.: Phayao Dist. (vic. NW of Phayao) 19°10-11'N 99°53-54'E: 3♀♀, 18 July JB; Chiang Mai Prov.: Huai Kaeo (~4 km NW of Chiang Mai) 18°48'N 98°57'E: 1♀, 5 June K. Somporn; 2♀♀, 9-10 June KS; 1♀, 13-14 June KS; 5♀♀, 16-18 July KS; Tak Prov.: Mae Sot Dist.: Huai Muang Canton 16°40'N 98°31'E: 78♀♀, 9 July JB; 111♀♀, 11 July JB; Tak Prov.: Mae Sot Dist. (~5 km E of Mae Sot) 16°43'N 98°37'E: 86♀♀, 10 July JB; Loei Prov.: Dan Sai Dist.: Dan Sai & vic. 17°16'N 101°09'E: 91♀♀, 22 May JB; 198♀♀, 9-11 July C. Dettong-chai; Loei Prov.: (12-15 km NW of Loei) ~17°34'N ~101°39'E: 7♀♀, 18 May 1967 JB; 6♀♀, 17-19 May 1967 R.R. Pinger; 14♀♀, 6-7 July 1966 RRP; Loei Prov.: Loei & vic. 17°29'N 101°44'E: 1♀ on each date: 4, 7, 10 & 19 May, 23, 25 & 26 June, 1, 4 & 5 July CD; Loei Prov. [uncertain locality]: 100♀♀, 8-28 June CD; Roi Et Prov.: Phon Thong Dist.: Phon Thong: 2♀♀, 12 June 1967 RRP; Nakhon Ratchasima Prov.: Pak Chong Dist.: Khao Yai Nat'l. Park: 1♀, 5 May 1967 RRP; Nakhon Ratchasima Prov.: Pak Chong Dist.: Mu Si Canton: 3♀♀, 22 June & 16 July G.R. Ballmer; Chanthaburi Prov.: Tha Mai Dist. (23 km NW of Chanthaburi) 12°03'N 101°59'E: 1♀, 20 June JB; Chumphon Prov.: Tha Sae Dist. (area ~15 km NW of Chumphon) 10°34-37'N 99°05-07'E: 4♀♀, 12-13 June JB; Phangnga Prov. (vic. of Amphoe Muang Phangnga town) 08°28-29'N 98°32'E: 13♀♀, 5-6 June JB; Nakhon Si Thammarat Prov.: Phrom Lok Canton (20-24 km NW of Nakhon) ~08°31'N ~99°48'E: 50♀♀, 2-3 Apr. JB. Also seen from Provinces of Khon Kaen, Saraburi, Phra Nakhon, and Chon Buri.

Taxonomy. The thoracic and abdominal dorsums and various other features of *anabates* are quite similar to those of *siamensis*, but these are quickly distinguished by the presence in *anabates* of the infuscated costal margin, and the pale parts of the abdominal venter have white (not yellow) tomentum and hairs. It is not at all close to any of the other species with infuscation limited to the costal margin.

Biology. *T. anabates* is known from as far north as Muong Sing, Laos, near the Yunnan, China border, as far south as Phangnga and Nakhon Si Thammarat Provinces, as far west as the Burma border, and as far east as Roi Et Province. It was very common at some localities. In view of its commonness and distinctiveness it

is surprising that it remained unnamed until 1960, but I have seen no older types to which it is referable. Known altitude range is 400 m (at the Chiang Rai Province localities) to sea level. Known seasonal range in upper Thailand and Laos is 4 May-20 August, hence during the rainy season, and in southern Thailand April to June. Host interest was recorded in water buffalo, cattle,

elephants, serow, and horse. In collections for which time of attack was recorded, the species showed a distinct preference for the final hour before darkness, and nearly all specimens so recorded were collected within 2 hours of darkness. Several specimens were Malaise trapped and 1 was taken at light.

Tabanus birmanicus (Bigot) Fig. 28

Atylotus Birmanicus Bigot, 1892, Mém. Soc. Zool. France 5:653-654.

Tabanus albocreus Philip, 1974, J. Med. Ent. 11(4):394-395. (New synonym.)

Female. Length 14-18.5 mm. **Head.** Frons slightly divergent above, index 1:5.8-7.7 (from selected sample); tomentum orange to brown, hairs usually mixed but highly variable from almost entirely black to almost entirely orange. Callosity orange to blackened, generally inverted U- or V-shaped and commonly irregular below, dorsal extension orange to black, more or less linear but often irregular. Subcallus orange to yellowish brown, face similar but sometimes partly yellowish below, facial hairs including beard brown to blackish brown, often with orange yellow hairs arising from ventral aspect and sometimes elsewhere also. Antenna with scape black haired; plate orange, elongate, dorsal tooth acute to obtuse, close to base, annuli orange to somewhat darkened, apical annulus usually darkened. Palpus orange to yellowish brown, basal segment variable from entirely black haired to almost entirely orange yellow haired, apical segment entirely black haired or partially orange yellow haired. **Thorax.** Dorsum principally yellowish brown to brown, hairs mixed orange yellow and black. Venter variable shades of brown, hairs usually predominantly brown with a variable amount of orange yellow hairs anteriorly and laterally; coxae brown to blackish brown with brown to black hairs; fore femur blackened with black hairs, extreme apex pale and apical area may or may not have pale hairs, other femora brownish black to dark brown basally becoming paler toward apex and yellowish at apex, hairs mostly black with some pale hairs at apex if not also elsewhere; fore tibia white with white hairs except apex rather narrowly brown to black with black hairs, other tibiae white with white hairs except apex narrowly yellowed with black hairs; fore tarsus black. Wing with a brown tint which is strong over the costal, subcostal, marginal, and 1st submarginal cells, elsewhere becoming paler brown, yellowed, or subhyaline; 1st P cell open; anterior branch of 3rd vein curved, angulate, or with a spur vein; halter stem and knob yellow to brown. **Abdomen.** Dorsum quite variable from almost entirely blackened with black hairs except narrowly paler with a few orange yellow hairs on tergite 1, to orange brown basally becoming dark brown apically with orange yellow hairs covering 1 and part of 2 and

extensively scattered elsewhere, the pale hairs often forming a median stripe or triangles. Venter variable from all blackened with black hairs to all brown with blackish brown hairs, often a few pale hairs on sternite apices, sternite 1 often paler than others. (178+)

Male unknown to me, but discussed in 1 Japanese language sentence by Ouchi (1943:525).

Type data (♀): "*Atylotus/Birmanicus*. ♀/n. sp. Inedict./[illegible word]. Fevrier./1899. J. Bigot./Birmanica." handwritten by Bigot; and on a newer label: "Burma./Ex coll./J. Bigot./ex coll./G.H. Verrall./1914. 500." (Seen in BMNH.)

Published records. Ricardo (1911:201) reported ♀♀ from Ningpoh (Assam), India, 1♀ from Lushai Hills, Burma, and 1♀ from Kuala Lumpur, Malaya. Shiraki (1918:424) reported 1♀ from Taiwan, which Stekhoven (1926:260) questioned. Ouchi (1943:524-525, 552) reported 1♀ and 2♂♂ from Tienmushan, China (=T'ien-Mu-Shan, 30°21'N 119°29'E). Stone (1975:55) added Thailand. This record is based on 1♀ from USNM without further locality. The China and Taiwan records are quite far from the remaining known range and require reconfirmation. Holotype of *albocreus* from "VIET NAM. Dak Song/76 km SW of BanMeThuot, 870 m/19-21.V.1960". This is very close to the Cambodian border.

New records. THAILAND (all 1969 unless shown otherwise): Chiang Rai Prov.: Mai Sai Dist.: Mae Sai & vic. 20°26'N 99°53'E: 1♀, 17 July JB; Chiang Mai Prov.: Huai Kaeo (~4 km NW of Chiang Mai) 18°48'N 98°57'E: 28♀, 10-15 May K. Somporn; 11♀, 18 May KS; 33♀, 20-25 May KS; 25♀, 26-31 May KS; 10♀, 1-5 June KS; 9♀, 6-10 June KS; 10♀, 11-17 June KS; 3♀, 18-19 July KS; Chiang Mai Prov.: "Chiengmai": 4♀, Apr. 1928 Dr. and Mrs. J.W. McKean; Tak Prov.: Mae Sot Dist.: Huai Muang Canton 16°40'N 98°31'E: 3♀, 9 July JB; 19♀, 11 July JB; Loei Prov.: Dan Sai Dist.: Dan Sai & vic. 17°16'N 101°09'E: 1♀, 22 May JB; 5♀, 9-10 June C. Dettongchai; Nakhon Ratchasima Prov.:

Pak Chong Dist.: Mu Si Canton: Khlong Yai: 5♀, 18-24 June G.R. Ballmer; Saraburi Prov.: Muak Lek Dist. (area S of Muak Lek) 14°36'38"N 101°12'E: 1♀, 24 June JB; Ranong Prov.: Kra Buri Dist.: Kra Buri & vic. 10°24'N 98°47'E: 1♀, 11 June JB; Phangnga Prov. (vic. of Amphoe Muang Phangnga town) 08°28'29"N 98°32'E: 1♀, 6 June JB; Krabi Prov. (vic. N of Krabi) 08°04'N 98°55'E: 1♀, 4 June JB; Nakhon Si Thammarat Prov.: Phrom Lok Canton (20-24 km NW of Nakhon) ~08°31'N ~99°48'E: 9♀, 2-3 Apr. JB; Nakhon Si Thammarat Prov.: Thung Song Dist. (~8 km E of town) 08°09'N 99°45'E: 3♀, 1 Apr. JB.

Taxonomy. Despite the variation noted, the dorsal coloration and wing tint distinguish this species from others in the area. However, all aspects of the head and venter are startlingly similar to those of *admelanopygus*, and *birmanicus* would probably fall into the *basalis* group if the latter were not so artificially defined. In a sense, *birmanicus* is a member whose tergites have all darkened rather than leaving 2 or more of the basal ones sharply orange, and even this character does not very effectively set *birmanicus* off from the rest of the group since some specimens show a visible (but not dramatic) color break between tergites 1 and 2 or between 2 and 3.

Philip (1974) has described *albocreus* from

a specimen in greasy, rubbed and broken condition. This type (seen from BPBM, 1975) was at first difficult to associate due to its condition, but after due consideration I believe it to be a specimen of *birmanicus*. This type appears paler than most *birmanicus*, but does not exceed the range of variation observed therein except that the extent of black at the apex of the fore tibia is reduced. Recent research has shown that *birmanicus* has a N-S range of over 1900 km, and hence it is not surprising that the distribution should be extended 300 km SE in the middle of this range to include the *albocreus* type locality from the nearest known spot (Muak Lek, Thailand). Inclusion of the latter type, however, does represent a significant jump in known altitude.

Biology. *T. birmanicus* was found from the very top of Thailand south to Thung Song, and subsequent collecting has revealed it in Malaya as far south as near Batu Kikir in the state of Negeri Sembilan. Known altitude range is from about 400 m at Mae Sai to near sea level in the south. The Viet-Nam locality rises to 870 m. Known seasonal range is April-July (excluding Malaya). Host interest was recorded in water buffalo, cattle, and elephant; several were Malaise trapped. Specimens for which the time of attack was recorded show a preference for the final hour before darkness.

Tabanus basalis group

Those species which possess orange basal tergites and abruptly black apical tergites are sometimes recognized in the literature as a group. Various species show this trait which, by virtue of other characters such as closed 1st P cells and infuscated crossbands display their lack of phylogenetic relationship with the "true" members of the group. Thus the group is further limited to those species in which the infuscation is in the form of a cloud rather than a crossband. Even so, the group cannot be firmly delimited, as there are quite a variety of transitional forms in which a tergite is intermediate in color, wing infuscation reduced to a tint, etc. Coher (1962(1963):157-158) has published a list of group members based on the literature which contains some very diverse elements; and there are errors of fact, e.g. *thurmani* has 4 orange basal tergites, not 3.

The species accounted herein which clearly fit the usual concept of the *basalis* group are *abbasalis*, *thurmani*, and *admelanopygus*. Other species show a trailing out of phylogenetic lines in various directions, and it takes very little imagination to see the relationship of *paviei* or even *birmanicus* to those just named.

T. basalis Macquart has itself once been reported from Thailand, by Ricardo (1911:148)

as follows: "A specimen in Brit. Mus. coll. from Chanthabun [=Chanthaburi], Siam, which I believe to belong to this species—though owing to its bad preservation it is not possible to be certain—has the **scutellum** covered with gray tomentum, the legs as Schiner [sic] describes, and measures 15 mm." Stone's (1975:54) Thailand listing must be based on this statement, as no other specimens of *basalis* have been reported from there. I herewith wish to delete *basalis* from the list of known Thailand species, for the following reasons: (1) All other specimens have come from Indonesia, and Chanthaburi at 12°36'N 102°09'E is very far out of range; (2) I have neither collected nor seen any specimens whatsoever of this species from Thailand, despite much collecting in the south where it might be expected to occur; (3) Ricardo herself expressed uncertainty about the identification, and her discussion of *basalis* (pp.147-148) contains both errors of fact (e.g., crediting the species to Schiner in the citation above) and questionable interpretations which may indicate that her notes were confused at this point; (4) I could not find any such specimen in BMNH (where it was said to be), indeed the index card file to the collection did not even contain any mention of the presence of this species.

Tabanus abbasalis Philip Fig. 29

Tabanus abbasalis Philip, 1960a, Stud. Inst. Med. Res. Malaya 29:8.

Female (holotype). Length 18 mm. **Head.** Frons divergent above, index 1:6.9; tomentum dark brown when viewed from above, black when viewed from below, hairs black. Callosity black, slender drop-shaped; dorsal extension black, prominent but essentially linear. Subcallus and face very dark brown, hairs including beard brownish black. Antenna with scape blackened and black haired; flagellum black, plate with acute dorsal tooth. Palpus with both segments black and black haired. **Thorax.** Dorsum brown, hairs mixed black and brownish orange, lateral face from wing base to apex of scutellum dark orange with mostly brownish orange hairs. Venter and coxae brown to brownish black, with brownish black to black hairs; femora black with black hairs; fore tibia mostly black with black hairs, but with a whitish area on outer face near the base which has some white hairs, most of area of middle tibia whitish with predominantly white hairs, apical area blackened and with black hairs, hind tibia also paler basally but whitish, white haired area restricted to inner face and over only half (or less) the segment's length, outer face more brownish basally and with mostly black hairs. Wing with costal cell yellowed, basal cells much more lightly so; apex of subcostal cell, stigma, and area below it tinted brown, the tint persisting but becoming much paler toward hind margin and apex of wing; anterior branch of 3rd vein curved; 1st P cell open; halter stem and knob yellowish. **Abdomen.** Tergites 1 and 2 orange with orange hairs, lateral margins (ventral face) brownish (and brown haired on 1); 3

blackened and with black hairs, basolateral areas brownish, apical margin with a median patch of pale tomentum and white hairs; 4 black with black hairs, with median apical white haired patch as on 3; 5-7 black with black hairs. Sternite 1 brown; 2 brownish black to black with black hairs, entire apical margin narrowly white with white hairs; 3-5 black with black hairs, apical margins as on 2 except 5 has apical pale band partially black haired; 6 and 7 black with black hairs. (1)

Male unknown.

Type data (♀): "Chiangmai, Thai./X-15 1951/DC&EB Thurman/fly trap no. 151". (Seen from USNM.) Dr. Ernestine Thurman (personal communication) has kindly added that this specimen "was collected in a light trap in our garden on Chang Poak (White Elephant) Road". The altitude of Chiang Mai is about 310 m.

Published records. Known only from holotype.

New records. None.

Taxonomy. This is a very distinctive species. The nearest relative known to me is *admelanopygus*, which see for comparative notes. I have seen another (probably undescribed) relative from S. Viet-Nam in which tergites 3-6 have white median apical patches and the entire coloration, especially the head and venter, is very much paler.

Tabanus admelanopygus Philip Fig. 30

Tabanus admelanopygus Philip, 1974, J. Med. Ent. 11(4):393-394.

Female. Length 14.0-17.0. **Head.** Frons slightly divergent above, index 1:6.0-6.8; tomentum orange; hairs orange and a variable amount of black, black hairs more numerous at and near vertex including on an inconspicuous darkened spot just below vertex. Callosity orange to brown, flattened oval in shape to angular and slightly tapering upward; dorsal extension orange to brown, linear. Subcallus and entire face orange, concolorous with frons; almost all hairs arising from anterior aspect of face brown to brownish black, those beard hairs which arise from the strictly ventral and posterior aspect of head yellow to orange. Antenna with scape entirely black haired; plate orange, elongate, rather angulate below, with a low acute to obtuse dorsal tooth close to the base; 3 basal annuli orange and concolorous with plate, apical annulus apically to entirely darkened. Palpus orange, basal segment

with orange, brown and/or black hairs, apical segment with an even covering of short black hairs. **Thorax.** Scutum brownish orange, lighter orange around periphery, with mixed orange and black hairs; scutellum almost entirely orange haired and bicolorous orange, a darker orange band across most of the basal half, the remainder paler orange. Venter broadly orange at sides with orange and dark hairs (either predominating), central area brown with mostly black to brown hairs; fore femur blackish brown, yellow at apex; middle femur brown to yellowish orange and hind femur dark brown to yellowish orange, with orange and black hairs; fore tibia white with white hairs over basal 5/6 (approximately) of area, apical 1/6 brownish with black hairs; middle and hind tibiae also white over basal 5/6 and with white hairs (orange hairs on inner surface of hind tibiae), becoming orange at tip and with

black and orange hairs; all tarsi black to brown. Wing with costal and subcostal cells and stigma brownish yellow, a cloud of infuscation present which is concentrated in broad swaths along the 2nd and 3rd longitudinal veins, fading to a pale brownish tint along the hind margin, prearcular (1st M cell) and some adjacent areas yellow; 1st P cell open; anterior branch of 3rd vein curved, angulate, or spurred. Halter stem and knob orange to yellow. **Abdomen.** Tergites 1 and 2 entirely orange and almost entirely orange haired; 3 variable from brown to mostly black (appears darker to naked eye), almost entirely black haired or with scattered orange hairs which are more concentrated at midline; 4 brownish black to black, 5-7 black, all with entirely black hair. Sternite 1 orange to brown; 2 brown to black and almost entirely black haired or with orange hairs present as small basal patches and narrow apical fringe; 3 and 4 progressively blacker, 5-7 black, 3 and beyond entirely black haired or with several orange bristles present at the midline of 3-6. (6)

Male unknown.

Type data (♀): "THAILAND: NW./Chiang-mai: Doi/Suthep 1278 m./III-29-V-4-'58"; and on the second label "T.C. Maa/Collector/No. 305". (Seen from BPBM.) Doi Suthep is a mountain rising just NW of the city of Chiang Mai.

Published records. Holotype only.

New records. THAILAND: Chiang Mai Prov.: Huai Kaeo (4 km NW of Chiang Mai)

Tabanus thurmani Philip Fig. 31

Tabanus thurmani Philip, 1960a, Stud. Inst. Med. Res. Malaya 29:24-25.

Female. Length 13.5-18.5 mm. **Head.** Frons slightly divergent above to occasionally almost parallel sided, index 1:5.5-8.5; tomentum orange, with a pale gray or brown patch just below vertex; hairs mixed black and orange throughout, or black may predominate. Callosity brownish yellow to reddish brown, rather narrow and parallel sided to triangular; dorsal extension linear, reddish brown to black. Subcallus, upper cheek corners and most of central area of frontoclypeus orange, remainder of face yellow to gray; most or all of anterior facial hairs brown to black; beard hairs variable, usually dark in front and pale behind. Antenna with scape black haired except some short orange hairs at dorsal apex; plate orange, rather slender, with an acute to obtuse dorsal tooth near the base; annuli orange, concolorous with plate except apical annulus often slightly darkened over apical half. Palpus yellow; basal segment with long black hairs and sometimes also long yellow hairs, apical segment evenly covered with short black hairs, some incon-

18°48'N 98°57'E: 4♀♀, 10-15 May 1969, K. Somporn; Chiang Mai Prov.: "Chiangmai": 1♀, Apr. 1928, Dr. and Mrs. J.W. McKean.

Taxonomy. See discussion of *basalis* group. *T. admelanopygus* and *abbasalis* are the only 2 from Thailand (from the same area!) with 2 basal abdominal segments orange and the rest blackened. They are immediately distinguished by many color characters, e.g.: *admelanopygus* has no white hairs on the abdomen, *abbasalis* has small transverse white patches at the midline of tergites 3 and 4 and white apical fringes on sternites 2-5; *admelanopygus* has an orange face and frons, *abbasalis* dark brown.

The type of the Indonesian *basalis* (see above) was seen in Paris Museum. It had no label designating it as the type, but I see no reason to think that it is not the type, as it is the only specimen present in the separately-curated Macquart collection which is identified as *basalis*. Macquart's original description did not mention more than 1 specimen. The specimen is very badly rubbed and eaten. It generally agrees with *admelanopygus* in having only the first 2 abdominal segments orange, and in wing, antennal and palpal characters; but the *basalis* type has the fore tibia orange over approximately the basal 2/3 (vs. white over a larger area), and the frons and callosity of *basalis* are narrower. If Schuurmans Stekhoven's (1926: Plate 9 Fig. 3) association of fresh material was correct, then *basalis* has white haired apical fringes on tergites 3 and 4, but this cannot be told from the bad condition of the type.

spicuous orange hairs may or may not be present; tip rounded. **Thorax.** Dorsum yellowish brown to brown, with recumbent orange hairs and more erect black hairs. Venter with yellow, yellowish gray, yellowish brown, and gray areas; hairs mixed and variable, mostly yellow orange and black. Femora mostly black and mostly to entirely black haired; tibiae variable, sometimes orange and mostly orange haired at base, darkened over apical area (blackened on fore tibia), but tibiae may also be almost entirely black haired. Wing infuscated, most strongly in the cells flanking the 2nd longitudinal vein, basal and hind area of wing with a yellowish to brownish tint, some cells often partly or entirely approaching a hyaline condition; costal cell yellowish brown or brownish yellow; 1st P cell open; anterior branch of 3rd vein variable from curved to distinctly spurred; halter stem and knob pale yellow to brownish yellow. **Abdomen.** Tergites 1-4 orange (4 sometimes darkened basally) and often almost entirely orange haired (or even entirely so), or there may

be a distinct concentration of black hairs along the bases of 3 and 4; 5 dark brown to black, 6 and 7 black, 5 and 6 usually with variable apical bands of paler tomentum which may expand into a triangle at the midline of 5, a few orange hairs sometimes present on the apical band of 5 but 5-7 otherwise black haired. Sternite 1 yellow and mostly pale haired; 2-4 highly variable, characteristically orange on 2 with a darkened central spot which becomes larger on 3 and fills most of the area of 4, but occasionally 2-4 remain so light that all could be called orange (as in the ♂♂), or may be so darkened that all are predominantly black, but the progressive nature of the darkening on these sternites can almost always be seen; 2 black haired but usually with pale haired bands both basally and apically; 3 and 4 black haired with pale haired bands apically, or at least some pale hairs in apical fringe; 5-7 black and black haired, 5 with a narrow inconspicuous apical band of pale tomentum, which may sometimes also be considered present on the apex of 6. (459+)

Male. Associated with ♀ without difficulty; but, in addition to the usual sexual differences, the 4 basal tergites show greater variability, sometimes almost as pale as ♀, sometimes much browner overall or browner basally (due largely to black hairs), leaving orange haired apices and sometimes triangles at the midline; 4 basal sternites average lighter than in most ♀♀, usually remaining mostly orange over 2-4. (10)

Type data (♀): "Thailand, Chieng-mai, 24 May 1952/D.C.Thurman - in house". A second, pencilled label shows only "767". (Seen in USNM.) Chiangmai [=Chiang Mai] is a city located at 18°47'N 98°59'E. The original description shows "in house at foot of mountain", though only "in house" is shown on the specimen. If Philip's information is correct, then my Huai Kaeo specimens (below) are probably perfectly topotypic.

Published records. The original description was based on a single ♀. The only subsequent record was by Coher (1962(1963):160-161), a single ♀ from Chiangmai, 13 July 1959.

New records. LAOS: Vientiane Prov.: Ban Na Pheng 11 km W. Ban Keun: 5♂♂, 2♀♀, 15 & 19 May 1968 F.G. Howarth; [Sayaboury Prov.]: Mg. Sayaboury: 6♀♀, 23 May-2 June 1967 FGH; 1♂, same but 30 Apr. 1968 FGH. THAILAND: Chiang Mai Prov.: Huai Kaeo (≈4 km NW of Chiang Mai) 18°48'N 98°57'E: 348♀♀, taken on an almost daily basis between 2 May 1969 and 17 June 1969, when collecting was suspended; 3♀♀, 18-19 July 1969 when collecting resumed for those 2 days only—almost all collections by Kaeo Somporn, a few by JB; Chiang Rai Prov.: Muang Chiang Rai (≈19°54'N 99°50'E): 4♂♂, 22 Apr. 1970 G.R. Ballmer; Mae Hong Son Prov. (vic. SW of Mae Hong Son) 19°17'N 97°58'E:

2♀♀, 12 & 14 May 1969 JB; Loei Prov.: Dan Sai Dist.: Dan Sai & vic. 17°16'N 101°09'E: 21♀♀, 18 Apr. 1969 JB; 19♀♀, 22 May 1969 JB; 14♀♀, 9-11 June 1969 C. Dettongchai; Tak Prov.: Mae Sot Dist.: (≈5 km E of Mae Sot) 16°43'N 98°37'E: 4♀♀, 10 July 1969 JB; Tak Prov.: Mae Sot Dist.: Mae Moei Canton 16°41'N 98°31'E: 1♀, 11 July 1969 JB; Tak Prov.: Mae Sot Dist.: Huai Muang Canton 16°40'N 98°31'E: 39♀♀, 9 & 11 July 1969 JB.

Taxonomy. All of the listed localities lie above 16°N. At present there is insufficient evidence to decide whether an "element" which occurs below this latitude should properly be lumped with *thurmani* or made subspecifically or specifically distinct. The "element" has tergite 5 broadly orange at the midline and along the apex, beard and other areas more extensively orange haired. It is represented by 2♀♀ in USNM from Chonburi [13°22'N 100°59'E].

See under *siamensis* for comparative notes with that species. These 2 are quickly distinguished when specimens are in good condition.

In the original description of *thurmani*, Philip compared it with *joindus* (Bigot) from Assam, India. The tibial bases are reported as white in the latter, though Ricardo (1911:211-212) reported seeing some in the Kertesz collection in which the tibial bases were the "same colour as the rest, with no white hairs." Apparently I overlooked the *joindus* type in BMNH, but Philip had examined it before his description of *thurmani*.

Also in the original description of *thurmani*, Philip (1960a:24) stated, "The inadequately described *T. pseudopallidepectoratus* Surcouf from Laos could be the same..." Both of these species were described from single specimens, so it is not surprising that there was some doubt about their relationship in Philip's mind. But unfortunately, even now with over 450 specimens at hand, the relationship remains just as unresolved as ever for the simple reason that Surcouf's type is lost from the Paris Museum. Diligent search by Mr. Matile and myself failed to locate it. I see no way to be sure that *thurmani* and *pseudopallidepectoratus* are different species. Surcouf's (1922: 14-15) brief description gives characters which fall within the range of variability observed in the present long series, though some characters may represent the less common rather than the more frequent condition, including sternite and fore tibial coloration. I am unable to trace the exact type locality of "Muong-Kofa (Laos)," but it is probably in the northeastern area of Laos, in which its collector was known to have traveled (see discussion of Vitalis de Salvaza collection). On the basis of the brief but essentially matching original description of *pseudopallidepectoratus*, as well as both the distribution (including Laos) and the commonness of the species at hand, I am

personally inclined to think that Surcouf's species is the same as *thurmani*. But I am using *thurmani* as the name for the present specimens since I know them to be conspecific with the *thurmani* type after comparison in USNM, while *pseudopallidepektoratus* remains something of an unknown.

Wharton (1957:102) published a record of 9 specimens of "*pseudopallidepektoratus* [sic] Surc." from north central Cambodia. These specimens were originally deposited in USNM and presumably identified for Wharton's study by Stone. I have carefully studied 2 of these specimens (the remainder are almost certainly conspecific with the 2, though I do not have them at hand), and I find no reason to think that they are *pseudopallidepektoratus*. I herewith delete this latter species from the known Cambodian fauna. The specimens are redetermined as another species.

Philip (1974:393) alluded to a specimen which he considered to be *pseudopallidepektoratus* apparently taken at Col de Blao, southern S. Viet-Nam. This situation seems even less likely to give rise to an accurate association of a recent specimen with Surcouf's original.

T. chryساتer Schuurmans Stekhoven is related to *thurmani* by virtue of overall coloration

(Stekhoven 1926:Plate 9 Figs. 1 & 2), but, in addition to various lesser color differences, *chryساتer* is known from Java and Sumatra, while *thurmani* is from upper Thailand. The deep south of Thailand appears to represent a profound hiatus in the distribution of *basalis* group members in general, though I know of no explanation why this should be the case.

Biology. *T. thurmani* occurs above 16°N in Thailand in situations where some forest cover is within flight range, though high altitude is not a requisite. The altitude range represented is approximately 200-400 m. The species may be very common, though this seems to be a local phenomenon since it may occur in large numbers in a given locality but be absent from a seemingly similar locality not too far away. Of the great number of species taken at Huai Kaeo (Chiang Mai), it was 1 of the 4 commonest. Host interest has been recorded in water buffalo, elephant, and cattle. Known flight season is from 18 April to 19 July, and, although of course this will be extended with future collecting, June may be the peak. This may indicate a correlation with the onset of the rainy season. There is good evidence to believe that this is a truly crepuscular species, as at various localities where I collected throughout the afternoon and up until nightfall, it did not appear until the last hour before darkness.

Tabanus paviei new species Fig. 32

Holotype female. Length 21 mm. **Head.** Frons slightly divergent above, index 1:5, with yellowish brown tomentum and yellow hairs, callosity and dorsal extension orange brown, merging to form a columnar structure. Subcallus and upper cheeks concolorous with frons; remainder of face with yellow tomentum and hairs, including long yellow beard. Basal segments of antenna black haired; plate brown at base, with a large rounded dorsal tooth, becoming much narrowed and blackened beyond tooth; annuli blackened. Basal segment of palpus yellow with long yellow hairs; apical segment pointed, yellowish brown with an even covering of black hairs. **Thorax.** Dorsum yellowish brown with yellow hairs. Venter with orange yellow tomentum and hairs. Fore coxa with yellow tomentum overlying apparently black integument and with yellow hairs on outer face and dark hairs on inner face; all femora black with yellow tips, and mostly dark haired except yellow at tips and in midleg fringe; fore tibia yellow and yellow haired over basal 1/2 to 3/5, apical area blackened; other tibiae same but yellow over basal 2/3 or more; all tarsi blackened. Base of wing, costal cell, stigma, calypter and all veins deep yellow, remainder of wing paler yellow; 1st P cell open; no spur vein or angulation; halter stem dark yellow, knob pale yellow. **Abdomen.** Tergites 1 and 2 yellow orange and yellow haired throughout; 3 and 4 brownish black and dark haired, except with bands which

are yellow and yellow haired that are quite even in width and extend all the way across the apices of these tergites, occupying about 1/6 of their breadth; 5 and beyond all black and black haired. Sternite 1 yellowish gray with a patch of yellow hairs at the midline; 2-4 black, with white tomentose, white haired narrow bands all the way across the apices which are even and of equal width on each of these segments; 5 and beyond black.

Paratypes (6♀♀). Length 21-24 mm. Frontal index 1:4.5-5.0. In close agreement with holotype, except some show even greater apical narrowing of antennal plate, to the extent that they actually appear slightly excavated below as well as above, and may possess more pointed teeth; one specimen has a distinctly bicolorous scutellum which is yellowish brown basally and reddish apically; the type and several paratypes have a small darkened spot at the midline of tergite 2, while others lack it. 1st P cells of some wings show slight signs of narrowing apically. Although all specimens suffer dermestid feeding damage and frass deposition, it has not seriously affected the external morphology.

Male unknown.

Type data. Holotype ♀ and 6♀♀ paratypes, all same data: "MUSEUM PARIS/LUANG-PRA-BANG/à THENG Pavie 1888", in Paris Museum.

The locality is identified as northern Laos; for further information, see discussion of Pavie collection.

Taxonomy. Bigot would have described these 7♀ as new in 1890 or 1892, just as he did with the other species collected during Pavie's expeditions, if he had thought that they were new. But instead he identified them as "*Tabanus (Atylotus) basalis*.♀/Macq.D. Ex." (one pin bore this label, in Bigot's handwriting), and they have been associated under *basalis* in the Paris Museum ever since. *T. paviei* is related to *basalis* in the sense that both have tergites 1 and 2 orange, the remainder black or mostly so, orange notums, tinted wings, and bicolorous legs.

But *T. manipurensis* Ricardo is by far the closest relative I have seen. Both are in the extra-large category, and the overall coloration of the two is strikingly similar. Despite their very close relationship, *manipurensis* is quickly distinguished from *paviei* in possessing obvious white-haired spots at the midline of the apices of tergites 2-4 and in having tergite 2 mostly blackish-gray (not orange as in *paviei*). The type locality of *manipurensis* is given by Ricardo in the original description as "Ukrul, Manipur, 6400 feet (Rev. W. Pettigrew)." Another species described in the same paper (1913a) shows the same data but adds

"lat. 25°N., long. 94°-95°E." Thus it is in the higher mountains of the northeastern part of Manipur State, India, very close to the Burmese border. There is only one specimen of *manipurensis* in BMNH, which shows the correct collecting data (including coordinates), but with no original type-designation label. A label has been added by Oldroyd in 1963 indicating that it is a paratype. I should say that it is at least a paratype, if not the holotype, as the holotypes of several, but not all, of the other species described in Ricardo (1913a) are now in BMNH (even if they were originally in the Indian Museum, Calcutta). An inquiry will need to be made of this latter museum to be more sure. Austen (1922a:442) referred to the BMNH specimen as the holotype. There are also 2 specimens of *manipurensis* in Paris Museum, one of which I have compared with the BMNH specimen.

Both *paviei* and its relative *manipurensis* are seen as mountain-area species, and if *paviei* should someday be found in Thailand, it will likely be at the higher altitudes and latitudes. See also *T. annamensis* Philip.

This attractive species is named for its collector, Auguste Pavie, French naturalist and colonial administrator who explored and charted Indochina from 1879 to 1895.

Tabanus praematurus Austen Fig. 33

Tabanus praematurus Austen, 1922a, Bull. Ent. Res. 12(4):440-442.

Female. Length 15.5 mm. **Head.** Frons divergent above, index 1:6.0; tomentum orange below becoming brown above; hairs mostly dark. Callosity and dorsal extension orange-brown; tomentum of subcallus orange and concolorous with lower frons, tomentum of upper cheeks brown, remainder of face pale to dark yellow, upper cheeks dark haired, remainder of face including beard yellow haired. Basal segments of antenna black haired; entire flagellum concolorous orange, the plate highly distinctive in shape with a prolonged forward-projecting dorsal tooth. Basal segment of palpi yellow and yellow haired except some black hairs at apex; apical segment orange-brown, entirely black haired. **Thorax.** Dorsum yellow tomentose and yellow-haired, darker in middle perhaps due to staining. Venter and coxae also yellow tomentose and yellow haired, the fore coxa with a few black hairs at apex; femora and tibiae pale brown to dark brown, each leg essentially unicolorous but with foreleg darker than the others, black haired except some yellow hairs basally on mid and hind femora. Wing tinted yellow throughout, stronger in areas of costal cell and stigma; veins yellow; 1st P cell widely open, venation normal. Halter stem and knob yellow. **Abdomen.** Tergite 1 orange with yellow hair, 2 orange-brown, 3 and 4 darker brown, 5-7 blackish

with black hairs, tergites 2-4 black haired, with narrow yellow tomentose and yellow haired apical bands. Venter also progressively darker from base to apex, with sternite 1 orange, 2 orange laterally but with a large median dark patch, 3 and 4 brown, 5 and beyond black and black haired, sternites 2-4 with white tomentose and white haired apical bands. (1+)

The above diagnosis is from the single non-type Thurman specimen which was compared with the holotype in BMNH and found to be in good agreement. The type (thoroughly described by Austen) has a white spot at the midline on tergite 2, and the pale scutellum seems to contrast more distinctly with its surroundings.

Male unknown.

Type data (♀): "N. Siam/Doi Chom Chang,/nr. Chiangmai./Alt. 5,500 ft./15.iv.1921./Dr.M.E. Barnes./1921. 393." (Seen in BMNH.) This locality is believed to be at or near the summit of the mountain presently called Doi Suthep, with coordinates estimated at 18°49'N 98°54'E.

Published records. THAILAND: 1♀, "Chiangmai./Thailand 4546/IV-4-8-1952/DC&EThurman",

by Philip (1960b:54). (Seen from Philip, originally USNM.)

New records. None.

Taxonomy. Austen (1922a:442) was correct in indicating a relationship with *T. manipurensis* Ricardo, and it is similarly related to *paviei*. All three have yellow wings; yellow to orange heads, thoraxes, and abdominal bases; and mostly brown to black abdominal venters with white apical bands at least on sternites 2-4. *T. praematurus* distinctly differs from the other 2 species in smaller size (15.5-16.2 mm versus 21 mm upward), possession of long, forward-projecting dorsal teeth on antennal plates, dark tibiae, and abdominal dorsum which darkens gradually (not abruptly) toward the apex.

Tabanus tamthaiorum new species Fig. 34

Holotype female. Length 11 mm. **Head.** Frons nearly parallel sided, index 1:5.7; tomentum mostly dark orange, hairs black. Callosity dark brownish black to black, rather inverted V-shaped but pitted at lower corners; dorsal extension black, drawn up smoothly from callosity into a slender and sharp pointed apex. Subcallus dark orange; face dark orange to yellow, hairs including beard brown. Antenna with scape black haired, area of dorsal apex with a few orange hairs; flagellum orange, apical annulus darkened at tip, dorsal tooth of plate obtuse to right angled but small. Palpus brownish orange, both segments black haired, apical segment with a few scattered orange hairs. **Thorax.** Dorsum dark orange to orange yellow, hairs mixed yellow and black. Venter and coxae mostly yellowish brown, hairs blackish and yellow; fore femur brownish black with black hairs, apex paler, other femora brown becoming yellow apically, hairs black and yellow; fore tibia brown basally with black and some yellow hairs, blackened apically with black hairs, other tibiae yellow to yellowish brown, hairs black and yellow. Wing with costal and subcostal cells and stigma tinted yellowish brown; marginal cell beyond stigma tinted brownish, 1st submarginal cell much paler brownish except dark along costal margin (including costal margin of 2nd submarginal cell), remainder of wing with tint faded out but not entirely clear, most veins yellowish; anterior branch of 3rd vein angulate and with a minute spur (left wing) to strongly curved (right wing); 1st P cell open; halter stem yellow, knob brownish yellow. **Abdomen.** Tergite 1 yellow to orange with yellow and black hairs, 2 and 3 orange, 4 orange brown, 2-4 black haired with yellow hairs laterally and along apical margins, 5-7 progressively darker grayish with black hairs, 5 with some yellow hairs scattered along apical margin. Sternites 1-3 orange yellow with yellow hairs, 4 similar but a little darker, 5 mostly gray with mixed black and yellow hairs, 6 dark gray with black hairs and some yellow hairs along apical

Biology. Only 2 specimens are known, collected 31 years apart but separated seasonally by only about a week in the first half of April, thus the dry season. The type was taken at 1676 m on Doi Suthep; the later specimen is labeled as Chiang Mai, a town near the base of the same mountain with an altitude of 314 m. Austen (1922a:441-442) quoted a note by Barnes, the collector of the type: "This specimen was caught while attacking me at dawn in my cottage. On three mornings I was awakened about day-break by attacks by one or more of these flies, which I did not see on any other occasion." Thus in addition to a human host-interest record, there is the strong suggestion that the species is characteristically high-altitude, and this together with the reported propensity of attacking at dawn may help to explain its rarity in collections.

margin, 7 dark gray with almost all black hairs.

Paratypes (18♀). Length 11-12.5 mm. Frons very slightly convergent to very slightly divergent above, index range 1:5.0-6.5; frons may have some yellow hairs; callosity often orange brown below; subcallus and face may be orange brown, beard uncommonly with some yellow hairs; dorsal tooth of antennal plate not large but variable from acute to obtuse and low, annuli sometimes all darker than plate; palpus orange to brown, sometimes entirely black haired. Thoracic venter highly variable from brownish yellow to dark brown over most of its area; wing tint may be perceptible over a more extensive area than in type; halter knob yellow to brown. Abdomen with some modest variation in coloration and hair color, including presence of a quantity of black hairs on sternite 4 in some specimens, and some with yellow hairs sparsely scattered on dorsal midline.

Male unknown.

Type series data. Holotype ♀: THAILAND: Tak Prov.: Mae Sot Dist. (~5 km E of Mae Sot) 16°43'N 98°37'E: 10 July 1969 about cattle John J.S. Burton 1830-1915 hrs. (In Cornell University.) The type locality was a farm clearing in a hilly, forested area, altitude about 250 m. Paratypes: 8♀, precisely same collecting data as holotype; 3♀, same collecting data as holotype but 1500-1830 hrs.; Tak Prov.: Mae Sot Dist.: Huai Muang Canton 16°40'N 98°31'E: ♀, 9 July 1969 about water buffalo JB 1815-1915 hrs.; 2♀, 11 July 1969 about water buffalo JB 1730-1830 hrs.; 4♀, same but 1830-1930 hrs.

Taxonomy. This species resembles *helvinus*, *aurilineatus* and *longibasalis* but lacks their dorsal abdominal stripe of yellow hairs, and has a much more strongly orange face and somewhat paler wing tint. It is named for Dr. Bunliang Tamthai,

Dean of the Graduate School at Chulalongkorn University, and his family, who have been "family" to us in Bangkok.

Biology. Both Mae Sot District localities are in the Salween River drainage, with approxi-

mate altitudes of 200 and 250 m. The area is under the climatic influence of the Andaman Sea and is relatively humid. All specimens were collected from either cattle or water buffalo and were taken principally, if not entirely, during the last hour before darkness.

Tabanus longibasalis Schuurmans Stekhoven Fig. 35

Tabanus longibasalis Schuurmans Stekhoven, 1926, Treubia 6, Suppl.: 243-244.

Tabanus aurilineatus gilvilineis Philip, 1960a, Stud. Inst. Med. Res. Malaya 29:12. (New synonym.)

Female. Length 13-16.5 mm. **Head.** Frons slightly to very slightly divergent above, index range 1:5.6-7.6; tomentum various shades of orange, paler yellow below; hairs black, often some scattered yellow hairs; callosity yellow to brown, usually essentially inverted V-shaped but sometimes rectangular or elliptical, often with irregular lower corners, dorsal extension brown to black, variable from slender and linear to broader and sometimes irregular. Subcallus and upper cheek corner variable shades of coppery orange; remainder of face white to pale yellowish, upper cheek area often largely dark haired, remainder of facial hairs including beard generally white to pale yellowish white. Antennal scape with variable hairs, commonly mostly black on outer face and mostly orange on inner face and above; plate orange, very elongate, dorsal tooth commonly acute but small, sometimes obtuse; apical annulus partly to entirely blackened, others usually orange like plate but sometimes somewhat darker. Palpus dull yellowish, basal segment white haired or sometimes a few black hairs at apex, apical segment mostly pale haired at base becoming mostly to entirely black haired beyond the basal area, pale hairs occasionally predominate. **Thorax.** Dorsum orange brown, hairs mixed black and yellow. Venter and coxae pale yellowish white to grayish white; femora light brown with black and pale hairs; fore tibia yellow to light brown with mostly pale hairs basally and blackened apically with black hairs, other tibiae yellow to light brown, darkened apically, hairs yellow and black. Wing with costal area distinctly brown tinted, including costal, subcostal, marginal, and at least upper margin of 1st submarginal cells; elsewhere not completely hyaline; anterior branch of 3rd vein curved, uncommonly slightly angulate and rarely with a short spur; 1st P cell open; halter stem yellow, knob yellow to brown. **Abdomen.** Dorsum brownish orange to brown, overall coloration generally gradually darkening from base to apex; hairs mostly black, midline of tergites 1-5 and sometimes 6 with a stripe of yellow hairs which is indistinct because underlying coloration usually differs little from submedian area; lateral margin of 1-5 and often 6 yellow with yellow hairs. Sternites 1-5 usually yellow to orange with mostly yellow hairs, 2-5 with median patches of black hairs which may expand basally on 3-5; 6 darker, coloration and hairs highly variable; 7 usually darker with black hairs. (86+)

Several Luang Prabang and Vientiane Province (Laos) specimens placed here have the pale ventral abdominal hairs distinctly whiter than other specimens (BPBM).

Male. A specimen from BPBM identified here measures 13.5 mm and is easily associated with the ♀. The pale ventral abdominal hairs are mixed white and some yellowish. Legs and apical sternites remain rather pale, not strongly darkened as in *helvinus*.

Type data (♀): "HONG KONG, 1913./Dr. H. Macfarlane." and "Pres. by/Imp. Bureau Ent./1916-146". (Seen in BMNH.)

Published records. No further records have been published as *longibasalis*. *T. aurilineatus gilvilineis* was described from Loei Prov.: Dan Sai Dist.: Na Haeo, Thailand. A paratype was said to be from Chiang Mai. This specimen is in USNM (not CDC, Georgia), and is actually from Phayao in Chiang Rai Prov., and in any case I found it not conspecific with the species being accounted here. Stone (1975:54) listed Laos and Malaya for *gilvilineis* without further explanation. Laos is substantiated by new records (below), but Malaya must be deleted. The latter record is based on Philip's discussion (1960a:12; 1960b:42) of Malayan specimens which, however, Philip did not see and which can no longer be regarded as conspecific due to geographic findings.

New records. LAOS: "Luang Prabang./Muong You": 2♀, 25 May 1919 R.V. de Salvaza; "Luang Prabang": 2♀, 11-12 June 1960 S. Quate; Vientiane Prov.: "Phou-kow-kuei": 1♂, 17 Apr. 1965 J.L. Gressitt; Vientiane Prov.: "Ban Van Heue/20km E of Phou-kow/kuei": 1♀, 1-15 May 1965 J.A. Rondon; Sayaboury Prov.: "Mg. Sayaboury": 1♀, 26 May 1967 F.G. Howarth; Sayaboury Prov.: "Muong Phieng": 1♀, 3 June 1967 FGH. THAILAND: Loei Prov.: Dan Sai Dist.: Dan Sai & vic. 17°16'N 101°09'E: 68♀, 22 May 1969 JB; 12♀, 9-11 June C. Dettongchai.

Taxonomy. *T. longibasalis* is related to *helvinus* and *aurilineatus*. One of the most consistent differences is that the orange subcallus is in rather strong contrast with the pale yellowish to whitish frontoclypeus, while in the other 2 species

named these areas are both yellowish. There are many other average differences, including, in *longibasalis*, a duller and more evenly colored abdomen with less conspicuous stripe and with pale hairs on lateral margin more narrowly confined, body averages larger, antennal plate averages more elongate. *T. auristriatus* Ricardo from western India (type seen in BMNH) is also related.

Despite the Hong Kong type locality, *longibasalis* agreed with recent specimens compared. Future collecting in Kwangtung, Kwangsi and N. Viet-Nam may fill the distribution gap. Recent Thailand specimens were all collected in the same District (Dan Sai) as the *aurilineatus gilvilineis* type (seen in USNM) and a paratype (seen from Philip coll.). They are conspecific.

Tabanus helvinus new species Fig. 36

Tabanus aurilineatus var. *griseipalpis* Toumanoff, 1941, Revue Méd. Franc. d'Extrême-Orient 19:1079, 1078, 1086, Figs. 1 & 4a-b. (Preoccupied by Schuurmans Stekhoven 1926:312.)

Holotype female. Length 14 mm. **Head.** Frons nearly parallel sided, index 1:5.0; tomentum yellow orange, hairs black and very sparse yellow. Callosity dark yellow, rather rounded below and with tomentose patches at lower corners, tapering gradually upward into dark brown rather linear dorsal extension. Subcallus and most of frontoclypeus and eye margin of upper cheek yellow, remainder of face pale grayish; cheek hairs mostly brown, beard hairs arising from posteroventral aspect yellow. Antenna with scape black haired; plate orange, dorsal tooth acute but not large, annuli darkened with tip black, 2 basal annuli remain orange on inner face. Palpus pale brownish yellow, basal segment pale yellow haired with some black hairs at apex, apical segment black haired. **Thorax.** Dorsum orange brown with mixed golden yellow and black hairs, those on scutellum almost entirely golden yellow. Venter and middle and hind coxae gray to yellowish gray with variable yellow to yellowish white hairs, fore coxa yellow with golden yellow and black hairs; femora mostly brownish black with black hairs, brown apically, middle femur also brown dorsally with golden yellow hairs on dorsum and at apex, hind femur with some golden yellow hairs at apex; fore tibia brown basally with black hairs and several golden yellow hairs, black apically with black hairs, other tibiae rather similar but pale brown basally becoming dark brown apically; fore tarsus black, others very dark at least on upper face. Wing with costal, subcostal, marginal, and upper area of 1st submarginal cells tinted brown, stigma dark brown, remainder of 1st submarginal and part of 2nd submarginal cell paler brownish, remainder of wing subhyaline; anterior branch of 3rd vein curved; 1st P cell open; halter stem yellowish brown, knob pale brown. **Abdomen.** Dorsum mostly bright yellow orange with golden yellow hairs, including a broad median stripe on tergites

Biology. The 2 known Thailand localities lie in the adjacent valleys of the Nam Man and Nam Phung in Dan Sai District, a mountainous area which separates northern from northeastern Thailand. This seems strangely restricted in view of the wider overall distribution to the northeast. The Thai localities are at estimated altitudes of 375 and 450 m; in Laos, one locality is as low as 300 m and the Ban Van Heue locality is probably much higher. The known seasonal range includes only May and June, with the species not represented in a mid-April collection at the Dan Sai site. Recorded host interest includes water buffalo and cattle. Specimens collected by me were taken between 1630-1915 hours.

1-6, the stripe flanked on 1 and 2 by a small amount of black hair, on 3 by more black hair which is also scattered sublaterally, on 4 and 5 by black hair and also by darkening integument; on 6 by black hair and blackened integument, lateral margins on 1-6 remain pale; 7 mostly blackened with black hairs, a small median basal spot of yellow continues dorsal stripe. Sternite 1 yellow with yellow hairs; 2 orange yellow with golden yellow hairs and a central patch of black hairs; 3 and 4 progressively darker orange and more extensively black haired, apices remain pale with golden yellow hairs; 5 mostly blackened centrally, apex remains pale as above; 6 black except lateral margins; 7 all black with black hairs.

Allotype male. In generally good agreement with type except for usual sexual differences. Body hairs much longer, apical segment of palpus with some pale hairs, darkened areas of abdominal apex somewhat darker than type. [Antennal flagellums missing due to ant damage before specimen was discovered.]

Paratypes (443♀, 1♂). Length 11.5-15 mm. Frons parallel sided to very slightly divergent above, index range 1:4.0-5.9 (from selected sample); callosity yellow to orange brown, rounded to truncate below and with or without pits of tomentum, dorsal extension dark yellow to blackened, variable from slender and linear to much broader and often fused to callosity such that the whole forms a smoothly tapering column throughout; cheeks yellowish or grayish or both, cheek hairs (and hence beard) variable from mostly dark to almost all pale; annuli may be all blackened or basal 2 or 3 may remain orange, dorsal tooth of plate acute to obtuse; basal segment of palpus may be entirely pale haired,

apical segment all black haired to mostly yellow haired at least over basal area. Fore coxa with pale hairs golden yellow to whitish yellow, black hairs may be scattered overall or restricted to apex or absent; femora often brown becoming yellow apically, fore femur often partly golden yellow haired and other femora may be mostly so; tibiae brown to yellow basally with variable amount of golden yellow hair. Anterior branch of 3rd vein sometimes angulate and occasionally with a very short spur; halter stem and knob yellow to brown. Dorsal median pale abdominal stripe may be strongly accentuated by flanking submedian black hairs and darkened integument beginning even on tergite 1, or 1-4 variable to entirely yellow orange with almost all golden yellow hairs, with the stripe only apparent on 5 and 6; venter also variable, sternites 3 and 4 yellow orange to orange brown (sometimes darker brown centrally), black hairs very extensive or restricted to median patches, 5 and 6 dark centrally but lateral margins variable.

Type series data. Holotype ♀: THAILAND: Loei Prov.: Dan Sai Dist.: Dan Sai & vicinity 17°16'N 101°09'E: 22 May 1969 about water buffalo John J.S. Burton 1630-1915 hrs. (In Cornell University.) This locality is in the rather isolated valley of the Nam Man at about 375 m altitude, in the mountainous area separating northern from northeastern Thailand. Allotype ♂: same collecting locality as type but 23 May 1969 found dead under light JB. (In Cornell University.) Paratypes: 35♀, exactly same collecting data as type but a few taken attacking cattle; Loei Prov.: Loei & vic, 17°29'N 101°44'E (all C. Dettongchai in 1969): 19♀, 3-12 May; 2♀, 17 May; 53♀, 25-31 May; 88♀, 1-5 June; 29♀, 7 June; 120♀, 1♂, 22-25 June; 49♀, 26-28 June; 48♀, 1-5 July.

Also identified here but not designated as paratypes: LAOS: "Muong Sing": 1♀, 6-10 June 1960 S&L Quate; Luang Prabang Prov. (vic. E of Luang Prabang) ~19°53'N 102°10'E: 13♀, 3 Aug. 1969 JB; "Mg. Sayaboury": 15♀, 23-27 May 1967 F.G. Howarth; 1♀, 1 June 1967 FGH; 1♀, 9 July 1967 FGH; 1♀, 5 Aug. 1967 FGH.

THAILAND: same locality as type: 252♀, 9-11 June 1969 C. Dettongchai; Loei Prov.: [Loei or Dan Sai]: 126♀, 8-28 June 1969 CD. S. VIET-NAM: Bien Hoa Prov.: "Long Binh": 1♀, 2 Feb. 1969 W.H. Pierce; 1♀, Apr. 1969 WHP; 1♀, 18 June 1969 WHP.

Taxonomy. This new species is a close relative of *aurilineatus* (which see), but *helvinus* has the pale hairs of the abdomen more brilliantly golden orange yellow; and the legs (especially the fore leg) are darker. There is also apparently a large geographic separation. In the same range, *longibasis* has a similar appearance but can be separated by characters noted under the latter. *T. xanthoimus* Philip from Assam shows much similarity but its dorsal pale stripe is strongly serrated among other differences.

I believe that *helvinus* is the same taxon as that described by Toumanoff (1941) as *aurilineatus* var. *griseipalpis*. I have compared material at hand with his description and find them in basic agreement. His specimens were from the area around Mimot, Cambodia (see p.1077 & 1082-1083). The occurrence of *helvinus* in S. Viet-Nam serves as further evidence for the association of these names. Toumanoff must certainly have been aware that Schuurmans Stekhoven (1926) named a species *griseipalpis*, but he apparently did not then concern himself with priority since only a variety was being described. Toumanoff made no mention of designating or depositing any formal type material, and none has been found so labeled.

Biology. *T. helvinus* clearly reaches dense proportions from May to August in Thailand and Laos, hence during the rainy season. Known localities in these countries range in altitude from 250 m (Loei) to 650 m (Muong Sing). Although now known in Thailand only from Loei Province, the records from elsewhere suggest wider distribution in the north and northeast. Recorded host interest includes water buffalo and cattle, and some specimens were attracted to light. A number of specimens were definitely collected during the final hour before darkness, but it is not known if flight activity is restricted to that time.

Tabanus aurilineatus Schuurmans Stekhoven Fig. 37

Tabanus aurilineatus Schuurmans Stekhoven, 1926, Treubia 6, Suppl.:231-234, Plate 7 Figs. 5 & 6. (*aureolineatus* and *aurilineatus*: Wharton, 1957:78 & 102—*lapsus*.)

Female. Length 10.5-16 mm. **Head.** Frons parallel sided to very slightly divergent above, index 1:4.6-6.7 (from selected sample); tomentum orange to orange yellow; hairs black and scattered pale. Callosity variable shades of dark yellow to orange brown, inverted U- or V shaped, generally broad and truncate below, dorsal extension dark yellow to brown, usually tapering throughout and often forming a continuous and smooth taper

upward from sides of callosity. Subcallus orange, upper eye margin of cheek and at least the lower part (if not all) of frontoclypeus also orange to dark yellow, remainder of face pale grayish; facial hairs usually brownish, beard hairs which arise posteroventrally are white. Antenna with scape black haired at least on outer face, inner face and/or dorsal apex often partially orange haired; plate orange, dorsal tooth obtuse to acute but low

hence plate rather slender; 2 basal annuli orange like plate or somewhat darker, 2 apical annuli commonly at least partially darkened and with a distinct tendency toward fusion. Palpus dull yellowish, basal segment pale haired basally and black haired apically, apical segment usually entirely black haired, sometimes with scattered pale hairs. **Thorax.** Dorsum orange brown to orange, hairs mixed orange yellow and black, those on scutellum all orange yellow. Venter and coxae pale brownish white with white hairs, fore coxae with some black hairs at least apically; all femora and middle and hind tibiae dull brownish yellow to orange brown with mixed and variable hairs, fore tibia darker brown apically and mostly black haired; fore tarsus with basal segment mostly brown, usually blackened beyond, other tarsi generally brown with apical segment blackened. Wing as in *helvinus*, brown tint of costal margin perhaps more variable in intensity. **Abdomen.** Dorsum primarily brownish yellow to yellowish brown with highly variable (brownish yellow to blackened) hairs, apical tergites often darker; midline of 1-6 with a dull yellow-tomentose yellow haired stripe; lateral margins of 1-6 often similarly yellow with yellow to yellowish white hairs. Venter gradually darkening from base (yellow) to apex (brown to black); hairs variable, sometimes entirely whitish yellow on sternites 1-4 or with central black haired areas on 2-4, 5 and 6 highly variable, 7 mostly to entirely black haired. (5389+)

Male. Agrees in essence with ♀. See Stekhoven's original description. (2)

Type data. Stekhoven designated a type in both sexes. The type ♂ was from "Rumpibun" [=Ron Phibun in Nakhon Si Thammarat Prov., Siam. Dr. T. van Leeuwen has informed me that this specimen is now in Zoologisch Museum, Amsterdam. The type ♀ was described from Sumatra: "Meurendoë, Gvt. Atjeh, East Coast". Dr. van Leeuwen has noted that his institution has 1♀ which agrees with the type locality and is probably the type but is not so labeled. But he has quoted its date as "1.23" while the type was published as "3.23" (this may be an error). I have not seen these specimens. A ♀ in BMNH labeled "Tebing Tinggi/Kelantan/July 1920/Coll. V. Knight" is a perfect match for a set of paratype data (and including a Raffles Museum label), but was not labeled as such. I believe it to be a paratype, and determination of present material is based primarily on comparison with it.

Published records. The type series included specimens from Sumatra, Malaya, and southern Thailand. Stekhoven (1928:442) added another southern Thai record. All subsequent records are from farther north, and I do not agree that they are true *aurilineatus*. Toumanoff's (1941) series from Cambodia, which he described as a new subspecies, is herein assigned to *helvinus*. I have no record of seeing Wharton's (1957) material from Cambodia, but expect that it too was *helvinus*.

Philip's (1960a:12; 1960b:42) new subspecies of *aurilineatus* from northeastern Thailand is herein synonymized under *longibasalis*.

New records. THAILAND: Chumphon Prov.: Tha Sae Dist.: (area ~15 km NW of Chumphon) 10°34-37'N 99°05-07'E: 62♀♀, 12 June 1969 JB; 27♀♀, 13 June 1969 JB; Phangnga Prov. (vic. of Amphoe Muang Phangnga town) 08°28-29'N 98°32'E: 1♀, 6 June 1969 JB; Krabi Prov. (Route 5, ~6 km N of Krabi) 08°06'N 98°55'E: 1♀, 4 June 1969 JB; Krabi Prov. (vic. N of Krabi) 08°04'N 98°55'E: 65♀♀, 4 June 1969 JB; Nakhon Si Thammarat Prov.: Phrom Lok Canton (20-24 km NW of Nakhon) ~08°31'N ~99°48'E: 2♀♀, 3 Apr. 1969 JB or A. Wanchitnai; Songkhla Prov.: Rattaphum Dist.: Tha Chamuang Canton ~06°58'N 100°08'E (all A. Wanchitnai in 1969): 34♀♀, Apr.; 943♀♀, 2♂♂, May; 120♀♀, June; 1091♀♀, July; 1045♀♀, Aug.; 848♀♀, Sep.; 414♀♀, Oct.; 84♀♀, Nov.; 19♀♀, Dec.; (same but 1970): 25♀♀, Feb.; 331♀♀, Mar.; Satun Prov.: Thung Nui (~06°53'N ~100°08'E): 45♀♀, 28 May 1970 G.R. Ballmer; Satun Prov.: Satun & vic. 06°38'N 100°04'E: 25♀♀, 11-14 May 1969 AW; 67♀♀, 14-16 July; 49♀♀, 28-31 Aug. 1969 AW; 91♀♀, 1-5 Sep. 1969 AW.

Taxonomy. As interpreted here, *aurilineatus* is not now known to occur above the Isthmus of Kra, but a full account is given because of the earlier records including infraspecific descriptions. See under *longibasalis* and *helvinus*, respectively, for removal of a subspecies and a variety formerly assigned to *aurilineatus*. *T. helvinus* is clearly the closest relative, and these might be difficult to distinguish if it were not for the pronounced separation of geographic ranges (at least in Thailand). True *aurilineatus* is confirmed only as far north as Tha Sae Dist. (Chumphon Prov.), though I should not be surprised to find it in coastal lowland areas as far north as Bangkok. *T. helvinus* is now known only as far south in Thailand as Loei Prov., but the S. Viet-Nam record extends down to 11°N. Both species are slender bodied yellowish to brownish flies with a median yellow dorsal abdominal stripe, and both share the distinct tendency toward fusion of the 2 apical annuli of the antenna. In general, *aurilineatus* has paler legs, paler thoracic venter, darker (more orange) subcallus, frontoclypeus, and eye margin of upper cheek; and abdominal coloration including hairs usually more subdued.

Biology. This is a very important species in southern Thailand, and probably occurs in economically significant quantities over much of the year in many localities. In the hilly area of Tha Chamuang Canton (Songkhla Prov.), it was present throughout the year except for the period 29 December-22 February (a relatively dry time). Thai localities include coastal lowland (sea level) up to 230 m. Recorded host interest includes water buffalo, cattle and elephants; some were taken around a kerosene light (burning wick) at night.

Tabanus brunnipennis Ricardo Fig. 43

Tabanus brunnipennis Ricardo, 1911, Rec. Indian Mus. 4(6):160-161, Pl. 13 Fig. 9. (*brunipennis*: Toumanoff, 1953:203; *brunnipennis* and *brunnipennis*: Sen & Fletcher, 1962:158 & 605—*lapsus*.)

Female. Length 9.5-15.5 mm. **Head.** Frons slightly divergent above to nearly parallel sided, index 1:4.2-5.9 (from selected sample); tomentum brownish off-white when viewed from above becoming brown when viewed from below, vertex usually gray; hairs variable, mixed black and yellowish to all yellowish except black at vertex. Callosity and dorsal extension together form a single tall strong triangle which is yellow to brown below and orange to black above, lower margin truncate to somewhat rounded and often pitted. Subcallus yellowish white; face various shades of whitish with white hairs including beard. Antenna with scape white haired, usually some orange hairs and often also some black hairs dorsally; plate orange, sometimes darkened apically, relatively small with dorsal tooth obtuse and usually rounded; annuli relatively elongate, orange to blackened. Palpus usually creamy white (occasionally grayish), basal segment white haired and sometimes with a few black hairs apically, apical segment variable from mostly white haired to mostly black haired. **Thorax.** Dorsum gray or sometimes grayish brown with black hairs, the periphery including part or all of scutellum paler with white and yellow hairs, central area usually with some faint striping. Venter and coxae pale gray with white hairs, upper area of mesopleurite occasionally pale yellowish; fore femur gray to brownish, inner face relatively darker with black hairs and outer face white haired, other femora yellowish or pale brownish to grayish with mostly to entirely white hairs; fore tibia pale basally becoming blackened apically, outer face white haired over pale area but black haired elsewhere, other tibiae mostly pale, at least partly black haired on outer face and apex, white haired on inner face. Wing with costal infuscation which covers costal and subcostal cells, marginal cell variable from entirely infuscated to only narrowly so along costal vein (rarely absent), 1st submarginal cell generally infuscated along costal vein and may or may not be tinted along 2nd vein, costal tint usually enters top of 2nd SM cell, wing elsewhere hyaline or nearly so; 1st P cell open; anterior branch of 3rd vein curved, very uncommonly angulate or with a vestigial spur; halter stem whitish to pale brownish, knob whitish, often brownish laterally at base and occasionally more extensively so. **Abdomen.** Dorsum brown to black, basal tergites variable from pale brown to dark brown, dorsum gradually blackening toward apex, a broad and very conspicuous median stripe of whitish tomentum and hairs crosses tergites 1-6, 2 usually (but certainly not always) with a sublateral spot of pale tomentum and hairs, 3 occasionally with a similar but much smaller spot; lateral margins of 1-6 and sometimes 7 pale with white hairs. Sternites 1-6 pale (yellowish to gray) with white hairs and

sometimes some yellowish hairs, median area with a highly variable amount of black hairs which may begin on 2 or as far back as 5, median area not as pale tomentose as lateral area, 7 dark with mostly to entirely black hairs. (1064+)

Male. In good agreement other than sexual differences, except that basal tergites average paler brown, and the sublateral spot on tergite 2 is either absent or present only as a trace. (72)

Type data (♀): "Basti./N. Canara./India./11. VI. 1907/T.R. Bell./1908-49." (Seen in BMNH.) Note differences from original rendering by Ricardo. The type specimen is in perfect condition.

Published records. The paratypes (4♀♀) were from India and from Bangkok, Thailand. Other records to date are from India, Burma, Thailand, Cambodia, Indochina, Sumatra, and Java. I have no reason to doubt these though I have seen no specimens from Indonesia.

New records. Due to the frequency of collections, only the provinces, districts, date range and numbers for each district are recorded here. The great majority were collected by the writer and his assistants. **LAOS:** Houa Khong Prov.: 1♀, Muong Sing, 6-10 June; Vientiane Prov.: 3♀♀, "Ban Na Pheng", 19 May; 1♀, Vientiane, 31 May-3 June; 1♀, "Muong Kaw/Muong Tourakom", 22 May; Sayaboury Prov.: 13♀♀, 11♂♂, Sayaboury, 17-18 Apr. & 18 May. **VIET-NAM:** Lam Dong Prov.: 3♀♀, Di Linh, 22-28 Apr.; Bien Hoa Prov.: 1♀, "Long Binh", Mar.-May. **THAILAND:** Mae Hong Son Prov.: 7♀♀, Muang Mae Hong Son Dist., 12-13 May; Chiang Mai Prov.: 6♀♀, 8♂♂, Fang Dist., 12 Apr.-5 May; 147♀♀, 1♂, Muang Chiang Mai Dist., 3 May-18 July; Tak Prov.: 29♀♀, Muang Tak Dist., 8 July; 5♀♀, Mae Sot Dist., 9-11 July; Loei Prov.: 1♀, 1♂, Chiang Khan Dist., 17 Apr.; 181♀♀, Dan Sai Dist., 18 Apr.-11 June; 352♀♀, 38♂♂, Muang Loei Dist., 16 Apr.-1 July; Sakon Nakhon Prov.: 24♀♀, 8♂♂, Muang Sakon Nakhon Dist., 22-23 Apr.; Ubon Ratchathani Prov.: 1♀, Phibun Mangsahan Dist., 25 July; Nakhon Ratchasima Prov.: 8♀♀, 1♂, Pak Chong Dist., 6 May & 25 June; Saraburi Prov.: 3♀♀, Muak Lek Dist., 24 June; Phra Nakhon Prov.: 3♀♀, 2♂♂, Bang Khen Dist., 8 Apr. & 14-16 June; Chon Buri Prov.: 3♀♀, Si Racha Dist., 14 Feb. & 24-27 Mar.; Chanthaburi Prov.: 1♀, 21 Feb. & 66♀♀, 19 June, Muang Chanthaburi Dist.; Prachuap Khiri Khan Prov.: 1♀, Muang Prachuap Khiri Khan Dist., 25 June; Chumphon Prov.: 12♀♀, 1♂, Muang Chumphon Dist., 13 June & 3 Aug.; 1♀, Tha Sae Dist., 12 June; Ranong Prov.: 2♀♀, Kra Buri Dist., 11 June; Nakhon Si Thammarat Prov.: 5♀♀, Muang Nakhon Si Thammarat Dist., 3 Apr.;

1♂, Thung Song Dist., 1 Apr.; Phuket Prov.: 4♀♀, Thalang Dist., 7 June; 2♀♀, Muang Phuket Dist., 7 June; 21♀♀, Kathu Dist., 8 June; Songkhla Prov.: 141♀♀, Rattaphum Dist., 25 Feb.-17 May; Satun Prov.: 9♀♀, Muang Satun Dist., 2-7 Mar. & 14 May.

Taxonomy. The abdominal coloration including strong whitish median stripe together with infuscation of the costal margin and the heavy callosity/dorsal extension makes *brunni-pennis* highly distinctive. The fact that this widespread species has gathered no known junior synonyms is in a sense an attestation to its distinctness.

Biology. *T. brunni-pennis* is considered com-

mon throughout Thailand, and was taken from sea level up to 1450 m (and possibly up to 1650 m) on the Doi Suthep/Doi Pui massif. Over most of the country it occurs from at least April through July and perhaps longer. At Chanthaburi it was apparently rare in February and very common in June. In the far southern provinces it appears restricted to February-June. Host interest is recorded in water buffalo, cattle, elephants, and horses. Both sexes have the habit of resting on trees and buildings especially in proximity to animals; and both sexes have been taken at lights at night. Feeding activity was observed at least as early as 0930 hours, throughout the day and during the final hour before darkness, with no apparent preference.

Tabanus striatus complex

This is referred to as a "complex" as much on nomenclatural as on zoological grounds. The overall situation must rank near the top as 1 of the most chaotic taxonomic circumstances of all times. The literature on the complex is a desperate medley of competing types and competing syn-types and even competing lectotypes, of synonyms of all sorts, of primary homonyms, of overlooked specimens, overlooked descriptions, of geographically impossible assemblages, and of discussions which leave out vital morphological distinctions.

This is all the more unfortunate in view of the importance of the species involved. Two members of the complex, *striatus* and *megalops*, occur in Thailand, with the related but easily distinguished *juvundus* also present. A thorough reexamination of the complex over its entire wide range would be very desirable. In addition to the synonyms listed and discussed below, the name *costalis* Lichtenstein has yet to be tied down; and "*ophthalmicus* Hagenbeck" is a nomen nudum created by the listing of Stekhoven (1926:163).

Tabanus striatus Fabricius Fig. 38

Tabanus striatus Fabricius, 1787, Mantissa Insectorum 2:356.

Tabanus hilaris Walker, 1850b, Insecta Saundersiana, Dipt. 1:49-50 & Plate 2 Fig. 3-3c. (*hilaris* of some authors—*lapsus*.)

Tabanus tenens sous forme *cambodiensis* Toumanoff, 1953, Bull. Soc. Path. Exot. 46(2):201-203, Plate 1 Fig. 1, Plate 2 Fig. 3. (New synonym.)

Female. Length 10-15.5 mm. **Head.** Frons very slightly divergent above to parallel sided, index at least 1:4.3-6.3 (from selected sample); tomentum very pale brownish when viewed from above, becoming orange brown when viewed from below; hairs mostly pale but with black hairs at vertex and usually also some at sides of median callus. Callosity (basal callus) yellow to brown, sometimes blackened, essentially rather rectangular and filling entire width of frons at base, usually pulling away from eye margins only very slightly above or remaining contiguous with them; dorsal extension forming a separate median callus which is orange to dark brown and essentially spindle shaped, connected to the basal callus by a usually narrow line; a large rather rectangular bare spot present just below vertex which may appear to cross entire frons. Subcallus pale yellowish white to essentially white; face white to grayish white with white hairs including beard. Antenna with scape mostly white haired, commonly a few black hairs scattered above and with some orange

hairs at dorsal apex; plate orange, rather short and broad, dorsal tooth obtuse; annuli orange to blackened. Palpus with basal segment creamy white to grayish and white haired; apical segment creamy white, entirely white haired or with scattered black hairs, generally rather bulbous at base. **Thorax.** Dorsum mostly dark gray and with black hairs, pale whitish gray with white hairs around periphery, some yellowish hairs scattered on scutum, poorly defined submedian pale stripes present on scutum which are most easily seen on apical half; scutellum sometimes bicolored with apical half paler. Venter and coxae gray with white hairs, some black hairs often present on mesopleurite; fore femur gray with white hairs on outer face and blackened with black hairs on inner face, other femora mostly gray with white hairs, yellow at apex and occasionally more extensively yellow; fore tibia pale with mostly pale hairs basally and blackened apically, other tibiae yellow with mixed pale and black hairs. Wing hyaline; 1st P cell open; anterior

branch of 3rd vein curved or angulate, very uncommonly with budlike spur vein; halter stem yellow to brown, knob brownish to yellowish at base and yellowish to whitish beyond. **Abdomen.** Dorsum black with black hairs, the basal segments often of a paler (brownish black) hue and gradually becoming jet black toward the abdominal apex, with pale areas as follows: tergite 1 with basal areas of gray tomentum and white hairs; junction of 1 and 2 at midline with a whitish, at least partially white haired patch; a strong stripe of whitish tomentum and white hairs present at midline beginning at base of 3 and ending somewhere on 6, its sides are more or less smoothly drawn with no tendency to form a series of triangles, that portion on 6 often greatly reduced and commonly at least partially black haired; uncommonly a thin trace of pale tomentum but not pale hairs may cross 2 at the midline; sublateral stripes of whitish tomentum and mostly white hairs begin on 1 and continue to somewhere on 4, that portion on 4 occasionally reduced to a trace; lateral margins of 1-6 whitish with white hairs. Venter variable from gray to drab yellowish orange and mostly white haired, the midline with some darker tomentum and at least enough black hair to cause the venter to appear to the naked eye to have a broad stripe. (604+)

Male. In very good agreement with ♀ except for usual sexual differences. The agreement includes abdominal pattern and (usually) color and entirely hyaline wing. (11+)

Type series data. Chvála & Lyneborg (1970b:546-547) identified 4 specimens from the Copenhagen and Kiel Collections (both now in Copenhagen) which they believed to be part of the type material. Before that time, only 3 specimens were thought to be extant (and, in earlier literature, only 2). They established the single specimen (♀) in the Copenhagen collection as lectotype. The labels of this specimen are: an ancient label showing only "*T. striatus*" in handscript; a modern red label showing only "TYPE"; and a lectotype designation label which identifies the selection as Chvála's. (Seen from Copenhagen Museum.)

The only specimen data published by Fabricius was "Habitat in China Dom. de Sehestedt." Based on recent and presently reported findings, the chances are fairly good that China's fauna includes only that species represented by the *striatus* lectotype and not "the other species" (*megalops*) so regularly confused with it. Therefore the true origin of the type material is of considerable interest in solving the zoological puzzle surrounding the complex, and might solve it rather conclusively if a definitive statement could be made. Unfortunately, there are some compromising circumstances: (1) For most of the first half of this century, rival sets of synonymy were used by different workers depending on which of the syntypes was thought to be the "real" *striatus* (Senior-White 1927:51-54). I have

not had a chance to assess the conspecificity of the syntypes (if indeed this can now be assessed at all since the non-lectotype specimens are all said to be in bad condition), but the fact that the rival sets were once drawn up suggests that the series is not conspecific. If the latter is the case, then all specimens probably did not come from China. (2) Simple substitutions or additions to the type series may have been made as "better material" became available and before the type concept was instituted, and this material may not have come from China. (3) Fabricius described the species from a private collection. The lectotype, and presumably the other type series specimens as well, has no collecting data label, and Fabricius's "Habitat in China" may have been little more than a guess on the part of someone whose hands the specimens passed through. For example, more collecting may have been done at Southeast Asian ports on the ship's way back to Europe, where *megalops* could easily have been encountered and added to the China boxes. Hence, reliance on the "type locality" should not be carried too far. Dr. Lyneborg (personal communication) has related the following: "It is impossible to say from which collector the original syntypic series of *striatus* came. Fabricius saw it in the Sehestedt-Tønder Lund collection. Both these persons were in the Danish central administration [customs officials] and built up an enormous collection on the basis of their many connections abroad. At that time there were good commercial connections with the Amoy-region in South China and the material may well originate from this area."

Published records. Due to the confusion of at least 2 or more species under this name, the reported distribution of *striatus* has at one time or another included almost the entire Oriental Region from W. Pakistan to Guam and China to Bali. Based on my examinations of type and non-type material of various species, on published diagnoses and illustrations, and on my findings in Thailand, I believe that the records from Malaysia, Indonesia, the Philippines and Guam must be deleted, and a substantial portion (but by no means all) of the India records are similarly based on material that is not conspecific with the *striatus* lectotype. Isaac's (1925a) paper, in which the taxonomic interpretation is Austen's, is apparently accurate as regards species identifications. His figure of a *striatus* ♀ (1925a: Plate 15 Fig. 4a) is lighter at the midline of tergite 2 than any specimens I have seen, but at least the white tomentum is shown to be interrupted. The abdominal coloration of his ♂ (Fig. 5a) is a better likeness of the ♀♀ at hand. Other mainland records will have to be reassessed individually. In general, *striatus* occupies a relatively "northern" range.

New records. LAOS: Luang Prabang Prov. (vic. E of Luang Prabang) ~19°53'N 102°10'E: 3♀, 2-3 Aug. 1969 JB; Sayaboury Prov.: Sayaboury: 23♀, 1♂, 17-18 Apr. 1967 F.G. Howarth.

S. VIET-NAM: [Bien Hoa Prov.]: Long Binh: 1♀, 1♂, Mar.-May 1969 W.H. Pierce. THAILAND (all 1969 unless shown otherwise): Mae Hong Son Prov. (vic. SW of Mae Hong Son) 19°17'N 97°58'E: 45♀♀, 12-14 May JB; Mae Hong Son Prov.: Mae Sariang Dist. (area W of Mae Sariang) ~18°09'N ~97°55'E: 2♀♀, 11 May JB; 8♀♀, 12-13 May P. Chaemmanee; Chiang Rai Prov.: Mae Sai Dist.: Mae Sai & vic. 20°26'N 99°53'E: 4♀♀, 17 July JB; Chiang Rai Prov.: Phayao Dist. (vic. NW of Phayao) 19°10-11'N 99°53-54'E: 6♀♀, 18 July JB; Chiang Mai Prov.: Fang Dist.: Fang: 1♀, 12-19 Apr. 1958 T.C. Mae; Chiang Mai Prov.: Fang Dist.: (~10 km W of Fang) ~19°56'N ~99°07'E: 3♀♀, 4-5 May JB; Chiang Mai Prov.: Chiang Mai: 19 May 1952 D.C. Thurman; Chiang Mai Prov.: Huai Kao (~4 km NW of Chiang Mai) 18°48'N 98°57'E: 6♀♀, 2 May JB; 36♀♀, 8-10 May JB; 10♀♀, 10-27 May K. Somporn; 6♀♀, 5-14 June KS; 28♀♀, 15 July PC; 10♀♀, 16 & 18 July KS; Chiang Mai Prov.: Doi Pui (a Maeo vill.) 18°49-50'N 98°53'E: 1♀, 3 May JB; Uttaradit Prov.: Tron Dist.: 1♀, 21 Nov. 1967 JB; Tak Prov.: Mae Sot Dist.: Mae Sot & vic. 16°43'N 98°34-35'E: 3♀♀, 1♂, 9 July JB; Tak Prov.: Mae Sot Dist. (~5 km E of Mae Sot) 16°43'N 98°37'E: 34♀♀, 10 July JB; Tak Prov.: Mae Sot Dist.: Huai Muang Canton 16°40'N 98°31'E: 22♀♀, 9 & 11 July JB; Tak Prov. (area on W side of Ping River, opp. Tak) 16°51-52'N 99°05-07'E: 4♀♀, 8 July JB; Loei Prov.: Chiang Khan Dist.: Chiang Khan 17°53'N 101°39'E: 3♀♀, 17 Apr. JB; Loei Prov.: Loei & vic. 17°29'N 101°44'E: 25♀♀, 14-17 Apr. JB; 5♀♀, 19-20 Apr. JB, PC or C. Dettongchai; 20♀♀, 21-29 Apr. CD; 21♀♀, 1-13 May CD; 28♀♀, 17-31 May CD; 7♀♀, 2-7 June CD; 5♀♀, 23-28 June CD; 6♀♀, 1-5 July CD; Loei Prov. (12-15 km NW of Loei) ~17°34'N ~101°39'E: 2♀♀, 18 May 1967 JB; 1♀, 14 Apr. JB; Loei Prov.: Dan Sai Dist.: Dan Sai & vic. 17°16'N 101°09'E: 19♀♀, 18-20 Apr. JB; 32♀♀, 22 May JB; 13♀♀, 9-11 June CD; Sakon Nakhon Prov.: Sakon Nakhon & vic. 17°10'N 104°10'E: 5♀♀, 2♂♂, 22-23 Apr. JB; Sakon Nakhon Prov. (~12 km NW of Sakon Nakhon) ~17°13'N ~104°03'E: 1♀, 22 Apr. PC; Ubon Ratchathani Prov.: Phibun Mangsahan Dist.: town & vic. 15°14-15'N 105°13-14'E: 9♀♀, 22 July JB; 9♀♀, 24-25 July PC; Nakhon Ratchasima Prov.: Pak Chong Dist.: Mu Si Canton: Khlong Yai: 1♀, 21 Mar. G.R. Ballmer; Nakhon Ratchasima Prov.: Pak Chong Dist.: Klang Dong Canton 14°37-38'N 101°12-13'E: 1♀, 25 June JB; Saraburi Prov.: Muak Lek Dist. (area S of Muak Lek) 14°36-38'N 101°12'E: 1♂, 25 June JB; Nakhon Sawan Prov. (1-4 km SW of Nakhon Sawan) 15°40-41'N 100°06-07'E: 2♀♀, 26 June JB; Nakhon Sawan Prov. (~10 km S of Nakhon Sawan) 15°36-38'N 100°07-08'E: 1♀, 27 June JB; Phra Nakhon Prov.: Bang Khen Dist.: (N suburban Bangkok) 13°51'N 100°35'E: 1♀, 15 June A. Wanchitnai; Chon Buri Prov.: Si Racha Dist.: Bang Phra Canton 13°13'N 100°57'E: 29♀♀, 1♂, 12-13 Feb. JB; 42♀♀, 3♂♂, 14-17 Feb. PC; 22♀♀, 23-30 Mar. PC; 5♀♀, 1-3 Apr. PC; 30♀♀, 1-10 July PC; 1♂, 13 July PC; Chanthaburi Prov.

(~2 km S of Chanthaburi) 12°36'N 102°07'E: 1♀, 21 Feb. JB.

Taxonomy. In Thailand, *striatus* has an extremely close relative in *megalops*, and the 2 have without doubt been confused in this country as elsewhere. The ♀♀ are distinguished by the 2nd tergite, which does not have a pale tomentose, pale haired stripe crossing it at the midline in *striatus*, but does have such a stripe in *megalops*. (This assumes that material is in good condition, as specimens of *megalops* which are stained and/or rubbed on tergite 2 may have a very *striatus*-like appearance.) Also, the dark pattern on the abdominal dorsum generally has a distinctly darker (blackier) hue in *striatus* than in *megalops*; this is very clear when a series of both are compared, but might sometimes present subjective difficulties in determining a single specimen. For the ♂♂, the hue of the dark abdominal pattern usually (but not always) holds true; but the striping criterion cannot be used because the median stripe generally does not cross tergite 2 in either species. In the Thailand material a good character is the costal cell, which remains hyaline in the *striatus* ♂, but is tinted yellow in the *megalops* ♂.

The geographic criterion can also be of help in determining Thailand material, as the upper parts of the north and northeast were found to have only *striatus*, while the deep south has only *megalops*. There is a broad zone of overlap across central Thailand which was found to extend at least as far north as Mae Sot (in Salween River drainage), and at least as far south as Chanthaburi. They were taken together at: 2 Mae Sot localities, where all but 1 specimen was *striatus*; Bangkok and Chanthaburi, where all but 1 specimen was *megalops*; and Bang Phra (Chon Buri Prov.), where both species were common.

I have examined the *striatus* lectotype, and conclude that it is conspecific with the population diagnosed above. It is not in very good condition and tergite 2 has been subjected to some rubbing. But there is enough tomentum remaining to distinctly favor considering it to be the species with the pale median stripe not crossing tergite 2; and the dark stripes are still quite blackened. I believe that this combination warrants the present association. The argument would be further substantiated if the "China" type locality could be invoked to associate the lectotype with the present "northern" population; but as discussed above its dependability is open to question.

T. hilaris was described from "East India." It was first synonymized under *striatus* by Surcouf (1923:196). Since that date, *hilaris* has been juggled between *striatus* and *tenens*, reflecting the uncertainty surrounding the latter 2 names. Curiously, Surcouf's interpretation has proven accurate in retrospect, as the character which he used to make the association [median stripe

beginning at anterior border of 3rd tergite] is in agreement with the recently designated *striatus* lectotype. The type of *hilaris* is a ♂ (seen in BMNH). It is a very faded specimen, such that the legs are all pale and the dark pattern of the abdomen is reddish brown. However, I consider it to be in basic agreement with ♂♂ of the present species, and therefore confirm this synonymy.

The name *cambodiensis* was proposed by Toumanoff as a "sous forme" of *tenens*. The original description stated, "Le specimen type de cet insecte est conservé dans la collection de M. le professeur Roubaud à l'Institut Pasteur." Dr. P. Grenier and the staff of the Paris Pasteur Institute searched diligently in my behalf for this type, but it was not found. For that matter, I saw no specimens at all of *striatus* (as herein interpreted) in the Pasteur Institute collection. The *cambodiensis* type should therefore be regarded as lost. However, Toumanoff's description included a detailed habitus drawing of his insect (1953: Plate 1 Fig. 1), and this drawing is actually a very good illustration of *striatus*. I herewith synonymize *cambodiensis* under *striatus* on the basis of this drawing and the text of the original description.

T. chinensis Thunberg has been suggested as a synonym here (beginning with Ricardo 1911: 152-153), but this was guesswork. The original description was brief, and both China and the Cape of Good Hope were given as the "habitat". No worker since Thunberg himself has claimed to have examined any type material, and perhaps none exists. At any rate, listing *chinensis* as a

synonym of anything at this point would be purely speculative, and I see no reason to do so.

Biology. A great deal of biological and veterinary information has been published under the name *striatus*, but most of it is based on populations which are not conspecific with the *striatus* lectotype. An exception to this is Isaac (1925a), whose work at Pusa, India, enabled him to publish a brief life history and color plate of all 4 stages of *striatus*. The following comments refer only to Thailand. *T. striatus* is a common species which occurs throughout the upper part of the country and has been collected as far south as Chanthaburi. (The upper part of the southern peninsula, including Prachuap Khiri Khan Province, has not been sampled.) It was taken from sea level up to a possible 1650 m on Doi Pui (outside Chiang Mai). The majority of specimens were taken in rather open plains situations. Specimens often rested on trees and other structures near tethered livestock around human habitations. The species was present in quantity throughout the sampling period of early February to early August, and it seems likely that it should be present throughout the year at least in the lower latitudes of its range. Host interest was recorded in water buffalo, cattle, elephants, and horse; some were taken resting on vegetation and in buildings and vehicles, in Malaise trap, and at lights at night. At least a few of the specimens were active during the day, but my records show that there is a distinct preference for the late hours, especially the last hour before darkness.

Tabanus megalops Walker Fig. 39

Tabanus tenens Walker, 1850b, Insecta Saundersiana, Dipt. 1:49. (Preoccupied by Walker 1850a:ixv-Neotropical.)

Tabanus megalops Walker, 1854, List Dipt. Ins. British Mus. 5:247.

Tabanus partitus Walker, 1856, J. Proc. Linn. Soc. Zool. 1:9. (New synonym.)

Tabanus manillensis Schiner, 1868, Riese Novara Dipt. :84. (*manillensis*: van der Wulp, 1896:61-*lapsus*.)

Tabanus rufocollis Bigot, 1892, Mém. Soc. Zool. France 5:679. (New synonym.)

Tabanus strophiatius Surcouf, 1923, Bull. Soc. Ent. France 1923:197. (New synonym.)

Female. Length 9.5-15 mm. Frons index range at least 1:4.3-5.8 (from selected sample only). Diagnosis agrees with that for *striatus*, except as follows: Antennal plate usually orange as in *striatus*, but occasionally darkened; palpus may average slightly less expanded at base of apical segment; scutum usually scattered with more bronzy yellow hair including some along hind margin; upper area of mesopleurite commonly with pale yellowish tomentum; femora average paler than in *striatus* (i.e., fore femur usually paler brownish on inner face, other femora commonly yellowish rather than gray), though femoral coloration is decidedly variable with much overlap between the 2 species; middle tibia may be almost entirely pale haired; 3rd vein curved or very rarely angulate; tergite 2 with a median stripe of

pale tomentum which crosses entire tergite (unrubbed and non-greasy specimens required), though it is generally narrower and duller than the continuation on 3-5, and sometimes also some pale hairs scattered on the pale tomentum of 2; dark pattern of abdominal dorsum averages paler (i.e. more brownish rather than blackish); abdominal venter appears to average paler (i.e. commonly more yellowish and much less frequently grayish than in *striatus*). (886+)

Male. Identifiable with ♀, but in addition to usual sexual differences, the median pale abdominal stripe generally does not cross tergite 2 (hence like *striatus*); and the costal cell is tinted yellow. (26+)

Isaac (1925a:102-108) has made a thorough study of the genitalia of both sexes in India (as *tenens*).

Type data (♂): "Java./Recd. in Exch./fr. Hon.E.India/Coy./51.112". (Seen in BMNH.)

Published records. Only the type from Java has ever been reported as *megalops*; but *tenens* has been reported very widely in the Oriental Region from NW India east to the Philippines, and China south to Java. As with *striatus*, existing determined material should be reexamined and the species distribution redrawn. I think the relatively southern position of this species would then become clear. Existing records from upper latitudes and high altitudes should be suspect.

New records. THAILAND (all 1969 unless shown otherwise): Tak Prov.: Mae Sot Dist.: Mae Sot & vic. 16°43'N 98°34-35'E: 1♀, 9 July JB; Tak Prov.: Mae Sot Dist.: Huai Muang Canton 16°40'N 98°31'E: 1♀, 11 July JB; Pathum Thani Prov.: Sam Khok Dist.: Wat Phailom: 1♂, 10 July 1966 T.C. Maa; Phra Nakhon Prov.: Bang Khen Dist. (N suburban Bangkok) 13°51'N 100°35'E: 26♀, 2♂♂, 26-27 Feb. JB; 1♀, 23 Mar. P. Chaemmanee; 7♀♀, 6♂♂, 8 Apr. JB; 5♀♀, 6♂♂, 9 Apr. PC; 21♀♀, 14 June JB; 125♀♀, 1♂, 14-16 June A. Wanchitnai; 4♀♀, 1♂, 20 July JB; 1♂, May 1951 & 1♀, 5 Sep. 1956 [Thai student colls.]; Phra Nakhon Prov.: Bangkok: 1♀, 26 Feb. G.R. Ballmer; 1♀, 31 Mar. 1966 J. Sedlacek; 1♂, 6 Apr. 1961 K. Iwata; 1♀, 11 Mar. 1966 JB; 1♂, 19 Mar. 1966 R.W. Matheny; 2♀♀, 21 Mar. PC; 1♀, 22 Mar. 1966 JB; 1♂, 8 Apr. 1966 JB; 1♂, 10 Apr. GRB; 1♀, 17 Aug. 1966 J.C. McDonald; 1♂, 26 Nov. 1965 JB; Chon Buri Prov.: Si Racha Dist.: Bang Phra Canton 13°13'N 100°57'E: 1♂, 12 Feb. JB; 6♀♀, 15 & 17 Feb. PC; 17♀♀, 24-30 Mar. PC; 3♀♀, 1-2 Apr. PC; 52♀♀, 1-13 July PC; Chon Buri Prov.: Si Racha Dist.: Si Racha 13°11'N 100°56'E: 2♀♀, 14 Mar. PC; Chanthaburi Prov.: Tha Mai Dist. (23 km NW of Chanthaburi) 12°43'N 101°59'E: 1♀, 21 June AW; Chanthaburi Prov. (~2 km S of Chanthaburi) 12°36'N 102°07'E: 6♀♀, 1♂, 19 & 21 Feb. JB; 5♀♀, 19 June JB; Chanthaburi Prov.: Laem Sing Dist. (vic. of Laem Sing) 12°28'N 102°05'E: 2♀♀, 1♂, 22 Feb. JB; Chumphon Prov.: Tha Yang Canton (~5 km SE of Chumphon) 10°28'N 99°13'E: 2♀♀, 13 June JB; 1♀, 1 Oct. AW; 4♀♀, 2 Dec. AW; Ranong Prov.: Kra Buri Dist.: Kra Buri & vic. 10°24'N 98°47'E: 9♀♀, 11 June JB; Ranong Prov.: La-un Dist.: Bang Kaeo Canton (~10°10'N ~98°46'E): 1♀, 12 May 1970 GRB; Ranong Prov.: Ranong & vic. 09°57'N 98°38'E: 7♀♀, 9 & 10 June JB or AW; Nakhon Si Thammarat Prov.: Phrom Lok Canton (20-24 km NW of Nakhon) ~08°31'N ~99°48'E: 16♀♀, 2-3 Apr. JB or AW; Phuket Prov.: Thalang Dist.: Tha Rua (crossroads) 07°59'N 98°22'E: 1♀, 7 June JB; Phuket Prov. (~3 km N of Phuket) 07°55'N 98°24'E: 3♀♀, 7 June JB; Phuket Prov.: Kathu Dist.: Ra Wai Canton 07°46'N 98°19'E: 3♀♀, 8 June JB; Trang

Prov.: Na Tham Nua Canton (~13 km N of Trang) 07°40'N 99°35'E: 2♀♀, 11 Mar. JB; Songkhla Prov.: Songkhla 07°13'N 100°35'E: 2♀♀, 28 Feb. JB; 2♀♀, 3 Apr. JB; Songkhla Prov.: Rattaphum Dist.: Tha Chamuang Canton 06°58'N 100°08'E: 14♀♀, 6-30 Mar. AW; 23♀♀, 4-30 Apr. AW; 10♀♀, 2-22 May AW; 4♀♀, 5-11 July AW; 11♀♀, 7-22 Aug. AW; 7♀♀, 6-24 Sep. AW; 2♀♀, 4-5 Oct. AW; 1♀, 24 Nov. AW; 50♀♀, 4-31 Dec. AW; 22♀♀, 1-29 Jan. 1970 AW; 26♀♀, 2-28 Feb. 1970 AW; 2♀♀, 19 & 21 Mar. 1970 AW; Satun Prov.: Satun & vic. 06°38'N 100°04'E: 9♀♀, 7 & 8 Mar. JB or PC; 1♀, 30 Mar. JB; 42♀♀, 7-10 Apr. AW; 24♀♀, 10-14 May AW; 19♀♀, 12-16 July AW; 27♀♀, 27-31 Aug. AW; 42♀♀, 1-5 Sep. AW; 110♀♀, 27-31 Oct. AW; 19♀♀, 3-5 Nov. AW; 55♀♀, 26 & 27 Nov. AW; 43♀♀, 11-15 Dec. AW; 27♀♀, 10-18 Feb. 1970 AW; 41♀♀, 2-10 Mar. 1970 AW; Satun Prov. (~3-6 km NE of Satun) 06°40'N 100°05'E: 31♀♀, 7 & 8 Mar. JB; Narathiwat Prov.: Waeng Dist. (vic. of Waeng) 05°56'N 101°53'E: 1♀, 13 Dec. 1968 GRB; 1♀, 2 Mar. JB. MALAY-SIA: Perak State: Tapah 04°12'N 101°15'E: 1♀, 27 Mar. 1969 JB.

Taxonomy. See above and under *striatus* for comparative notes with this very close relative.

Tabanus megalops was first stated to be a junior synonym of *tenens* by Austen (1922a:445). It had earlier been synonymized under *striatus* by Ricardo (1911:150). It has since been treated as a synonym of one or the other of these names by most subsequent authors. The exceptions are Philip (1959:609; 1960b:59), who proposed it as a synonym of *triceps* Thunberg; and Stone (1972:640), whose statement is taken as proposing a reestablishment of an independent existence for the name, since he thought the slenderness of the middorsal stripe of the *megalops* type "rules out conspecificity with either *striatus* or *tenens*". He hinted at synonymy with *effilatus* Schuurmans Stekhoven; but these are definitely not synonyms in my opinion. I have thoroughly examined the types of *megalops* and the Indian *tenens* in BMNH, and I find them conspecific. The type of *megalops* is a ♂ and though it has some broken parts it agrees with Thailand ♂♂ compared. The type of *tenens* is a ♀ and agrees with compared Thailand ♀♀ of the same species. The latter type's abdominal markings appear to have become faded, but it was easily associated with the fresh material.

If Philip's (1959:609) association of *tenens* with *triceps* is correct, then *triceps* would be the senior synonym of the species under consideration here. (Its date is 1827, when Thunberg, a botanist and apostle of Linnaeus, described it at age 85 in the year before his death.) However, I consider the situation surrounding *triceps* entirely too confused to warrant use of the name without further solid reconfirmation. I have reservations about Philip's concept of the members of the complex, and hence about his determination that

the *triceps* lectotype is conspecific with the *tenens* type (his comparison of these was indirect). Judging from various statements, key, and illustration in Philip (1960b), it appears to me that his concept of *striatus* actually included not only *striatus* but the great majority of *tenens* as well, with his concept of *tenens* correspondingly entirely too narrow due to reliance on minor or variable characters. Philip (1960b:58-59) placed *sinicus* Walker in synonymy under both *striatus* and *triceps* at once; *sinicus* has since been made a synonym of *rubidus*. And, although there is no question that Philip's 1959 lectotype designation for *triceps* has priority, the picture was still further confused when (1967:1235-1237) he designated a different syntype as lectotype in competition with the first. Only "Cayenna et Brasilia" was given as "habitat" in Thunberg's original description. In speaking of the same specimen as the 1959 lectotype (i.e. the "alpha syntype"), Philip (1967:1236) stated, "the locality is an obvious mislabel and the specimen may not have been an original syntype." For these reasons I decline to use the name *triceps* as senior synonym at this time. I have not had occasion to see the *triceps* syntype series in Uppsala, Sweden.

The valid name of the species at hand would thus remain as *tenens*, but an unfortunate homonymy has just come to light. It has been common knowledge that Walker described 2 unrelated species both as *tenens* in 1850. One of these was from "East India" and the other from "Pará" [Brazil]. Walker himself soon became aware of the homonymy and replaced the Neotropical *tenens* with the new name *confligens* (1854:326). It has apparently been assumed ever since that Walker correctly determined the priority for the name and replaced the true junior homonym. Mr. H. Oldroyd of BMNH has kindly researched the question of priority on my behalf, and his findings necessitate a reversal of what has been held heretofore. He stated (personal communication), "The evidence is conclusive that *Zoologist* came first, with *tenens* from Pará." He pointed out that the Saundersiana paper containing the Oriental *tenens* description, appeared after September 12, 1850, since "the Introduction by W.W. Saunders himself is dated from his home, East Hill, Wandsworth, Sep. 12, 1850. This is the Introduction to Part I of *Insecta Saundersiana*, Vol. I, Diptera. The separate title page for Part I is dated 1850, and is bound with other parts to form the complete volume, which has its own title page and Introduction dated 1856." Further, the BMNH Entomology Department's set of the *Zoologist* is bound in the original monthly parts each with its original covers. "This makes it quite certain that Walker's paper, with description of *Tabanus tenens* from Pará was published as an Appendix to the monthly part for May 1850 thus antedating the Saundersiana species by at least four months." This reversal of recognized priorities will have no effect on Neotropical nomenclature, as *tenens/confligens* has been synonymized under

an earlier Wiedemann name; but the Oriental *tenens* must fall to the next oldest name for the species, which is *megalops*.

The types of *partitus* and *rufocallosus* are both ♀♀ (seen in BMNH), from Singapore and Java respectively. The 2 have long been considered conspecific with each other, and have generally been placed as synonyms of *striatus*. Stone (1972: 637, 640) synonymized them under *tenens*. I consider them to be the same as *megalops*.

The type of *manilensis* is a ♀ in Vienna Museum from Manila, Philippines. The original description and subsequent writers have stated that there is only 1 type, but Delfinado & Hardy (1971:20) have listed it as "syntype 1♀". I have not seen the type, but I have seen some specimens from central Luzon including 1 at hand (R.R. Pinger coll.) which do appear to be conspecific with the Thailand material. Thus I find no reason at present to doubt that *manilensis* is a synonym of *tenens* and *megalops*, as first placed by Senior-White (1927:53). Philip (1959:607) made the only type comparison statement about *manilensis* since the original description. *T. megalops* is hence one of the very few species which the Philippines has in common with the Asian mainland. It was on this species and not on true *striatus* that Mitzmain conducted his Philippine biology and surra transmission studies.

T. strophiatius was a new name created by Surcouf for what he called "*striatus* auctorum." He recognized 2 species in which the median abdominal stripe crossed the 2nd tergite, 1 of them with "Pattes sombres" which he called *partitus* Walker, the other with "Pattes testacées" which he called *strophiatius*. Philip (1959:606-608) placed *strophiatius* as a questionable synonym of *striatus*, stating inaccurately that Surcouf's proposal was "based solely on the presence of the median band on tergite 2." Stone (1975:71) switched *strophiatius* to a questionable synonym under *tenens*, presumably due to the reported coloration of the 2nd tergite of each. I am switching *strophiatius* into synonymy under *megalops*, as I believe that Surcouf based his new name on specimens which are conspecific with those being reported here from Thailand. In the Paris Museum is a long series of specimens (I counted 69) associated under a box-bottom label reading "*T. strophiatius* Surcouf/nom. novum/=*striatus* auctorum". I was told that the label was written by Ségué, but I think the association can be taken as a true reflection of Surcouf's concept. All but the last 13 specimens are labeled "I N D E M E R I D I O N A L E / T R I C H I N O P O L Y / F. C A I U S 1 9 1 1". Surcouf would probably have been the first to examine these, and they bear no individual determination labels. Of the last 13 specimens, some are unlabeled and some show Mindanao. A total of 3 specimens show either Singapore or Sumatra, and these 3 were determined by Kröber in 1921 as *striatus*. Surcouf did

not indicate which "auctorum" he had in mind as misdetermining *striatus*, but Kröber must have been 1 of them (if not the only 1), as these 3 specimens would almost certainly have been in front of Surcouf at the time of his writing. Actually, Kröber had not yet published on these specimens, but did so very shortly (1924:19). A lectotype, when designated, should be selected from among these 3 specimens in order to tie the name down. I was not fully aware of the desirability of such a designation during my visit, and do not wish to do so now since the specimens are not at hand.

Biology. Isaac (1925a:97-102 and Pl. 12-14) has worked out various detailed aspects of larval head morphology (as *tenens*), as well as a brief life history (1925b:23-24, and Pl. 5-7 & 9). Life history studies on this species have almost certainly been published elsewhere under the name *striatus*. In Thailand *megalops* and *striatus* tend to displace one another, with *striatus* occupying the more northern and *megalops* the southern latitudes, though there is a considerable zone of overlap and the 2 are known to fly together (see under

striatus taxonomy). *T. megalops* was taken as far north as Mae Sot (Tak Prov.), but is probably quite scarce anywhere north of the lower Chao Phya plain. It can be called a lowland plains species, with nearly all known Thailand localities very close to sea level, but ranging up to 200 m at the Mae Sot sites. It was common around Bangkok and Satun, and its presence at these and other near-coastal localities suggests a tolerance to, and possibly even a preference for, brackish water. The species is known to be present the year round at both coastal and inland localities in the southern peninsula, and this is probably also true at Bangkok. Populations appear to decline during the rainiest months, but this may be an artifact of human collecting inconvenience. Recorded host interest includes water buffalo, cattle, horses, and deer; many were taken at rest on vegetation and animal sheds; some were taken by Malaise trap, canopy (Catts) trap, in buildings, and at light at night. Flight activity was observed at least as early as 1000 hours, throughout the day, and during the last hour before darkness. There may be a preference for the final hour, but much attack activity occurred in the heat of the day.

Tabanus jucundus Walker Fig. 40

Tabanus jucundus Walker, 1848, List Dipt. Ins. British Mus. 1:187.

Female. Length 11-13 mm. **Head.** Frons slightly divergent above, index 1:3.7-4.8; tomentum yellowish above callosity and broadly gray at vertex, the 2 areas separated by a band which is yellowish when viewed from above but blackish when viewed from below; hairs on yellow portion pale, those on changeable and gray portions mostly to entirely black; an "ocellar vestige" of sorts occurs in the gray portion, with diagonal rays pointing inward to it from below. Callosity brownish black to black, essentially rectangular, large and rather protruding, filling approximately the lower 2/5 of frons; dorsal extension variable from entirely absent to linear below and knobbed above. Eye (relaxed) with the following banding pattern from top to bottom: purple field above with light green margin on lower border—2 blue-green bands which alternate with 2 reddish bands that have light green borders—dark bluish field below. Subcallus with very pale yellowish tomentum; face with white tomentum (ventral aspect somewhat grayish) and white hairs including beard. Antenna with scape white haired, some black hairs on and near dorsal apex; flagellum orange, the apical annulus may be somewhat darkened at tip, dorsal tooth of plate obtuse to rounded and low. Palpus with basal segment grayish to creamy white and white haired; apical segment creamy white, white haired at base, beyond the base mostly white haired but with some black hairs. **Thorax.** Dorsum strongly striped with grayish black to brownish black lines which alternate with 4 pale lines, the hairs mostly agree with the underlying pattern though some black hairs are

scattered on the pale stripes; the broad black band on the midline extends all the way to the apex of the scutellum. Venter and coxae gray with white hairs; fore femur gray on outer face and with mixed white and black hairs, other femora pale gray, yellowish apically, mostly to entirely white haired; fore tibia mostly brownish yellow with pale hairs, blackened and with black hairs apically, other tibiae brownish yellow with mixed hairs. Wing hyaline; 1st P cell open; anterior branch of 3rd vein variable from curved to possessing a very short spur vein; halter stem pale yellow, knob yellowish white. Dorsum strongly striped with black and white as follows: median of tergite 1 broadly blackened, the black area becoming progressively broader from base to apex of 2 but bifurcating at midline somewhere between middle and extreme apex of 2 due to the intrusion of a stripe of creamy white tomentum which extends to somewhere between the base and the apex of 6; sublateral black stripes begin independently on 1 but merge with the submedian black stripes at the apex of 2 or base of 3, the sublateral white stripes usually occur only on 1 and 2 but may show some disjunct manifestation on 3; lateral white stripes extend from 1 through 6; hairs generally agree with underlying pattern. Venter gray with mostly whitish hairs, relatively undifferentiated though very slightly darker about the median when viewed with the naked eye, and sternite apices very narrowly yellowed. (4)

Male. None taken in Thailand. But the type itself is a ♂, and this sex has been adequately

published (e.g., Stekhoven 1926:148). It is easily associated with the ♀ on the basis of thoracic and abdominal striping, etc.

Type data (♂): "Hong Kong" on older label, and "Hong Kong./Pres. by J.C. Bowring/48-60" on another label. (Seen in BMNH.)

Published records. To the east, localities in upper W. Pakistan; N and SW India, and Ceylon have been recorded (e.g., see Ricardo 1911:164). To the west, in addition to the type locality there are the following records: "Indochine méridionale", by Toumanoff (1953:203), and indeed I saw 1 specimen in Pasteur Institute of Paris which was correctly identified here, without benefit of any locality label, that must have been the basis of Toumanoff's record. **PHILIPPINES:** Mindoro: San José, 4♀♀ by Philip (1959:611). I have at hand 1 of these specimens (from Philip collection) which disagrees with all the mainland specimens I have seen in that the frons is much broader (index 1:2.5) and parallel sided, and the callosity is a great deal more bulbous. If the other 3 specimens (in California Academy of Sciences) share this degree of divergence, then I think the Philippine population represents a new daughter species.

New records. CHINA [no further locality

or date]: 1♀, in USNM. **THAILAND:** Loei Prov.: Loei & vic. 17°29'N 101°44'E: 1♀, 6 June 1969 (C. Dettongchai; Chanthaburi Prov.: Tha Mai Dist. 23 km NW of Chanthaburi) 12°43'N 101°59'E: 2♀♀, 20 June 1969 JB & 22 June 1969 A. Wanchitnai.

Taxonomy. This species is quickly separated from the "*striatus* complex" by the much stronger thoracic striping and the frons characters. It shares the strong thoracic striping and the eye banding (though not the details) with *dorsilinea*, but these are easily separated by the frons characters, robustness of body, etc. See also under published records.

Biology. The 2 known Thailand localities represent approximately sea level and 250 m, and both are in essentially flat areas; but the N. India localities attain over 2130 m. The type is likely to have been collected not far from sea level, though several spots within the colony of Hong Kong are over 920 m. In view of the extensive range and diverse localities, it is hardly possible to categorize the species by habitat, and its apparent uncommonness is even more difficult to understand. Known seasonal range in Thailand includes only June. Host interest was recorded in horses and water buffalo.

Tabanus dorsilinea Wiedemann Fig. 42

Tabanus dorsilinea Wiedemann, 1824, *Analecta Ent.* p. 22. (*dorsolinea*: Bigot, 1891a:267-268; *dorsilineata*: Wu, 1940: 186—*lapsus*.)

Atylotus macer Bigot, 1892, *Mém. Soc. Zool. France* 5:649. (New synonym.)

Tabanus bicallosus Ricardo, 1909, *Ann. Mag. Nat. Hist.* (8)3:489-490. (New synonym.)

Tabanus trichinopolis Ricardo, 1914b, *Ann. Mag. Nat. Hist.* (8)14:359-360. (New synonym.)

Female. Length 9.5-11 mm. **Head.** Frons divergent above, index 1:4.8-6.3; tomentum below median callus brownish yellow, beside and above median callus usually brownish, a grayish V at vertex, hairs mostly pale yellow but with black hairs concentrated at vertex. Basal callus yellowed, essentially rectangular or rounded below, very closely paralleling eye margins at sides; median callus black, quite variable in shape and size from rather large and rectangular to small and irregular; calli unconnected and widely separated. Eye in life with 3 red (or purplish) bands across principally green field, the field generally darkest above, lighter in the interband area, and variable below. Tomentum of subcallus and upper area of cheek yellowed, often also yellowish on upper area of frontoclypeus, remainder of face gray; hairs on upper cheek area pale yellowish, remaining facial hair including beard whitish. Antenna with scape pale haired, that on dorsal apex usually reddish orange, uncommonly with a few black hairs; flagellum orange, plate broad, dorsal tooth area large but obtuse and rounded, apical annulus elongate. Palpus with basal segment gray basally

and creamy white apically, hairs whitish; apical segment creamy white, plump basally and with whitish hairs, beyond the base usually with mixed whitish and black hairs but variable from entirely whitish haired to almost entirely black haired. **Thorax.** Dorsum strongly and distinctly striped with black and pale lines, the stripe at the midline broad, beginning gray on surface facing occiput, then becoming black and proceeding strongly all the way across both the scutum and scutellum in approximately equal breadth throughout; a sub-lateral black stripe on each side begins at about the same level as the blackening of the median stripe, but becomes bifurcate beyond the transverse suture; pale bands creamy white to quite yellow, the yellow coloration especially on the mesal half of the antealare and just above the extreme base of wing; hair color mostly matches underlying pattern. Venter and coxae mostly gray, pale haired, often with some yellow tint on upper part of mesopleurite, fore coxa sometimes pale brownish (tan); femora and tibiae essentially pale, orange yellow with some grayish white tomentum, hairs predominantly pale; fore tarsus mostly dark

brownish, darker than others. Wing hyaline; 1st P cell open; 3rd vein curved, angulate, or with a budline short spur vein; halter stem creamy yellow to yellowish brown, knob yellow to whitish yellow. **Abdomen.** Dorsum strongly and distinctly striped with black and pale lines, all black stripes begin on tergite 1, the 2 submedian black stripes fused on T1, diverge at or near the base of 2, and merge again on 7 (which is mostly black); the 2 sublateral black stripes begin independently but merge with the submedian stripes somewhere between the apex of 4 and the base of 6; at the midline a creamy white tomentose convex-convex stripe on 2-6 and sometimes partly manifested on 7; sublateral pale stripes mostly pale gray tomentose on 1, creamy white tomentose on 2-4 or 5; lateral margins of 1-7 broadly pale tomentose; most hairs on entire dorsum essentially agree with underlying pattern. Venter with pale tomentum throughout, but underlying integument varies from yellow to blackened; hairs on 1-5 all pale, or occasionally a few black hairs on 5, 6 with mixed pale and black hairs, 7 almost entirely or entirely black haired. (15) [Thailand only.]

Male. The usual sexual differences, but easily associated with ♀ without confusion. None were collected in Thailand, but I have examined Indian ♂♂ including the type itself and that of *macer*.

Type data (♂): Given by Wiedemann as "Ostindien." The label on the type shows: "*T. dorsilinea*/Wied./Ind. or." (Seen from Copenhagen Museum.)

Published records. Many Indian records have been published under the junior synonyms of this name, as well as records in the upper part of W: Pakistan (e.g., see catalog of Senior-White (1927:44)). Though the species seems to be very widespread in India (including the far north and far south), the vast majority of records are west of 81°E. Indeed, the only published locality which I can pinpoint that lies farther to the east is Pusa, in Bihar State at 25°59'N 85°40'E, the type locality of *T. bicallosus*. At this locality, it was common enough to be the subject of life history research for some years, culminating in the excellent paper of Isaac (1925b:21-22 & Plates 5-8). The type locality of *dorsilinea* is also eastern India, but cannot be further delimited.

New records. INDIA: Bangalore, July 1957, 1♂ from USNM. **THAILAND** (all 1969): Mae Hong Son Prov. (vic. SW of Mae Hong Son) 19°17'N 97°58'E: 3♀♀, 12-14 May JB; Chiang Mai Prov.: Huai Kaeo (~4 km NW of Chiang Mai) 18°48'N 98°57'E: 2♀♀, 2 & 8 May JB; 3♀♀, 15 July P. Chaemmanee; Chiang Mai Prov.: Doi Pui (a Maeo vill.) 18°49-50'N ~98°53'E: 1♀, 3 May JB; Tak Prov.: Mae Sot Dist. (~5 km E of Mae Sot) 16°43'N 98°37'E: 10 July JB; Loei Prov.: Loei & vic. 17°29'N. 101°44'E: 1♀, 11 May C. Dettongchai, 1♀, 25 May CD, 3♀♀, 1-7 June CD.

Taxonomy. The Thailand ♀♀ diagnosed as a composite above differ from all the India ♀♀ I have seen (29♀♀ in BMNH) as follows: the pale stripe on the midline of the abdomen does not cross tergite 1 since the submedian black stripes are fused on it; while in the India specimens the pale stripe completely crosses T1. Also, the sublateral pale stripes of the Thailand specimens usually taper out by the apex of tergite 4, or if present on T5 then they are very slight; in the India ♀♀ the submedian pale stripes are always displayed on T5 and generally beyond. These distinguishing features of the striping do not always hold true in the ♂♂. Isaac (1925b:Plate 8 Fig. 1a) has figured the ♀ (as *macer*) as having the sublateral pale stripes strongly yellowed; but I have observed this to be a variable character among the India ♀♀, and so cannot serve as a differentiating character. The dark stripes on the Thailand specimens are blacker, but this may be due to the fresher condition.

In view of the difference in extent of abdominal stripes and the apparent (but essentially untested) geographic separation, some workers would regard the Thailand population as a candidate for a new subspecies. But I have an aversion to this methodology, and in this case (as in most other Oriental situations, where the fauna is so incompletely known) there is insufficient information available to make the necessary taxonomic analysis for such a rank. (See Wilson & Brown 1953). Alternatively, the Thailand population may eventually prove to be a different species from that in India, but again there is too little known at present to properly assess the importance of the extent of the stripes. In other striate Oriental species, this criterion sometimes provides a good separation between species but in other cases it is quite variable within a given species even at a single locality. Whatever is eventually decided about the Thailand population will have no effect on the synonymy presented here, as all 4 names have Indian types.

The syntype ♀ and syntype ♂ of *bicallosus* were seen in BMNH, and the conspecificity of these specimens with the type (a ♂) of *macer* (also seen in BMNH) is reconfirmed. This can be stated despite the condition of the *macer* type itself, which even in the original description over 80 years ago was given as "très détérioré". Ricardo (in her description of *bicallosus*) was, I believe, correct in pointing out that the species is "very nearly allied to *Tabanus gratus*, Loew" of principally Ethiopian region distribution. The syntype female (♀) of *bicallosus* is herewith established as lectotype.

The BMNH also contains 2♀♀ and 2♂♂ all of which are labeled as paratypes of *trichinopolis*. The conspecificity of all of these with both *macer* and *bicallosus* is also reconfirmed (the synonymy of both *bicallosus* and *trichinopolis* under *macer* dates from Austen 1922b:264). However, there

is a mystery surrounding the type series of *trichinopolis*. Ricardo's original description clearly stated that she was designating a male type and a female type, but had at hand "another male and female from the same locality." She also stated by way of introduction that the material was sent to her "for identification by M. Surcouf from the Paris Museum..." I did not find any such types in the Paris Museum; nor, for that matter, do I have a record of seeing any specimens at all of the zoological species in question in Paris. Thus it appears to me that none of the 4 original specimens were returned to Paris; instead all ended up in BMNH and came somehow to be labeled "Para-type". I have asked Mr. Oldroyd of BMNH if he concurred with this assessment of the situation, and his reply was affirmative. He added that a handwritten label on each specimen shows "Presented by the Paris Museum August 1914" in addition to the paratype-designation label on each. He further related that the handwriting on all these labels is that of Frank Barnett, assistant to E.E. Austen; that both of these men marched off to war in August 1914 leaving unfinished work; that Barnett was apparently later responsible for incorporating these specimens into the collection, which he must have done on the mistaken assumption that the type had been returned to Paris and hence labeled all 4 specimens before him as paratypes without checking the original description. Ricardo's description gave no indication just which ♀ and which ♂ were being selected as the types. I have asked Mr. Oldroyd to choose the more appropriate of the 2♀♀ and affix a holotype selection label to it. He has now done so, and reports that the specimen selected is "the female that is in better condition, preserving the pattern of thorax and abdomen; this specimen can be distinguished by having the pin fixed to the celluloid stage by a lump of brown adhesive." This ♀ is herewith designated as holotype. The species name was based on the type locality of Trichinopoly, which has since changed its name to Tiruchirappalli, and is located in the central part of Madras State, southern India.

The type of *dorsilinea* was borrowed from Copenhagen (Universitetets Zoologiske Museum), courtesy of Dr. L. Lyneborg. It is in quite satisfactory condition, and is immediately recognizable as conspecific with *macer* and its

synonyms. Wiedemann's name is senior to Bigot's by some 68 years, and is herewith established as the valid senior synonym of the taxon. The first listing of *dorsilinea* in synonymy under *striatus* which I can find in the literature was by van der Wulp (1880:163-164), and subsequent authors reiterated this synonymy, some of them indicating that it was questionable, and some others shifting it to fall under *tenens* according to their interpretation of taxa within the *striatus* complex. Since Wiedemann's writings, no subsequent worker until now has given any formal indication of having made a type comparison with *dorsilinea*, and as a result the incorrect synonymy has stood for at least 94 years. *T. dorsilinea* is more slender bodied and generally smaller than *striatus* complex members, and ♀♀ are conclusively separated by the frons characters. There was a period dating from Ricardo (1911: 149-150) when *dorsilinea* and *macer* were actually brought together and listed as conspecific for a time because both were in turn interpreted as junior synonyms of *striatus*. I maintain that these 2 wrong synonymy listings do not make a right however, and believe that the presently proposed synonymy should be regarded as new.

Biology. For Indian biology, see Isaac (1925b) (as *macer*). The following comments refer only to Thailand unless stated otherwise. In Thailand (as in India), it is difficult to generalize about collecting localities since they include both mountain and river valley situations. Altitude range is from about 200 m at Mae Sot up to a possible 1650 m on Doi Pui. It seems likely that the species is approaching its southern limits in upper Thailand, though further collecting may reveal it further south than Mae Sot in the western mountains. Known seasonal range is 2 May to 15 July, both extremes reached just outside of Chiang Mai, and certainly artificially short. Host interest was recorded in water buffalo, elephant, cattle, and horses, and several were taken resting on trees. At least several (if not all) of those collected attacking animals by me were taken during the last hour before darkness, and I venture to say that this is the preferred time of biting, though they may or may not be restricted to it. Some early work in India showed this species (as *bicallosus*) to be experimentally capable of transmitting surra.

Tabanus rubidus Wiedemann Fig. 44

Tabanus rubidus Wiedemann, 1821, Diptera Exotica 1:69-70.

Tabanus ? lageniferus Macquart, 1838, Mém. Soc. Roy. des Sci., de l'Agr. et des Arts, Lille, 1838(2):152.

Tabanus priscus Walker, 1848, List Dipt. Ins. British Mus. 1:176.

Tabanus sinicus Walker, 1848, List Dipt. Ins. British Mus. 1:163.

Tabanus albimediis Walker, 1850b, Insecta Saundersiana, Dipt. 1:48.

Tabanus umbrosus Walker, 1850b, Insecta Saundersiana, Dipt. 1:52.

Tabanus vagus Walker, 1850b, Insecta Saundersiana, Dipt. 1:50-51. (Not Walker 1850a—Hong Kong.)

Atylotus lacrymans Bigot, 1892, Mém. Soc. Zool. France 5:669-670. (*lachrymans* of some authors—*lapsus*.)

Tabanus ? annamiticus Surcouf, 1911, Rev. Méd. Hyg. Trop. 8(1):42-44. (New synonym.)

Tabanus rubidus subform *priscooides* Schuurmans Stekhoven, 1926, Treubia 6, Suppl.:206-208.

Tabanus rubidus subform *violaceus* Schuurmans Stekhoven, 1926, Treubia 6, Suppl.:204-206.

Female. Length 13-19.5 mm. **Head.** Frons slightly divergent above to nearly parallel sided, index range at least 1:4.3-6.4 (from selected sample only); tomentum yellow to whitish, yellowish brown when viewed from below; a small bare spot may or may not be present below vertex; hairs variable, commonly pale below and predominantly black above. Callosity and extension usually brown but variable from deep yellow to blackened, callosity inverted U or V shaped, more or less truncate below and sometimes pitted; dorsal extension linear and generally not broad. Subcallus and upper cheek corners yellowish to whitish; face white with white hairs including beard. Antenna with scape usually mostly white haired and with a variable amount of black hairs above, the dorsal apex sometimes with a few orange hairs; plate not very broad, dorsal tooth generally acute but rather low, sometimes obtuse, flagellum often entirely black but plate frequently orange basally, the blackening sometimes not beginning until the apical 1/3 of plate. Palpus creamy white, basal segment commonly entirely white haired but occasionally with a few black hairs apically, apical segment generally mostly white haired with scattered black hairs, but variable from entirely white haired to mostly black haired beyond the base. **Thorax.** Dorsum mostly brownish gray, mostly black haired centrally but with much pale hair peripherally and scattered anteriorly; poorly defined areas of paler tomentum create a striped appearance; scutellum often bicolorous, with the base dark and the apex orange brown. Venter and coxae essentially gray with white hairs, mesopleurite partially black haired; fore femur highly variable on inner face from orange brown to black, outer face variable whitish to gray with white hairs, other femora yellow to rather dark gray with mostly white hairs; fore tibia pale over most of its length, blackened or at least darkened apically, other tibiae pale with mostly pale hairs on inner face and mostly black hairs on outer face. Wing commonly hyaline or only very slightly tinted, but sometimes with a more discernible tint which may to some extent follow the venation or be a bit stronger below the stigma; 1st P cell open; anterior branch of 3rd vein curved, rarely slightly angulate; halter stem yellow, knob generally yellowish white. **Abdomen.** Dark areas of dorsum variable from brown to rather blackish and black haired; highly variable pale markings as follows: median stripe of pale tomentum present on tergites 1-6 which may be rather narrow and linear or appear as a series of connected narrow triangles, some of the overlying hairs are black which gives the stripe a rather poorly defined appearance; a series of sublateral rather diagonal and also rather poorly defined pale spots present on 2-5 and indicated on 1 partly by a pale basal area; lateral margins of 1-6 pale with pale hairs.

Venter highly variable from dull orange to dark gray, lateral areas and extreme apices of sternites 2-5 pale haired but with a median stripe of black hairs which varies in intensity depending on how much pale hair is also present on the central area and is often difficult to discern, 6 similar but generally with black hairs scattered throughout, 7 mostly to entirely black haired. (2090+)

Male. In addition to sexual differences, the body has a more reddish cast, the antennal plate generally remains orange throughout, and the wing is often tinted in the costal area. See descriptions in literature, e.g. Schuurmans Stekhoven (1926). It is not now certain that ♂♂ of this species can always be accurately separated from those of some closely related species, e.g. *pristinus*. (129)

Type data. Original series said to contain 3♀ syntypes (seen from Copenhagen Museum), though Wiedemann's writings (1821, 1828) give no reason to think that more than 1 specimen was involved originally; hence the specimens may be additions and/or substitutions. Collecting data given only as "Bengalia" in original description, i.e. Bengal (now including the Indian state of West Bengal plus East Bengal which has become independent Bangladesh). The lectotype selected (see below) possesses no collecting data label.

Published records. This tremendously common species has been reported from W. Pakistan to the Philippines and China to Indonesia, though many records both inside and outside of its true range are surely the result of lumping. The Philippines have recently been deleted from the distribution (Chvála & Lyneborg 1970a:365). All of the Indochina area countries except Laos have been reported.

New records. Due to the tremendous quantity of specimens at hand, only the provinces, districts, date range and numbers for each district are recorded here. The great majority were collected by the writer and his assistants. LAOS: Luang Prabang Prov.: 13♀♀ from Luang Prabang, 2-3 Aug.; Sayaboury Prov.: 15♀♀, 1♂ from Sayaboury, 4 Feb.-23 May; Vientiane Prov.: 1♀, 1♂ from Muong Phone Hong, 14 May-17 July. CAMBODIA: Kampot Prov.: 2♀♀ from Damrey Phong, 14-16 Apr.; Kandal Prov.: 1♂ from Phnom Penh, 6 Dec. S. VIET-NAM: Bien Hoa Prov.: 8♀♀, 1♂ from Long Binh; Quang Tin Prov.: 1♂ from Chu Lai, 3 Mar. THAILAND: Mae Hong Son Prov.: 82♀♀, 39♂♂ from Mae Sariang Dist., 11-14 May; Chiang Rai Prov.: 8♀♀ from Mae Sai Dist., 17 July; Chiang Mai Prov.: 57♀♀, 16♂♂ from Fang Dist., 4-5 May; 2♀♀ from Chiang Dao Dist., 7 May; 105♀♀, 3♂♂ from Muang Chiang Mai Dist., 2 May-15 July; Tak Prov.: 5♀♀ from

Mae Sot Dist., 9-10 July; 20♀ from Muang Tak Dist., 8 July; Loei Prov.: 73♀ from Dan Sai Dist., 18 Apr.-10 June; 1♀ from Chiang Khan Dist., 17 Apr.; 735♀, 10♂ from Muang Loei Dist., 14 Apr.-6 July and 1♀ 13 Sep.; Sakon Nakhon Prov.: 14♀, 33♂ from Muang Sakon Nakhon Dist., 22-23 Apr.; Ubon Ratchathani Prov.: 19♀ from Phibun Mangsahan Dist., 22-24 July; Nakhon Ratchasima Prov.: 2♀ from Pak Chong Dist., 25 June & 5 Sep.; Saraburi Prov.: 1♀ from Muak Lek Dist., 25 June; 1♀ from Phra Phutthabat Dist., 14 Oct.; Prachin Buri Prov.: 1♀ from Kabin Buri Dist., Oct.; Nakhon Sawan Prov.: 2♀ from Muang Nakhon Sawan Dist., 27 June; Kanchanaburi Prov.: 1♂ from Sai Yok Dist., 29 Mar.; Phra Nakhon Prov.: 143♀, 12♂ from greater Bangkok area, 1 Feb.-28 July; Chon Buri Prov.: 449♀, 5♂ from Si Racha Dist., 12 Feb.-13 July; 1♀ from Ban Bung Dist., 17 Nov.; Chanthaburi Prov.: 3♀ from Tha Mai Dist., 19 Feb. & 21 June; 1♀ from Mahkam Dist., 20 Feb.; 6♂ from Laem Sing Dist., 22 Feb.; 35♀, 3♂ from Muang Chanthaburi Dist., 19-21 Feb. & 21 June; Chumphon Prov.: 25♀ from Tha Sae Dist., 12 June; 54♀, 2♂ from Muang Chumphon Dist., 13 June, 2-3 Aug., 1-2 Oct. & 1 Dec.; Ranong Prov.: 6♀ from Kra Buri Dist., 11 June; 2♀ from La-un Dist., 12 & 16 May; 3♀ from Muang Ranong Dist., 10 June; Phangnga Prov.: 4♀ from Muang Phangnga Dist., 5 & 6 June; Phuket Prov.: 4♀ from Thalang Dist., 7 June; 2♀ from Kathu Dist., 8 June; 1♀ from Muang Phuket Dist., 7 June; Krabi Prov.: 2♀ from Muang Krabi Dist., 4 June; Trang Prov.: 11♀ from Muang Trang Dist., 11 Mar.; Nakhon Si Thammarat Prov.: 1♀ from Muang Nakhon Si Thammarat Dist., 3 Apr.; Songkhla Prov.: 21♀ from Rattaphum Dist., 21 Feb.-8 May, 10 Sep.-5 Oct., & 6-16 Dec.; Satun Prov.: 147♀ from Muang Satun Dist., collected in all months except January and June.

Taxonomy. In view of the large amount of intraspecific variation seen in a long series, it is difficult to define species limits and relationships. A good deal more reassessment of the *rubidus* group regionwide may be necessary before it is correctly understood. In the present paper, *virgulus*, *pristinus*, *rusticatus*, and *fontinalis* are members of the group; and *quadrifocus*, *firmus*, and *griseilineis* are in a sense peripherally related to it. See under these species and in key for morphological distinctions from *rubidus*. In addition to the abdominal pattern, considerable reliance is placed on the "modest" (not broad) antennal plate of *rubidus*, which is at least apically darkened if not extensively blackened; and the "modest" callosity.

Junior synonyms were assigned to *T. rubidus* by roundabout means and not through type comparisons. In fact, other than the notation that 3♀ syntypes exist, the only commentary which has been published on the original specimens was by Chvála & Lyneborg (1970a:365), who contrasted *rubidus* with a new Philippine

species. Dr. Lyneborg has kindly loaned me the 3 *rubidus* syntypes from the Copenhagen Museum, and I find that they belong to 2 different species. Wiedemann's description did not indicate how many specimens were before him, but I believe that he did not describe (or include in a composite) the odd specimen with broad abdominal triangles, since he stated "vitta media e maculis angustis trigonis..." All 3 specimens are in good condition, and all bear machine printed labels showing "Mus. Westerm." plus modern red labels showing "TYPE". The specimen which does not agree with the other 2 bears an old handwritten label showing "T: *rubidus* Wied./Java/May 1815." The other 2 specimens are in close agreement with each other, and either would make an appropriate lectotype in accordance with the literature. One of them has an old handwritten label showing "Java", and the other has no further labels at all. I herewith designate as lectotype the specimen which bears no locality label, as there is a chance that it is from Bengal. I do not wish to invoke the geographic argument excessively, however. The non-specific specimen appears to me to be near, if not, *T. speciosus* Ric., which is known only from India and Ceylon and not from Java; hence a question about label accuracy (or about original reporting of the type locality) is opened. To further distinguish it from the other 2 specimens, the lectotype has a small lump of glue or some other extraneous material on the lower part of its right cheek and beard. This lectotype designation preserves the general usage of the name, including the retention as junior synonyms of those types listed above which are deposited in BMNH. The characters of the lectotype fall into the range diagnosed above, though overall it is paler than recent specimens, likely due to age and preservation. The scutellum is bicolorous, and the pale median abdominal stripe is slender and serrated. The wing is hyaline (untinted), and the slender antennal flagellum is blackened beyond the dorsal tooth of the plate.

The synonymy is lengthy. *T. lageniferus* was first placed here by Philip (1960b:55), who called it "an undoubted synonym from the head characters..." I too have now examined the type (in Paris Museum), which is and apparently always has been in bad condition (Macquart noted "Abdomen mutilé!"). There are no geographic clues available. I should have liked to agree with Philip without hesitation; however, the fact that there is a "spot" in each wing representing a rudimentary spur vein causes me to consider the synonymy questionable. Spur veins are absent and even true angulations of the anterior branch of the 3rd vein are rare in the extremely long series at hand. Ricardo (1911:156) originally synonymized *priscus*, *umbrosus*, *vagus* and *lacrymans* with *albimediis*; and this latter in turn was later placed under *rubidus*, for which Ricardo is also largely responsible. All of these types except *rubidus* are in BMNH; I have seen the BMNH types and confirm their conspecificity. *T. sinicus*

Wälker (not Bigot) was first placed as a synonym by Stone (1972); I have seen this type in BMNH and concur with Stone's action, insofar as it is possible to make an accurate association from a ♂ in this species group, and the type is partially damaged in addition. *T. annamiticus* is herewith entered as a questionable synonym of *rubidus*; the situation is discussed under a separate *annamiticus* heading. As for the Stekhoven "subforms", *priscoides* is properly listed in synonymy as a matter of objective definition (see under *pristinus*); *violaceus* may or may not be a true, full synonym—this is yet to be assessed. Stone (1975:68) listed *vagus* Walker (1850a, Zoologist 8:lxviii) as a synonym of *rubidus* as well. Walker used the name *vagus* twice in the same year for what must have been 2 different species, as the 2 original descriptions are not at all in good agreement, and hence could not be synonyms of the same species. The type of the "Zoologist 8" *vagus* has been lost at least since the time of Ricardo (1911:234); and its original description does not agree with *rubidus*. Thus all the evidence is against placing the "Zoologist 8" *vagus* as a synonym under *rubidus*, and I herewith remove it from that synonymy; but the "Insecta Saundersiana" *vagus* remains as a synonym of *rubidus*. The "Saundersiana" *vagus* is a junior homonym of the "Zoologist 8" *vagus*. For a discussion of priority of the 2 Walker papers in question, see under *megalops* herein, as a similar homonymy was created for the name *tenens* in exactly the same 2 publications.

Biology. Much has been written about the life stages of *rubidus* in Indonesia and India (e.g., Singh 1968); and surra transmission experiments in both these countries were positive. The following comments refer only to Thailand. The

species is present throughout the country, and is without doubt one of the several most common species. It almost certainly reaches pest proportions for at least part of the year over most of the country. It appears to clearly prefer more open plains situations rather than hilly jungle tracts. It is "domesticated" in the sense that it may spend extended periods resting around human habitations and hence near domestic livestock, rather than retreating quickly. When present, both sexes may be easily collected from trunks of coconut and other trees. There is certainly some seasonality at any given locality in terms of population fluctuations, though it seems to be well adapted to both the very dry and the wet seasons. It was collected by me from sea level coastal situations up to 500-600 m at Fang in the far north, and I have seen several specimens labeled 1278 m from Doi Suthep outside of Chiang Mai. Host interest is recorded in water buffalo, cattle, elephants, horses, and deer, many were collected resting on sheds, trees and other vegetation, and some were taken at lights at night, in Malaise trap, in vehicles, and in buildings. A few were seen resting near hogs but no attacks were observed. An assistant collected a pair in Loi on 16 April 1969 at 1430 hours, and related the following: the ♀ was observed sitting on a vertical board of the eaves of a house. Before he had a chance to catch it, a ♂ flew in and appeared to undertake copulation. He caught them right away, and they parted as soon as they were caught. The ♀ apparently offered no resistance to the ♂, but they were only together for several seconds before being disturbed. Feeding activity was observed from at least as early as 1000 hours, throughout the day, and during the final hour before darkness.

Tabanus virgulatus Austen, Fig. 45

Tabanus virgulatus Austen, 1922a, Bull. Ent. Res. 12(4):446-448.

Female. Length 11.5-16 mm. **Head.** Frons slightly divergent above, index 1:5.5-6.8; tomentum somewhat brownish off-white becoming moderately darker when viewed from below; hairs black. Callosity brown to partially blackened, robust, triangulate, truncate and sometimes pitted below, dorsal extension dark brown to black, broadly linear or tapering above. Subcallus somewhat brownish yellow to yellowish white, generally contrasting very little with the color of the frons tomentum; face white with white hairs including beard. Antenna with scape mostly black haired above and white haired below; plate orange basally and darker orange to strongly blackened apically, dorsal tooth more or less right angled; annuli black. Palpus with basal segment gray to creamy white and white haired; apical segment creamy white, mostly white haired at base, becoming mostly black haired (rarely predominantly white haired) beyond the base. **Thorax.** Dorsum

dull brownish gray, poorly defined areas of pale gray tomentum appearing as stripes, hairs mostly black, with some pale hairs peripherally and scattered elsewhere. Venter and coxae pale gray with white hairs, mesopleurite partially black haired; fore femur black with black hairs on inner face and gray with white hairs on outer face, other femora gray becoming orange yellow at apex, mostly white haired but with some black hairs; fore tibia yellowish basally becoming blackened apically, other tibiae yellowish and mostly pale haired on inner face and mostly to entirely black haired on outer face. Wing with a very light brownish tint (occasionally essentially hyaline) which is generally most discernible in the costal and subcostal cells and fades out toward hind margin of wing; 1st P cell open; anterior branch of 3rd vein curved; halter stem yellow, knob whitish yellow but usually darker at base. **Abdomen.** Dorsum mostly dark brown to brown-

ish black (tergite 1 gray basally), and with pale markings as follows: a distinct median stripe of whitish tomentum and hairs crossing tergites 1-6 which is smooth-sided or slightly uneven; a sublateral spot of pale tomentum and hairs present on each side of 2-4 and diminishing in size, sometimes also apparent on 5 and even 6 as small areas of paler tomentum, and this row is also represented on 1 by a patch of pale hairs; lateral margins of 1-6 pale with pale hairs. Sternite 1 usually pale gray with white hairs; 2 gray to dull orange, 3-6 dull orange to gray, 7 darkened, 2-5 mostly to entirely pale haired and with whitish gray tomentum laterally, but with a very broad central stripe of black hairs and darker tomentum which begins about 1/3 of the way from the base of 2, extreme apices remain pale, 6 similar but often more extensively black haired, 7 black haired. (63+)

Male unknown.

Type data (♀): "Siam:/Bangkok/Nov. 1919./F.J. Godfrey./1920-244." (Seen in BMNH.) The label is machine printed, and I believe it contains 2 errors. The "Bangkok" is almost certainly intended to be Bangkok; and, just as certainly, the collector must have been Edward John Godfrey, a British lepidopterist who taught and researched in Thailand for well over 20 years. His obituary appeared in 1933 in J. Siam Soc. Nat. Hist. Suppl. 9(2):264.

Published records. This species has been mentioned in the literature only twice since the original description. Philip (1960b:60) stated, "I suspect that this is a variant of *T. rubidus*..." Stone (1975:72) listed "Laos, Thailand" as the distribution. I searched in USNM for any specimens on which the Laos report might have been based, and found only 1 determined as *virgulatus* which, however, is not from Laos but from Assam, India (17-X-43/DEHardy). Stone has affixed a 2nd label showing, "*T. virgulatus*/Compared/with type/1971/A.S." I borrowed this specimen and made the same type comparison, and I cannot agree that it is conspecific with the type, though they are indeed closely related. The Assam specimen is larger (18 mm versus 16 mm for the largest of the *virgulatus* series), the dark pattern of the abdomen is blacker, dorsal tooth of antennal plate lower and more rounded, and tomentum of frons differs. Finally there is an important environmental consideration (see be-

low). Therefore, I wish to delete Assam (or "Laos", as reported) from the known distribution of *virgulatus*.

New records. THAILAND (all 1969): Chon Buri Prov.: Si Racha Dist.: Bang Phra Canton 13°13'N 100°57'E: 1♀, 28 Mar. P. Chaemmanee; Chanthaburi Prov. (~2 km S of Chanthaburi) 12°36'N 102°07'E: 14♀♀, 19 Feb. JB; 12♀♀, 21 Feb. JB; Chumphon Prov.: Pak Nam Canton (~10 km SE of Chumphon) 10°25'-26'N 99°15'E: 2♀♀, 13 June JB; Satun Prov.: Satun & vic. 06°38'N 100°04'E: 1♀, 7 Mar. P. Chaemmanee; 2♀♀, 8 Mar. JB; 1♀, 8 Apr. A. Wanchitnai; 1♀, 9 Apr. AW; 1♀, 10 Apr. AW; 2♀♀, 13 May AW; 4♀♀, 28 Aug. AW; 3♀♀, 29 Aug. AW; 1♀, 27 Oct. AW; 2♀♀, 28 Oct. AW; 1♀, 29 Oct. AW; 1♀, 30 Oct. AW; 3♀♀, 31 Oct. AW; 2♀♀, 3 Nov. AW; 1♀, 4 Nov. AW; 2♀♀, 5 Nov. AW; 2♀♀, 26 Nov. AW; 1♀, 27 Nov. AW; Satun Prov. (~3-6 km NE of Satun) 06°40'N 100°05'E: 2♀♀, 7 Mar. JB; 1♀, 8 Mar. JB.

Taxonomy. *T. virgulatus* is a member of the *rubidus* group. It can be distinguished from other known Indochina members by the robustness of the callosity. The pale median stripe on tergites 1-6 is narrow and rather well defined, and the frons tomentum is not as changeable when viewed at different angles as in some relatives.

Biology. All of the localities from which fresh material was collected are dominated by brackish coastal water; and Bangkok (the type locality) is even today under strong tidal influence, and would have been even more so in 1919 before so much fill dirt was used. Thus the evidence is very good that *virgulatus* breeding is restricted to brackish water situations. This will serve as another differentiation from its relatives considered herein, and is a reinforcement for the position that neither Assam nor Laos is a possibility. The Chanthaburi locality was quite productive in February (dry), with none of this species collected there during a revisit in June (very wet). Across the Gulf, June did yield 2 specimens near Chumphon (moderate). On the west coast, Satun had a low level population from March to May and August to November (which includes some very wet months). Host interest was recorded in water buffalo and in 1 case cattle, and some were taken by Malaise trap (with and without dry ice). Most specimens were collected during the after-

Tabanus pristinus new species Fig. 46

Holotype female. Length 18 mm. Head. Frons very slightly divergent above, index 1:6.0; tomentum whitish, becoming rather brownish when viewed from below, somewhat darkened at vertex and with a small shiny spot; hairs mixed pale and black. Callosity dark reddish brown,

triangular, tapering into concolorous rather broad linear dorsal extension which is somewhat constricted at base. Subcallus pale yellowish white; face white with white hairs including beard. Antenna with scape mostly white haired below and black haired above, the dorsal apex with

some orange hairs; plate broad, orange becoming rather blackened apically, dorsal tooth rather right-angled; annuli black. Palpus creamy white, basal segment almost exclusively white haired, apical segment with mixed white and black hairs.

Thorax. Dorsum gray, anteaerale paler, hairs mostly black but with some mixed pale hairs anteriorly and more concentrated pale hairs between wing base and scutellum apex. Venter and coxae gray with white hairs, some scattered black hairs on mesopleurite; inner face of fore femur black with black hairs, outer face gray with white hairs, other femora gray with white hairs, yellow at extreme apices; fore tibia yellow with mostly pale hairs basally, black with black hairs apically, other tibiae yellow with mixed pale and black hairs. Wing hyaline, stigma yellowed, costal cell sometimes yellowed; 1st P cell open; anterior branch of 3rd vein curved; halter stem and knob yellow. **Abdomen.** Dorsum mostly reddish brown with black hairs, a median stripe of paler (yellowish) tomentum runs from tergites 1 through 5 and even slightly on 6, the stripe formed from a series of slender triangles which more or less completely cross the respective tergites, ill-defined and gradually diminishing pale sublateral patches also present on 2-5, all of these paler areas with at least a small amount of scattered pale hair; lateral margins of 1-6 with pale tomentum and hairs; most of 6 and almost all of 7 darker, blackish gray. Sternites 1-6 yellow with yellowish white hairs, a few black hairs scattered at midline of 6; 7 mostly blackened with black hairs; whitish tomentum of venter seen when viewed from behind.

Paratypes (120♀). Length 15.5-19.5 mm. Frons very slightly divergent above to parallel sided, index range 1:4.8-6.7; tomentum whitish to quite yellowish, with the most yellowed and yellow haired fronses also tending to average the broadest indices. Callosity triangular to ovate, dorsal extension variable in width, both variable in color from brownish orange to rather blackened. Annuli of antenna always black, but plate varies from entirely orange to blackened apically and darkened elsewhere. Apical segment of palpus variable from almost entirely white haired to predominantly black haired. Thoracic dorsum gray to grayish brown. Anterior branch of 3rd vein occasionally angulate, rarely with a budlike spur vein. Pattern of abdominal dorsum quite variable, the pale stripe at midline sometimes rather narrow and fairly well defined, at other times broader and more indistinct, the sublateral pale patches may have no pale hairs; the reddish brown areas vary in tone from medium to dark. The sternites are sometimes quite darkened (probably due to abdominal contents showing through integument), and the apical sternites may often be naturally darkened; scattered black hairs may be present about the midline of 2-6.

Male unknown. Hypothetically, it may be very similar to that of *rubidus* (and some ♂♂

identified as *rubidus* might possibly be this).

Type series data. Holotype ♀: THAILAND: Chiang Mai Prov.: Huai Kaeo (~4 km NW of Chiang Mai) 18°48'N 98°57'E: 9 May 1969 about elephant John J.S. Burton 1715-1900 hrs. (In Cornell University.) The type locality was the environs of a zoological garden at the foot of Doi Suthep, at about 350 m altitude. Paratypes: total of 120♀, all from same locality and same year as holotype, but dates, hosts, collectors and times vary: 8, 2 May JB; 3, 8 May JB; 2, 9 May JB; 3, 10 May JB; 23, 10-15 May K. Somporn; 4, 18 May KS; 5, 19 May KS; 1, 20 May KS; 7, 21 May KS; 8, 22-23 May KS; 6, 25 May KS; 6, 26 May KS; 6, 27 May KS; 1, 31 May KS; 1, 1 June KS; 6, 6 June KS; 1, 9 June KS; 3, 10 June KS; 6, 11 June KS; 4, 12 June KS; 2, 13-14 June KS; 4, 15 June KS; 8, 16 June KS; 1, 17 June KS; 1, 16 July KS.

Also identified here but not designated as paratypes (all 1969 unless shown otherwise): THAILAND: Mae Hong Son Prov. (vic. SW of Mae Hong Son) 19°17'N 97°58'E: 1♀, 13 May JB; Chanthaburi Prov.: Makham Dist. (vic. of Makham) 12°40'N 102°12'E: 10♀, 20 Feb. JB; Chanthaburi Prov.: Tha Mai Dist. (23 km NW of Chanthaburi) 12°43'N 101°59'E: 39♀, 19 Feb. JB; Nakhon Si Thammarat Prov.: Phrom Lok Canton (20-24 km NW of Nakhon) ~08°31'N ~99°48'E: 3♀, 2 Apr. JB or A. Wanchitnai; 30♀, 3 Apr. JB or AW; Trang Prov.: Na Tham Nua Canton (~13 km N of Trang) 07°40'N 99°35'E: 83♀, 11 Mar. JB; Songkhla Prov.: Rattaphum Dist.: Tha Chamuang Canton ~06°58'N 100°08'E: 7♀, 5-6 Mar. JB; 25♀, 8-10 Mar. A. Wanchitnai; 19♀, 11-15 Mar. AW; 10♀, 17-20 Mar. AW; 7♀, 21-25 Mar. AW; 1♀, 30 Mar. AW; 19♀, 20-26 Feb. 1970 AW; Satun Prov.: Satun & vic. 06°38'N 100°04'E: 1♀, 14 Feb. 1970 AW; 1♀, 6 Mar. 1970 AW; Narathiwat Prov.: Waeng Dist.: Ban Khao Sam Sip: 1♀, Mar. 1969 Charoon Chan-Udom.

Taxonomy. The type locality produced specimens of this species in quantity, and the formal paratype series is being limited to this topotypic material, though specimens from the other disjunct localities are in essentially good morphological agreement. Specimens from lower Thailand may average smaller size, somewhat darker antennal plates, and paler middle and hind tibiae, but these are by no means consistent differences. Intraspecific variation in color patterns is very much the same as that found within *rubidus*.

In spite of its widespread (but localized) distribution, I have found no existing available name for this taxon. If specimens of it have been present in earlier collections, it has perhaps been lumped into *rubidus*. Although the 2 are clearly related, in a mixed series the great majority of *pristinus* can be separated with the naked

eye from ♀♀ of *rubidus* by the more reddish brown (versus grayish) color of the abdominal dorsum: (Some of the nominal species which have since come to be regarded as junior synonyms of *rubidus* were originally described on similar grounds of color pattern; but none of the type specimens I have examined seem to fit the present taxon.) the venter of *pristinus* generally does not develop an easily discernible broad, dark median stripe. The conclusive structural differentiation lies with the antennal plate, which is broad in *pristinus* and distinctly narrower in *rubidus*.

Schuermans Stekhoven (1926:206) created an interesting nomenclatural situation which may or may not be relevant to the species under consideration here. First it should be noted that by 1926 the names *albimediis* and *priscus* had come to be synonymized under *rubidus*, and Stekhoven would certainly have known this. Presumably during his BMNH visit in preparation for his monograph, he examined the *priscus* type and found that he agreed with this synonymy at the species level, but felt that his Javanese material was distinct at the "subform" level and that it was the same as the *priscus* type. Apparently believing that the name *priscus* could not be left intact if demoted in rank, Stekhoven created the new name *priscoides* and listed *priscus* as a synonym of it. Thus, even if the Javanese population which he had before him is indeed zoologically distinct from *rubidus* and *priscus* and is otherwise unnamed, the name *priscoides* is not nomenclaturally available for it because the latter name, as originally proposed, was only an unjustified replacement name for *priscus*. The "Type ♀ from India," which he stated to be in BMNH, must surely be an allusion to the type of *priscus*, as I found no specimens labeled *priscoides* in BMNH. The synonymy of these names is thus objective both because of Stekhoven's listing and because both names are based on the same type specimen. (Note that no type is designated for his *rubidus* subform *violaceus*, which is not shown to have any synonym.) In fact, the origin of the

priscus type is unknown. In view of the known distribution of *pristinus*, which includes the deep south of Thailand, it is possible that the range of the species could also include Java, and that it could be the same as Stekhoven's Javanese specimens of *priscoides* (some Thai specimens are not unlike his color figure, Plate 5 Fig. 3). But even if there were some way to demonstrate conspecificity, the name *priscoides* cannot be applied to the population at hand since that name is an objective synonym of *priscus*. I concur with the system of placing *priscus* in full synonymy under *rubidus*.

Toumanoff (1953:203) reported var. *priscoides* from "Indochine méridionale". His report may have been based on specimens of *pristinus*, but this is purely conjectural.

Biology. I can think of no explanation why the distribution of *pristinus* should be so disjunct. This is even more mysterious in that the species was fairly common in almost all the localities where it was found. The localities seem to have very little in common. Altitude range is from nearly sea level (e.g. at the Chanthaburi localities) up to about 350 m at the type locality. There is very good evidence of seasonality, but again almost no correlation can be made between northern and southern populations. At the type locality, it was present throughout the sampling period of 2 May to 16 July; the rainy season had already begun and was in full swing before long during that period. At the locality NW of Chanthaburi, the species was present in quantity in February but absent in mid-June during a revisit. At the Thā Chamuang (Songkhla Prov.) locality, it was found to be restricted to the period 20 February-30 March, thus during the driest season. Host interest was recorded in elephants, cattle, water buffalo, and horses; some were also taken resting near these hosts; some were taken by Malaise trap both with and without the use of dry ice. The time of day seemed to be no obstacle to activity, as specimens were taken from mid-morning up until darkness.

Tabanus fontinalis Schuurmans Stekhoven Fig. 47.

Tabanus fontinalis Schuurmans Stekhoven, 1926, Treubia 6, Suppl.: 161-162, Plate 6 Fig. 1.

Female. Length 14-20 mm. **Head.** Frons slightly divergent above to parallel sided, index 1:5.3-7.2 (from selected sample); tomentum white to brownish off-white when viewed from above, brown when viewed from below; hairs variable but commonly predominantly black haired above and mostly to entirely pale haired below. Callosity orange brown to brown or sometimes blackened, generally shaped like an inverted V with convex sides, the base may be truncate, rounded, or toothed; dorsal extension orange brown to blackened, generally linear but variable in width, some-

times with a slight convexity. Subcallus white to brownish off-white; face white with white hairs including beard, frontoclypeus sometimes partially pale brown haired. Antenna with scape black haired above and mostly white haired below; plate variable from black throughout to orange basally and blackened beyond the level of the dorsal tooth, dorsal tooth variable from markedly acute to obtuse and rounded; annuli black. Palpus with basal segment grayish white to creamy white and white haired; apical segment creamy white, hairs variable from almost entirely white through-

out to white basally and black beyond the base. **Thorax.** Dorsum blackish gray with black hairs, cut by 2 relatively distinct submedian stripes of pale gray tomentum and pale hairs, the lateral margins of scutum and scutellum similarly paler. Venter and coxae gray with white hairs, some dark hairs on mesopleurite; fore femur black with black hairs on inner face and gray with white hairs on outer face, other femora mostly gray (rarely yellowish) with areas of white and of black hairs; fore tibia pale basally becoming blackened and black haired apically, other tibiae generally pale, with pale hairs on inner face and black hairs on outer face. Wing may be construed as hyaline or with a very slight yellowish tint; 1st P cell open; anterior branch of 3rd vein curved; halter stem yellow, knob brownish at base and whitish elsewhere. **Abdomen.** Dorsum mostly blackened (basal segments sometimes brownish black), with pale areas as follows: a median stripe of whitish tomentum and white hairs crosses tergites 1-6, with the white hairs closely following the limits of the whitish tomentum to create a sharp stripe, though 6 and the bases of 2 and 3 may occasionally have black hairs, the stripe variable from very slender and linear to broader and/or with a tendency to form a series of connected triangles; 1 with sublateral gray basal areas which are at least partially white haired, sublateral spots of pale tomentum also present on 2-4 and sometimes also 5 which have a variable amount of white hairs, these spots sometimes appear to form a connected stripe on 1-4 but most commonly are not connected; lateral margins of 1-6 pale with white hairs. Venter with pale gray tomentum and white hairs, a very broad median stripe of darker tomentum and black hairs begins about 1/3 of the way from the base of sternite 2 and continues to the apex of 6, the extreme apices of some sternites with a white haired fringe, 7 with dark tomentum and black hairs. (174)

The above diagnosis is based on Thailand specimens only, and disagrees in some details with the original description, e.g., the femora of specimens at hand are almost always strongly gray and hence darker than described, and I do not consider the hind border of the scutum of specimens present to be "covered with long, white hairs" though this latter may be more of a difference in interpretation than of zoological discrepancy. In the color figure (1926: Plate 6 Fig. 1), Stekhoven's artist's conception has the dark part of the abdomen paler than the material at hand, the thoracic striping contrasts are very decidedly underemphasized, and the wing tint is overemphasized.

Male unknown.

Type data (♀): Type locality given in original description as Djambi, the collector Marsidi, and the depository: Veterinary State Laboratories [Bogor]. Djambi is a town in Sumatra located at

1°36'S 103°37'E; it is also the name of the surrounding province, which straddles the breadth of the island: I have not seen the type, and its present whereabouts is unknown. Stekhoven did not single out the date of collection or host for the type, but instead incorporated this data with that of the 11 paratypes. All were from Djambi, but various dates and hosts were involved, including the months of January, July, and September. Dr. T. van Leeuwen of Zoölogisch Museum, Amsterdam, has informed me that that institution has 3 specimens from "Djambi, buffalo" which probably belong to the type series but are not so labeled.

Published records. No records have been published since the original 12 specimens, and the only discussion of the species was by Toumanoff (1953), who contrasted it with *tenens* and his new "sous forme *cambodiensis*."

New records. THAILAND (all 1969 unless shown otherwise): Chiang Mai Prov.: Huai Kaeo (≈4 km NW of Chiang Mai) 18°48'N 98°57'E: 2♀, 5 May JB; 5♀, 10 May JB; 67♀, 10-15 May K. Somporn; 8♀, 18 May KS; 7♀, 19 May KS; 3♀, 20 May KS; 12♀, 22 May KS; 2♀, 22-23 May KS; 1♀, 26 May KS; 1♀, 27 May KS; 2♀, 6 June KS; 4♀, 9 June KS; 3♀, 11 June KS; 6♀, 13-14 June KS; 6♀, 15 June KS; 2♀, 16 June KS; 1♀, 15 July KS; 3♀, 16 July KS; 2♀, 17 July KS; 4♀, 18 July KS; Loei Prov.: Loei & vic. 17°29'N 101°44'E: 1♀, 16 Apr. JB; 1♀, 3 May C. Dettongchai; 2♀, 9 May CD; 1♀, 17 May CD; 1♀, 24 May CD; 1♀, 26 May CD; Chon Buri Prov.: Si Racha Dist.: Bang Phra Canton 13°13'N 100°57'E: 1♀, 12 Feb. JB; 1♀, 14 Feb. P. Chaemmanee; 1♀, 2 July PC; Chon Buri Prov.: Ban Bung Dist.: 1♀, 4 Dec. 1965 R.W. Matheny; Chanthaburi Prov.: Tha Mai Dist. (23 km NW of Chanthaburi) 12°43'N 101°59'E: 1♀, 22 June A. Wanchitnai; Ranong Prov.: La-un Dist.: Bang Kaeo Canton (≈10°10'N ≈98°46'E): 1♀, 17 May 1970 G.R. Ballmer; Ranong Prov.: Ranong & vic. 09°57'N 98°38'E: 1♀, 10 June AW; Ranong Prov.: Bang Rin Canton (4 km S of Ranong) 09°56'N 98°38'E: 2♀, 10 June JB; Phuket Prov.: (≈3 km N of Phuket) 07°55'N 98°24'E: 1♀, 7 June JB; Songkhla Prov.: Rattaphum Dist.: Tha Chamuang Canton ≈06°58'N 100°08'E: 1♀, 8 Mar. AW; 1♀, 9 Mar. AW; 1♀, 14 Mar. AW; 1♀, 24 Mar. AW; 1♀, 26 Mar. AW; 1♀, 22 Apr. AW; 1♀, 27 Apr. AW; 1♀, 6 May AW; 1♀, 7 Sep. AW; 1♀, 10 Sep. AW; 1♀, 5 Oct. AW; 1♀, 17 Oct. AW; 1♀, 21 Oct. AW; 1♀, 16 Dec. AW; Satun Prov.: Satun & vic. 06°38'N 100°04'E: 1♀, 7 Apr. AW; 1♀, 13 July AW.

Taxonomy. The type and all of the paratypes were apparently originally in Bogor, and there has been no further mention of any of them in the literature. In addition to the 3 Amsterdam specimens noted above, BMNH contains a single specimen labeled as *fontinalis*. It, too, does not bear any type series designation labels; but in all

probability it is indeed one of Stekhoven's paratypes, as its data shows that it is from Djambi, collected on buffalo on 25 September 1922, just as listed for 2 of the paratypes. I was unable to separate the Thailand material considered herein from this presumed paratype, and the determination as *fontinalis* is made on the basis of this comparison.

T. fontinalis is a member of the *rubidus* group, and is distinguished from *rubidus* in having a much more distinct median dorsal abdominal stripe, due to the coincidence of pale tomentum and white hairs; the thoracic stripes are also more distinct, as is the broad black haired stripe on the abdominal venter; and the frons may average narrower. The 2 species are rather closely related, and the lack of previous records may be due to determining specimens of *fontinalis* as *rubidus*.

Tabanus rusticatus new species Fig. 48

Holotype female. Length 17.5 mm. **Head.** Frons slightly divergent above, index 1:6.3; tomentum whitish when viewed from above, upper half brownish at other angles and even lower half brownish when viewed from below; hairs mixed black and pale, vertex black haired. Callosity brownish orange, rather triangulate but parallel sided below, dorsal extension concolorous and linear. Subcallus pale yellowish white; face white with white hairs including beard. Antenna with scape white haired, some black hairs dorsally and a few short orange hairs at dorsal apex; plate orange brown basally becoming gradually darkened to the apex, dorsal tooth rather right angled but low; annuli blackened. Palpus with basal segment pale grayish to creamy white, white haired; apical segment creamy white, almost entirely white haired at base but with mixed white and black hairs beyond the base and even some brownish hairs toward the apex. **Thorax.** Scutum various shades of gray from pale to dark, and with a semblance of pale stripes which are most noticeable lateral to the midline toward the hind margin, hairs mostly black centrally but with much whitish hair laterally and scattered anteriorly; scutellum bicolorous, dark gray with black hairs basally, reddish brown with whitish hairs apically. Venter and coxae pale gray with whitish hairs, a few black hairs on mesopleurite; fore femur gray with white hairs on outer face, blackened with black hairs on inner face, other femora mostly grayish tomentose and mostly white haired, middle femur with a patch of black hairs on anterior face; fore tibia pale brownish yellow over most of length of outer face, blackened apically, other tibiae brownish yellow with white and black hairs. Wing essentially hyaline though there are faint traces of tinting in some areas, stigma yellowed; 1st P cell open; anterior branch of 3rd vein curved; halter stem brownish yellow, knob mostly creamy white. **Abdomen.** Tergite 1 mostly gray

Biology. The type locality of Djambi, Sumatra, is situated well inland but in a very low-lying area. The following comments refer only to Thailand. The species was widespread from north to south, occurring in both coastal lowland and upland plain areas. It reached its greatest abundance, altitude (~350 m), and latitude at once at the Chiang Mai (Huai Kaeo) locality. A variety of localities were represented below the latitude of Bangkok, with only 2 localities represented above it, so the abundance at Chiang Mai is somewhat surprising. Records of the low-level population in Tha Chamuang (Songkhla Prov.) give some indication of seasonality, which may be related to the 2 monsoons. Host interest was recorded in water buffalo, cattle, elephants, horses, and serow (*Capricornis*); some were taken resting near host animals and in vehicles. Flight activity was found to occur at least as early as 1000 hours, through the day and at least as late as 1700 hours.

but with brown areas including the apical margin; 2 and 3 mostly brown with the tone darkening toward the apex of 3, 4-7 mostly blackened, the dark areas of all tergites with black hairs; dorsum very conspicuously marked with spots of off-white tomentum and white hairs as follows: small spot at midline of tergite 1, tall slender triangle crosses 2, triangle with broader base (but still taller than wide) almost entirely (at some viewing angles entirely) crosses 3, similarly proportioned triangles completely cross 4 and 5 and merge rather broadly with those on 3 and 4 respectively, 6 with a suggestion of a pale tomentose stripe at midline only; sublateral pale spots prominent on 2, smaller but still very distinct on 3, present but greatly diminished on 4; lateral margins of 1-6 pale with pale hairs. Sternites 1-6 yellow with yellowish white hairs, black hairs widely scattered on 6; 7 darker and black haired.

Paratypes (39♀). Length 16-19 mm. Frons index range at least 1:5.8-7.4. Callosity varies from triangulate to ovate, and orange to dark brown. Antennal plate orange to much darkened, occasionally even mostly blackened, dorsal tooth may be simply obtuse. Palpus entirely white haired to almost entirely black haired beyond base of apical segment. Scutellum may not be bicolorous but remain dark gray overall. Costal cell may be regarded as tinted yellowish. Dark pattern of abdominal dorsum variable from brown on at least tergites 2 and 3 to blackened overall; pale triangles may be equilateral on 3 and 4, sometimes any or all of them may have the apical corners considerably rounded, that on 2 sometimes quite linear. Abdominal venter may appear more grayish than yellow; amount of black hair on sternite 6 variable.

Male. There is a specimen in Cornell University from Chiang Mai (thus essentially from the

type locality), collected by a Thai student on 11 May 1959, which I consider to be this species. I prefer not to apply any formal type series terminology to it, however, due to the uncertainty which surrounds sexual associations among members of the larger group to which this species relates. It seems to be in good agreement with the ♀♀. Other than the usual sexual differences, the specimen is considerably lighter in color, notably on the femora and the dorsum of thorax and abdomen. The proportions of the pale triangular markings as well as other features make this an attractive association.

Type series data. Holotype ♀: THAILAND: Chiang Mai Prov.: Huai Kao (≈4 km NW of Chiang Mai) 18°48'N 98°57'E: 15 June 1969 Kao Somporn. (In Cornell University.) The type locality was the environs of a zoological garden at the foot of Doi Suthep, at about 350 m altitude. Paratypes: total of 39♀♀, all from same locality and same year as holotype, but dates and collectors differ as follows (a few also show host orientation): 1, 21 May KS; 2, 6 June KS; 5, 9 June KS; 2, 10 June KS; 3, 11 June KS; 7, 13-14 June KS; 11, 15 June KS; 3, 16 June KS; 4, 15 July P. Chaemane; 1, 17 July KS.

Taxonomy. *T. rusticatus* is related to the *rubidus* group, but perhaps the closest described relative is *speciosus* Ricardo, a species which occurs in India and Ceylon. I have studied the original material of the latter species in BMNH. Ricardo (1911:157-158) originally established a type specimen for both sexes of *speciosus*. The type ♀ is herewith designated as lectotype, and is chosen in preference to the ♂ for many reasons. This type ♀ bears only the following information on its data label: "India/Wroughton Coll." Of the 7♂♂ present in BMNH, none bears a type designation label; but only 1 of these shows Travancore in its data (as did the 1 in Ricardo's description), and is therefore believed to be the type ♂. The data label shows "Trivandrum./Travancore/April, 188_/Ind. Mus.", plus 2 other words which I find illegible. A second label shows only "6923/15". I have affixed another label stating that it is believed to be in the type series (and hence Ricardo's type ♂, since only 1 specimen of this sex was mentioned). This specimen is in very bad condition, with most of the thorax eaten away, left wing missing and only basal half of right

wing present. *T. speciosus* is generally characterized in the literature as having unusually broad pale markings at the midline of tergites 3 and 4. Of the material seen by me (16 in BMNH and 8 in Paris Museum), these markings are indeed striking in all specimens but the type ♀. This is not to say that the type ♀ and the associated specimens are other than conspecific, but simply to point out that the type ♀ is not as showy and distinctive as the species is otherwise represented. Thus of all the observed *speciosus* specimens, the type ♀ is the 1. closest to the configuration seen in *rusticatus*. Even so, it will suffice to differentiate the 2 species by the extent to which the triangles on tergites 3-5 join and their breadth. The ♀ types of both species are less than 1 mm different in overall length, but the base of the pale triangle at the apex of tergite 4 in *speciosus* is about 1.5 mm wide (minimal for the species as represented in collections) while that in *rusticatus* is only about 1 mm wide; the triangles on 3-5 in *speciosus* converge broadly with absolutely no interruption by darker tomentum or hairs, while the convergence in *rusticatus* is not so extensive and there are a few dark hairs basally at the midline of 4 and 5. Also, in *speciosus* the dorsal extension of the callosity is very thin, and its keel may even be entirely grown over with tomentum (as in the type ♀).

In terms of the extent and intensity of the abdominal triangles, *rusticatus* falls between *speciosus* and *rubidus*. *T. rusticatus* has much more distinct triangles than *rubidus*; and *rusticatus* does not have a broad median stripe of black hairs on the abdominal venter as does *rubidus*. Other differences are a matter of averages.

Biology. *T. rusticatus* is known only from the type locality, which is rather surprising in view of the length of the series taken there. Known seasonal range is from 21 May to 17 July. The May date may not be far from the true beginning of the season (and May is also the onset of the rainy season), as earlier collecting at the locality failed to produce it; but the season certainly extends beyond the July date, as the latter simply represents the end of collecting efforts there. Host interest is recorded in water buffalo and others were taken resting near cattle; elephant collections were almost certainly made but not formally recorded.

Tabanus quadrifokus new species Fig. 49

Holotype female. Length 17.5 mm. **Head.** Frons slightly divergent above, index 1:7.9; tomentum pale brownish white when viewed from above, becoming brown when viewed from below; hairs pale on lower area, mixed pale and black centrally, and with black hairs concentrated at vertex. Callosity brown, ovate-lanceolate, smoothly tapering into brown to blackish brown linear dorsal extension. Subcallus and upper cheek

corners dull yellowish, remainder of face yellowish white with yellowish tinted white hairs including beard, a few inconspicuous dark hairs on frontoclypeus. Antenna with scape black haired above and pale haired below; plate orange at base but quickly becoming rather blackened on outer face and darkened on inner face, dorsal tooth obtuse and low; annuli blackened. Palpus with basal segment gray to yellowish white with

yellowish tinted white hairs; apical segment yellowish white with a few pale pairs basally but otherwise evenly clothed with black hairs. **Thorax.** Dorsum dark-grayish brown (antealare very light brown), black haired with pale hairs around periphery, and with paler tomentum and hairs forming ill-defined submedian stripes on scutum. Venter and coxae pale gray with yellowish white hairs, mesopleurite partially dark haired; fore femur black with black hairs on inner face and gray with yellowish white hairs on outer face, other femora gray to orange with black and off-white hairs; fore tibia yellowish with pale hairs over most of its length and blackened apically, other tibiae orange yellow with pale hairs on inner face and black hairs on outer face. Wing with a brownish tint which is easily discernible with the naked eye, strongest in the costal and subcostal cells and stigma, weaker in the basal cells and the area below stigma, and fading out toward hind margin of wing; 1st P cell open; anterior branch of 3rd vein curved; halter stem yellow, knob whitish yellow. **Abdomen.** Tergite 1 mostly gray, brown apically; 2-4 mostly dark brown, 5 dark brown basally becoming rather blackened apically, 6 and 7 mostly blackened, all of the above dark areas black haired; dorsum with pale markings as follows: 1 with a pale, whitish yellow haired spot at midline; 2 with a very slender whitish triangle which completely crosses the tergite, and with a distinct pale sublateral patch on each side; 3 with a whitish triangle that is taller than broad which does not entirely cross the tergite, and with a pale sublateral patch on each side which is much smaller than that on 2; 4 with a whitish triangle whose base is about as broad as that on 3, which completely crosses the tergite and merges fairly broadly with that on 3, the sublateral spots reduced to a trace; 5 with a narrower triangle which merges very broadly with that on 4; 6 with only a trace of pale tomentum at the midline; the triangles on 2-5 all yellowish white haired, and at least a few scattered pale hairs on sublateral pale spots; lateral margins of 1-6 pale with pale hairs. Sternite 1 gray to orange with pale hairs; 2-5 broadly orange with yellow hairs laterally but darkened centrally and with black hairs beyond the basal 1/3 of sternite 2, a narrow band at the apices remaining orange with yellow hairs; 6 similar but more broadly darkened and more black haired; 7 almost entirely blackened and with black hairs.

Paratypes (14♀♀). Length 15.5-18.5 mm. Frons index 1:7.3-8.7. Vertex of frons may have a small shining spot. Callosity sometimes truncate below. Antennal scape may have some black hairs below; plate always paler at base than beyond, but may remain essentially orange throughout. Uncommonly some scattered pale hairs present throughout apical palpal segment. Pale hairs throughout entire fly may be somewhat more yellowed than in type. Brown wing tint sometimes

so pale that it is only discernible to the naked eye in the costal cell. The dark areas of tergites 2-4 variable from deep brown to blackish brown, tergite 5 generally blackened basally as well as apically; triangles on 2-5 may be less tall, or taller than, in type, e.g. that on 2 may appear to cross the entire tergite only when viewed at a low angle from the rear, that on 3 may occasionally appear to reach apex of 2, that on 4 may reach 3 only narrowly, pale marking at midline of tergite 5 may be triangular and reach 4 rather narrowly, or even be essentially rectangular and reach 4 broadly. Pale tomentum and hairs often entirely absent from the midline of tergite 6. The black hair forming the midventral abdominal stripe may begin at the base of sternite 2.

Male unknown.

Type series data. Holotype ♀: THAILAND: Loei Prov.: Loei & vicinity 17°29'N 101°44'E: 17 May 1969 about water buffalo Chusuk Detongchai. (In Cornell University.) The type locality is in the Loei River plain at an altitude of 250 m. Paratypes: 6♀♀, same collecting locality and year as holotype (and all but 1 shown to have same host), but dates and collectors differ as follows: 1, 16 Apr. JB; 1, 25 Apr. CD; 1, 29 Apr. CD; 1, 17 May CD; 1, 31 May CD; 1, 13-22 June CD; Chiang Rai Prov.: Phayao Dist. (vic. NW of Phayao) 19°10'-11°N 99°53'-54'E: 1♀, 18 July 1969 JB; Chiang Mai Prov.: Fang Dist. (~10 km W of Fang) ~19°56'N ~99°07'E: 1♀, 5 May 1969 JB; Chiang Mai Prov.: Huai Kaeo (~4 km NW of Chiang Mai) 18°48'N 98°57'E: 1♀, 10 June 1969 K. Somporn; Nakhon Ratchasima Prov.: Pak Chong Dist.: Mu Si Canton: Khlong Yai [14°26'-36'N 101°21'-37'E]: 1♀, 23 June 1969 G.R. Ballmer; Prachin Buri Prov.: Kabin Buri Dist.: Thung Pho Canton [~14°10'N ~102°00'E]: 2♀♀, Oct. 1970 G.R. Ballmer; Ubon Ratchathani Prov.: Phibun Mangsahan Dist.: town & vic. 15°14'-15°N 105°13'-14'E: 1♀, 25 July 1969 P. Chaemmanee; Chanthaburi Prov.: Tha Mai Dist. (23 km NW of Chanthaburi) 12°43'N 101°59'E: 1♀, 20 June 1969 JB.

Taxonomy. *T. quadrifocus* has many features in common with the *rubidus* group, and can in a sense be regarded as a member of that group. It is quickly distinguished from all other Thailand members of the group by its 4 extremely sharply defined pale median triangles on tergites 2-5 (in other species the triangles are more dilute even if larger), and by its more heavily tinted wing, which can at the least be observed in the costal cell and usually elsewhere as well.

Biology. Six of the 8 localities are represented by a single specimen, and only the type locality yielded more than 2 (over scattered dates). The sites are widespread in upper Thailand, and seem not to have much in common. The altitude range is from near sea level (the Tha

Mai site) up to perhaps 600 m (outside of Fang), and a diversity of habitat and climate exists among them. Thus although not apparently suffering from narrow environmental restrictions, the species seems to occur only in low numbers.

Known seasonal range is 16 April to October, so both the dry and rainy seasons are represented. Host interest was recorded in water buffalo, cattle, and horses, and 1 specimen was Malaise trapped.

Tabanus lentis Stone · Fig. 41

Tabanus lentis Stone, 1972, Ann. Ent. Soc. Amer. 65(3):638-639.

Female. Length 18-18.5 mm. **Head.** Frons very slightly divergent above, index 1:6.3-6.7; tomentum creamy white when viewed from above, orange brown when viewed from below; pale hairs predominate over lower area and black hairs over upper area. Callosity orange brown, spindle-shaped to inverted U-shaped in outline, dorsal extension narrow and linear. Subcallus with creamy white tomentum; facial tomentum white; facial hairs including beard white, with a few dark hairs on each side of the frontoclypeus. Antenna with basal segments black haired except white haired ventrally on scape; plate brown, moderately elongate and with a heavy but not elongate acute dorsal tooth near the base; annulus 1 somewhat darker than plate, (unknown beyond). Palpi with basal segment creamy white above with black hairs and grayish white below with long white hairs; apical segment creamy white with a fairly even covering of black hairs throughout, tip rounded. **Thorax.** Dorsum dark brown with short black hairs and indications of scattered pale hairs, paler tomentum and longer white hairs at sides and extending back along the sides of the scutellum; apical half of scutellum reddish orange in type specimen, not so distinctly bicolorous in others. Venter and coxae gray, predominantly white haired but with some black haired patches; femora gray to brown or black; fore tibiae yellowish white on outer face over about 3/5 of its length, blackened apically; other tibiae yellow, blackened apically. Wing lightly infuscated throughout, the pigment a bit more concentrated along the veins; 1st P cell open, no spur vein present. Halter stem yellow, knob creamy white with some brown at the base. **Abdomen.** Dorsum dark brown, becoming blackened toward the apex; black haired; a distinct spot of gray tomentum present on each side of tergite 2, which may or may not be pale haired; tergites 3-5 share a very conspicuous white tomentose; white haired spindle-shaped or inverted top-shaped spot along the midline. Venter gray tomentose laterally, with a dark brown stripe down the midline which occupies about 1/3 the width of the sternites and which is black haired. The gray tomentose area of the sternites is pale haired in the type specimen, at least partially black haired in the others. (3)

Male unknown.

Type data (♀): "Siam/precise locality/un-

certain./3. ii. 1914./at light/K.G. Gairdner/1914. 227." (Seen from BMNH.) In view of the origin of the other specimens (below), it seems safe to assume that the type came from somewhere in the northern part of Thailand.

Published records. 1♀ paratype, "Assam, India/Digboi jungle/Oct. 17, 1943/D.E. Hardy". (Seen from USNM.)

New records. 1♀ specimen bearing precisely the same data as the above paratype was found among the undetermined material in USNM.

Taxonomy. The Assam specimens tend to show more dark hairs than the Thai holotype, but I am satisfied that they are conspecific.

Austen had not only identified the specimen that is now the holotype of *lentis* as *finalis* Walker, he published it as the latter species as well (1922a:442). This added *finalis* to the Thailand list, while before that time the origin or range of the species represented only by the type ♂, was entirely unknown. In association with the original description of *lentis*, Stone (1972:638) concluded that the *finalis* ♂ was not an Oriental specimen at all but the ♂ of a still earlier-described Nearctic species. It is therefore accorded no further treatment as a member of the Thailand fauna.

Like Austen, Stone was impressed by the similarity of the 2 specimens, and the original description of *lentis* was based on differences between it and the Nearctic species under which he synonymized *finalis* (i.e., *trimaculatus* Palisot de Beauvois). The similarity cannot be said to represent any phylogenetic relationship.

T. lentis does, however, have an Oriental relative in the form of *T. subcanipus* Philip. They both have infuscated wings, a white area at the midline of tergites 3-5 which is essentially convex-convex in outline, bicolorous scutellum with the apex reddish orange, broad ventral abdominal dark stripe, frons tomentum variable with line of vision. But *lentis* is quickly distinguished by having its abdominal white spot generally broader and contained on tergites 3-5, not crossing tergites 1-2 in a distinct stripe (though there is a slight suggestion of paler tomentum); gray spot on each side of tergite 2; frons and callosity narrower.

Tabanus subcanipus Philip Fig. 50

Tabanus subcanipus Philip, 1960a, Stud. Inst. Med. Res. Malaya 29:22.

Female. Length 16-18 mm. **Head.** Frons slightly divergent above, index 1:4.3-4.8; tomentum grayish white when viewed from above, mostly orange when viewed from below; hairs whitish, sometimes a black patch at middle of frons and at vertex; callosity orange brown, dome shaped to nearly square; dorsal extension linear and not truly connected with callosity, sometimes almost entirely grown over with tomentum; a bare orange spot present near vertex. Tomentum of subcallus yellowish white; that of remainder of face mostly grayish white with some yellowish white areas. Beard and other facial hair whitish, usually a patch of dark hair on each side of frontoclypeus. Antenna with basal segments yellow to blackish brown and black haired; entire flagellum blackened beyond extreme base, which is brown; plate narrow and elongate, with a small acute tooth near the base. Palpus pale yellow, with long white hairs on basal segment; short white hairs present throughout apical segment, but black hairs predominate on apical half (though they may be less numerous than the white ones). **Thorax.** Scutum generally brownish to the naked eye, with some pale tomentum creating faint striations anteriorly; hairs mixed black and pale. Scutellum distinctly bicolorous, the basal area essentially dark brown and the apical area reddish orange. Venter and coxae grayish white tomentose and white haired. Femora and tibiae variable, brown to black, but femora generally darker than most of the area of the tibiae; both segments predominantly pale haired on all legs. Wings infuscated over the area basad to the bifurcation of the 3rd longitudinal vein and costad to posterior cells 2-5 and axillary cell, remaining area with a slight brownish tint, the transition between the 2 areas is gradual; 1st P cell open; no spur veins seen though an angulation is sometimes present. Halter stem brown, knob pale yellow. **Abdomen.** Dorsum dark purplish to blackish brown with a well-defined white tomentose, white haired stripe extending across tergites 1-5 and usually present on 6 as a needle-like extension; that portion of the stripe from near the apex of tergite 2 to the apex of tergite 5 is usually expanded smoothly into a narrow spindle shape in outline. Sides of tergites 1-6 narrowly grayish-white tomentose and white haired. Sternites grayish white tomentose

and white haired laterally, but with a broad black haired stripe at the midline which occupies about one third the breadth of sternite 2 and maintains its absolute breadth (thus increasing its relative breadth) to the apex of sternite 6; the apices of sternites sometimes have a white haired fringe, and the black haired stripe may be indistinct on sternite 2. (4+)

Male unknown.

Type data (♀): "50km WSW/Khong Cambodia VI-14-52/53-2059 CWharton". (Seen in USNM.) For explanation of locality, see discussion of Wharton collection.

Published records. Known to date only from type series, given in original description as holotype and 10♀ paratypes, "same data as holotype, except different dates in v.-vi." Those paratypes seen by me do indeed have the same locality data, though the sequence on the printed labels is not completely standardized.

New records. 1♀ found in USNM which was apparently not made part of the type series shows a locality of "40km WSW/Khong Cambodia VI-10-52/53-2059CWharton", thus just 10 km from the type locality.

Taxonomy. The closest described relative of this species is *T. lentis* Stone. For comparative notes, see discussion under the latter.

I have seen a fly with much similarity to *subcanipus* from Phibun Mangsahan in Ubon Ratchathani Province, Thailand. Its abdomen has deteriorated so that good comparison is not possible, but it is essentially darker than *subcanipus*, e.g., in its callosity, scutellum, and wing infuscation.

Biology. All that can be noted here is that the dates of collection for this species, i.e., the first half of June and some date(s) in May which is unknown to me, suggest the onset of the rainy season. The extent of the flight season is unknown. The species is not yet counted as part of the Thailand fauna, but it is probably only a matter of time until it is discovered in the northeast.

Tabanus symmetrus new species Fig. 51

Holotype female. Length 12 mm. **Head.** Frons slightly divergent above, index 1:7.1; tomentum dull yellowish brown, gray at vertex; hairs black, except those which flank callosity brown. Callosity black, rather spindle shaped but truncate at bottom; dorsal extension black and

linear; a tiny black median spot below the vertex. Subcallus and uppermost corners of cheeks dull brownish yellow, essentially concolorous with lower frons; remainder of face pale grayish white and with white hairs including beard. Antenna with scape mostly black haired above and white

haired elsewhere; plate orange, with an obtuse black haired dorsal tooth near the base, annuli only slightly darker orange than plate. Palpus creamy white; basal segment with long white hairs only; apical segment rather bulbous at base and tapering to a narrow tip, with white hairs basally but black hairs predominating beyond the base. **Thorax.** Dorsum gray to naked eye, with gray to brown tomentum and recumbent yellow hairs except whitish hairs at posterior periphery including on scutellum, and with more erect black hairs overall. Venter and coxae with pale gray tomentum and white hairs, a few scattered black hairs on mesopleurite; fore femur grayish black, pale at extreme apex; fore tibia with approximately basal half yellow and with mostly white hairs, apical half darkened becoming black and with mostly black hairs; middle and hind femora gray except yellow at extreme apex, tibiae yellow becoming a little darker at apices. Wings hyaline, stigma brownish, veins brown; 1st P cell open, no spur vein or angulation present; halter stem dark yellow, knob pale yellow. **Abdomen.** Dorsum mostly blackish gray to naked eye, with a single straight sided grayish white stripe of pale tomentum and hairs down the midline of tergites 1-6 which narrows very gradually over most of its length; tergite 1 mostly pale gray; a certain amount of dark brownish cast present on dorsum when examined closely; hairs black, except whitish on stripe and over lateral area of tergite 1 and lateral margins of 2-6. Venter with mostly pale gray tomentum; hairs white over sternites 1-5, except with scattered black hairs which are concentrated about the midline basally on 3-5, 6 with mixed black and white hairs.

Paratypes (158♀♀) show variability as follows. Length 10-13.5 mm. Frons indices observed from 1:6.1-7.7, but seldom exceeding 6.7-7.3; frons sometimes with rather orange tomentum. Callosity may be large and triangular, with its base approaching the eye margins; dorsal extension usually linear but variable from expanded into a spindle shape to entirely grown over with tomentum, leaving only a keel beneath; upper frons may have a median spot which varies in color, or may lack it entirely. Dorsal tooth on plate of antennal flagellum variable from obtuse to acute; tip of apical annulus sometimes distinctly darkened. Apical segment of palpus always with black hairs beyond the base, but they are not always plentiful enough to predominate the white ones. Occasionally the halteres are discolorous brown. Abdominal dorsum with color variation (at least on tergite 2) from dark brown to gray black. Black hairs on abdominal venter variable in extent, from rather sparse to very numerous over a wide swath down the midline.

Maie unknown.

Type series data. Holotype ♀: THAILAND:

Chanthaburi Prov.: Tha Mai Dist. (23 km NW of Chanthaburi) 12°43'N 101°59'E: 20 June 1969 about horses 1100-1830 hrs. John J.S. Burton. (In Cornell University.) The type locality was a commercial citrus grove named "John-Jan Gardens", in which horses were tied to graze. Paratypes: 70♀♀, data precisely identical to holotype; 58♀♀, same locality as holotype but 21 & 22 June 1969 A. Wanchitnai; Chiang Mai Prov.: Huai Kaeo (~4 km NW of Chiang Mai) 18°48'N 98°57'E: 2♀♀, 13-14 June 1969 K. Somporn; 6♀♀, 15 June 1969 KS; 4♀♀, 15 July 1969 P. Chaemmanee; 5♀♀, 16 July 1969 KS; 1♀, 18 July 1969 KS; Chumphon Prov.: Tha Sae Dist.: (area ~15 km NW of Chumphon) 10°34-37'N 99°05-07'E: 10♀♀, 12 June 1969 JB; Ubon Ratchathani Prov.: Phibun Mangsahan Dist.: Chong Mek 15°08'N 105°26'E: 1♀, 22 July 1969 JB. CAMBODIA: "40km WSW/Khong Cam-/bodja VI-10-52/53-2059CWharton": 1♀ (a paratype of *taeniellus* Philip).

Also identified here but not made paratypes due to poor condition of the specimens: THAILAND: Loei Prov.: Dan Sai Dist.: Dan Sai & vic. 17°16'N 101°09'E: 14♀♀, 9-11 June 1969 C. Dettongchai; Loei Prov.: 17 km NW Loei: 3♀♀, 17 May 1967 R.R. Pinger. S. VIET-NAM: Prov. Binhhoa, Trang Bom: 1♀, 12 Aug. 1932 M. Poilane; "Annam Asia/Sept 05/Vassal", 1♀.

Taxonomy. The overall appearance of *symmetrus*, *systemus*, and *taeniellus* quickly attests to the close relationship of the 3 species. All are rather small and mostly gray, with a single dull white fairly narrow abdominal stripe crossing tergites 1-5 or 6, wings hyaline or mostly so, legs strongly bicolored. But the 3 are easily differentiated by the presence in *taeniellus* of yellow costal cells, rounded abdominal apex and very much narrowed callosity; in *symmetrus* of hyaline costal cells, rounded abdominal apex and "standard" callosity; and in *systemus* of yellow costal cells, pointed abdominal apex and "standard" callosity. The Malayan *hirtistriatus* Ricardo is a more distant relative which is essentially brown rather than gray, and with a lightly infuscated costal area which includes all of the marginal cell and a lighter tint over the 1st submarginal cell also.

Biology. The type locality in Tha Mai District and the Tha Sae District locality were lush tropical areas under the climatic influence of the Gulf of Thailand. The other Thai localities were in areas of much more pronounced wet-and-dry climate. All could be characterized as plains, whether coastal lowland or inland, ranging in altitude from near sea level to about 350 m at Huai Kaeo (Chiang Mai). The geographic range of this species overlaps that of both its relatives. It occurs together and on the same date as *systemus* at Huai Kaeo, and together and on the same date as *taeniellus* at the Cambodia locality. Known seasonal range in Thailand is from 17 May

in Loei Province to 22 July in Ubon Ratchathani Province. It is certain to be extended in both directions, but it is interesting to note that at the type locality where the species was found to be a pest in June, none of them were taken during collections at exactly the same spot on 19 February. It is possible that the flight season

begins with the onset of the rainy season. All of the specimens taken at the type locality were attacking horses; host interest was also recorded in water buffalo, elephants, and cattle, and were also taken resting near cattle. There was no reluctance to attack during the heat of the day.

Tabanus systemus new species Fig. 52

Holotype female. Length 12 mm. **Head.** Frons slightly divergent above, index 1:6.0; tomentum dark yellow; hairs mostly black but also a few scattered pale hairs. Callosity orange yellow and essentially ovate; dorsal extension black and linear. Subcallus and upper cheek corners yellow, concolorous with lower frons; remainder of face with grayish white tomentum and white hairs including beard. Antenna with scape black haired dorsally and white haired elsewhere; flagellum orange with only the tip of the apical annulus darker than the rest, plate with an obtuse black haired dorsal tooth. Palpus white; basal segment with long white hairs; apical segment with white hairs basally and black hairs predominating scattered white hairs beyond the base. **Thorax.** Dorsum essentially gray to naked eye, with recumbent pale hairs and more erect black hairs. Venter and coxae with whitish gray tomentum and white hairs; fore femur grayish black over most of its area but becoming paler brown apically; fore tibia yellowish and pale haired over basal half but darkening gradually to almost black and black haired over apical half; middle and hind femora gray basally and orange yellow apically, tibiae orange yellow. Wings with costal cell, apex of subcostal cell, and stigma yellow, remainder hyaline, veins brownish yellow; 1st P cell open; left wing with no trace of a spur or angulation, but right wing with a very slight angulation; halter stem dark yellow, knob pale yellow. **Abdomen.** Dorsum mostly blackish gray to naked eye with a single straight sided grayish white stripe of pale tomentum and hairs down the midline of tergites 1-6 which narrows very gradually over most of its length and which is barely apparent on 6; hairs black except whitish on stripe and over a yellowish lateral area which is rather broad on tergites 1 & 2 becoming steadily narrower on 3-6. Sternites mostly gray or yellowish, hairs mostly whitish on 1-4, but 3 & 4 with extensive black hairs also, 5 & 6 darker and mostly black haired, 7 black. Entire abdomen tapering to a blunt point (hence the name, from Greek *systemos*), with the tergite and sternite of segment 7 forming a circle in posterior view.

Paratypes (61♀) vary as follows. Length 10-13 mm. Frons index 1:5.0-6.5; tomentum sometimes considered orange, and sometimes gray at vertex; pale hairs on frons numerous to lacking entirely. Shape of callosity ovate, elliptical, spindle

shaped, etc. Apical segment of palpus usually with black hairs predominating beyond the base, but may have only scattered black hairs. Dorsal tooth of antennal plate may be considered acute (but small) on occasional specimens; scape rarely black haired below as well as above. Fore femur darker than others, but may simply be gray basally and yellow to orange apically; other femora highly variable from almost entirely gray to mostly orange yellow. Relative extent of the basal pale and apical dark areas of fore tibia somewhat variable, and subject to interpretation due to the rather gradual transition. Pale stripe on abdominal dorsum often not manifest at all on tergite 6. White haired lateral area of tergites variable from yellow to gray. Sternite 4 sometimes with more black than pale hair; sternite 6 sometimes entirely without pale hair. Only one specimen with a short spur vein in one wing, and angulations are also rare even though the anterior branch may come off the base of the 3rd longitudinal vein at a full right angle.

Male unknown.

Type series data. Holotype ♀: THAILAND: Nakhon Sawan Prov. (~10 km S of Nakhon Sawan) 15°36-38'N 100°07-08'E: 27 June 1969 about water buffalo 1100-1630 hrs. John J.S. Burton. (In Cornell University.) The type locality straddles the road below Nakhon Sawan, and is part of the lowland plain of the Chao Phraya River. Paratypes: 57♀, same locality, date, and collector as holotype: Chiang Mai Prov.: Huai Kao (~4 km NW of Chiang Mai) 18°48'N 98°57'E: 2♀, 15 July 1969 P. Chaemmanee; 1♀, 18 July 1969 K. Somporn; Chiang Rai Prov.: Phayao Dist. (vic. NW of Phayao) 19°10-11'N 99°53-54'E: 1♀, 18 July 1969 JB.

Also positively identified here and within the range of variation stated above but not made paratypes due to inferior condition: 15♀, same locality, date, and collector as holotype; Chiang Mai Prov.: Huai Kao (as above): 1♀, 15 June 1969 K. Somporn.

Taxonomy. See under *symmetrus* above for relationships and comparative notes.

Biology. Like its 2 relatives, this species belongs to lowland plains. The type locality at just under 50 m altitude and the Huai Kao

(Chiang Mai) locality at about 350 m are both essentially riverine plains of the Chao Phraya drainage system. The Phayao locality rises to 400 m but is part of a large lacustrine plain and is in the Mekong drainage. A seasonal range of 15 June-18 July was seen at Huai Kaeo. This will certainly be extended in the future, but

the beginning of the season may not be too far wrong, as, like *symmetrus*, it may be found to correlate with the onset of the rainy season. Most interest is recorded in water buffalo and cattle. Attacks occurred at midday and all afternoon as well as during the hour before darkness.

Tabanus taeniellus Philip Fig. 53

Tabanus taeniellus Philip, 1960a, Stud. Inst. Med. Res. Malaya 29:23-24.

Female. Length 10.5-12.5 mm. **Head.** Frons slightly divergent above to parallel sided, index 1:7.3-8.8; tomentum pale grayish yellow above and below, darker yellow in middle; hairs mostly or entirely pale over lower half and predominantly or entirely dark over upper half. Callosity dark brown to black, very slender, tapering smoothly into and very little differentiated from the black linear dorsal extension. Tomentum of subcallus and sometimes also upper cheeks grayish yellow, concolorous with lower frons; remainder of face with grayish white tomentum and whitish hairs including beard. Antennal scape black haired with a few white hairs below; plate orange, with a low, usually rounded dorsal tooth; annuli usually concolorous with plate or nearly so, except apical annulus which is often somewhat darker. Palpus creamy whitish yellow, basal segment with long whitish hairs, apical segment with whitish hairs basally and mixed black and whitish hairs beyond. **Thorax.** Entire dorsum brownish gray or gray to naked eye, with scattered recumbent pale hairs and more erect black hairs. Venter and coxae whitish gray with white hairs; fore femur blackened except yellow at extreme apex; fore tibia whitish over approximately basal 3/5 of its area with apical 2/5 blackened; middle and hind femora with basal 4/5 gray and apex yellow, tibiae whitish yellow, moderately darkened at apex. Wing with costal and subcostal cells and stigma yellow, a slight tint also present as a narrow band along costal margin in marginal cell; veins brownish yellow; 1st P cell open; anterior branch of 3rd longitudinal vein highly variable from curved to angulate to distinctly spurred. Halter stem and knob yellow to orange. **Abdomen.** Dorsum gray to dark brownish gray, and black haired, except with a single sharp and conspicuous stripe of whitish tomentum and hairs down the midline of tergites 1-6. Venter paler gray; whitish hairs usually but not always more conspicuous than the black hairs on sternites 1-4 and often also on 5, and with a white haired apical fringe

on 6. (16)

Male unknown.

Type data (♀): "40km WSW/Khong Cam-/bodia VI-5-52/53-2059CWharton". (Seen from USNM.) For explanation of locality, see discussion of Wharton collection.

Published records. I have at hand 13 correctly associated specimens bearing Philip's *taeniellus* paratype labels (from USNM and Philip collection). Two of these agree exactly with the holotype data; 10 others show the same locality but "VI-10-52"; 1 other shows "50km WSW/Khong Cam-/bodia VI-14-52..." There are also 2 others taken at the type locality on "VI-10-52" which do not have paratype labels. Most specimens are in rather poor condition, but are nevertheless positively associated here. Also at hand is a 14th paratype (from the *taeniellus* type locality) which has proven to be *symmetrus*. Stone (1975:71) has added Viet-Nam to the distribution of *taeniellus*. This record has been traced to a broken specimen in USNM bearing the locality label "Annam Asia", and is actually another member of *symmetrus*. Therefore Viet-Nam is herewith deleted from the known distribution of *taeniellus*.

New records. None.

Taxonomy. See under *symmetrus* above for relationships and comparative notes. It is curious that the specimens of *taeniellus* from 1 locality exhibit such variation in the presence or absence of spur veins and angulations, while the widespread *symmetrus* is consistent in lacking them.

Biology. The species is known only from June collecting at 2 adjacent localities on the low, flat Cambodian plain. It is probably only a matter of time before it is found in northeastern Thailand.

Tabanus fulvilinearis Philip Fig. 54

Tabanus fulvilinearis Philip, 1960a, Stud. Inst. Med. Res. Malaya 29:16.

Female. Length 9-11 mm. **Head.** Frons very slightly divergent above, index 1:4.6-5.3;

tomentum brownish yellow and hairs pale yellow, sometimes a few scattered black hairs, some

darker brown area and black hairs at vertex. Callosity yellow, variable from triangulate to rather rounded below, tapering smoothly upward into a broadly linear dorsal extension. Subcallus with orange yellow tomentum, upper cheek area also with yellow tomentum but remainder of cheek yellowish gray, frontoclypeus pale yellow, facial hairs including beard yellow. Antennal scape usually entirely yellow haired, and a few yellow hairs also on inner face of pedicel; plate orange, with a squared dorsal tooth, annuli orange but darker than plate. Palpi yellow; basal segment with pale yellow hairs; apical segment with mixed yellow and black hairs, the amount of black hairs variable from scattered to predominant. **Thorax.** Dorsum dull yellow to brownish, with mixed pale and black hairs, a distinctly darker brown broad stripe on each side half way between the midline and the wing base which begins at or before the transverse suture and extends almost to the hind margin of the scutum. Venter and coxae entirely yellow tomentose and yellow to yellowish white haired; remainder of legs orange yellow, fore tibia becoming more brownish apically and fore tarsus brown. Wing hyaline, costal cell may or may not be slightly tinted yellowish; 1st P cell open; short spur vein present; halter stem and knob yellow. **Abdomen.** Dorsum yellowish laterally, becoming brown with black hairs mesad, the midline with a very broad and conspicuous stripe of yellow tomentum and hairs which crosses the entirety of tergites 1-6. Venter covered with yellow tomentum and whitish yellow hairs, the underlying integument may become darker beyond the base of sternite 4. (3)

Male. In excellent agreement with ♀ except for usual sexual differences. Abdomen tapers throughout, fore tibia remains paler at apex, short spur veins may or may not be present. (2)

Type data (♀) (seen from Philip collection): "[5 January 1951/Bang Khen/Boonsom.]" The original label is written in the Thai language, which caused Philip to fall into error in his description. The label shows the year as "94", which Philip guessed to mean 1894, but is in fact Buddhist era 2494, which is the same as Christian era 1951. Similarly, the month was abbreviated in the normal fashion by the use of 2 letters of the Thai alphabet. The first of these (the Thai equivalent of the Roman letter m) looks remotely like "21", and Philip so rendered it as the collecting day in the original description. Before he completed the second half of his manuscript (1960b:46), he had it translated accurately, but did not change it in the original. "[Boonsom]" is all that is given for the collector, and this is a

very common first name. See under new records below for a more thorough delimitation of the type locality.

Published records. Known only from holotype.

New records. THAILAND: Phra Nakhon Prov.: Bang Khen Dist. (N suburban Bangkok) 13°51'N 100°35'E: 1♀ & 2♂♂, 8 Apr. 1969 JB; 1♀, "Bangkok/23 March 1966/R.W. Matheny".

Taxonomy. The holotype was badly damaged during Dr. Philip's recent move from Montana to California, with the wings, legs, and antennae now mostly gone. Fortunately, the body pattern is very distinctive, and there is no doubt at all that the fresher specimens are the same. I have seen nothing that could be easily confused with this species. It can be summarily diagnosed as a rather small, yellowish brown species with hyaline wing, single broad pale abdominal stripe, and 2 short brown thoracic stripes. There is resemblance to *vernus*, but the latter has the abdominal stripe less well defined, thoracic dorsum darker, wing somewhat tinted, and is known only from Laos. The size and general body coloration are reminiscent of the Ceylonese *T. puteus* Ricardo, but the resemblance ends there, as *puteus* has infuscated wings and an extremely large and distinctive callosity.

Biology. The 3 specimens collected by me are in essence perfectly topotypic, though the ecological characteristics of the area may have changed in 18 years. The Matheny specimen was also collected very close by, probably from Bang Kapi District. The lack of specimens representing this species to date is a great mystery in view of its collecting localities on the outskirts of Bangkok. The area is not only totally accessible, but its physical properties are not dissimilar to those found elsewhere in many places. Now that it is known exactly where to look, more specimens will probably be easily obtainable. Mine were taken "on buildings and vegetation" inside the compound of the Applied Scientific Research Corporation of Thailand, 196 Phahonyothin Road. This is adjacent to the Kasetsart University campus, and there are stagnant or semi-stagnant drainage ditches containing a variety of plant life. There is also domestic livestock, but the fact that none were ever collected about livestock tempts me to wonder whether or not they indulge in haematophagy. The known seasonal range, 5 January to 8 April, falls entirely in the dry season, though standing water is present the year round.

Tabanus vernus new species Fig. 55

Holotype female. Length 12.5 mm. **Head.** Frons very slightly divergent above, index 1:6.4; tomentum orange yellow, dark at vertex; hairs

black and more concentrated at vertex, except yellow around callosity. Callosity orange, rather slender; dorsal extension orange, linear. Subcallus

and upper cheeks orange yellow, concolorous with frons; remainder of face with yellow tomentum and yellow to yellowish white hairs, including beard. Antennal scape black haired laterally and white haired ventrally; plate orange except a small blackened area at apex, broad, with an acute dorsal tooth at the crest; annuli blackened. Palpus pale yellow, basal segment with yellowish white hairs, apical segment mostly pale haired but with scattered black hairs. **Thorax.** Dorsum dark brown to the naked eye, due to yellow tomentum overlying darker integument, with striping faintly suggested by an elongate darker sublateral mark on each side of the midline; with recumbent pale yellow to golden yellow hairs and more erect black hairs. Venter and coxae with whitish yellow tomentum and hairs; all femora and tibiae yellow to orange. Wing with costal and apical area of subcostal cell yellowed; remainder of wing also slightly tinted, strongest along costal margin; 1st P cell open; anterior branch of 3rd vein angulate but not spurred; halter stem and knob yellow. **Abdomen.** Tergites 1 and 2 orange brown, becoming darker brown beyond, and hairs black; a distinct yellow stripe is formed from both tomentum and hairs down the midline of 1-5 (partial on 6). Venter yellow except darker on sternite 7, with yellow tomentum throughout; 1-3 yellow haired, 4 yellow haired except a few black hairs basally at the midline, 5 yellow haired except some black hairs which are more widely scattered than on 4, 6 with some yellow hairs but longer black hairs predominating throughout.

Paratypes (6♀♀). Length 12-13 mm. Frontal index 1:5.6-6.8. Associated without difficulty with type, but displaying the following variability: frons may be virtually parallel sided; callosity may be elliptical, dorsal extension may be darkened; antennal plate entirely orange, not blackened at apex; 3rd vein of wing variable from "normal" to possessing a short spur; sternites 1 and 2 may be yellow with all remaining sternites mostly gray to the naked eye, though with yellow tomentum throughout; sternites 4 and 5 may be entirely yellow haired.

Tabanus diversifrons Ricardo Fig. 56

Atylotus flaviventris Bigot, 1892, Mém. Soc. Zool. France 5:657-658. (Preoccupied by *Tabanus flaviventris* Macquart, from Brazil, now *Stibasoma*.)

Tabanus diversifrons Ricardo, 1911, Rec. Indian Mus. 4(6):214-215.

Tabanus ochrogaster Philip, 1960a, Stud. Inst. Med. Res. Malaya 29:31. (New name for *flaviventris* Bigot. Preoccupied by *ochrogaster* Schuurmans Stekhoven, 1932, from Sumatra.)

Female. Length 14-16 mm. **Head.** Frons slightly to very slightly divergent above, index 1:4.5-5.9; tomentum orange yellow; hairs mostly black and more concentrated at vertex. Callosity orange and quadrangular, elliptical, or dome shaped; dorsal extension black to orange, usually linear. Tomentum of subcallus and uppermost cheek area orange yellow, concolorous with or

Male unknown.

Type series data. Holotype ♀: "LAOS/Mg. Vang Vieng/Vientiane Prov./13 March 1968/250 m./F. G. Howarth". (In Cornell University.) Vang Vieng is located half way between Vientiane and Luang Prabang at 18°55'N 102°27'E. Paratypes: 2♀♀, same data as holotype but 15 Mar. 1968 FGH; Vientiane Prov.: "3 km W. Vang Vieng": 2♀♀, 17 Mar. 1968 FGH; Vientiane Prov.: "4 km W. Mg. Vang Vieng": 1♀, 17 Mar. 1968 FGH; Sayaboury Prov.: "5 km SW Muong Sayaboury": 1♀, 30 Mar. 1968 FGH.

Also seen but not made paratypes: LAOS: Sayaboury Prov.: Sayaboury: 2♀♀, 24 Mar. 1966 (BPBM).

Taxonomy. This is a relative of *diversifrons*, and some specimens require close examination for accurate separation. Well preserved specimens of *vernus* have a much more distinct and sharply drawn yellow abdominal stripe, due to the broader participation of both hairs and tomentum. There is a gap between the body length ranges of the two species as encountered in Thailand and Laos; however, if specimens in Ricardo's original series of *diversifrons* from the Assam area are conspecific and her measurements correct, then the entire length range of *vernus* is embraced by *diversifrons*. Although there is some overlap in the range of frontal indices for the 2 species, the fronses of those specimens of *vernus* which fall in the overlap zone are nevertheless seen as narrower because of their tendency to remain more parallel sided above. The tomentum of the face and thoracic venter is whitish in *diversifrons* and yellow in *vernus*.

Biology. The localities represented are mountainous or in valleys within flight distance of mountains, and range from just below 300 m to 500 m in altitude. All were taken between 13 and 30 March in neighboring parts of Laos, and will almost certainly be found to occur in northern Thailand in the future.

slightly lighter than frons; facial tomentum and hair including beard whitish. Antenna with scape dark haired above and white haired below; plate of flagellum orange, broad, with an obtuse but tall dorsal tooth; annuli black, in strong contrast to orange plate. Palpus yellowish white, basal segment with long whitish hairs, apical segment with shorter whitish hairs and scattered black hairs

which may predominate, tip variable. **Thorax.** Dorsum appears gray or grayish brown to naked eye due to pale tomentum overlying darker integument, with recumbent yellowish white to yellow hairs and more erect black hairs, and tufts of white hairs at side caudally and on scutellum. Venter and coxae a paler shade of gray to naked eye, with whitish tomentum and hairs; fore femur, apex of tibia, and tarsus blackened; middle and hind femora gray, tibiae yellow. Wing with costal and apical area of subcostal cell yellowed; remainder of wing also slightly tinted, strongest along costal margin; 1st P cell open; anterior branch of 3rd vein variable from "normal" to angulate to spurred; halter stem yellow to pale brown, knob yellow. **Abdomen.** Tergites 1-4 orange brown except darkened on 1 over area adjacent to the scutellum, and also on 2 at the midline; 5 and beyond partly or entirely darkened; hairs of dorsum black except pale down the midline in the form of a light stripe or tall triangles and pale sides of 1-6, and with a narrow fringe of pale hairs at the apices of 1-6. Venter with sternite 1 partly gray, 2-5 yellow orange except narrowly darkened at midline on 2, 6 mostly gray, 7 light black; hairs pale over 1-6 except some black hairs basally and/or about midline of 3-6. (12+)

The leg and abdominal portions of the above diagnosis are based on a single specimen from Chiang Dao which was found to be in good agreement with the types of *flaviventris* Bigot and *diversifrons* Ricardo. The remaining 11 specimens placed here lack the darkening on tergites 1 and 2, and sometimes also lack the darkening on 5 and beyond; pale haired fringe along tergite apices may be lacking; sternites variable but 1-6 usually yellow orange; fore femora variable from orange to blackened; middle and hind femora essentially concolorous with yellow to orange tibiae, not gray.

Male unknown.

Type data (♀): "India:/Assam./Shillong/ Recd. fr./ H.M.-Lefroy." (Seen in BMNH.)

Published records. The specimens bearing the type designation label for *flaviventris* Bigot is correctly reported as from N. Khasi Hills, Assam, India. Ricardo's Ceylon record (1911:213) of *flaviventris* Bigot must be removed from the distribution as it is based on her "small yellow species" interpretation (see taxonomy below). Her mention (1911:214) of Calcutta and Tenasserim specimens must also be disregarded, as they were doubtful even from her own standpoint. Kröber (1924:17) added the Philippines to the list, quoting Ricardo's diagnosis at great length and in so doing making it clear that his interpretation was also based on hers. I would suspect that Szilády's (1926:21) record from Kashmir was similarly based on Ricardo's "*flaviventris*

Bigot." The original description of *diversifrons* showed a type series of "type ♀ and seven others" from several localities in Assam, Bengal, and Sylhet which is now in Bangladesh. Szilády (1926:21) added Tonking (=N. Viet-Nam) to the *diversifrons* distribution. I have seen no specimens from there, but it is not unreasonable to assume that the species may occur there. The distribution would then be western Assam to N. Viet-Nam, and the results from northern Thailand are in accord with this.

New records. THAILAND (all 1969): Chiang Mai Prov.: Chiang Dao Dist. (~5 km NW of Chiang Dao) 19°23'N 98°56'E: 1♀, 6 May JB; Chiang Mai Prov.: Huai Kaeo (~4 km NW of Chiang Mai) 18°48'N 98°57'E: 2♀♀, 8 May JB; 2♀♀, 10-15 May K. Somporn; Chiang Mai Prov.: Doi Pui (a Maeo vill.) 18°49-50'N ~98°53'E: 1♀, 3 May JB; Chiang Mai Prov.: Fang Dist. (~10 km W of Fang) ~19°56'N 99°07'E: 2♀♀, 4 May JB; 3♀♀, 5 May JB; Mae Hong Son Prov. (vic. SW of Mae Hong Son) 19°17'N 97°58'E: 1♀, 13 May JB.

Taxonomy. Bigot's original description of *flaviventris* was based on a type series of 4 specimens, and only "Indes" was given as locality. Ricardo (1911:213-214) diagnosed what she believed to be true *flaviventris* Bigot, noting that "the specimens are all labeled with the locality" of Sibsagar, Assam. She concluded that one of Bigot's 4 specimens was not conspecific with the other 3, and described it as *diversifrons*. Her characterization of *flaviventris* Bigot as "A small yellow species easily recognized by its yellow abdomen, legs and antennae, clear wings and parallel forehead with a small indistinct yellow frontal callus" does not fit the fly in BMNH which is now labeled as type; nor does the locality fit, as the "present type" is labeled as coming from N. Khasi Hills, with no mention of Sibsagar. Since neither the morphology nor the locality fit, it is tempting to think that the type-designation label came to be placed on the wrong specimen subsequent to Ricardo's work. With the exception of Oldroyd (1957), published interpretations of *flaviventris* Bigot have followed Ricardo's "small yellow species" diagnosis rather than diagnosing the "present type," which was accessioned by BMNH in 1914 from the Verrall collection. Oldroyd's (1957:62) work is significant here. He was the first to indicate in print that Bigot's name was preoccupied by Macquart's. He also stated that Ricardo "was mistaken about the type of Bigot's species...the true *flaviventris* of Bigot is not the species considered by Miss Ricardo, nor is it the *flaviventris* of Macquart, but is an earlier name for *diversifrons* Ricardo." I have seen and compared the 2 specimens in BMNH which are presently labeled as the type of these 2 names, and am well satisfied that the 2 are conspecific. It seems to me that if Ricardo had had the same 2 specimens before her she would not have been tempted to consider them as other

than conspecific, and would not have established a new name. Thus there are 3 good pieces of evidence that the material treated by Ricardo as *flaviventris* Bigot did not include the specimen which now bears the type-designation label. And there is nothing in the literature to indicate how it came to be chosen as type over the other 2 (from the original series of 4) which Ricardo regarded as conspecific with it. Therefore Oldroyd may be correct in believing that Ricardo had the wrong thing in front of her, but it is perhaps as likely that the type-designation label was placed on the wrong specimen at a later date. The specimen does have a label on it in Bigot's own handwriting indicating that it is *Atylotus flaviventris* n. sp., but presumably the others in his series were also so labeled.

In any case, *diversifrons* now stands as the valid name of the species under consideration, due to Macquart's earlier usage of *flaviventris*. Apparently overlooking Oldroyd's statement that *flaviventris* Bigot is an earlier name for *diversifrons* Ricardo, Philip proposed *ochrogaster* as a new

name for Bigot's species, but the latter name was itself preoccupied by a Schuurmans Stekhoven species.

See under *vernus* for comparative notes with that species.

Biology. This is evidently a species of higher latitudes and altitudes. Although 5 localities are represented, it has not yet been taken below Chiang Mai; altitudes range from almost 300 m at Mae Hong Son to a possible 1650 m on Doi Pui, a mountain outside Chiang Mai. In all cases, mountainous terrain was within flight range. The type locality at Shillong, Assam, is just over 1000 m. The known seasonal range in Thailand is only 3-15 May, its shortness an artifact of collecting. There may be more flight activity in the evening hours before nightfall, but no certain statement can yet be made. I have recorded host interest in horses, cattle, and water buffalo, and specimens have also been taken resting near cattle and in a Malaise trap.

Tabanus agnoscibilis and "allies"

Included here are a sizeable number of medium to small, yellow to gray and brown, rather drab flies, which are construed to constitute 3 species. More than 3 may eventually come to be recognized, but with present techniques and poor quality holotypes, I cannot justify recognizing more than that number, though many more published names are involved. The interpretations made here regarding these species (with *pugiuncu-*

lus, *konis*, and *agnoscibilis* retained as valid) are not intended to be taken as the final consideration; they are the most reasonable I can provide with present resources. There is a certain amount of morphological diversity within each of the species, and if more than 3 are to be recognized in the future, the types will need to be reexamined. Fortunately, only 2 museums hold all of these types.

Tabanus konis Philip Fig. 57

Tabanus konis Philip, 1960a, Stud. Inst. Med. Res. Malaya 29:17-18.

Tabanus acuminaris Philip, 1960a, Stud. Inst. Med. Res. Malaya 29:9, 8. (New synonymy.)

Female. Length 11.5-14.5 mm. **Head.** Frons slightly convergent above to parallel-sided, index 1:3.8-5.5, but almost always within the 4-5 range; tomentum yellow to whitish yellow, hairs mixed pale and dark, often a dark V near vertex. Callosity with a very broad base, gradually tapering upward into the dorsal extension in such a way that the whole almost always forms a broad, conspicuous triangular structure, basal portion black to orange, dorsal portion usually black. Subcallus with pale yellow tomentum. Face with white to yellowish white tomentum and hairs, including beard. Antenna with scape black haired above, mostly white haired elsewhere; flagellum entirely orange except for darkened tip of apical annulus, (all annuli sometimes slightly darker than plate), plate with obtuse black haired dorsal projection. Palpus creamy white, basal segment with long whitish hairs, apical segment with whitish hairs basally and above and below, but a

variable amount of black hairs on lateral face (occasionally almost absent). **Thorax.** Body of thorax as well as wing, halter, and legs the same as in diagnosis of *pugiunculus*. **Abdomen.** Basal 2 or 3 tergites medium brown to dull grayish brown, darkened beyond; hairs on dorsum black except pale at extreme sides and usually down the midline; tomentum underlying the pale hairs down the midline of the dorsum sometimes paler than that surrounding it. Venter mostly gray with pale hairs, occasionally dull orange brown on sternites 1-4, commonly with inconspicuous narrow bands of paler tomentum at sternite apices, sometimes with black hairs scattered down the midline. (162)

Male. Considered unknown under present interpretation.

Type data (♀): "Thailand, Chiang-mai, 20

Aug. 1952/D.C. & EBThurman/light trap". (Seen from USNM.)

Published records. 1♀ paratype, same locality and collectors as holotype, but 26 Aug. 1952, flower garden (seen from Philip coll.); 1♀ paratype, same collectors but "Lampoon/Thai. VIII-8-1951" (seen in USNM). Holotype of *acuminaris* from "Thailand, Chiang-mai, 25 July 1952/D.C. Thurman/In house" (seen from USNM).

New records. THAILAND (all 1969 unless stated otherwise): Chiang Mai Prov.: Huai Kaeo (≈4 km NW of Chiang Mai) 18°48'N 98°57'E: 1♀, 15 June K. Somporn; 1♀, 16 July KS; Chiang Rai Prov.: Phayao Dist. (vic. NW of Phayao) 19°10'-11'N 99°53'-54'E: 7♀♀, 18 July JB; Loei Prov.: Loei & vic. 17°29'N 101°44'E: 1♀, 29 Apr. C. Dettongchai; 1♀, 2 May CD; 1♀, 8 May CD; 8♀♀, 25 May CD; 1♀, 27 May CD; 4♀♀, 2 June CD; 1♀, 6 June CD; 1♀, 7 June CD; 1♀, 26 June CD; 1♀, 4 July CD; 1♀, 5 July CD; Loei Prov.: Dan Sai Dist.: Dan Sai & vic. 17°16'N 101°09'E: 1♀, 22 May JB; 50♀♀, 9-11 June CD; Loei Prov.: (mixed Loei and Dan Sai): 10♀♀, 8-28 June CD; Loei Prov.: 17 km NW Loei: 1♀, 17 May 1967 R.R. Pinger; Nakhon Ratchasima Prov.: Pak Chong Dist.: Klang Dong Canton 14°37'-38'N 101°12'-13'E: 2♀♀, 25 June JB; Nakhon Sawan Prov.: (1.4 km SW of Nakhon Sawan) 15°40'-41'N 100°06'-07'E: 1♀, 26 June JB; Nakhon Sawan Prov.: (≈10 km S of Nakhon Sawan) 15°36'-38'N 100°07'-08'E: 52♀♀, 27 June JB; Phrae Prov.: at light in train S of Den Chai: 1♀, 19 July JB; Saraburi Prov.: Muak Lek Dist. (area S of Muak Lek) 14°36'-38'N 101°12'E: 2♀♀, 24 June JB; 1♀, 25 June JB; Ubon Ratchathani Prov.: Phibun Mangsahan Dist.: town & vic. 15°14'-15'N 105°13'-14'E: 2♀♀, 22 July JB; 2♀♀, 24 July P. Chaemmanee; 6♀♀, 25 July PC.

Taxonomy. The holotypes of both *konis* and *acuminaris* are in poor condition, including an inverted abdomen on the former and extensive glue on the abdomen of the latter which I believe is responsible for bringing out an unnatural

amount of orange coloration. The fact that the *konis* type is "dusty" (which Philip indicated was responsible for the name of the species) is seen as the unnatural result of having been caught in a light trap, and is not a natural condition at all. The name *konis* is nevertheless herewith selected to represent this species, because its type specimen is less misleading than the type specimen of *acuminaris*. The latter fly appears to have been swatted. Both types, which are from the same locality, fall easily within the range of variability found in a series of new specimens, and the ♀♀ are quickly distinguished from all relatives in the area by their extraordinarily broad frontal callus, in which the callosity and extension combine to form a large triangle. The frons characters are so distinctive that the species can usually be recognized even from the most poorly preserved material.

See discussion for *T. pugiusculus*, under which *konis* could eventually fall if the holotype ♂ of the former is found to be misassociated herein. In his original description of *pugiusculus*, Austen (1922a:453) tentatively associated a ♀ from "Phrapatoo" (which locality I have found to mean Phra Pathom=Nakhon Pathom of today) with his type ♂. This ♀ (seen in BMNH) is conspecific with *konis*, and is therefore removed from conspecificity with *pugiusculus* under present interpretation. It is unfortunate that Austen did not select this ♀ as holotype (collected August 1906 by P. G. Woolley).

Biology. The species was found locally common in a variety of situations in Northeastern, Central, and Northern Thailand, at altitudes ranging from 27 m at Nakhon Sawan to 400 m at Phayao. It seems to be characteristically a plains and valley species. Known seasonal range is from 29 April-25 July, but future collecting is certain to extend the range in both directions. Almost all specimens were taken about water buffalo or cattle, both of which they attacked readily even during the heat of midday, but including the last hour before nightfall as well.

Tabanus agnoscibilis Austen Fig. 58

Tabanus agnoscibilis Austen, 1922a, Bull. Ent. Res. 12(4):453-454.

Tabanus abauristriatus Philip, 1960a, Stud. Inst. Med. Res. Malaya 29:7-8. (New synonymy.)

Tabanus ardalus Philip, 1960a, Stud. Inst. Med. Res. Malaya 29:10-11. (New synonymy.)

Tabanus cambodianus Philip, 1960a, Stud. Inst. Med. Res. Malaya 29:13. (New synonymy.)

Female. Length 10-13.5 mm. **Head.** Frons very slightly divergent above to parallel-sided, index 5.8-7.8; tomentum orange yellow (sometimes darker), commonly with a bare black spot near vertex. Callosity fairly slender, brownish yellow; dorsal extension linear, black. Subcallus (and sometimes upper cheeks) with orange yellow tomentum, concolorous with that of lower frons. Face with yellowish gray to gray tomentum and

whitish hairs, sometimes also dark hairs mixed in. Hairs on basal segments of antenna variable from black haired to predominantly white haired on scape; flagellum entirely orange except tip of apical annulus often darkened; plate commonly but not always distinctly elongate, with black haired tooth near the base which is usually obtuse but may be low and acute. Palpus creamy white; basal segment with long whitish hairs and

sometimes a few dark hairs; apical segment with mixed black and white hairs, either one of which may predominate; tip slender but rounded. **Thorax.** Dorsum brown to naked eye, the color formed from pale tomentum overlying dark integument, and with reclining pale hairs and more erect black hairs. Venter and coxae gray with whitish hairs; foreleg beyond coxa blackened except for yellow area at apex of femur and basal part of tibia; middle and hind femora usually grayish basally and yellow to orange apically, tibiae yellow to orange. Wing with costal and at least apex of subcostal cell (and stigma) almost always distinctly yellowed, remainder hyaline; veins yellow in basal half of wing, and even those in apical half not strongly darkened; 1st P cell open; anterior branch of 3rd longitudinal vein variable from "normally" curved to angulate to distinctly spurred; halter stem yellow orange, knob yellow. **Abdomen.** Tergites 1-3 or 4 orange, darkened beyond; dorsum black haired, except yellow haired at extreme sides and down the midline of 1-6, with the tomentum underlying the pale haired stripe also paler than the lateral tomentum on the darker tergites. Venter with sternites 1-3 or 4 usually orange and with pale hairs; darkened beyond and with a variable mixture of pale and black hairs on 5 and 6. (88+)

In poorly preserved specimens, more emphasis must be placed on the yellow costal cell and head characters, and less on the abdomen.

Male. The association with the female is made easily. Aside from the usual sexual differences, the male has a paler abdominal dorsum than the "average" female, as tergites 1-4 are even more distinctly yellow to orange, and the pale stripe at the midline is broader. Length 10.5-12 mm. The area of enlarged eye facets usually remains pale (tan to reddish) after death. (6)

Type data (♀): "Siam/precise locality/uncertain./3. ii. 1914./At light./K.G. Gairdner./1914. 227". (Seen in BMNH.) The holotype of *T. lentis* bears exactly the same data, and the latter species is probably northern, hence it is likely that the *agnoscibilis* holotype is also from the north.

Published records. *T. agnoscibilis* was heretofore known only from the type. The holotype and paratype of *T. abauristriatus* are, respectively, from 40 km WSW and 50 km WSW of "Khong Cambodia", collected by C. Wharton on 5 and 14 June 1952 (seen from USNM and Philip coll.). The holotype of *T. ardalus* is from "Thailand,

Tak./Ban Ta Pui 1952/D.C. & EBThurman/20 July-Riv. bank" (seen from USNM). I have seen 1 of the 3♀ mentioned by Philip (1960a: 11) under *ardalus* from near Saigon (S. Viet-Nam) and do not consider it conspecific here; if the other 2 agree with it, then Viet-Nam is not yet known to be included in the distribution, though it may well occur there. The holotype of *T. cambodianus* has the same locality and collector as the *abauristriatus* holotype, but is dated 10 June 1952 (seen from USNM). See discussion of Wharton collection for locality notes.

New records. CAMBODIA: Siem Reap: 1♀, 7 June 1961 K. Iwata (in Cornell). LAOS: Vientiane Prov.: Ban Na Pheng, 11 km W Ban Keun: 12♀, 5♂, 15 & 19 May 1968 F. G. Howarth. THAILAND (all 1969): Khon Kaen Prov. (Univ. campus NW of Khon Kaen) 16° 27'N 102° 49'E: 28♀, 4 July JB; Loei Prov.: Dan Sai Dist.: Dan Sai & vic. 17° 16'N 101° 09'E: 2♀, 18 Apr. JB; 15♀, 22 May JB; 25♀, 9-11 June C. Dettongchai; Loei Prov.: Dan Sai Dist.: Na Haeo Canton: Muang Phrae 17° 30'N 101° 05'E: 3♀, 19 Apr. JB; Mae Hong Son Prov. (vic. SW of Mae Hong Son) 19° 17'N 97° 58'E: 2♀, 13 May JB.

Taxonomy. The *agnoscibilis* type seems to have a more hyaline costal cell than is usual for this species. The cell is commonly yellow, and helps to distinguish it from *pugiunculus*. As an average, the species is smaller and paler than *pugiunculus*, with a more distinct abdominal stripe when specimens are in good condition. Rubbing, greasing and other mechanical damage may eliminate the stripe and otherwise cause quite a different abdominal appearance, which is probably why Philip thought 3 species were involved in the series of 4 specimens before him.

Biology. This is another plains and valley species, with its concentration in NE Thailand and adjacent parts of Laos and Cambodia. Future collecting is certain to connect the western records of Mae Hong Son and Tak with the rest of the geographic range. Altitude range is from 20 m at Siem Reap (Cambodia) to 450 m at Muang Phrae (Loei Prov.). Known seasonal range is from 18 April to 20 July, but will of course be extended. Host interest records include horses, water buffalo, and cattle, as well as resting on animal enclosures, and at stream margins. The species was found to attack livestock throughout the afternoon as well as the final hour before nightfall.

Tabanus pugiunculus Austen Fig. 59*Tabanus pugiunculus* Austen, 1922a, Bull. Ent. Res. 12(4): 451-453.

Female. Length 12-16.5 mm. **Head.** Frons slightly divergent above, index 1:6.5-8.2; tomentum yellow to brown with a conspicuous bare black to dark brown spot near the vertex which is often in the form of a V or triangle; hairs mixed yellow and black. Callosity dark, sometimes yellow basally and black above, the base usually quite flat bottomed and sometimes as wide as frons, tapering gradually above; dorsal extension linear to slightly expanded at middle, black. Subcallus with yellow tomentum. Face with grayish white tomentum and white hairs, including beard. Antennal scape with black hairs dorsally and white hairs elsewhere, pedicel ringed with black hairs and may have a few white hairs below; flagellum entirely orange except for the usually blackened tip of the elongate apical annulus, plate with a black haired obtuse dorsal tooth. Palpi creamy white, basal segment with long white hairs, apical segment white haired basally and ventrally but with some black hair beyond the base which ranges from a few scattered hairs to distinctly predominating on the segment, tip pointed. **Thorax.** Dorsum with pale tomentum overlying dark integument, hence appearing grayish or gray brown to the naked eye; hairs mixed reclining yellow and more erect black, pale haired patches at periphery. Venter and coxae gray with whitish hairs; foreleg beyond coxa blackened except for pale basal area of tibia; middle and hind femora mostly gray, tibiae yellow. Wings hyaline; if costal cell is yellowed, it is extremely slight; veins brown at least over apical half of wing, 1st P cell open, no spur vein but angulation sometimes present; halter stem dark yellow, knob yellow. **Abdomen.** Dorsum rather shiny, tergites 1-4 orange brown, remainder blackened, or the blackening may begin with tergite 4 or 6; hairs black except pale yellow at extreme sides, and often narrowly down the midline ranging from scattered pale hairs to a complete stripe, but even if complete it is inconspicuous because there is no involvement of any underlying tomentum or integument. Venter orange with pale hairs and tomentum over most of its area, but darkened apically like dorsum. (334)

Male. Thoroughly described by Austen as holotype of the species. Aside from the usual sexual differences of more slender and pointed abdomen, etc., it is smaller and paler than the average ♀. Tergites 1-4 orange, blackened beyond. (3)

Type data (♂): "Siam: nr. Bangkok./June, 1921./In railway/carriage./Dr. M.E. Barnes./1921. 393." (Seen from BMNH.) In Thailand, night passenger trains with their electric lights and open windows attract a variety of insects from the dark countryside which they pass slowly through. I have collected some Tabanidae in this way. The

fact that the type is a ♂ makes its presence in a railway car even more likely to be the result of attraction by light. Therefore I suggest that "near Bangkok" should not necessarily be taken as the natural provenance of this specimen, as it may have had an overnight train ride. Since Barnes' work was in the north (see Barnes collection discussion), it is not unlikely that he was arriving in Bangkok by train from that direction. The vast majority of the ♀♀ associated here are from the north.

Published records. The only other record is a ♀ specimen from "Phrapatoon" which Austen (1922a: 453) doubtfully associated with the holotype. Under the present interpretation, this ♀ is removed from *pugiunculus* and placed in *konis*.

New records. THAILAND (all 1969): Chiang Mai Prov.: Huai Kao (~ 4 km NW of Chiang Mai), 18° 48'N 98° 57'E: 8♀, 2 May JB; 52♀, 8-10 May JB; 143♀, 10-15 May Kao Somporn; 28♀, 15 & 19 May JB; 47♀, 18-25 May KS; 34♀, 26-31 May KS; 11♀, 1-5 June KS; 6♀, 10 & 15 June KS; Loei Prov.: Loei & vic. 17° 29'N 101° 44'E: 1♂, 19 May C. Dettongchai; Loei Prov.: Dan Sai Dist.: Dan Sai & vic. 17° 16'N 101° 09'E: 1♂, 9-11 June CD; Loei Prov.: Dan Sai Dist.: Na Hao Canton: Muang Phrae 17° 30'N 101° 05'E: 1♀, 19 Apr. 1969 JB; Mae Hong Son Prov.: Mae Sariang Dist. (area W of Mae Sariang) ~ 18° 09'N 97° 55'E: 3♀, 13 & 14 May P. Chaemmanee; Tak Prov.: 1♀, Mae Sot Dist.: Mae Sot & vic. 16° 43'N 98° 34-35'E: 1♀, 9 July JB.

Taxonomy. The association of the holotype ♂ with the composite ♀ diagnosed above is largely a matter of nomenclatural convenience at this point. It averts the necessity for bringing any new names into being in a "group" which is already heavily burdened with synonyms. Morphologically, it seems to me that the *pugiunculus* type ♂ is equidistant from the "*pugiunculus*" ♀♀ above and the ♀♀ of *konis* diagnosed below. If future collecting provides a ♂ which is in better agreement with the above ♀♀ than the *pugiunculus* type, then they could represent a new species, and *konis* and *acuminaris* could fall in synonymy under *pugiunculus*.

The above "*pugiunculus*" ♀♀ are separated without difficulty from *konis* ♀♀ because they lack the unusually broad, triangular frontal callus (= callosity and extension) of the latter. They are separated from ♀♀ of *agnoscibilis* by a combination of hyaline costal cell or nearly so (not yellow), veins brown (not yellow), callosity usually dark (not yellow), and abdominal stripe indistinct or lacking entirely.

Four specimens included here in *pugiunculus* which were taken in the Salween River drainage (i.e., the Mae Sariang and Mae Sot specimens) have darker abdomens (dark brown to black overall, not orange brown on 3 or 4 basal tergites) which cause them to resemble *T. muscoides* Toumanoff in habitus. But the latter species (type seen in Institut Pasteur de Paris), from S. Viet-Nam, is smaller than all but the smallest specimens of *pugiunculus* (12 mm), has a narrower frons and narrower, more linear callosity, apical palpal segment almost entirely black haired, middle and hind femora orange yellow like tibiae (not darkened).

Biology. The known seasonal range includes

Tabanus oxybeles new species Fig. 60

Holotype female. Length 14.5 mm. **Head.** Frons slightly divergent above, index 1:6.1; tomentum mostly yellowish brown above and yellow below, gray at vertex; hairs black and scattered pale. Callosity black, rather slender drop-shaped but angulate below; dorsal extension black, linear. Subcallus strongly yellow, upper cheek corner also yellow and some slight yellowing in grooves on frontoclypeus, face otherwise white with white hairs including beard. Antenna with scape mostly white haired, black haired above; plate orange, dorsal tooth acute but not large, annuli moderately darkened. Palpus with basal segment pale gray to whitish, hairs white; apical segment white, white haired basally and mostly black haired apically. **Thorax.** Scutum brown and scutellum darker brown, hairs mixed black and yellow throughout. Venter and coxae gray with white hairs; fore femur black with hairs mostly black but also some white hairs, other femora gray with narrowly yellow apices, middle femur mostly and hind femur almost entirely pale haired; fore tibia whitish with mostly white hairs over approximately basal 2/5, black with black hairs over remainder, other tibiae mostly yellow, darkened apically. Wing with costal and subcostal cells and stigma yellowed, much of remainder of wing very faintly tinted; short spur vein present; 1st P cell open; halter stem and knob yellow. **Abdomen.** Dorsum brown over tergites 1-4, 5 moderately darker and 6 blackened, 7 black, tergites almost entirely black haired except for the pale, yellow and white haired lateral area of 1 and the pale, yellow haired lateral margins of 2-5. Apex of segment 6 laterally compressed and segment 7 protruded and strongly laterally compressed, appearing slender in dorsal view. Sternites 1-4 dull orange to yellowish gray, hairs yellow to yellowish white except broad median basal areas on 3 and 4 which are black haired; 5 mostly dark gray, black haired with some scattered yellow hairs; 6 blackened, black haired and only a few pale hairs; 7 black with black hairs.

Paratypes (26♀). Length 12.5-15 mm. Frons

the period from 19 April to 9 July, but is certain to occur over a wider range on both sides of these dates. It is characteristically a northern Thai species which was found in such abundance at Huai Kaeo (Chiang Mai) that it should be considered a pest there. It was obtained throughout the collecting effort at that locality (2 May-15 June), and was taken biting elephant and cattle, and resting near these animals; one was taken at lights at night. Water buffalo host interest was recorded from elsewhere. Altitude range represented by the localities is from about 250-450 m. Very sparse data suggests there may be greater biting activity in the 2 hours before night-fall.

index range 1:5.6-7.3; tomentum may be deep brown above and light brown below. Callosity black to brown. Subcallus yellow to yellowish brown. Antennal scape may have more black than white hairs; dorsal tooth of plate may be obtuse; annuli may be nearly as orange as plate or moderately darker. Apical segment of palpus white haired basally but varies from almost all black haired to almost all white haired beyond the base. Fore femur variable from entirely black haired to partially white haired, hind femur with very few to more extensive black hairs; fore tibia may have the basal whitish area reduced or occasionally expanded. Wing with tint in costal cell variable from very pale yellowish to rather strong yellowish brown; anterior branch of 3rd vein most often spurred but sometimes curved or angulate. Abdomen often with a distinct color break from tergite 4 (brown) to 5 (black). Tergite 1 often with a median patch of yellow hairs, and 2-5 sometimes with yellow hairs scattered on midline and along tergite apices. Segment 6 may or may not be laterally compressed; segment 7 slightly to strongly protruded but opening always higher than broad in posterior view. Black hairs on sternites 3 and 4 quite variable in extent, and some black hairs may be present on 2.

Male. Identified here and listed below are 7♂♂ from Vientiane Prov., Laos, to which I do not choose to apply formal type series terminology. In addition to the usual sexual differences, the terminal segments are not so distinctly laterally compressed, the 4 basal abdominal segments are paler, and the fore tibia is brown to blackish brown basally with entirely to almost entirely black hairs. These are separated from ♂♂ herein identified as *agnoscibilis* (from the same locality) by the distinctly more robust body of *oxybeles*, lack of connected, broad abdominal stripe of yellow hairs, and darker femora.

Type series data. Holotype ♀: THAILAND: Chanthaburi Prov.: Tha Mai Dist. (23 km NW of Chanthaburi) 12° 43'N 101° 59'E: 20 June 1969

about horses John J.S. Burton 1100-1830 hrs. (In Cornell University.) The type locality was a commercial citrus grove named "John-Jan Gardens", in which horses were tied to graze. It is close to sea level. Paratypes: 11♀, precisely same collecting data as holotype; 4♀, same collecting locality as holotype but 21 June 1969 A. Wanchitnai; 2♀, same but 22 June 1969 AW; Chiang Mai Prov.: Huai Kao (~ 4 km NW of Chiang Mai) 18° 48'N 98° 57'E: 1♀, 13-14 June 1969 K. Somporn; 2♀, 15 July P. Chaemmanee; 7♀, 18 July 1969 KS.

Also identified here but not designated as paratypes: LAOS: Sayaboury Prov.: Sayaboury: 1♀, 23 May 1967 F.G. Howarth; Vientiane Prov.: "Ban Na Pheng/11 Km. W. Ban Keun": 1♀, 6♂, 15 & 19 May 1968 FGH; Vientiane Prov.: "Mg. Phone Hong": 1♂, 17 May 1966 FGH; Vientiane Prov.: Vientiane: 2♀, 8 Aug. 1968. S. VIETNAM: "24km E of Dilinh (Djiring)": 1♀, 25 Apr. 1960 R.E. Leech; "40km N of Dilinh (Djiring)": 2♀, 26 Apr. 1960 REL. THAILAND (all 1969 unless shown otherwise): Tak Prov.: Mae Sot Dist. (~ 5 km E of Mae Sot) 16° 43'N 98° 37'E: 3♀, 10 July JB; Tak Prov.: Mae Sot Dist.: Huai Muang Canton 16° 40'N 98° 31'E: 5♀, 9 & 11 July JB; Loei Prov.: "17 km NW Loei": 3♀, 17 & 18 May 1967 R.R. Pinger; Loei Prov.: Dan Sai Dist.: Dan Sai & vic. 17° 16'N 101° 09'E: 10♀, 22 May JB; 74♀, 9-11 June C. Dettongchai; Ubon Ratchathani Prov.: Phibun Mangsahan Dist.: town & vic. 15° 14'-15° 10'N 103° 13'-14'E: 1♀, 25 July P. Chaemmanee; Krabi Prov. (vic. N of Krabi) 08° 04'N 98° 55'E: 5♀, 4 June JB; Songkhla Prov.: Rattaphum Dist.: Tha Chuanung Canton 06° 58'N 100° 08'E: 18♀, 21-26 July A. Wanchitnai; 18♀, 5-10 Aug. AW; 42♀, 11-15 Aug. AW; 49♀, 16-19 Aug. AW; 71♀, 21-26 Aug. AW; 25♀, 6-10 Sep. AW; 20♀, 12-15 Sep. AW; 12♀, 16-20 Sep. AW; 19♀, 21-26 Sep. AW; 6♀, 4-11 Oct. AW; 4♀, 18-23 Oct. AW; Satun Prov.: Satun & vic. 06° 38'N 100° 04'E: 37♀, 12-16 July AW; 11♀, 27-31 Aug. AW; 12♀, 2-4 Sep. AW.

Taxonomy. The lateral compression of ab-

dominal segment 7 and usually the apex of 6, plus the lack of striping, generally suffice to distinguish this species with the naked eye. *T. effilatus* Sch. Stek. of the Malayan Subregion has the abdomen attenuated but patterned. Lateral compression or attenuation alone are not necessarily an indication of phylogenetic relationship, as such configurations seem to have arisen independently in various lines and are likely correlated with the niche of 1 or more of the life stages (e.g., perhaps oviposition in specialized situations). The closest relatives of *oxybeles* seem to be the 2 laterally non-compressed species herein identified as *pugiunculus* and *agnoscibilis*. In addition to the more robust base and compressed apex of the abdomen, *oxybeles* has the costal cell at least slightly yellowed (not hyaline as in *pugiunculus*), and the abdomen generally has no pale-tomentose stripe (present in *agnoscibilis*).

The paratype series is limited to 2 localities mostly for the sake of convenience. Specimens identified as *oxybeles* from all the other localities seem to be in quite satisfactory agreement, though due to the length of the series there is more variety. This includes range of overall size (as low as 10.5 mm) and frons index, sometimes more extensive yellowing of cheeks, sometimes paler femora with more pale hairs on fore femur, and occasionally even a rudimentary pale abdominal stripe which involves not only pale hairs but also some pale tomentum.

Biology. The range of *oxybeles* covers the principal geographic areas of Thailand. Known altitudinal range is from near sea level to about 375 m in Thailand and 900 m in Viet-Nam. The localities represented do not suggest any specialized habitat requirements for the species. It appears to have a distinct rainy season pattern in far southern Thailand, occurring from mid-July to late October in Satun and Songkhla Provinces. In central and upper Thailand and Laos, the known season is May to August. Host interest was recorded in water buffalo, cattle, horses, elephant, and man. The species was taken as early as 0700 hours, during the day, and in the last hour before darkness.

Tabanus monilifer (Bigot) Fig. 61

Atylotus monilifer Bigot, 1892, Mém. Soc. Zool. France 5:654-655. (*monilifer*: Schuurmans Stekhoven, 1926:352-lapsus.)

Female. Length 16-18.5 mm. **Head.** Frons very slightly divergent above, index 1:5.8-6.7; tomentum orange yellow below and extensively orange brown on upper 2/3, hairs orange, often with some black hairs at vertex. Callosity brownish orange to brown, generally inverted U-shaped, tapering into essentially linear orange brown to black dorsal extension. Subcallus and upper cheek corners rather orange yellow, remainder of face paler yellow; hairs on upper face yellow to orange brown, hairs on lower face including beard pale yellow. Antenna with scape black

haired; plate variable from entirely blackened to partially orange, very broad at base with acute dorsal tooth, annuli black. Palpus with basal segment grayish to yellowish with yellow hairs basally and some black hairs apically; apical segment brown with an even covering of black hairs (uncommonly with some scattered orange hairs). **Thorax.** Dorsum brown, with paler and darker hues giving the suggestion of indefinite striping; hairs mostly black but with some recumbent scattered pale hairs and patches of pale hairs near wing base. Venter and coxae mostly gray with

pale yellowish hairs, mesopleurite mostly more pinkish or yellowish and usually with some dark hairs; fore femur gray, narrowly pale at apex, hairs mostly pale but with some black hairs on inner face, other femora mostly gray but becoming orange over apical area, hairs mostly pale but with some black hairs on anterior face; all tibiae essentially orange, the apex of fore and sometimes of hind tibia becoming brown but not in strong contrast with the base. Wing tinted brownish, with the tint concentrated in the costal cell, apex of subcostal cell and stigma, and fading toward hind margin of wing; 1st P cell open; anterior branch of 3rd vein with a strong and distinct spur vein; halter stem yellow, knob yellow to brownish yellow laterally and pale yellow at apex. **Abdomen.** Dorsum orange brown to darker brown, darkening gradually from basal to apical tergites; dorsum mostly black haired; tergite 1 with a median spot of pale tomentum and hairs, midline of 2-5 with small but conspicuous apical triangles of pale tomentum and hairs, a small spot commonly also present on 6, the triangle on 2 topped by a blackened spot, the base of 3 occasionally also darkened at the median, the lateral margins of 1-5 with pale tomentum and hairs, 2-5 may have inconspicuous pale hairs along apices. Venter with sternite 1 gray; 2-6 with large blackened median spots, the lateral areas variable from orange to gray, overlain by yellowish tomentum and with mixed black and pale hairs, the apices of 2-6 pale with pale hairs. (28+)

Color patterns diagnosed above are based on the 9 Laos specimens collected by Howarth. The 4 McKean Thailand specimens and 13 (light trapped) of the 15 Bishop Museum Laos specimens are distinctly paler in all aspects. I have no question of their conspecificity with the Howarth specimens, and believe they have become unnaturally pale through some collecting, treatment or preservation technique.

Male unknown.

Type data (♀): The label composed by BMNH shows "India:/Assam,/N. Khasi Hills/G. A./Ex coll J. Bigot:/Ex coll. G. H. Verrall/1914, 500". Two tiny earlier labels show only "G. A." and "N. Khasi." Bigot's own type designation label shows genus *Atylotus*, with the species name written as an adjective rather than a noun. (Seen in BMNH.)

Published records. Ricardo (1911:173) mentioned that "two other females with [the type] are from Sibsagar, Assam, and India", but these may or may not have been conspecific with the *monilifer* type, as Ricardo considered all of them to be the same as *rubicundus*. Stekhoven (1926:357) added 3 more records from Khasi Hills, and 2♀♀ from "Kolaw, S. Shen. States, 400 feet, 4. '14, Mackwood [collector]". The latter locality is corrected to "S. Shan States" of east central Burma.

New records. BURMA: "Upper Burma, Mali Hka Valley, Kachin Hills", an unrecorded number of ♀♀ in BMNH. LAOS: "Xiang-Om/le 30-III-1920/R. Vitalis de Salvaza", 1♀ (in Paris Mus.); "Pak Beng/5-3-15", 1♀ (in Paris Mus.); Vientiane Prov.: "Ban Ky Sok/30 Km. N, Vang Vieng": 3♀♀, 14 Mar. 1968 F. G. Howarth; 3♀♀, 15 Mar. 1968 FGH; Vientiane Prov.: "28 km. N./Mg. Vang Vieng": 2♀♀, 12 Mar. 1968 FGH; Vientiane Prov.: "3 Km W./Vang Vieng": 1♀, 17 Mar. 1968 FGH; Vientiane Prov.: "Ban Van Eue//Native Collector": 1♀, 15 Feb. 1966 (from Bishop Mus.); 13♀♀, 28 Feb. 1966 (from Bishop Mus.); 1♀, 30 Apr. 1967 (from Bishop Mus.). VIETNAM: "ANNAM/HALANG/B. TAXENG": 1♀, 1897 J.M. Bel (in Paris Mus.). THAILAND: "Chiengmai": 4♀♀, 20 Apr. 1928 Dr. & Mrs. J.W. McKean (from BMNH).

Taxonomy. The Annam specimen (above) is identified here as *monilifer*, but its antennal plate is broader distally because it is not as excavated as those of other specimens seen, and its reported locality is somewhat disjunct from other known records.

Bigot's *A. monilifer* was recombined with *Tabanus* by van der Wulp (1896:63). Ricardo (1911:172-173) then synonymized it, together with *internus* Walker, under *rubicundus* Macquart. Senior-White (1922:105-106) raised a question about Ricardo's sinking of *monilifer*. He reluctantly identified "Two females from Petsut, Katha [Burma], on 15th and 21st June 1921" as *rubicundus*. I have not seen his specimens, but judging from his mention of "a very long appendix at fork of the third vein", they were certainly not *rubicundus* and were quite probably *monilifer*. Schuurmans Stekhoven (1926:357, 412-413) then formally removed both *monilifer* and *internus* from synonymy under *rubicundus* and established independent identities for all 3. Unfortunately, Senior-White's catalogue (1927) came hard on the heels of Stekhoven's monograph, and the additions and changes made by Stekhoven were not published in time for inclusion in it. Thus, although postdating the monograph, Senior-White (1927: 48) perpetuated the earlier synonymy as proposed by Ricardo; and Stone (1975:67) has followed Senior-White.

I have examined the types (in each case a single ♀, none in good condition) of *rubicundus*, *internus*, and *monilifer* in BMNH, and wish to state my concurrence with Stekhoven (1926) that none of these 3 is conspecific with either of the others. *T. internus*, described from "Silhet" (=Sylhet, near the northeastern corner of Bangladesh), is most convincingly separated from the other 2 in having an attenuated abdominal tip (segments 5 and beyond). I saw only 1 other specimen among the current BMNH assemblage of the 3 species in question which agreed with the *internus* type in this character, and have determined it as *internus*.

T. monilifer is distinguished from *rubicundus* in having larger size, strong spur vein, darker antennal plate and palpus, dark spot at base of midline on tergite 2, row of dark spots on abdominal venter, base and apex of fore tibia not very strongly contrasting. The type of *T. mentitus* Walker is a ♂ from China (seen in BMNH). It is related to *monilifer*, as seen in the dorsal abdominal pattern and wing infuscation. *T. monilifer* is quickly distinguished from *mentitus* in having a distinct pale triangle on tergite 2, yellow-tomentose abdominal venter, and spur vein. Despite its dirty condition, the type of *monilifer* was easily associated with specimens diagnosed above. The type has dark patches atop the white triangles on tergites 2, 3 and 4.

Tabanus rubicundus Macquart Fig. 62

Tabanus rubicundus Macquart, 1846, Mém. Soc. Roy. des Sci., de l'Agr. et des Arts, Lille, 1844:160. (Not Walker 1848—Ethiopian.)

Atylotus Laotianus Bigot, 1890, Nouv. Arch. Mus. Hist. Nat., Paris, (3) 2:205. (New synonym.)

Female. Length 12.5-15.5 mm. **Head.** Frons slightly divergent above, index 1:5.9-7.7; tomentum yellow to brownish yellow below becoming more brownish above; hairs mostly pale below becoming mostly black above. Callosity brown to brownish black, elliptical to inverted U-shaped; dorsal extension brown to black, linear and sometimes very slender; an undefined somewhat shiny median area below vertex. Subcallus and upper cheek area dull yellowish; remainder of face yellowish white with yellowish white hairs including beard. Antenna with scape variable from white haired below and black haired above to almost entirely black haired, sometimes a few short orange hairs at dorsal apex; plate variable from entirely bright orange to darker beyond the base, dorsal tooth rather strong, right angled to acute, annuli black. Palpus with basal segment pale gray basally and creamy yellowish apically, hairs yellowish white with a few black hairs apically; apical segment creamy yellowish, variable from mostly black haired with pale hairs basally and scattered elsewhere to almost entirely black haired. **Thorax.** Dorsum mostly dark brown with areas of paler brown and grayish brown, hairs mostly black with patches of pale hairs near wing base and scattered elsewhere. Venter and coxae essentially gray with pale hairs, mesopleurite with some yellowish tomentum and some black hairs; fore femur gray with pale hairs on outer face and blackened with black hairs on inner face; other femora gray basally becoming orange yellow apically, the proportions of gray to yellow variable, pale haired but some black hairs present at least on middle femur; fore tibia mostly pale with pale hairs and becoming blackened with black hairs apically, other tibiae yellowish. Wing with costal and subcostal cells and stigma tinted light brownish, remainder of wing with a very pale brownish tint becoming subhyaline toward hind border; 1st P cell open; anterior branch of 3rd

Biology. The known distribution of *monilifer* is Assam, Burma, northern Thailand and upper Laos, with only the Annam specimen falling outside this pattern. All of the localities which I can trace fall above 18°N, though it is expected that the species may be found further south in mountainous areas. Altitudinal range represented by the Howarth Laos specimens is 300-950 m; the only known Thailand locality (Chiang Mai) falls near the lower end of this range. Known seasonal range is 15 February to 30 April, which in Thailand and adjacent parts of Laos is a time of dry weather with temperatures moving from relatively cool to hot. Specimens have been collected on horse and in light trap and Malaise trap.

vein curved or angulate, very uncommonly with a budlike vestigial spur vein; halter stem yellow to yellowish brown, knob yellowish to brownish basally and yellowish apically. **Abdomen.** Dorsum essentially brown and gradually becoming darker apically than basally, tergites 1-3 generally orange brown, 4-6 variable overall from hardly darker than 3 to blackish brown, 7 black to gray; dorsum mostly black haired, apices of tergites 1-5 with a patch of yellowish white tomentum and hairs at the midline, the patches on 2-5 taking the shape of small triangles, 6 may or may not also have a very small pale patch, base of 1 and lateral margins of 1-6 also with pale tomentum and hairs. Sternite 1 yellowish to grayish orange, 2-5 mostly orange with yellowish hairs, but median broadly black haired and underlying color slightly (or sometimes rather distinctly) darker than that of lateral areas, narrow apical margins remain pale with pale hairs; 6 generally similar but often darker and with black hairs also scattered laterally; 7 usually mostly dark, black haired. (23+)

Male unknown. (That discussed by Macquart has been deleted.)

Type data (♀): Macquart's original type designation label is present as well as a BMNH acquisition label showing "India./Ex coll./J. Bigot:/ex coll./G.H. Verrall./1914.500." (Seen in BMNH.)

Published records. For *rubicundus*, localities in Assam, East Bengal, Burma, and Java have been reported. I can confirm Assam from a specimen seen in BMNH which was formerly in the Bigot collection. I believe the Burma specimens (Senior-White, 1922) are not this species but *monilifer* instead. Thus for the time being Burma is not represented, but the species must certainly occur there. Java is very far out of range, but this record has persisted in the literature (e.g. Stone

1975:67) and so must be explained. It was created by Macquart when, in 2 different publications, he treated a ♂ specimen which he believed to be conspecific with his type ♀. Ricardo (1911:174) questioned this association; and Stekhoven (1926:515-516) settled the issue by describing exactly the same ♂ specimen as new species *fuscibarbus*. Senior-White (1927) did not have time to incorporate this change, and it has since been overlooked, so I shall call attention to the fact that the Java record must be deleted. Records for *laotianus* include: the Laos type locality, which lies between Luang Prabang and Dien Bien Phu (see herein under Pavie collection for further discussion)—this has been erroneously reported as India; and another Laos record from Luang Prabang by Hervé-Bazin (1919:291), which was erroneously reported as Cambodia by Toumanoff (1941:1076 & 1078). The Cambodia listing of Stone (1975:62) is not based on the Toumanoff mention, but instead is believed to be based on 2 specimens from the Wharton collection which stood in a tray labeled *laotianus* in USNM. I have redetermined these as another species, and Cambodia must for the time being be deleted. The known confirmed distribution, as published for both synonyms, is reduced to India and Laos.

New records. LAOS: Vientiane Prov.: "30 Km N./Vang Vieng": 2♀♀, 12 Mar. 1968 F. G. Howarth; Vientiane Prov.: "Ban Ky Sok/30 Km. N, Vang Vieng": 1♀, 15 Mar. 1968 FGH; Vientiane Prov.: "28 km. N./Mg. Vang Vieng": 18♀♀, 12 Mar. 1968 FGH; Vientiane Prov.: "2 km. W./Mg. Vang Vieng": 2♀♀, 11 Mar. 1968 FGH.

Taxonomy. *T. rubicundus* appears to be part of the taxonomically complicated *immanis-fumi-*

fer group found primarily in the Malayan Subregion, and various species have been contrasted with it. See under *monilifer* for comparative notes with that species and for removal of 2 former junior synonyms.

T. laotianus is added as a synonym. Its type (seen in Paris Museum) is in very bad condition, but in spite of this, important diagnostic characters can still be observed and agree with those of recent specimens compared. Austen was aware of the similarity of the types, as he placed notes dated 2 February 1922 in BMNH and in Paris Museum to the effect that *laotianus* was "Allied to and perhaps a form of" *rubicundus*. I have taken note of Austen's and of Stekhoven's (1926: 414) reasons for keeping *laotianus* separate from *rubicundus*, but it is my subjective decision that they are a single species. The *rubicundus* type differs from the recent Laos material diagnosed above in larger size (17.5 mm), palpus with mostly pale hairs and only scattered black hairs, frontotumumentum apparently a more even dull orange (though this might be the result of some rubbing). The type's antennal flagellums are unfortunately both missing. If the existence of 2 separate species is later reestablished, then the new records herein should be determined as *laotianus*.

Biology. *T. rubicundus* appears to be a hill tract species. The Howarth Laos specimens were taken mostly at 400 m but varied from 250-950 m. Vang Vieng is located at 18° 55'N 102° 27'E, and is the southernmost confirmed locality. The species is expected to occur in northern Thailand. Seasonal information is badly lacking. The recent Laos specimens were taken from 11-15 March, with host interest recorded in horse.

Tabanus cepuricus Surcouf Fig. 63

Tabanus cepuricus Surcouf, 1922, Bull. Soc. Ent. France 1922(1):14.

Tabanus roubaudi Toumanoff, 1950b, Bull. Soc. Path. Exot. 43(5-6):383-384. (New synonym.)

Tabanus sphinx Philip, 1960a, Stud. Inst. Med. Res. Malaya 29:21. (New synonym.)

Female. Length 10-13 mm. **Head.** Frons parallel sided to slightly divergent above, index 1:4.6-5.0; tomentum yellowish but becoming brownish around upper part of median callus and grayish at vertex, hairs usually mixed pale and dark with dark predominating in areas of dark tomentum. Callosity variable, sometimes quite square, commonly taller than broad and rectangular, dome shaped, or rounded, dull orange to dark brown; median callus usually lenticular, but sometimes broadly linear, usually entirely separated from callosity but occasionally connected by a narrow line; area near vertex variable from bare over a large rounded space to entirely dark-tomentose, the bare portion when present often seen as upwardly diverging striations. Eyes reported as having 3 bands on darker field. Subcallus and upper cheeks with orange-yellow tomentum and mixed dark and pale hairs; remainder of face pale

yellow with yellow hair including beard; basal segments of antennae black haired, rarely pale haired laterally and below on scape; plate broad throughout, with rounded black haired tooth near the base, usually orange but may become brownish beyond the base, annuli variable from orange to blackened, often with apical annulus darker than the rest. Palpi dark yellow, most (rarely all) hairs on basal segment long and pale, hairs on apical segment highly variable from all black to almost all white, usually mostly black with scattered pale hairs. **Thorax.** Dorsum dark brown, with sparse golden hairs and scattered erect black hairs, paler at sides with yellowish tomentum and hairs, the anteaes mostly with erect black hairs. Venter and coxae predominantly gray with yellow to white hairs; femora highly variable from concolorous with orange tibiae to blackened on foreleg and gray on other legs, thereby distinctly darker

than tibiae, inner face of fore femur almost always darkened, and fore tibia pale haired basally and black haired apically. Wings with a faint brownish or yellowish tint which is usually most easily observed at the base, in the costal cell, and along some veins; 1st P cell open; no spur vein present but occasionally an angulation; halter stem yellow to brown, knob brown, often pale at apex. **Abdomen.** Dorsum brown, darker apically; tergites 2-6 with narrow apical bands of yellow tomentum and hairs, 7 also pale apically but not pale haired, tergite 1 may also show incomplete banding, 1 to 5 or 6 usually with the apical bands expanding at the midline to form pale triangles or spots, most conspicuous on 2, 1 and 2 with distinctly blackened median areas above the pale apical spots. Venter yellow, with sternites 1-5 entirely yellow tomentose and yellow haired, 6 same but sometimes with scattered black hairs. (13+)

Male unknown.

Type data (♀): "LAOS/Nam Pik/le 27-III 1918/R. Vitalis de Salvaza". (Seen in Paris Museum.) This locality is tentatively identified as south of Muong Soui at 19° 23'N 102° 54'E; for reasoning behind this placement, see discussion of Vitalis de Salvaza collection.

Published records. S. VIET-NAM: 1♀, "Dat lat (Annam)", by Toumanoff (1950b:383-384) as type locality of *roubaudi*. THAILAND: 2♀♀, "Chiengmai, Thailand 290/III-2-1952/DC&EB Thurman", by Philip (1960a:21-22) as type and paratype locality of *sphinx*.

New records. LAOS: ~ 40♀♀ in USNM tray-labeled as *sphinx*, and 43♀♀ from BPBM, all in poor condition and not used for redescription, showing dates falling in Feb. 1965, Feb. 1966, and Feb.-Mar. 1967, and all with the following data: "Vientiane Prov./Ban Van Eue/Native Collector/RONDON-BISHOP MUS./COLLECTION/Malaise Trap". 8♀♀, from 3 localities between 12 km and 54 km S of Sayaboury, 29 Feb. and 1

Mar., 330-400 m, stream margin and ex. buffalo, all F. G. Howarth in 1968. 5♀♀, from 2 localities 25 km N and 4 km W Vang Vieng, Vientiane Prov., 350-500 m, 17 Feb.-17 Mar. 1968, FGH.

Taxonomy. This species was found to have a different name in each country from which it is known. The synonymy of *roubaudi* Toumanoff was established by direct comparison of its type (seen in Institut Pasteur de Paris) with that of *cepuricus*, borrowed from Paris Museum for the day. The synonymy of *sphinx* was established by borrowing the paratype from Philip, verifying its conspecificity with the holotype in USNM by direct comparison, then making a direct comparison of the paratype with the *cepuricus* and *roubaudi* types all together in Paris. The variability in the head and the leg characters is noted in the composite diagnosis above. This does not interfere with the rapid recognition of the species on the basis of tergite coloration, especially that on 2. All 3 original descriptions mentioned the 3-banded eyes (in life or relaxed), and Toumanoff included a detailed drawing (1950b: Plate 8, Fig. 3). Its closest relative is *thermarum*, which see for contrasting characters. *T. oxyceratus* (Bigot) from India (type seen in BMNH) appears to have come from the same ancestral stock; and *zoster* Philip from northern Thailand has a superficial resemblance.

Biology. This species apparently dwells at moderate heights in mountainous areas. It is to date known only from the narrow seasonal range of 15 February to 30 March, thus quite dry, and transitional from relatively cooler to warm weather... at the latitudes where it is commonest (around 19° N). The locality reported by Toumanoff for the *roubaudi* type is distant from all other records (at approx. 11° 56'N 108° 27'E), and is open to question, as the specimen has no data label affixed, but if accurate, compensates for lower latitude by higher altitude (~ 1500 m). Howarth's collections at "stream margin" suggest this as a breeding habitat.

Tabanus thermanum, new species Fig. 64

Holotype female. Length 13 mm. **Head.** Frons broad, very slightly divergent above, index 1:4; tomentum orange yellow except grayish vertex, hairs mixed pale and dark. Callosity dark orange, quadrate but narrower above; median callus brownish black, essentially lenticular, with only the faintest linear connection with the callosity; vertex with a small amorphous bare black spot at the median. Eyes in life with 3 dark bands across green field, becoming narrower from top to bottom. Subcallus and upper cheek margin with orange yellow tomentum concolorous with frons; remainder of face pale yellow with yellow hair including beard. Basal segments of antenna black haired; plate broad throughout with rounded black haired tooth near the base, entire flagellum

concolorous orange on outer surface, only apical annulus slightly darker on inner surface. Basal segment of palpus with long pale hairs and some shorter black hairs at apex; apical segment grayish yellow, rounded at tip, with an even covering of black hairs. **Thorax.** Dorsum brown over most of its area, with scattered black hairs which become denser around the posterior margin of the scutum, and with some golden hairs anteriorly, some of which overlie faint striations of paler tomentum at each side of the midline; dorsum with yellow tomentum and hairs at the sides and extending around to include the posterior margin of the scutellum. Venter and coxae with yellow to gray tomentum and yellow hairs; fore femur blackened and with black hairs, fore tibia pale yellow over

basal 1/2 to 2/3 of its area, blackened apically; middle and hind femora yellowish basally becoming brownish apically, tibiae yellow over about 4/5 of area on midleg and about 5/6 on hind leg, dark apically. Base of wing, costal cell, and stigma yellow, remainder of wing with an almost imperceptibly light tint; 1st P cell open, anterior branch of 3rd longitudinal vein with an angulation in left wing; halter stem yellow, knob brown, paler apically. **Abdomen.** Dorsum brown, becoming progressively darker apically from yellowish at base to blackish at apex; narrow apical bands of whitish yellow tomentum and hairs present on tergites 2-5 which expand to form small spots or triangles at the median, 6 and 7 also with yellow tomentose apices but lacking pale hairs; there is also an impression of pale bandedness at the apex of tergite 1, but close examination reveals this to be formed by the pale tomentum at the base of 2; a large yellowish white spot is present at the median of the junction of tergites 1 and 2 which is formed not only by the pale tomentum and hairs present on and crossing the upper face of 1 but also by the large whitish area on 2 which is exposed by the invagination of 1. Venter of abdomen yellow, darkened on sternite 5 and beyond, whitish yellow haired over 1-5, and with whitish tomentose bands on the apices of 2-6, less distinct on 7.

Paratypes (12♀♀). Length 11.5-13 mm. Frontal index 1:3.5-4.6, most commonly 4.2-4.3. In good agreement with the type as regards the conspicuous features, but the following variability is observed: frons sometimes parallel sided; callosity dark orange to dark brown, often rounded above, and sometimes touches eyes at lower corners; callosity and median callus may be connected quite broadly, or not be connected at all; apical bare black spot may occupy entire width of vertex, or be completely lacking; fore tibia pale over basal 1/2 to 2/3 of its area; spur vein in wing may be represented by a "bud," or venation may be perfectly normal, without even an angulation.

Male unknown.

Type series data. Holotype ♀; THAILAND: Chiang Mai Prov.: Fang Dist. (~10 km W of Fang) ~19° 56'N ~99° 07'E Altitude 500-600 m 5 May 1969 about horses John J. S. Burton 1800-1915 hrs. (In Cornell University.) Paratypes: 3♀♀, same data as holotype but 4 May 1969 a. horses 1700-1900 hrs.; 2♀♀, same but 5 May 1969 a.

cattle [no time recorded]; 1♀, same but 5 May 1969 [no host or time recorded]; 5♀♀, same but 5 May 1969 Malaise trap; 1♀, "THAILAND: NW./Chiangmai: Fang/500m. 1V-12-19-'58/T.C. Maa/Collector/No. 386" (in Philip collection).

Taxonomy. The closest described relative of this species is *cepuricus*, which is known from a locality just 130 km south of Fang (i.e., Chiang Mai), and whose range will probably be found to overlap with further collecting. Both are small brown species with pale bands on tergites expanding at the midline; and the frons, eyes and other head characters show a distinct phylogenetic relationship. They are quickly separated, however, by the presence in *cepuricus* of a black median spot above the white triangle on tergite 2, and the presence in *thermarum* of the distinct white spot covering the area of the junction of tergites 1 & 2 at the midline. Frontal indices rarely overlap, with *thermarum* at 1:4.6 and below, *cepuricus* at 1:4.6 and above. Tomentum at the sides of the median callus is distinctly darker than that surrounding it in *cepuricus*, but essentially colorous in *thermarum*.

Biology. The type locality (and only locality from which the species is known, assuming the specimen collected by Maa is the same but with a more approximate rendering of data) is the grounds of the Fang Agricultural Experiment Station in far northern Thailand, very close to the Burmese border. Both agricultural flatlands and jungled hills were within flight range. Horses and cattle were kept in adjacent open sheds and both attracted this species. The function of the Station is research on field crops, but its most interesting natural feature is a sizeable hot springs basin only a few minutes' walk up the road. The Malaise trap, which caught 5 specimens in one day of operation, was set only meters away from some of the boiling odoriferous pools. It is therefore tempting to suggest that the developmental biology of the species might in some way be connected with the hot springs, and the suggestion is reflected in the name assigned to it [the genitive of the Latin *thermae*=warm springs]. Other more "normal" aquatic habitats were also available in the area. The species is known to be active just before dark, but it is not known whether flight is restricted to this period (the Malaise trap was set up through the day and into the night before the catch was removed).

Tabanus zoster Philip Fig. 65

Tabanus zoster Philip, 1960a, Stud. Inst. Med. Res. Malaya 29:28, 27.

Female. Length 10-12 mm. **Head.** Frons parallel sided to very slightly divergent above, index 1:6.3-6.9; tomentum brown; hairs black or sometimes brown. Callosity orange brown to dark brown, variable from elliptical to triangular; dorsal extension orange brown to dark brown and variable from broadly linear to elliptical, its con-

nection with callosity moderately strong to very narrow. Tomentum of subcallus and upper cheek corners pale brownish yellow; remainder of face with grayish white tomentum and white hairs including beard. Antenna with scape mostly or entirely black haired above and mostly or entirely white haired below; plate orange and quite broad,

with a rounded black haired dorsal tooth; annuli orange and only slightly darker than plate, tip of apical annulus darkened. Palpus yellowish white, basal segment with long white hairs, apical segment variable from entirely white haired to white haired basally but black hairs as numerous as white hairs beyond the base. **Thorax.** Anterior surface facing occiput gray; remainder of dorsum brown, with alternating pale and dark brown stripes on scutum; hairs mixed pale and black. Venter and coxae gray to brown, with yellowish white to white hairs; fore femur dark brown; fore tibia yellow over basal half or a little more, and dark brown over apical half; middle femur yellowish brown and hind femur darker brown to grayish brown, middle and hind tibiae yellow. Wing hyaline; 1st P cell open; budlike spur vein present; halter stem yellow to brown, knob yellow. **Abdomen.** Dorsum shows various shades of brown, with tergite 1 mostly grayish, 2-4 rather orange, 5 and beyond blackened; apices of 2-6 with narrow bands of pale tomentum and hairs, which may in fresh condition show a tendency to expand at the midline of 2-4; tergite 1 with a patch of pale hairs at the midline; sides of tergites also pale haired, otherwise mostly dark haired. Basic color pattern of venter similar to dorsum; sternites 1-5 pale haired, 6 mixed. (4)

Male. In good agreement with female except for usual sexual differences. There is a tendency toward paler coloration, most noticeable on the abdomen. (2)

Type series data. Holotype ♀ (seen from USNM), allotype ♂ (seen from USNM), paratypes 3♀, 1♂ (seen from Center for Disease Control, USPHS, Atlanta, Georgia, U.S.A.; and Philip collection), and another paratype ♀ (not seen by me), all same data, as shown by the Thurmans' collecting number "332". The person who subsequently handprinted the data labels made some

slight but insignificant variations in format. The holotype label shows: "Thailand, Chieng/Mai, 5 Mar. 1952/D.C.&E.B. Thurman/In hot spring". Philip (1960b:60) added the word "Pann", though this appeared neither on the type label nor in his original description. Dr. Thurman (pers. comm.) has clarified the situation. Specimens labeled "332" were collected "floating in hot springs pools in Pann, Chiengrai Prov. on 5 March 1952." The standardized spelling for this locality is Phan, Chiang Rai Province, and should henceforth be used for the type locality designation. Phan is a district town located at approximately 19°30'N 99°45'E.

Published records. Known from type series only.

New records. None.

Taxonomy. The relationships of this species are rather obscured by the poor condition of the specimens, due to having been collected floating dead in hot water. In the original description, Philip stated that he believed this was related to *multicinctus* and *equicinctus*, both Schuurmans Stekhoven species. The former was described from Sumatra; the latter is Thai, but, as explained elsewhere, is a "peripheral member" of the *biannularis* group. In my opinion, *zoster* is not close to this group. Its abdomen is somewhat reminiscent of *cepuricus*, but again the relationship is not at all close.

Biology. The circumstances of collecting and the rarity of the species may suggest that there is a relationship between the hot springs and the biology of the species, but this is pure speculation. I visited some hot springs in Phan in July 1969 hoping to obtain more of this species, but was completely rained out and efforts were fruitless.

Tabanus crassus Walker Fig. 66

Tabanus crassus Walker, 1850b, Insecta Saundersiana, Dipt. 1:50.

Tabanus sanguineus Walker, 1850b, Insecta Saundersiana, Dipt. 1:54.

Tabanus Leucosparsus Bigot, 1890, Nouv. Arch. Mus. Hist. Nat., Paris, (3)2:203.

Tabanus abaculus Philip, 1960a, Stud. Inst. Med. Res. Malaya 29:7. (New synonymy.)

Female. Length 14-19 mm. **Head.** Frons slightly divergent above to parallel sided, index 1:4.2-5.2 (from selected sample); tomentum variable, whitish to brownish yellow when viewed from above, becoming darker when viewed perpendicularly and with a brown spot on each side of the median callus, brown when viewed from below; hairs mostly black but with some pale hairs below. Callosity (basal callus) reddish brown to orange brown, U-shaped to broadly elliptical or rectangular, narrowly separated from eye margin; dorsal extension (median callus) reddish brown, elliptical to lanceolate, attachment to basal callus

variable from a slender line to a moderately broad direct connection at midline; vertex reddish brown, bare and shining except usually with some tomentum at midline. Subcallus whitish and face white, hairs including beard white; some whitish yellow tomentum often present lateral to antennal bases. Antenna with scape brown, hairs of scape black above but with a variable amount of white hairs laterally; flagellum black, base of plate often narrowly brown, plate not broad, dorsal tooth obtuse to acute but low. Palpus with basal segment whitish to pale gray, hairs white; apical segment flesh colored to grayish white, stout overall but

pointed apically, hairs predominantly white but commonly with some scattered black hairs at least on apical half. **Thorax.** Dorsum various shades of brown to reddish brown, and with gray tomentum overall which also forms diffuse stripes anteriorly; anteaalare pale; scutum mostly black haired but with some pale hairs including on anterior stripes and on periphery, white tufts near wing base; scutellum commonly appears bicolorous with apex more reddish, hairs mostly pale. Venter pale gray to whitish, hairs mostly white but with some black hairs anterior to middle coxa and often scattered on mesopleurite; coxae pale gray, hairs on fore coxa white except black at apex, hind coxa with black and some white hairs; fore femur blackened except on outer face, which has a bushy white fringe and usually paler (brownish) integument, other femora paler, usually brownish and with mostly white hairs; fore tibia whitish with white hairs over approximately basal 2/3 to 3/4, black with black hairs over remainder, middle tibia generally similar but apex more narrowly brown, hind tibia with base pale and apex dark but transition not abrupt. Wing hyaline except a light brownish tint only in that part of costal cell which lies basal to the humeral cross vein, and in the 1st M cell below it; anterior branch of 3rd vein curved; 1st P cell open; halter stem yellow to yellowish brown, knob pale yellow to white. **Abdomen.** Tergite 1 largely brownish gray basally and paler apically, black haired except with a patch of white hairs at midline and broadly whitish with white hairs laterally; 2 mostly brownish gray with black hairs but with a large white, white haired median triangle crossing the segment and lateral margins and apical corners similarly white, and entire hind margin may have whitish tomentum though not white hairs, 1 and 2 appearing extensively whitish when viewed at a low angle from rear; 3-5 blackish brown to black with black hairs, midline with broad median white, white haired triangles which do not cross the respective tergites, apical corners also white with white hairs, apical margins with pale tomentum but not white hairs; 6 blackish brown to black with black hairs, apical and lateral margin with paler tomentum, white hairs absent or present only as a median apical patch; 7 mostly gray with black hairs. Sternites 1-6 gray to reddish brown, lateral area of 2-5 may be predominantly white haired or may have white hair confined to apical corners, midline of 2-6 with large darkened, black haired patches, sternite apices remain narrowly pale at least on 3-6; 7 blackened with black hairs. (263+)

Male. This is probably the most dichromatic of Oriental tabanid species in which both sexes are known. Thoracic dorsum blackish brown with concolorous hairs. Tergite 2 very extensively and much of tergite 1 whitish tomentose, lateral areas blackish brown; 3 and beyond blackish brown with black hairs. Entire ventral aspect blackish brown with concolorous to black hairs, including head and appendages (except black eyes), thorax including legs, and abdomen. Wing as

in ♀; halter knob remains mostly pale. (1+)

Type data (♂): "India/Ex coll./Saunders/68.4.", and on an older label simply "Ind". Also another label showing "Identified as the type/by E.E. Austen./25.VI.1907." and on the reverse "*Tabanus crassus*, Walk." (Seen in BMNH.)

Published records. Under various names (especially *rufiventris* or *sanguineus*), this taxon has been very widely reported in the Oriental Region from India and Ceylon fanning eastward to Taiwan, Philippines, and eastern Indonesia. In view of much confusion (both nomenclatural and zoological) surrounding this taxon, the records should not be accepted uncritically, and a region-wide review of the species group would be valuable.

New records. LAOS: Luang Prabang Prov. (vic. E of Luang Prabang) $\sim 19^{\circ}53'N$ $102^{\circ}10'E$: 1♀, 3 Aug. 1969 JB; Vientiane Prov.: "Mg. Vang Vieng": 1♀, 15 Mar. 1968 F.G. Howarth. THAILAND (all 1969 unless shown otherwise): Chiang Mai Prov.: Huai Kao (~ 4 km NW of Chiang Mai) $18^{\circ}48'N$ $98^{\circ}57'E$: 1♀, 2 May JB; 1♀, 10-15 May K. Somporn; 1♀, 9 June KS; 1♀, 17 July KS; Loei Prov.: Loei & vic. $17^{\circ}29'N$ $101^{\circ}44'E$: 1♂, 22 Apr. C. Dettonchai; 1♀, 11 May CD; 1♀, 3 June CD; 1♀, 7 June CD; 1♀, 1 July CD; Loei Prov. (12-15 km NW of Loei) $\sim 17^{\circ}34'N$ $\sim 101^{\circ}39'E$: 1♀, 7 July 1966 R.R. Pinger; 4♀♀, 14 Apr. JB; Loei Prov.: Dan Sai Dist.: Dan Sai & vic. $17^{\circ}16'N$ $101^{\circ}09'E$: 2♀♀, 18 Apr. JB; 1♀, 22 May JB; 5♀♀, 9-11 June CD; Nakhon Ratchasima Prov.: Pak Chong Dist.: Mu Si Canton: Pong-ta-long: 1♀, 26 May G.R. Ballmer; Nakhon Ratchasima Prov.: Pak Chong Dist.: Mu Si Canton: Khlong Yai: 9♀♀, 22-23 June GRB; 2♀♀, 20 Nov. GRB; Chon Buri Prov.: Si Racha Dist.: Bang Phra Canton $13^{\circ}13'N$ $100^{\circ}57'E$: 1♀, 1-2 Apr. P. Chaemmanee; Trang Prov.: Ban Kachong (~ 20 km E of Trang) $07^{\circ}33'N$ $99^{\circ}47'E$: 6♀♀, 10-11 Mar. JB or PC; Songkhla Prov.: Rattaphum Dist.: Tha Chamuang Canton $\sim 06^{\circ}58'N$ $100^{\circ}08'E$: 6♀♀, 5 & 6 Mar. JB; 5♀♀, 7-9 Mar. A. Wanchitnai; 8♀♀, 11-15 Mar. AW; 1♀, 17 Mar. AW; 10♀♀, 21-25 Mar. AW; 8♀♀, 26-30 Mar. AW; 4♀♀, 4-6 Apr. AW; 7♀♀, 11-15 Apr. AW; 2♀♀, 16 & 19 Apr. AW; 8♀♀, 22-24 Apr. AW; 19♀♀, 26-30 Apr. AW; 2♀♀, 1 May AW; 3♀♀, 8-9 May AW; 4♀♀, 15-17 May AW; 2♀♀, 1 & 5 July AW; 2♀♀, 11 July AW; 3♀♀, 25 July AW; 6♀♀, 8 & 9 Aug. AW; 3♀♀, 12 & 16 Aug. AW; 2♀♀, 20 & 22 Aug. AW; 8♀♀, 6-10 Sep. AW; 14♀♀, 11-15 Sep. AW; 3♀♀, 16 & 18 & 24 Sep. AW; 2♀♀, 3 & 4 Oct. AW; 2♀♀, 17 & 19 Oct. AW; 7♀♀, 21-26 Oct. AW; 5♀♀, 12-17 Nov. AW; 6♀♀, 24 & 25 Nov. AW; 2♀♀, 5 & 9 Dec. AW; 2♀♀, 16 Dec. AW; 3♀♀, 22 & 23 Dec. AW; 2♀♀, 2 & 8 Feb. 1970 AW; 41♀♀, 20-25 Feb. 1970 AW; 8♀♀, 26-28 Feb. 1970 AW; 7♀♀, 13 & 14 Mar. 1970 AW; Satun Prov.: Satun & vic. $06^{\circ}38'N$ $100^{\circ}04'E$: 1♀, 16 Feb. 1970 AW; 1♀, 10 Mar. 1970 AW. MALAYSIA: Perak State: Tapah $04^{\circ}12'N$ $101^{\circ}15'E$: 2♀♀, 27 Mar. 1969 JB.

Taxonomy. The closest Thailand relative of *crassus* is *larvatus*, which see for comparative notes.

The nomenclatural situation surrounding *crassus* is complicated. Ever since the monograph of Schuurmans Stekhoven (1926), *rufiventris* Fabricius has been treated as the senior synonym of *crassus*. I have seen the type of *rufiventris*, and it is unrelated to *crassus*. For further discussion, see separate account of *rufiventris* elsewhere. *T. crassus* is herewith resurrected as senior synonym.

The types of *crassus* (♂) and of *sanguineus* (♀) Walker were seen in BMNH. They agree in essence with recent Thailand material of the respective sexes, at least as nearly as could be told from the present condition of the types. In a crucial biological study at Pusa, India, Isaac (1924: 59-62, Pl. 8) associated the dichromatic ♂ and ♀ through rearing. He stated, "It is now definitely proved that *T. crassus*, ♂, Wlk., and *T. sanguineus*, ♀, Wlk., are conspecific and as the first name has priority the name *T. sanguineus*, Wlk., becomes a synonym." Walker proposed these names in the same publication, so the priority of which Isaac spoke was simply page priority. He might thus have been free to choose the other name with the more desirable effect of having a ♀ as type of the senior synonym; but I presume that his statement as "first reviser" must be taken as definitive, and hence we are left with the peculiar ♂ sex as type of the species. The type of *sanguineus* is from Java.

The type of *leucosparsus* Bigot, described from northern Laos, was seen in Paris Museum. I reconfirm it as a synonym of *crassus* and *sanguineus*. The first suggestion of synonymy of *leucosparsus* under *sanguineus* was by Shiraki (1918:350). The type of *abaculus* Philip, described from northeastern Malaya, was seen in USNM. It agrees with the species under consideration,

Tabanus larvatus new species Fig. 67

Holotype female. Length 18 mm. **Head.** Frons slightly divergent above, index 1:4.9; tomentum gray above and whitish gray below, upper half of median callus surrounded by brown, all tomentum much darker when viewed at a low angle from below; hairs black above and mixed black and white below. Callosity (basal callus) brownish black, essentially U-shaped and slightly curving inward above; median callus (dorsal extension) blackish, essentially a slender ellipse, connection with basal callus slender but appearing broad at some angles due to very thin covering of flanking tomentum; a large shining black V at vertex. Subcallus whitish and face white, a strongly contrasting band of brown tomentum occurs lateral to, and narrowly around, antennal bases; upper cheek hairs brown on and just below

and is herewith synonymized under *crassus*.

The type of *T. assamensis* (Bigot) was seen in BMNH. Its condition is poor, but there are enough features remaining to determine that it is not conspecific with *crassus* and *sanguineus* (and certainly not with *rufiventris*). Therefore I propose the reestablishment of the independent identity of this nominal species. It differs in possessing a brown band lateral to the antennal bases (as in the related *larvatus* described below), and has the costal cell yellowed.

Biology. The distribution of *crassus* which I am presently able to confirm includes: India (type locality of *crassus*), Laos (type locality of *leucosparsus* plus new records), Thailand (new records), Malaya (type locality of *abaculus* plus new records), and Java (type locality of *sanguineus*). Associated specimens from Taiwan, Hong Kong, and Burma are present in BMNH, but I did not have time to give them proper study and so cannot now include them in the distribution. In addition to Isaac's (1924) India work, biological and other work on what is presumably this same species was undertaken in Indonesia and reported under the name *rufiventris*. See especially Nieschulz (1929).

T. crassus occurs throughout Thailand though it does not seem to be especially common except in the southern peninsula. At Tha Chumuang (Rattaphum Dist.) it was apparently present all year round, with only January and June unrepresented. In upper Thailand and Laos the known range is March through July plus November, though the season may well be longer. Known altitudinal range is sea level to about 375 m, and it seems to prefer inland hilly areas. Host interest is recorded in water buffalo, cattle, elephant, and goat; a few were taken by Malaise trap, resting on vegetation, and at light at night. Feeding activity was observed from at least as early as 0700 hours, through the day and during the last hour before darkness.

the brown band, elsewhere all facial hairs including beard white. Antenna with scape mostly grayish black, black haired; flagellum blackened, dorsal tooth of plate small and rather right angled. Palpus with basal segment gray, white haired; apical segment pale gray basally becoming pale fleshy grayish apically, hairs white with some scattered black hairs apically. **Thorax.** Scutum various shades of gray, suggestions of striping anteriorly, hairs black with some mixed whitish hairs which become more extensive laterally, including patches of white hair near wing base; scutellum pale gray with white hairs, the base narrowly darker with black hairs. Venter pale gray with white hairs, a small amount of black hair anterior to middle coxae; fore coxa pale gray with white hairs except narrowly blackened

with black hairs at apex, other coxae gray with mixed black and white hairs; fore femur black with black hairs, other femora black to dark gray with black and some white hairs; outer face of fore tibia whitish with white hairs over approximately basal 3/5, black with black hairs over remainder, other tibiae essentially similar; tarsi black. Wing generally hyaline except subcostal cell and stigma tinted brownish, costal cell basal to humeral cross vein tinted paler and remainder of costal cell still paler; anterior branch of 3rd vein curved, 1st P cell open; halter stem brownish yellow, knob brownish yellow basolaterally and whitish elsewhere. **Abdomen.** Tergite 1 grayish black with black hairs basally and pale gray laterally and apically, white hairs on lateral pale area and along much or most of apex including a patch at midline; 2 mostly brownish black with black hairs, apical and lateral margins gray, these margins with white hairs except in submedian area, a conspicuous triangle of pale gray tomentum and white hairs at midline which only crosses about 1/2 of the tergite; 3-5 black with black hairs, apical margins pale gray with white hairs though there are also some black apical hairs in the submedian area, triangles at midline as on 2; 6 black with black hairs, apex pale gray with mixed black and white hairs; 7 black with black hairs. Sternite 1 gray; 2 gray with white hairs and a large blackened, black haired median area; 3 and 4 rather similar to 2 but basal areas become broadly blackish gray with black hairs; 5 blackened with black hairs over most of area, apical margin (as in 3 and 4) remaining pale gray and with white hairs except along median 1/3; 6 black, the pale gray apical margin almost obliterated except at corners (which have some sparse white hairs); 7 black with black hairs.

Paratypes (4♀♀). Length 16.5-18 mm. Frons index 1:4.6-4.9. Darkened area flanking upper portion of median callus variable from little darkened and present only at sides of callus to very strongly darkened and present both at sides and above callus. Calli brown to black, connection variable. Apical half of apical segment of palpus may be predominantly black haired. Tergites with pale hairs very sparse to absent on the area between median triangles and apical corners.

Tabanus hypomacros Surcouf Fig. 68

Tabanus hypomacros Surcouf, 1921(1922), Bull. Soc. Ent. France 1921(19):286.
Tabanus rubicundulus Austen, 1922a, Bull. Ent. Res. 12(4):442-444. (New synonym.)
Tabanus nilakinus Philip, 1960a, Stud. Inst. Med. Res. Malaya 29:19. (New synonym.)

Female. Length 16-22 mm. **Head.** Frons slightly to very slightly divergent above, index 1:6.7-10.0; tomentum brownish off-white when viewed from above becoming orange brown to brown when viewed from below; hairs black at vertex and mixed pale and black to mostly pale below. Callosity orange brown to blackish brown,

Male unknown.

Type series data. Holotype ♀: THAILAND: Chiang Mai Prov.: Huai Kao (~4 km NW of Chiang Mai) 18° 48'N 98° 57'E: 10-15 May 1969 Kao Somporn. (In Cornell University). The type locality was the environs of a zoological garden at the foot of Doi Suthep, at about 350 m altitude. Paratypes: 1♀, exactly same collecting data as holotype but 13-14 June 1969; THAILAND: Nakhon Ratchasima Prov.: Pak Chong Dist.: Mu Si Canton: Khlong Yai [14° 26-36'N 101° 21-37'E]: 1♀, 22 June 1969 G.R. Ballmer; LAOS: "Muong Sing/NW of Luang Prabang" [21° 11'N 101° 09'E]: 1♀, 6-10 June 1960 L.W. Quate; VIET-NAM: "35 km W/of Tan Cank": 1♀, 16 May 1960 R.E. Leech.

Taxonomy. This is an obvious relative of *crassus*, but shows a host of lesser differences: in *larvatus*, the face/subcallus shows a distinct brown horizontal band at the level of the antennal bases (thus appearing masked, hence the name); antennal scape blackened; pale tomentum of median triangle on tergite 2 only crosses half of segment, and that segment not so changeable when viewed at low angle from rear; fore femur lacks white hair, middle and hind femora mostly blackened; body somewhat darker overall, distinctly blacker in sternites 5 and 6. *T. assamensis* (Bigot) possesses the brown band on face/subcallus, but disagrees in some other ways. Due to the poor condition of the *assamensis* type and lack of other specimens of this species, the comparison is limited to antenna and wing: in *assamensis*, the scape and flagellum are not blackened as in *larvatus*; and *assamensis* has the costal cell distinctly yellowed, not subhyaline as in *larvatus*. There may also be a geographic distinction.

Biology. *T. larvatus* seems to be an upper altitude species, with a known range from about 350 m (at type locality, and the Mu Si Canton locality may be about the same) to 750 m (Viet-Nam). The species may perhaps require hilly jungle areas, and seems rather widespread but rare. All records fall between 10 May and 22 June. The only host and time data available is from the Ballmer specimen, which was taken attacking cattle at 1700-1800 hours.

variable from elliptical to inverted slender V-shaped; dorsal extension orange brown to blackened, linear; a small median bare spot sometimes present near vertex. Subcallus pale orange yellow to pale brownish orange, upper corner of frontoclypeus sometimes concolorous with subcallus and with some brown to black hairs, part of upper

cheek area either concolorous with subcallus or darker brownish and with some yellow to brownish hairs; remainder of face pale yellowish to white, with white hairs including beard. Antenna with scape black haired; plate broad but dorsal tooth variable from low and obtuse to rather sharply acute, color variable from orange to blackened overall; annuli orange to black. Palpus with basal segment gray to pale brownish, white haired with a few black hairs at apex; apical segment pale brownish, black haired, sometimes a few white hairs basally. **Thorax.** Dorsum various shades of grayish brown (uncommonly mostly orange brown), scutellum usually paler orange brown apically; hairs mostly black, with pale hairs in patches near wing base and scattered elsewhere including along hind margin of scutellum. Venter gray (uncommonly orange gray) with white hairs and sometimes a few scattered dark hairs, at least upper part of mesopleurite with paler tomentum; coxae similar to venter but commonly with some black hairs; fore femur black (uncommonly brown), other femora grayish black to black (occasionally variable to dull brownish orange); fore tibia brown basally and with black or mixed black and pale hairs becoming black apically and with black hairs, other tibiae mostly brown becoming blackened apically, occasionally variable to pale brown overall. Wing with costal cell, most of subcostal cell, and stigma tinted brown, remainder of wing tinted paler brownish becoming gradually paler toward hind margin, sometimes with the tint more concentrated along veins; a distinct and strong strong spur vein present; 1st P cell open; halter stem yellow to brown, knob brown, usually paler brown to yellow at apex. **Abdomen.** Dorsum commonly predominantly reddish black to black basally becoming even darker apically, but some specimens are orange brown, hairs mostly black, tergite 1 with a pale haired spot at midline, 2-5 with large and conspicuous median apical triangles of pale tomentum and hairs which are quite variable in shape but often equilateral on 3-5, a spot of paler tomentum may also be present on 6 but usually lacks pale hairs; 1 with extensive pale tomentum, which also appears broadly on 2 when viewed at a low angle from the rear, 3-5 with pale tomentose apical margins when viewed at same low angle, 1 and 2 broadly pale with pale hairs laterally, apical corners of 3-5 pale with pale hairs. Venter usually gray with pale hairs and a large median area of sternites 2-5 brown to black with black hairs which may expand at the bases of 3-5, the apices remaining gray; but coloration of venter highly variable with a few specimens orange brown overall, the median little darker than the lateral area. (73+)

Male. In addition to the usual sexual differences, the white hairs on the head and thorax of the ♀, including the beard and the thoracic venter and coxae, have become rusty red brown in the ♂. The spur vein is vestigial (in 1 wing) or absent (in the other). Some of the abdominal pale hair of the ♀, including the lateral area of ter-

gites 1 and 2 has become brown in the ♂. The pale hairs which the abdomen of the ♂ does possess, namely on the median triangles, a small amount at the apical corner of tergites 2-5, and along the apices of sternites 2-5, is not white but whitish yellow; hairs on median spot of tergite 1 are brownish yellow. Overall coloration paler than most (but not all) ♀♀. Readily associated with ♀♀ by general appearance including median triangles, wing tint, and dark legs. (1)

Type data (♀): "LAOS/Pang Hai/le 8-V-1920/R. Vitalis de Salvaza", plus a determination label handwritten by Surcouf, plus a small label showing "TYPE". (Seen in Paris Museum.) I cannot locate Pang Hai (see discussion of Vitalis de Salvaza collection).

Published records. In the original description Surcouf noted a second ♀ specimen from Tonkin [=N. Viet-Nam]. I examined this specimen in Paris Museum, and feel that it is probably not conspecific with the type. The specimen is darker, with narrower frons and callosity, and broader antennal plate; hence I think the presence of the species in Viet-Nam should be considered as not yet demonstrated, though it may eventually be found there. For *rubicundulus*, the type locality is "Chantabun". See discussion of Mouhot collection for clarification. This locality is farther south than other records, but is entirely reasonable, especially since the specimens (2♀♀ syntypes) may have been taken on a mountain. A specimen of *rubicundulus* was reported by Philip (1960b:54) from "Chiengmai, Doi Sutep, 3000", 23. iii. 1952". I have not examined this specimen, but the locality is not surprising for the species under consideration here, as it is known from the base of the same mountain. For *nilakinus*, the type locality label is cited in 2 different ways by Philip (1960a:19; 1960b:53). The handwritten label is not very clear, so it is easy to see how the confusion came about. I am acquainted with the area, and shall correctly relate and expand the data to conform to the present system: THAILAND: Loei Prov.: Dan Sai Dist.: Ban Khok, 27 May 1955, R.E. Elbel. Ban Khok is a village located about 12 km WNW of the town of Dan Sai. Stone (1975:65) added "?Viet Nam" for *nilakinus*. I do not know his reason for this record, but it may be based on material in USNM. Verification will be necessary.

New records. LAOS: Sayaboury Prov.: "20 km. SW/Muong Sayaboury": 1♀, 15 Apr. 1968 F.G. Howarth; Vientiane Prov.: Phou Khao Khouai: 1♀, 17 Apr. 1965 J.L. Gressitt; Vientiane Prov.: 20 km E of Phou Khao Khouai: 3♀♀, 15-30 Apr. 1965 JLG or others. THAILAND: Chiang Mai Prov.: Huai Kaeo (≈ 4 km NW of Chiang Mai) 18° 48'N 98° 57'E: 5♀♀, 10-15 May 1969 K. Somporn; 7♀♀, 18-23 May 1969 KS; 1♀, 26 May 1969 KS; 1♀, 11 June 1969 KS; "Chiengmai": 2♀♀, Apr. 1928 Dr. & Mrs. J. W. McKean; Lampang Prov.: 1♀, 15 May 1941 C. Kongthon; Nan Prov.: "Huayrong Water Fall":

1♀, 1 May 1947 C. Tongyai; Loi Prov.: Dan Sai Dist.: Dan Sai & vic. 17° 16'N 101° 09'E: 1♀, 18 Apr. 1969 JB; 11♀, 22 May 1969 JB; Nakhon Ratchasima Prov.: Pak Chong Dist.: Mu Si Canton: Pong-ta-long [14° 26-36'N 101° 21-37'E]: 3♀♀, 15 May 1969 G.R. Ballmer; 1♀, 17 May 1969 GRB; 13♀♀, 19 May 1969 GRB; 10♀♀, 20 May 1969 GRB; 2♀♀, 21-22 May 1969 GRB; 4♀♀, 1♂, 25 May GRB; 2♀♀, 26 May 1969 GRB; Nakhon Ratchasima Prov.: Pak Chong Dist.: Mu Si Canton: Khlong Yai: 1♀, 20 May 1969 GRB; 1♀, 15-18 June 1969 GRB.

Taxonomy. As herein interpreted, *hypomacros* exhibits a striking variation in overall color. Most of the specimens are dark, the abdomen (except for white markings) appearing black or blackish brown to the naked eye; but some specimens are much paler, appearing orange brown, and specimens with a variety of intermediate coloration are also present. This is not directly related to geography, as a range of coloration may occur at the same locality (e.g., the Dan Sai population). The association of this range of color forms influences nomenclature.

There is no question that *nilakinus* (holotype ♀ seen in USNM) is a synonym of *hypomacros*. The 2 types, compared through recent material, are in good agreement. Both are darkly colored. The 2♀♀ syntypes of *rubicundulus* (seen in BMNH) are at or near the pale end of the color range, however. Thus it is with reluctance that *rubicundulus* is also synonymized here, and would not be justified if it were not for the intermediate specimens present. In BMNH, the 2 specimens of *rubicundulus* bear type and paratype designation labels respectively; but in fact they are syntypes. The specimen bearing the BMNH type designation label is herewith designa-

ted as lectotype. It is lacking the left wing, but possesses the only remaining antennal flagellum of the 2 specimens (it is the left flagellum).

The paler specimens of *hypomacros* show much resemblance to *indianus* Ricardo, but *hypomacros* has the integument of the basal half of the fore tibia brownish (not whitish), the antennal plate is broader, and the wing has a strong spur vein which is lacking in *indianus* specimens I have seen. See separate heading for further discussion of *indianus*. In BMNH 2 paratypes of *exoticus* Ricardo, described from Taiwan, were seen. If these are conspecific with the types (♀ & ♂), then there is a considerable resemblance between *exoticus* and dark specimens of *hypomacros*.

Biology. *T. hypomacros* is known to occur in northern Thailand and in a rather vertical pattern from the southern part of upper Laos south to the Chanthaburi area of southeastern Thailand. Documented altitudes of specimens seen by me range from 350-800 m, though it may well have wider tolerances. I consider it probable that the Chanthaburi specimens (*rubicundulus* syntypes) were taken on a mountain to the southeast of town which rises to about 900 m, and not around town which is essentially at sea level. I regard it as a hill tract species. Seasonal range of specimens seen by me is 15 April-18 June, plus the Chanthaburi specimens which Mouhot probably collected no later than the end of March. This range includes both dry and some wet weather. Recorded host interest includes man, cattle, and water buffalo; some were taken by Malaise trap and a few at rest. Specimens are known to have been on the attack in the morning before 0830 hours, later in the morning, through the afternoon and during the last hour before darkness.

Tabanus euphanes Surcouf Fig. 69

Tabanus euphanes Surcouf, 1921(1922), Bull. Soc. Ent. France 1921(19):286.

Female. Length 16-18.5 mm. **Head.** Frons divergent above, index 1:6.5; tomentum brown, darker brown around tip of dorsal extension and with pale hair; black hair in V pattern at vertex. Callosity and extension variable from jet-black to orange brown. Eye (relaxed) with 2 green bands. Subcallus with brown tomentum, concolorous with frons; face and beard with brownish black to black hairs. Basal segments of antenna black haired, the pedicel with a strong dorsal projection; plate blackish red (in type) to deep black, with moderate to acute dorsal tooth, and angulate below; annuli black. Both segments of palpus entirely black tomentose and black haired. **Thorax.** Dorsum covered with whitish tomentum except for brown elliptical spot along midline which is a natural condition despite its appearance to the naked eye as a rubbed patch; hairs on

elliptical spot black, and scutum with scattered black hairs elsewhere, but sides, hind margin, and entire scutellum with conspicuous white hairs; anteaes with white hairs above and erect black hairs along lower margin. Entire venter below level of wing base with blackish brown tomentum and black hairs; legs black. Wing infuscated throughout, darkest in costal cell, sometimes becoming lighter in centers of some cells and toward hind margin; 1st P cell open, no spur vein. **Abdomen.** Entire area of dorsum and venter with blackish brown to black tomentum and hairs. (8+)

Male unknown.

Type data (♀): "Laos/Nam Mat/le 15-IV 1918/R. Vitalis de Salvaza". (Seen in Paris

Museum.) The type locality of Nam Mat has been traced to a stream in northeastern Laos, flowing eastward at about 19°40'N latitude from Phou San, a mountain at the eastern edge of the Tranninh Plateau. It flows into the Nam Neun which forms part of the Vietnamese border, then becomes the Ca River in Viet-Nam.

Published records. Type only.

New records. LAOS: Vientiane Prov.: "Ban Ky Sok/30 Km. N, Vang Vieng": 3♀, 15 Mar. 1968 F.G. Howarth; "30 Km N./Vang Vieng": 2♀, 12 Mar. 1968 FGH; "28km. N./Mg. Vang Vieng": 1♀, 12 Mar. 1968 FGH. THAILAND: "Chiengmai": 1♀, 13 Mar. 1928 Dr. & Mrs. J.W. McKean (BMNH); "Chieng Dao/Chiengmai": 1♀, 6 Apr. 1958 [student coll.] (USNM).

Taxonomy. This species and several relatives form a highly distinctive element of the Oriental fauna, though the strange color combination of robust flies with pale notums and blackish abdomens and venters has its counterparts elsewhere (e.g., the Nearctic *T. stygius* Say). One relative is *T. albocostatus* (Bigot), known only from the Indian type ♀ (seen in BMNH). The latter is slightly less robust and more elongate in outline, length 20 mm, with some white hairs at the apical corners

of tergites and sternites 2-6, and with a very thin line of pale hairs seen to go all the way across the apices of sternites 2 and 3. There is a conspicuous patch of white hair just anterior to and lying up against the calypter; the corresponding patch in *euphanes* is light brownish. The dark spot on the scutum of *albocostatus* covers most of the scutum's area, while that of *euphanes* covers only 1/5 or less of its area, at the midline. This last character is a conspicuous difference but may prove variable, as one of the Thailand *euphanes* specimens has the spot much reduced. Another relative is *unicus*, which see for comparative notes.

Biology. The original description reported the collection date of the *euphanes* type in error by one month (correctly April, not May), which is important both in narrowing the seasonal distribution of the species and in tracing the type locality. The known flight season is thus reduced to 12 March-15 April. Coordinates for the Howarth/Laos localities are approximately 19°10'N and 102°20'E. Thus, although the species is now known from only 9 specimens, 3 separate drainage systems are represented: Gulf of Tonkin, Mekong, and Chao Phya. All localities are adjacent to, if not in, mountainous areas, with an estimated altitudinal range of 310-1050 m. Host interest was recorded in horse.

Tabanus unicus new species Fig. 70

Holotype female. Length 19mm. **Head.** Frons slightly divergent above, index 1:6.2; tomentum brown, appearing brownish black when viewed from below; a pair of inconspicuous bare spots below vertex; hairs mostly black, some white hairs along upper eye margins. Callosity brown, rather elliptical; dorsal extension orange brown and broadly linear. Eye (relaxed) with 2 green bands across dark field. Subcallus brown; face blackish brown, with brownish black hairs including beard. Antenna black with black hairs, plate with a strongly acute dorsal tooth and angulate below. Palpus black with black hairs throughout. **Thorax.** Dorsum rather dark brown with black hairs, except around the periphery, which is very pale brown on scutum and reddish brown on scutellum and with a liberal amount of white hair. Venter brown to blackish brown, with black hairs; coxae dark brown to brownish black and with black hairs and a few scattered white hairs; femora and tibiae black with black hairs, middle and hind tibiae with a few stout reddish hairs at extreme apices; tarsi blackened and with black hairs, middle and hind tarsi also with some stout reddish hairs. Wing with a brownish yellow tint at extreme base, in costal and subcostal cells, and in area of stigma and below, some much paler tinting also present elsewhere; 1st P cell open, no spur vein or angulation present; halter stem and knob brown. A patch of white hairs present above extreme base of wing, and another patch present on membrane under wing base

which lies against upper surface of calypter. **Abdomen.** Dorsum brown to black on tergites 1 and 2, black beyond 2; hairs black except as follows: tergite 1 with a complete band of white hairs along entire apex, 2-4 with apical patches of white hair broadly at the midline and also laterally but which are not connected to form a complete band, 5 with a patch of white hair at the midline but not laterally, 6 also has a very small patch of white hair at midline which can only be seen at certain angles. Sternite 1 brownish black, other sternites black and with black hairs throughout except for narrow but complete and conspicuous bands of white hair at the apices of 2-4.

Male unknown.

Type data. Holotype ♀: THAILAND: Chiang Mai Prov.: Huai Kaeo (~4 km NW of Chiang Mai) 18°48'N 98°57'E: 8 June 1969, Kao Somporn. (In Cornell University.) The type locality was the environs of a zoological garden at the foot of Doi Suthep, at about 350 m altitude.

Taxonomy. *T. unicus* has a very close relative in Kwangtung and Kiangsi Provinces of southeastern China which is represented by 3♀ and 1♂ in USNM. As far as I know it is unnamed. *T. unicus* differs from it in somewhat smaller size, more hyaline basal cells, distinctly broader band of white hairs on apex of tergite 1, somewhat narrower antennal plate than the China ♀♀, broader frons

and rounder callosity. In Thailand its nearest relative is *euphanes*, from which *unicus* is immediately distinguished by the presence of white median apical spots on tergites, mostly darkened thoracic

dorsum (though the lateral margins remain pale), much paler wing tint, and sternites 2-4 with white apical bands. Both share blackened head parts and venters, and are structurally similar.

Tabanus nyctops new species Fig. 71

Holotype female. Length 16.5 mm. **Head.** Frons divergent above, index 1:8.0; tomentum grayish above becoming brown below, hairs black. Callosity black, mostly parallel sided and tapering into black rather slender dorsal extension. Subcallus and upper cheek corner brown, upper cheek with some dark hairs especially along eye margin, and upper corners of frontoclypeus with a few black hairs, face otherwise white with white hairs including beard. Antenna with scape black haired, some pale hairs below; plate orange, dorsal tooth acute but rather small, annuli a little darker orange. Palpus with basal segment gray to creamy white, white haired; apical segment creamy white, white haired at base becoming black haired beyond the base. **Thorax.** Dorsum dark gray to blackish gray throughout, hairs black with some white hairs especially peripherally. Venter and coxae pale gray with white hairs, some dark hairs on mesopleurite; fore femur black on inner face and gray on outer face with mixed black and white hairs, other femora gray with white hairs, a few black hairs at apices. Fore tibia whitish with mostly white hairs over approximately basal 3/5 to 2/3, remainder black with black hairs, other tibiae more extensively pale with mixed hairs, darkened apically. Wing with costal and subcostal cells, stigma and marginal cell beyond stigma strongly infuscated, 1st submarginal cell also infuscated along most of 2nd vein, at apex and along anterior branch of 3rd vein, remainder of wing tinted brownish; anterior branch of 3rd vein curved; 1st P cell open; halter stem brownish yellow, knob brown. **Abdomen.** Dorsum

predominantly black with black hairs, tergite 1 extensively gray with white hairs, 2 gray at midline and with an apical triangle of white hairs, 3-5 with tall and slender triangles of white hairs, 6 also with some white hairs at midline, 2-4 gray with white hairs along lateral margin, 5 with white hairs at apical corner but not along lateral margin. Venter gray with mostly white hairs, 2-5 with median patches of black hairs which increase in size, apices remain white haired; 6 black haired with some white hairs at apical corners; 7 blackened and black haired.

Male unknown.

Type data. Holotype ♀: THAILAND: Chiang Mai Prov.: Huai Kao (4 km NW of Chiang Mai) 18°48'N 98°57'E: 6 June 1969, Kao Somporn. (In Cornell University.) The type locality was the environs of a zoological garden at the foot of Doi Suthep, at about 350 m altitude.

Taxonomy. The combination of dark dorsum (black to dark gray), strong wing infuscation along costa, open 1st P cell, and lack of any connected abdominal stripe or band distinguishes this species quickly from all others herein. *T. perakiensis* Ricardo (type seen in BMNH) of the Malayan Subregion appears similar, but *nyctops* has broader frons, antennal plate not distinctly elongated, pale palpus and beard, tibiae partly pale, and many other differences.

Tabanus jeanae new species Fig. 72

Holotype female. Length 20mm. **Head.** Frons slightly divergent above, index 1:7.7; tomentum pale brownish yellow; hairs reddish orange. Callosity dark orange, slender and rectangular; dorsal extension reddish orange, linear and long, almost grown over with tomentum below; a shining orange vertical spot which curves inward below present at each side of vertex. Eye (dried) metallic, with a bronzy cast. Subcallus pale orange yellow; face pale yellowish, hairs including beard yellowish white, yellowish on upper cheek along eye margin. Antenna with scape pale haired below and reddish orange haired above; plate orange, dorsal tooth acute and prominent, plate strongly narrowed beyond; annuli elongate, basal 3 orange, apical annulus blackened beyond the base and especially long. Palpus yellow, basal segment pale haired, apical segment reddish orange haired. **Thorax.** Dorsum orange brown, hairs mostly yellowish with some scattered dark hairs; scutellum bicolorous with

apex paler orange. Venter and coxae pale whitish orange with yellowish white to yellow hairs; trochanters, femora, and tibiae orange with yellowish white to reddish orange hairs; fore tarsus brownish, black haired above and orange haired below, other tarsi orange with mixed hairs. Wing with costal and subcostal cells and stigma tinted pale yellowish, elsewhere hyaline; veins brownish orange; anterior branch of 3rd vein curved to slightly angulate; 1st P cell open; halter stem yellow, knob yellow to whitish. **Abdomen.** Dorsum orange, essentially patternless, hairs mostly reddish orange but with paler hairs at lateral margins of tergites 1-4. Venter orange, patternless, yellow haired on basal sternites becoming reddish orange haired on apical sternites.

Paratypes (7♀♀). Length 18.5-21 mm. Frons index 1:6.5-7.5. Callosity rectangular to rather elliptical, dorsal extension may or may not have

omentum encroaching below; vertex variable from having a pair of large shining spots to almost entirely tomentose. Eye (dried) variable from bronzy to reddish black. Facial hairs including beard yellowish white to yellowish overall. Pale thoracic hairs variable, those on venter yellowish white to rather dark yellow and sometimes partly orange.

Male unknown.

Type series data. Holotype ♀: THAILAND: Chiang Mai Prov.: Huai Kao (4 km NW of Chiang Mai) 18° 48'N 98° 57'E: 9 May 1969 about elephant John J.S. Burton 1715-1900 hrs. (In Cornell University.) The type locality was the environs of a zoological garden at the foot of Doi Suthep, at about 350 m altitude. Paratypes: 1♀, precisely same collecting data as holotype; 2♀♀, all same collecting data as holotype but 2 May 1969, 1730-1915 hrs.; Mae Hong Son Prov. (vic. SW of Mae Hong Son) 19° 17'N 97° 58'E: 2♀♀, 13 May 1969 about water buffalo JB 1800-1915 hrs.; 1♀, 13-14 May 1969 Malaise trap JB; LAOS: Vientiane Prov.: "Ban Van Eue"; 1♀, 10-11

Apr. 1965 Malaise trap J.L. Gressitt.

Taxonomy. This species is distinguished by its large size and overall reddish orange appearance, essentially without pattern. *T. uniformis* Ricardo (type seen in BMNH) of the Malayan Subregion is related but smaller, with black haired palpus, darker thoracic venter and coxae, and much black abdominal hair. *T. jeanae* is named for my wife, Jean D. Burton, who has brought to this project not only her personal support but also much clerical help, and who shares my love for Thailand.

Biology. Known localities are in or near hill forests at altitudes from about 210 m (Mae Hong Son) to 750 m (Laos), and are above 18°N. Records fall in April and May. Host interest included elephant and water buffalo. Two were Malaise trapped, with the trap left up overnight in 1 case and apparently also in the other. This species is as truly crepuscular (or perhaps even nocturnal) as any I know in the country. The 2 Mae Hong Son specimens collected about water buffalo did not attack until it was almost too dark to see.

Tabanus borealioris new species Fig. 73

Holotype female. Length 21.5 mm. **Head.** Frons slightly divergent above, index 1:6.8; tomentum orange, dull yellow at vertex; hairs mixed pale and black, more concentrated black at vertex. Callosity reddish orange, rather elliptical, swollen; dorsal extension concolorous, essentially linear but narrowing throughout. Subcallus yellowish orange to reddish orange, upper cheek area reddish orange, remainder of face orange to yellow; facial hairs including beard black, a few beard hairs which arise from the posterior aspect of the head orange. Antenna with scape entirely black haired; plate orange basally, darkened to blackish orange beyond the base, with a very large and prominent forward-projecting dorsal tooth; first 3 annuli progressively blacker than plate, apical annulus jet black. Palpus brown, basal segment with long black hairs, apical segment with even short black hairs; tip rounded. **Thorax.** Dorsum orange brown, with some paler tomentum causing an inconspicuous striped effect; with recumbent pale hairs and more erect black hairs; scutellum appears somewhat bicolorous, mostly orange brown but with an anterior transverse darker brown band. Venter reddish brown, hairs mostly black to brownish black; coxae strongly gray to reddish gray; all femora and tibiae unicolorous orange red, paler at joints only. Wing tinted yellowish brown, heaviest in costal cell and stigma area and along veins, lighter in centers of cells; veins orange to orange brown; 1st P cell open; spur vein present; halter stem and knob orange. **Abdomen.** Tergites 1-3 essentially orange, 4 orange brown in various hues, 5 darker reddish brown, 6 brown; 2 with a large blackish brown spot at the midline crossing about 2/3 of the tergite's

width, 3 with a wider but more diffuse brown spot at the midline; 4 could also be regarded as spotted at the midline but the very diffuse brown spot blends in much more with its surroundings; sides of 2-5 with dark patches; hairs on dorsum mostly black, but with more or less complete apical bands of golden hair and pale tomentum on 1-5 which broaden at the midline to form small spots, and also broaden at the corners; 6 also with an apical band of pale tomentum but golden hairs confined to corners. Central area of venter reddish orange, periphery essentially gray; venter black haired except golden haired on pale apical bands of sternites, which are like those on tergites but do not expand into spots at the midline.

Paratypes (2♀♀). Length 20.5-21.5 mm. Frons index 1:6.8 on both. Antenna of one (Chiangmai) paler than that of the type, with the entire plate remaining bright orange though the annuli are darkened and black at tip; antenna of the other darker than type with even the apex of the plate black. Thoracic venter reddish brown to reddish gray. Wing tint may be quite even, not paler in cell centers. Abdomen may have a gray "scutellum collar" on tergite 1; 4 and 5 may have the apical pale bands not expanded into a spot at the midline; golden hairs may be nearly complete across the apical band on 6.

Male unknown.

Type series data. Holotype ♀: THAILAND: Chiang Mai Prov.: Huai Kao (4 km NW of Chiang Mai) 18° 48'N 98° 57'E: 8 June 1969,

Kao Somporn. (In Cornell University.) The type locality was the environs of a zoological garden at the foot of Doi Suthep. Paratypes: "Chiengmai-IV.1928/Dr. and Mrs./J.W. McKean": 1♀ (in BMNH); Tak Prov.: Mae Sot Dist.: Huai Muang Canton 16°40'N 98°31'E: 1♀, 9 July 1969 JB.

Taxonomy. This Oriental species has distinctly boreal affinities (hence the name). It is part of a southward penetration which is derived from the same ancestral stock as *confucius* Macquart (type seen in BMNH), *rufidens* Bigot, and other Palearctic species. Entirely consistent with this is the fact that its closest known Oriental relatives occur at high altitudes and latitudes. They include *altermaculatus* Ricardo (type seen in BMNH) from 2050 m and 25°N in Manipur State, India; *fuscocomaculatus* Ricardo (type seen in BMNH) from about 1000 m and 25°N in Kachin State, Burma; and *pullomaculatus* Philip from 1100 m and 27° 30'N in Sikkim.

See discussion of *altermaculatus* elsewhere

Tabanus ballmeri new species Fig. 74

Holotype female. Length 14 mm. **Head.** Frons slightly divergent above, index 1:6.4; tomentum brown becoming gray at vertex; hairs black. Callosity brownish yellow below and brown above, slender drop shaped, dorsal extension brown and essentially linear. Subcallus coppery brown; upper cheek area brown, remainder of face gray to pale brown, facial hairs including beard brown, some beard hairs arising from postero-ventral aspect whitish. Antenna with basal segment black haired; plate orange, rather broad throughout, dorsal tooth acute but quite small; annuli orange, only slightly darker than plate. Palpus all brown, basal segment with white, brown, and black hairs, apical segment black haired. **Thorax.** Dorsum gray, anteaere paler brownish; hairs black with some whitish hairs at least anteriorly and at side. Venter and coxae gray to reddish brown with mixed brown and pale (whitish) hairs, mesopleurite gray below and reddish brown above; femora reddish brown, fore femur almost entirely dark (brown to black) haired, other femora with mixed black and pale (white to yellow) hairs; fore tibia brownish yellow basally with pale (off-white) hairs and brown apically with blackened hairs, other tibiae reddish brown with mixed hairs. Wing subhyaline throughout, stigma yellow; anterior branch of 3rd vein curved; 1st P cell open; halter stem and knob brownish yellow, paler at apex. **Abdomen.** Dorsum and venter both reddish brown and both appearing to be covered with pale gray tomentum when viewed at a low angle from rear. Dorsum pre-

in this study. The following characters distinguish *borealoriens* from *altermaculatus*: abdominal venter mostly reddish orange (not dark gray); all femora and tibiae concolorous reddish (not with gray femora contrasting with reddish tibiae); tomentum of frons orange (not dark gray to brown); small pale spots on tergite apices at the midline (vs. no spots).

Biology. The Chiang Mai localities, although not in mountains, are at about 350 m altitude and are within flight range of a mountain massif, as this species might be expected to require. The Mae Sot District locality was situated literally on the bank of the Mae Moei River, with Burma on the other side. The terrain rises sharply about 4 km to the west, but the collecting vicinity was a flat plain at only about 200 m altitude. Thus it would seem that the species has succeeded in invading a much more tropical niche than its relatives. Known flight season is April-July. The Mae Sot District specimen was taken attacking water buffalo during the last hour before darkness.

dominantly black haired but tergites 1-5 with pale (yellow to white) hairs on lateral margins and apical corners, apical fringe of 2-6 with yellowish hairs. Venter also predominantly black haired, slightly darker down the median, yellow hairs widely scattered over lateral areas of sternites 2-6 and forming apical fringes across 2-4 and probably also on 5 and 6, 7 black haired.

Male unknown.

Type data. Holotype ♀: THAILAND: Chiang Mai Prov.: Doi Pui (a Maeo vill.) Altitude 1450-1650 m 18° 49-50'N 98° 53'E: 3 May 1969 about horses John J. S. Burton 1600-1900 hrs. (In Cornell University.) See under *zodiacus* (type series data and biology) for details of this locality.

Taxonomy. I know of no other described species which is sufficiently close to warrant formal comparison. Although lacking outstanding markings, its combination of characters, including abdomen and legs with a reddish brown cast, seems quite distinctive. It is likely restricted to high altitudes. I have seen 2♀♀ (from BPBM) from the mountains of Vientiane Prov., Laos, which are close to this but have the wing distinctly tinted, abdomen paler orange brown with much less pale hair. This species is named for Gregory R. Ballmer, former U. S. Peace Corps Volunteer in Thailand, who has assisted this project in many ways.

Tabanus xanthochrus new species Fig. 75

Holotype female. Length 13.5 mm. **Head.** Frons divergent above, index 1:7.5; tomentum yellowish orange, hairs reddish orange. Callosity yellowish brown, triangulate and contiguous with eye margin for part of its height; dorsal extension reddish orange, broadly linear. Eyes blackened in dried condition but, when relaxed, with 3 reddish purple bands across green field. Subcallus and upper cheek corner yellow, frontoclypeus paler yellow, remainder of cheek whitish yellow, facial hairs including beard yellow. Antennal scape yellow and mostly yellow to orange haired, with a few dark hairs dorsolaterally; flagellum essentially unicolorous orange, with only the extreme tip of the apical annulus darker; plate with a prominent and distinctly acute dorsal tooth, plate narrow beyond tooth. Palpi yellow; basal segment yellow haired; apical segment slender, mostly yellow haired but with some inconspicuous scattered dark hairs. Labellum and apex of theca pale brown. **Thorax.** Scutum yellow anteriorly and laterally, central area brownish yellow due to darker integument underlying yellow tomentum, entire scutum predominantly yellow haired but with some scattered reddish orange hairs, and a few darker hairs on antealare; scutellum orange yellow with yellow hairs. Venter, coxae, and femora entirely yellow and yellow haired; tibiae also yellow and mostly yellow haired but with some dark hairs apically (fore femur) or forming outer fringes (hind femur) (middle femur intermediate); tarsi orange with orange and black hairs. Wing with costal cell, most of subcostal cell, stigma, and basal area tinted yellow; apico-costal area and at least some other cells with a slight yellowish tint; 1st P cell open, no spur vein or angulation present; halter stem and knob yellow. **Abdomen.** Dorsum entirely yellow to orange yellow, and mostly lacking tomentum; integument of the basal segments pale, integument of the middle segments yellow and orange yellow with the coloration combined in such a way that it forms a very inconspicuous pale row of spots on each side of the midline; the midline itself appears very inconspicuously pale striped, due to a combination of a light dusting of pale tomentum, some pale hairs on 1-6 which expand apically at least on 2 and 3, and the integumental pattern; tergites mostly reddish brown haired except pale

haired as noted at midline, broadly at side of 1 and 2 and narrowly at side of 3-5. Venter entirely yellow except some slightly darker yellow to yellowish brown area at apex of sternites 5 and 6 and centrally on 7; venter pale yellow haired except for some reddish brown hairs which are scattered about the midline of sternites 2-5, extensively scattered on 6, and predominant on 7.

Male unknown.

Type data. Holotype ♀: "LAOS:/Vientiane Prov./Ban Van Eue/28.II.1966/Native Collector/RONDON-BISHOP MUS./COLLECTION/Light Trap". (In Bishop Museum, Type No. 10475.) I cannot pinpoint this locality at present. Some other Bishop Museum specimens at hand are labeled "Ban Van Heue/20km E of Phou-kow-kuei", and they are presumably from the same locality; but this is of limited help because Phou Khao Khouai [=Khouai Mountain] is a very large and extensive mountain formation which has its southwestern flank about 40 km NE of Vientiane.

Taxonomy. This is a thoroughly unique fly which merited description despite the lack of paratype material. Its present coloration may be somewhat paler than in life, because I have at hand some specimens of an unrelated species taken in exactly the same collection as this, which are distinctly more "bleached" than conspecific specimens taken by me in Thailand. The type has moth scales and "cobwebs" as a result of being caught in a light trap, and it is possible that "bleaching" may also have resulted from this method of collection if the catch remained ungathered for a time or was otherwise sun-dried.

In any case, I know of no other species which even faintly resembles *xanthochrus*. Almost the entire fly falls into the yellow to orange color range, the exceptions being the pale brown proboscis, the slightly darker central area of the scutum, and the dark eyes. The eye band configuration (relaxed) is itself unusual and serves to reconfirm the uniqueness of this species. The name is formed from Greek *xanthos*=yellow + *chros*=surface of the body.

Tabanus soubiroui Surcouf Fig. 76

Tabanus soubiroui Surcouf, 1922, Bull. Soc. Ent. France 1922:13-14.

Tabanus pugnx Austen, 1922, Bull. Ent. Res. 12(4):449-451.

Female. Length 12.5-17 mm. **Head.** Frons slightly divergent above to parallel sided, index 1:5.7-6.8; tomentum yellow except grayish V at vertex, hairs mostly dark. Callosity and dorsal extension variable from reddish brown to black, and shape of dorsal extension variable from that

figured (which is similar to type ♀) to stouter and bladelike. Eyes in life with 3 slender red stripes across green field. Tomentum of subcallus yellow, essentially concolorous with frons, and remainder of face slightly paler yellow, entirely yellow haired including beard. Antennal scape usually

with black and orange hair above and mostly pale elsewhere; plate orange, with a variable (acute to obtuse) tooth near the base; annuli orange, concolorous with to moderately darker than plate, except for the apical annulus which is blackened at least apically. Palpus yellow, basal segment with long yellow hair and sometimes a few short black hairs at apex, apical segment highly variable from almost entirely yellow haired with only a few scattered black hairs, to almost entirely black haired with only a few scattered yellow hairs. **Thorax.** Dorsum grayish (occasionally brownish) overall, caused by pale tomentum overlying dark integument, with mixed pale hairs and more erect black hairs. Venter and coxae yellowish gray, with yellow hairs; all femora dark (brown to grayish black) except yellow at apices, and yellow haired; fore tibia yellow and mostly yellow haired over basal 4/5 of area, darkened apically, other tibiae yellow to orange with hind tibia often darker apically. Wings with a slight yellowish brown tint throughout, costal cell at least slightly yellowed; 1st P cell open; 3rd longitudinal vein usually "normal" but rarely with a tiny spur vein; halter stem yellow, knob yellow to brown. **Abdomen.** Tergites 1 and 2 yellow to orange, 3 and 4 highly variable from pale orange to mostly blackened; 5 and 6 usually strongly darkened over a large area on each side of midline; a yellow haired, yellowish tomentose stripe crosses 1-5 and sometimes 6 at the midline, which usually diverges toward the apices suggesting triangles on some segments, and with apical yellow bands on 3-5 and usually 6 (variable on 2); tergites otherwise black haired, yellow haired at sides of 1-6. Venter yellow tomentose and mostly yellow haired, basal sternites yellow and apical sternites (3 or 4 and beyond) usually gray with paler apical bands; 2 and 3 commonly with a suggestion of a narrow but variable dark stripe at midline. (13+)

The Yunnan (China) specimen differs from the others in having some gray tomentum on tergite 1 adjacent to the scutellum, and also some gray on tergite 2 on basal half at the midline which is largely overlain by yellow tomentum.

Male unknown.

Type data (♂ & ♀): "Laos/Nam Tien/le 14-IV 1918/R. Vitis de Salvaza". (Both seen in Paris Museum.) This locality has been traced to a stream and adjacent hill at 19° 33-35'N 103° 41'E. There are several streams in Laos which currently share the name Nam Tien, but the one at the above coordinates is just a short distance away from Nam Mat, where Vitis de Salvaza collected the type of *T. euphanes* the very next day. The Nam Tien flows east from the Tranninh Plateau, enters the Nam Mo at the Viet-Nam border and becomes the Ca River flowing SE into the Tonkin Gulf.

Published records. LAOS: "Co-types [=paratypes of *soubiroui*]: 2♂, et 7♀, du même

lieu" (Surcouf 1922: 14). There are now in the Paris Museum 3♂♂ and 5♀♀ associated with the *soubiroui* type ♂ & ♀, only one of which has a "cotypes" label on its pin. Note that there are fewer ♀♀ and an additional ♂ now than reported originally, so the exact identity of all cotypes is slightly doubtful (and 1♀ of those now associated may not be conspecific); in any case, all bear locality labels which are detailed in the discussion of Vitis de Salvaza's collection elsewhere. THAILAND: 2♀♀ (holotype and paratype of *pugnax*), "N. Siam/Doi Chom Chang, nr. Chieng-mai./Alt. 5,500 ft./12.iv.1921./Dr.M.E. Barnes./1921. 393./"Attacked me/at 10.a.m./"(note by donor.)" Austen (1922a: 451) also quoted Barnes as noting, "this species is not uncommon." (Seen in BMNH.) Austen also spoke of 2 other ♀♀ from Siam that "would appear to be a variety of *T. pugnax*"; these (seen in BMNH) are in such poor condition that belaboring their identity was thought to be unproductive. CAMBODIA: 3 specimens from north central Cambodia recorded by Wharton (1957: 102) which were in turn probably the basis of Philip's mention (1960a: 9). I have at hand 2 of these specimens (from tray so labeled in USNM), and they are not this species. Neither their morphology nor their habitat is consistent with *soubiroui*. It is herewith deleted from the known Cambodian fauna. These are the same Cambodian specimens discussed under the taxonomy section of *T. alumnus* herein.

New records. CHINA: 1♀ (which had been associated under *fulvimedius* Wlk.), "Ind. Mus./Man Hsien/Yunnan/W. China/1909-10./J. C. Brown" (in BMNH). THAILAND: 1♀, "[Pui] 3500 ft./[Chiang Mai]/7 APR. 1939/[collector: Chanthong]" (in USNM; brackets show transliterations from Thai). 1♀, "[Son Laan Sop Aep]/1500-1800ft/21 APR. 1939/[collector: Chanthong]" (in USNM; brackets as above); Sop Aep has been traced to a village along the footpath to the summit of Doi Inthanon, at ~18° 30'N ~98° 40'E, Son Laan may be translated as "conifer tree plateau." Chiang Mai Prov.: Doi Pui (a Mao vill.) 18° 49'N ~98° 53'E: 2♀♀, 3 May 1969 JB; Chiang Mai Prov.: 8♀♀, "Doi/Suthep 1278 m./III-29-V-4'58/T.C. Maa/Collector".

Taxonomy. The ♀ type of *soubiroui* in Paris Museum is herewith established as lectotype.

Though this species has no single, easily stated diagnostic feature, there seem to be no other species within its range that look like it. However, the taxonomic picture is complicated. In addition to its synonym *pugnax*, the species involved are *flavioculatus* and *fulvimedius*.

Surcouf's name *soubiroui* beat Austen's name *pugnax* to press by no more than a matter of weeks in early 1922. This fact was realized by Austen almost immediately, as his handwritten notation on the Paris Museum specimen labeled "*T. soubiroui* cotypes" shows: "Syn. *T. pugnax*,

Austen, E.E. Austen, 4.iv.1922." Thus it is quite amazing that it took 50 years for the synonymy to appear in published form, and even then its author (Stone, 1975:69) made no mention of the fact that new synonymy was involved. It is presumed that this new listing was based on notes seen and not on a type comparison. The synonymy is herewith confirmed, through comparison of Thailand material (see new records) with both types (in Paris and London).

T. flaviculatus was described by Toumanoff (1950b:382-383) from "Mimot (Cambodge)." This locality is at 11°49'N 106°11'E, very close to the S. Viet-Nam border. The original description showed "Institut Pasteur de Saigon" as type depository, and "Institut Pasteur de Paris" as paratype depository. The single specimen of this species which is now in the Paris Pasteur Institute has a label which reads "Type". Dr. Grenier of that institution knows of no transfers of museum specimens from Saigon to Paris, and there is every reason to believe that the specimen present is not the type but the paratype. I believe that the type-designation label for *T. nantae* has been transposed with the paratype-designation label for *flaviculatus*. Thus, my comparisons were made only with the true paratype, and should be judged accordingly. This specimen is in very greasy condition. About the only worthwhile morphological character I could find to separate it from the 4♀ of *soubiroui* from Thailand (see above) which I had along was that, in the paratype of *flaviculatus*, the pale areas on the tergites do not tend to form a stripe at the midline, though this could be attributed to the condition of the specimen. The type was presumably in better condition at the time of the original description, and was shown (1950b: Plate 7 Fig. 2) without the connected stripe at the midline. Also, the eye pattern given, "yeux présentant deux lignes transversales jaunes", does not agree with the one I observed fresh in *soubiroui*,

but then it also does not seem to agree with the above original description figure either, which depicts not 2 but 3 pale bands. Synonymy of *flaviculatus* with *soubiroui* is not suggested here, as there are not only morphological questions but also the difference in range and, most important, the difference in physiography of known localities. Mimot is at a low altitude in plantation surroundings near one source of the Saigon River. If the type is lost, the Paris Pasteur Institute specimen is available as lectotype.

Austen's original description of *pugnax* included a statement that it was allied to *Tabanus fulvimedius*, Ricardo, not Walker (1922a:451). Commentary on the name *fulvimedius* is given elsewhere in this paper.

The Bishop Museum contains 3 specimens collected at upper altitudes northwest of Da Lat which are closely related to *soubiroui* but not now considered conspecific. They are generally more robust, hair color more strongly orange, tergites more reddish throughout rather than the usual division between yellow basal tergites and blackened apical tergites.

Biology. *T. soubiroui* is a species of higher altitudes and latitudes, known in Thailand only from 3 mountains in Chiang Mai Province (Pui, Chom Chang-Suthep massif, and Inthanon) at altitudes from no lower than 450 m up to 1,676 m. In 1921, Barnes noted that the species was not uncommon at the highest altitude, and the relative length of the type series from upper Laos tends to substantiate this. Some of the Laos specimens may not have been taken above 300 m, though there is no way to be sure of this. Recorded host interest included horses and man, both morning and afternoon or evening. Known seasonal range is 17 March to 4 May, thus in the dry part of the year.

Tabanus firmus new species Fig. 77

Holotype female. Length 20 mm. **Head.** Frons moderately divergent above, index 1:6.5; tomentum dull off-white, grayish at vertex and with a small bare spot below vertex; hairs mixed black and pale. Callosity brownish black, shaped like slender drop; dorsal extension black, narrow and linear. Eyes (dried) bluish black on upper area and bluish green on lower area. Subcallus pale yellowish white; face white to grayish white with white hairs including beard. Antenna with scape mostly white haired below and black haired above, dorsal apex with a few orange hairs; plate orange, broad, dorsal tooth nearly right angled to obtuse and rounded, annuli blackened. Palpus with basal segment yellowish white to gray, white haired; apical segment yellowish white, some white hairs near the base but elsewhere evenly black haired. **Thorax.** Dorsum gray, some sutures and peripheral areas such as antalar and apical margin of scutellum

brownish; hairs black and pale, the pale hairs in patches near the wing base and scattered elsewhere, with only the very faintest suggestion of stripes. Venter and coxae gray with pale hairs, mesopleurite with some black hairs; fore femur black with black hairs on inner face and gray with white hairs on outer face, other femora gray, yellowish at apex, with black hairs on fore face and pale hairs on hind face; fore tibia yellowish white with mostly pale hairs basally and blackened with black hairs apically, other tibiae yellow with black and pale hairs. Wing with costal and subcostal cells and stigma strongly tinted brown, remainder entirely tinted pale brownish; 1st P cell open; anterior branch of 3rd vein curved; halter stem brownish yellow, knob yellowish white. **Abdomen.** Tergite 1 gray with pale haired areas basally and brown beyond, 2 and 3 brown, 4 brown becoming blackened, 5-7 black, all mostly

black haired; midline of 1-5 with a broad and conspicuous stripe of whitish tomentum and hairs which expand very slightly toward the apices of the individual tergites, and flanked on 2-4 with areas of somewhat darker integument than that of the sublateral areas of the same tergites, median stripe also crosses 6 but is greatly reduced; lateral margins of 1-6 pale with pale hairs. Venter orange with yellow hairs, sternites 2-6 each with a large median patch of somewhat darker tomentum and black hairs, apices remain pale; 7 dark gray with black hairs.

Paratypes (14♀). Length 17-21 mm. Frons index 1:6.5-7.8. Frons and subcallus may be yellowish, callosity and dorsal extension variable from black to orange brown, sometimes truncate at base; bicolouration of eyes usually not discernible (dry); face and facial hairs often yellowish white. Antennal plate with dorsal tooth variable from acute to very rounded; apical area of plate orange to much darkened. Thoracic dorsum often with more extensive pale hairs which may form faint stripes; scutellum may be entirely gray. Wing tint sometimes tends to follow veins. Pattern of abdominal dorsum variable from medium brown on basal tergites and with a pale sublateral spot on each side of 2 which even has some pale hairs, to much more evenly dark brown on basal segments and without sublateral spots.

Male unknown.

Type series data. Holotype ♀: THAILAND: Chiang Mai Prov.: Huai Kaeo (~4 km NW of Chiang Mai) 18°48'N 98°57'E: 18 May 1969 Kaeo Somporn. (In Cornell University.) This locality is at the foot of Doi Suthep, at about 350 m altitude. Paratypes: 4♀, same collecting data as holotype but dates differ as follows: 1 ♀, 21 May; 2♀, 22-23 May; 1♀, 16 June; THAILAND: Loei Prov.: Dan Sai Dist.: Dan Sai & vic. 17°16'N 101°09'E: 2♀, 10 June 1969 C. Det-tongchai; Nakhon Ratchasima Prov.: Pak Chong Dist.: Mu Si Canton: Pong-ta-long [14°26-36'N 101°21-37'E]: 1♀, 20 May 1969 G.R. Ballmer; [Nakhon Ratchasima Prov.: Pak Chong Dist.]: Khao Yai National Park: 4♀, 5 May 1967 R.R. Pinger.

Also tentatively identified here but not designated as paratypes: LAOS: Mg. Luang Prabang: Ban Na Lao: 1♀, 19 May 1967 F.G. Howarth; Vientiane: 1♀, 21 Mar. 1965 J.A. Rondon. THAILAND: "[Sop Aep Son/Laan] 1500-1800ft/ 5 MAY 1939/[collector: Chanthong]" (brackets show transliterations from Thai)—Sop Aep has been traced to a village along the footpath to the summit of Doi Inthanon, at ~18°30'N ~98°40'E, Son Laan may be translated as "conifer tree plateau."

Taxonomy. *T. firmus* shows some resemblance, but not a clear relationship, to the *rubidus* group. It can be distinguished from Thai members of the

latter group by a combination of large size, heavily tinted costal cell, strong and connected abdominal stripe, and orange abdominal venter. In Thailand it is a relative of *griseilineis*, and these even share the bicolorous eye pattern, but *firmus* is immediately distinguished by its strong whitish abdominal stripe.

Described relatives from other areas include *monotaeniatus* (Bigot) and *reducens* Walker. *T. reducens* belongs to island Southeast Asia, though it has also been reported from Johore, Malaya; *monotaeniatus* has literally been reported from all 4 sides of Thailand though not in it. I have seen the types of both of these in BMNH, and have seen nothing from Thailand which is conspecific with either of them. However, I have seen a curious assortment of specimens from various collections including material from Burma, Laos, and S. Viet-Nam, which could have been construed as *monotaeniatus* in the absence of a type comparison. Such related species are no doubt the source of some of the *monotaeniatus* records. The Java record must be considered invalid; it is based only on a simple notation of "Females from Assam and Java" by Ricardo (1914[1915]:123), from material in the German Entomological Museum, now presumed destroyed. This record is very far out of range and has not been substantiated by intensive subsequent collecting. The Cambodia and S. Viet-Nam (Cochinchine) records of Toumanoff (1941: 1078) are very doubtful and are probably also based on related species. Three of the 6♀ on which the upper Burma records (Mohnyin R., Katha) of Senior-White (1922:105) are based are in the BMNH collection. One of these does seem to agree with the *monotaeniatus* type; the other 2 (at hand, on loan) are closer to *firmus* than they are to *monotaeniatus*, but are probably not conspecific with *firmus* either. Note that Senior-White himself made a distinction between 2 color varieties in reporting his series. It is clear that a closely related species group is involved, and until its various members are further collected and revised much care should be taken in identifying specimens as conspecific with described taxa.

T. firmus differs from *monotaeniatus* in having the abdominal stripe distinctly wider and usually but not always more jagged; the abdomen is more brownish laterally on tergites 2 and 3, not the relatively uniform blackish color of *monotaeniatus*. The palpus of *firmus* is pale, not reddened.

There is a rather uncomfortable amount of heterogeneity even among the paratype series of *firmus*, and species limits must be considered as yet to be established.

Biology. This species apparently occurs in and adjacent to forested hill tracts, and is distributed in northern Thailand and adjacent parts of upper Laos, then down to the southern extremity of the Petchabun Range. The estimated altitude range represented by specimens identified as

firmus is 175 m up to at least 450 m and possibly 550 m. Known seasonal range is 21 March to 16 June. Host interest was recorded in water buffalo

and cattle, with elephant probably also involved. Time of attack was recorded for only 1 specimen, at 1400-1500 hours.

Tabanus griseilineis Philip Fig. 78

Tabanus griseilineis Philip, 1960a, Stud. Inst. Med. Res. Malaya 29:17.

Female. Length 15.5-20.5 mm. **Head.** Frons very slightly divergent above to parallel sided, index 1:4.7-6.5; tomentum dull brownish yellow, a median vertical bare spot just below vertex; hairs mixed black and yellow. Callosity black (rarely blackish brown), variable from slender drop shaped to irregularly pentagonal or triangulate; dorsal extension black, more or less linear. Eyes (relaxed) bicolored, the lower area green and the upper area darker. Subcallus variable from nearly concolorous with frons to considerably paler whitish yellow; face yellowish white to white, hairs including beard white. Antenna with scape mostly white haired below and black haired above, dorsal apex usually with a few orange hairs; plate variable from entirely orange to rather darkened beyond the level of the dorsal tooth, dorsal tooth variable from strongly acute to obtuse; annuli black. Palpus with basal segment gray and creamy white, with white hairs and sometimes a few black hairs at apex; apical segment creamy white, mostly to entirely white haired at base but beyond the base variable from predominantly white haired to almost entirely black haired. **Thorax.** Dorsum grayish brown and mostly black haired, with some pale hairs scattered at least anteriorly and on hind margin of scutellum, and patches of pale hair near wing base. Venter and coxae gray with whitish hairs, some dark hairs on mesopleurite; fore femur black with black hairs on inner face and gray with white hairs on outer face, other femora gray with yellow apices, mostly white haired but with some black hairs; fore tibia with basal area pale and usually mostly pale haired, apical area blackened and mostly black haired, other tibiae yellowish with mostly pale hairs on inner face and black hairs on outer face. Wing with a slight yellowish tint over part of its area which is often most easily discernible in the costal and subcostal cells; 1st P cell open; anterior branch of 3rd vein curved to angulate or with budlike spur vein; halter stem usually yellowish, knob commonly brownish at sides basally and pale yellowish beyond. **Abdomen.** Tergites 1-4 mostly orange brown and with black hairs, remaining tergites becoming gray, 5 often transitional; 1 gray adjacent to scutellum, 2-4 with the median darker (gray) than sublateral area, though this is highly variable and rather indistinct at best and sometimes is not discernible at all (it is best viewed with the naked eye), tomentum on the midline of 2-5 appears indistinctly pale when viewed at a low angle from the rear, 1-5 (and even 6) may or may not have a very small patch of pale hairs at the apex of the midline; lateral margins of 1-5 pale with pale hairs, 6 also pale but may be black haired. Sternite 1 variable from yellow to gray, gray at midline; 2 and

3 commonly orange (occasionally grayish) laterally with variable amounts of pale and black hairs, and a large median gray spot with black hairs; 4 and 5 essentially similar but becoming darker; 6 gray with a narrow pale apex; 7 gray. (293+)

Male unknown.

Type data (♀): THAILAND: Chiang Mai, 9 June 1952, D.C.&E.B. Thurman. (Seen in USNM.) The type's label actually shows only "Thailand/vi9 1952/DCÐurman", in handprinting. Philip (1960a:17; 1960b:48) published the "vi9" as "via", a reasonable mistake due to the similarity of a 9 and a handprinted a. In personal correspondence Dr. E. Thurman has supplied the above authentic collecting data from her field notes.

Published records. Known only from holotype.

New records. THAILAND (all 1969): Chiang Mai Prov.: Huai Kao (~4 km NW of Chiang Mai) 18°48'N 98°57'E: 1♀, 6 June K. Somporn; 8♀♀, 10-16 June KS; 21♀♀, 15 July P. Chaeemane; 29♀♀, 16 July KS; 78♀♀, 17 July KS; 155♀♀, 18 July KS.

Taxonomy. The character for which this species was named is not entirely dependable. A high percentage of specimens does show a gray abdominal median, but many specimens have the dark markings irregular or nonexistent on some tergites. The contrast with the sublateral area is not strong, and is partially masked by an overlay of pale tomentum which can be seen from a rear angle; but like the gray markings (when present), the overlay is diffuse and poorly defined. Rubbing can alter the appearance considerably. The type itself is rather bleached and suffers mechanical and pest damage, but association with the fresh material presented no difficulty.

T. griseilineis is related to the large and difficult *immanis* group of the Malayan and Philippine Subregions. In addition to the geographic separation, members of the latter group generally have blackened antennal plates and lack the gray median markings on the abdominal dorsum. At Chiang Mai, specimens of *pristinus* which have had the pale hairs rubbed off the abdominal dorsum may show a superficial resemblance to *griseilineis*, but the latter has the abdominal venter strongly marked with dark median patches.

Biology. All of the new specimens were taken at the base of Doi Suthep at about 350 m.

This is just outside of Chiang Mai and the specimens are essentially topotypic. This was probably the dominant tabanid in mid-July at the locality in question, and failure to collect it at several other northern sites sampled at that time is peculiar. It appears to prefer the rainy season. It was absent

from the May sampling and sparse in the mid-June sampling. Known seasonal range is 6 June to 18 July, when sampling ceased perhaps at peak incidence. Host interest was recorded in elephant, cattle, and water buffalo, with some taken at rest near the hosts.

Atylotus cryptotaxis new species Fig. 79

Holotype female. Length 8.5 mm. **Head.** Frons very slightly divergent above, index 1:5.0; tomentum entirely orange yellow; hairs mixed yellow and black. Callosity yellow, small and spindle shaped, dorsal extension very short, slender and inconspicuous. Subcallus orange yellow, face various shades of yellow with yellow hairs including beard. Antenna with scape yellow haired; flagellum orange yellow, plate rounded below and with an obtuse dorsal tooth. Palpus yellow, basal segment yellow haired, apical segment yellow haired but with some scattered black hairs beyond the base. **Thorax.** Dorsum dark orange yellow with mixed yellow and black hairs. Venter pale grayish yellow to yellow with yellow hairs; legs entirely yellow, yellow haired with mixed black hairs on tibiae and tarsi and at femoral apices. Wing hyaline, veins and stigma pale yellowish; anterior branch of 3rd vein curved; 1st P cell open; halter stem and knob yellow. **Abdomen.** Dorsum orange, patternless, hairs mixed black and yellow, an apical patch of yellow hairs at midline of tergite 1. Venter yellow with yellow hairs, sternite 7 black haired and 6 with a few scattered black hairs.

Paratypes (7♀♀). Length 8-9.25 mm. Frons may be essentially parallel sided, index 1:4.7-6.0; callosity always small and usually spindle shaped but may be somewhat irregular; dorsal extension may be of moderate length but always very slender. Apical segment of palpus may have black hairs predominating. Sternite 6 may lack black hairs.

Male unknown.

Type series data. Holotype ♀: THAILAND: Loei Prov.: Loei & vic. 17°29'N 101°44'E: 30 May 1969 about water buffalo Chusuk Dettongchai. (In Cornell University.) This locality is in the Loei River plain, at an altitude of about 250 m. Paratypes: 1♀, precisely same collecting data as type; 2♀♀, same collecting locality, year, and collector as type but 23 Apr. and 26 Apr.; 1♀,

same locality as type but 20 Apr. 1969 JB; 1♀, same locality as type but 20 Apr. 1969 P. Chaemmanee; Sakon Nakhon Prov. (12 km NW of Sakon Nakhon) 17°13'N 104°03'E: 1♀, 22 Apr. 1969 JB; Khon Kaen Prov.: Khon Kaen: 1♀, 14 Nov. 1970 C.O. Berg.

Taxonomy. This species is quickly distinguished from *lotus* in being yellow to orange throughout (except eye), and with much narrower frons and non-bulbous palpus. *A. gilvellus* (known only from the ♂) appears very close, and may ultimately prove to be the same species. However, for the time being *cryptotaxis* is distinguished by the much more strongly yellowed face and especially subcallus, and the lack of spur vein. There is also a geographic aspect, as no specimens of the species being accounted were collected in northern Thailand (the provenance of *gilvellus*) despite a strong effort there. I have seen a ♀ specimen from Assam, India, which is also closely related, but has a paler thoracic dorsum, antennal plate more elongate and narrowed apically, yellowed costal cell, and with a spur vein.

There is a lingering question about the generic placement of this and various other Oriental "*Atylotus*", as explained elsewhere under the generic heading. The name of this species is intended to call attention to the ambiguity. One of the characters of *cryptotaxis* which diverges from Holarctic members of the genus is the vertically oriented callosity with presence of a dorsal extension, however small and fine.

Biology. *A. cryptotaxis* is known from only 3 localities in the upper part of northeastern Thailand. These are plains sites lying between 160-250 m altitude. The present series does not suffice to generalize about flight season. Host interest was recorded in water buffalo and cattle. Known times of attack include mid-afternoon as well as the last hour before darkness.

Atylotus gilvellus (Philip), new combination

Tabanus gilvellus Philip, 1960a, Stud. Inst. Med. Res. Malaya 29:16-17.

Female unknown.

Male (holotype). Length 9 mm. **Head.** Subcallus pale yellowish. Face with cheeks mostly

whitish yellow, frontoclypeus yellow; hairs including beard pale yellow. Antenna with scape yellow haired; [flagelli missing]. Palpus yellow with yellow hairs, apical segment with a few dark hairs.

Thorax. Dorsum dark yellow with yellow hairs, apex of scutellum paler than base. Venter pale grayish yellow to yellow with yellow hairs. Legs yellow, fore tarsus somewhat darkened. Wing hyaline, veins yellow; 3rd vein of left wing very weakly angulate, of right wing with a strange bud-like bifurcating spur; 1st P cell open; halter stem and knob yellow. **Abdomen.** Dorsum orange yellow, hairs yellow to blackened but largely rather brownish, the proportion of dark hairs apparently increasing toward the apex. Venter yellow with yellow hairs, apical sternites somewhat darkened, 6 partly and 7 mostly dark haired.

Type data (♂): THAILAND: Chiang Rai Prov.: Phan Dist.: Phan: 5 March 1952, floating in hot springs pools, D.C.&E.B. Thurman. (Seen from USNM.) This locality data is at odds with that which is handprinted on the type data label, and in only partial agreement with that published with the original description. Fortunately the type bears a collecting number, "334", and Dr. Ernest

Thurman has kindly confirmed for me the above data from her field notes (place name transliterations and sequence made to conform to present format). Phan is located at approximately 19°30'N 99°45'E, at about 420 m altitude.

Published records. Known from holotype only.

New records. None.

Taxonomy. It may be very difficult to make an accurate association of sexes for this nominal species, and the fact that the type is a ♂ makes the new generic combination even more dubious. However, this seems the best course in view of the apparent closeness of its relationship with *cryptotaxis* (which see for comparative notes). A ♀ from Assam, India (seen from USNM) may be the same but has the costal cell yellowed. The relationship of *griseifacies* Schuurmans Stekhoven (the type of which I seem to have overlooked in BMNH) has yet to be assessed.

Atylotus lotus new species Fig. 80

Holotype female. Length 9 mm. **Head.** Frons divergent above, index 1:4.2; tomentum yellow, gray at vertex; hairs mostly yellow but black at vertex and some scattered below. Callosity (basal callus) brown, essentially rounded but rather flattened below; no dorsal extension. Subcallus and upper cheek corner yellow, concolorous with frons; remainder of face white, hairs white including beard. Antenna with scape white haired; flagellum orange yellow, plate rounded below and humped but also rounded above. Palpus with basal segment white, white haired, bulbous; apical segment white, white haired but with some scattered black hairs beyond the base, bulbous basally becoming very slender and pointed apically. **Thorax.** Dorsum gray, antealare paler, hairs mixed black and recumbent yellow, some white hairs at anterior corners. Venter and middle coxa pale gray with white hairs; fore and hind coxae whitish yellow with white hairs; femora yellow with white hairs, some black hairs scattered on apical half of fore femur and a few black hairs at apices of other femora; tibiae yellow with black and white hairs; tarsi yellow. Wing hyaline, venation pale yellowish throughout; anterior branch of 3rd vein curved; 1st P cell widely open; halter stem and knob mostly creamy white. **Abdomen.** Dorsum appears principally gray; tergite 1 mostly pale gray with brownish yellow apex; 2 grayish centrally and brownish yellow laterally; 3 brownish yellow basolaterally and on apical corners, remainder grayish; 4 similar but more extensively gray; 5 and 6 gray, brownish basally and yellowish on lateral margin; 7 gray; entire pattern poorly defined, the extent and hue largely dependent on angle of view, color of overlying hairs, etc., gray areas mostly with a purplish cast when viewed microscopically; hairs mostly black but pale hairs widely scattered else-

where, especially laterally and narrowly along tergite apices, 2 and 3 (and to a lesser extent 4) appear spotted due to a sublateral area of pale hairs and tomentum. Sternites yellowish to very pale grayish, white haired, 7 predominantly black haired.

Paratypes (46♀♀). Length 7-10 mm. Frons index 1:3.3-4.5. Callosity brown to black, round to rectangular, sometimes notched. Antennal scape commonly with some pale orange hairs at dorsal apex. Abdominal color appears highly variable from mostly yellow to gray, and pattern from distinctly banded (tergite apices darker) to somewhat striped (median areas of 1-4 darker), or a combination or neither of these, spots may or may not be apparent. This variation is continuous, with no doubt about the conspecificity of the series.

Male unknown.

Type series data. Holotype ♀: THAILAND: Loei Prov.: Loei & vic. 17°29'N 101°44'E: 7 May 1969 about water buffalo Chusuk Dettongchai. (In Cornell University.) This locality is in the Loei River plain, at an altitude of about 250 m. Paratypes: 39♀♀, same locality data, year, and collector as holotype, but dates vary: 2♀♀, 23 Apr.; 5♀♀, 28 Apr.; 3♀♀, 29 Apr.; 4♀♀, 3 May; 1♀, 6 May; 4♀♀, 7 May; 1♀, 8 May; 8♀♀, 9 May; 3♀♀, 12 May; 3♀♀, 16 May; 2♀♀, 21 May; 1♀, 29 May; 1♀, 30 May; 1♀, 1 June; Mae Hong Son Prov.: Mae Sariang Dist. (area W of Mae Sariang) ~18°09'N ~97°55'E: 1♀, 13 May 1969 P. Chaemmanee; "Chiengmai": 1♀, 9 May 1961 K. Iwata; Loei Prov.: Chiang Khan Dist.: Chiang Khan 17°53'N 101°39'E: 2♀♀, 17 Apr. 1969 JB; Loei Prov. (12-15 km NW of Loei) ~17°34'N

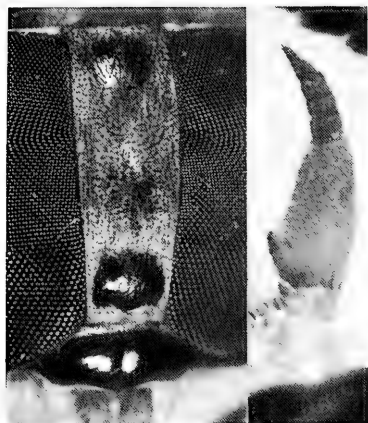
~101°39'E: 1♀, 18 May 1967 JB; Loei Prov.: "17 km NW Loei": 1♀, 17 May 1967 R.R. Pinger; N. VIET-NAM: "Hanoi": 1♀, 20 May 1926.

Taxonomy. Despite much intraspecific variation in abdominal pattern, this species is distinctive and even poor quality specimens can be easily identified. It is distinguished at a glance from *cryptotaxis* by the gray thorax (and usually also abdomen), as well as wider frons, white face and palpus, and many other differences. There are several closer relatives. One is *virgo* (Wied.), very close to the spotted configuration of *lotus* but quickly distinguished by its complete lack of calli. The type of *albulus* Walker from "East India" was seen in BMNH. It has since Ricardo (1911:136) been synonymized under *virgo*, without subsequent reconfirmation. Another close relative is *A. pusillus* (Macquart 1838, not 1855, [*Tabanus*]) (new combination). There is a single specimen in the Macquart collection at the Paris Museum (seen by me) which must be the type though it was not so labeled. Its data labels show, "Chine", "323", and "*Tabanus pusillus*", the latter in Macquart's

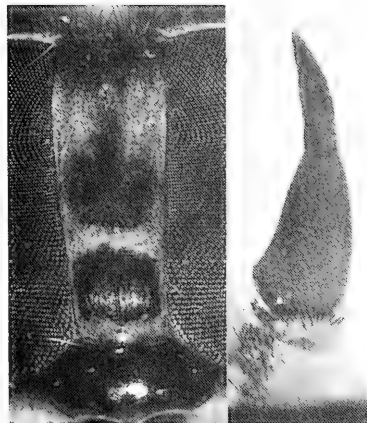
handwriting. It is in miserable condition, but can be distinguished from *lotus* by its less divergent frons, differently shaped callus, apical palpal segment not as bulbous at base, and distinctly yellowed costal cell.

This new species is named after the sacred lotus, an important Buddhist religious symbol and food plant in Southeast Asia.

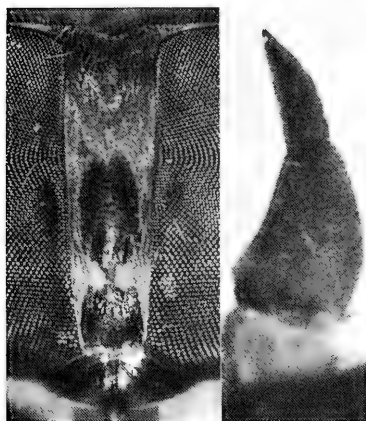
Biology. *A. lotus* is apparently not uncommon in Loei Province, where it was taken from 17 April to 1 June (the total known range from all localities). This is the season of increasing rainfall, and the adults may not survive the peak months. The distribution is northern (the type locality is the most southern thus far represented), but the Mae Sariang and Hanoi records indicate wide dispersion. Altitude range in Thailand is about 200-310 m; the Hanoi record, if accurate, is close to sea level. Host interest was recorded in water buffalo, cattle, and elephant. Attack time was noted for only 2 specimens (at Chiang Khan), and it was during the final hour before darkness.



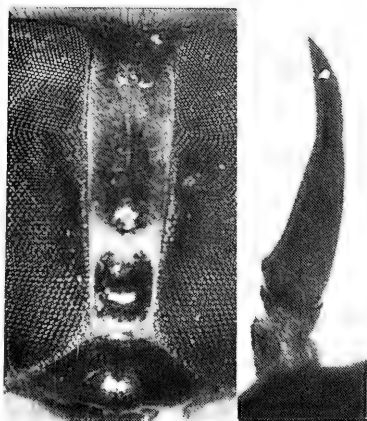
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Fig. 2. T. sexcinctus

Fig. 3. T. gyruchus

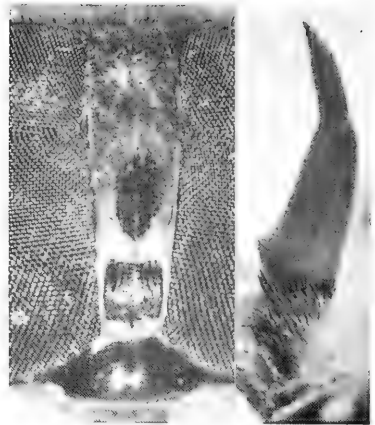
Fig. 4. T. idulis

Fig. 5. T. caduceus

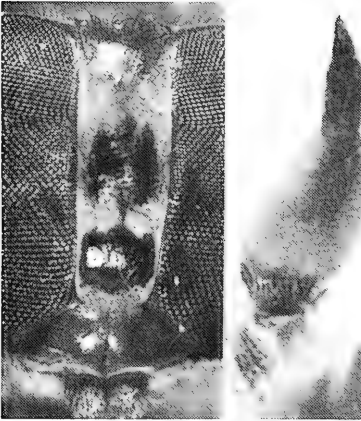
Figs. 2-80 each show frons and antenna. Holotypes are illustrated in the case of all new species.



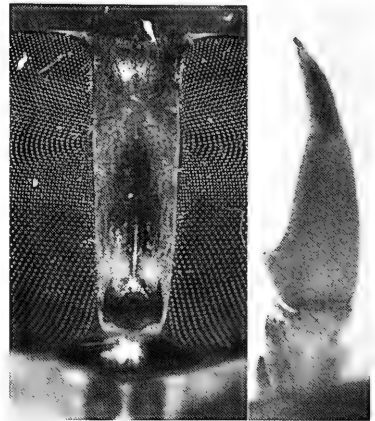
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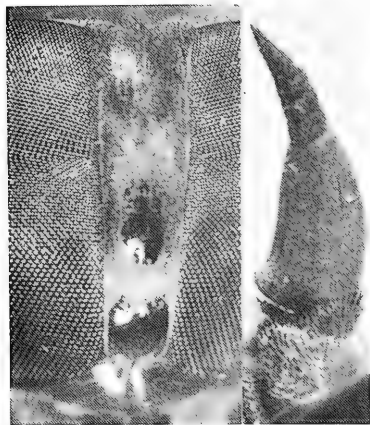
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Fig. 6. T. rhinargus

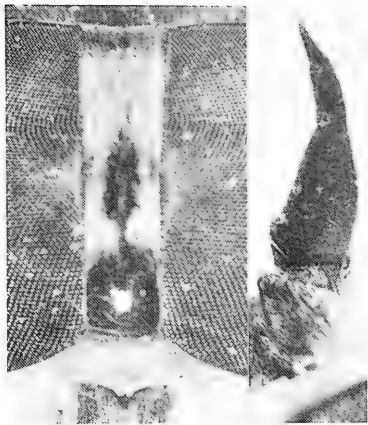
Fig. 7. T. discors

Fig. 8. T. zodiacus

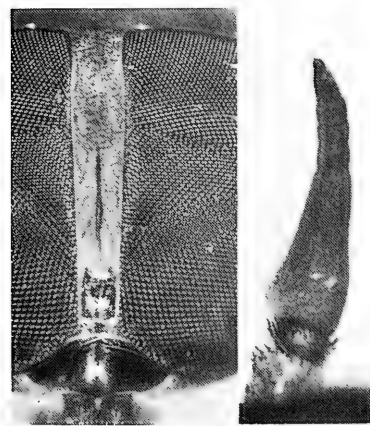
Fig. 9. T. tonglai



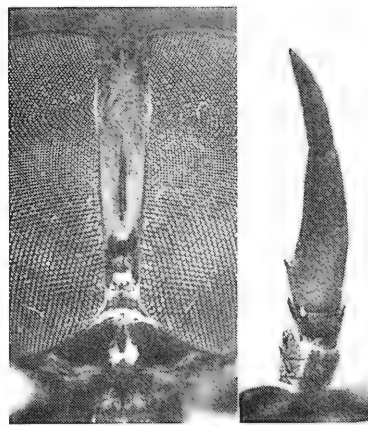
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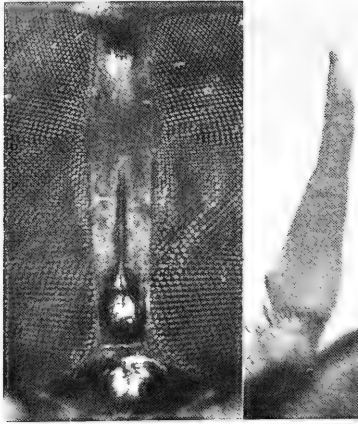
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Fig. 10. T. orbis

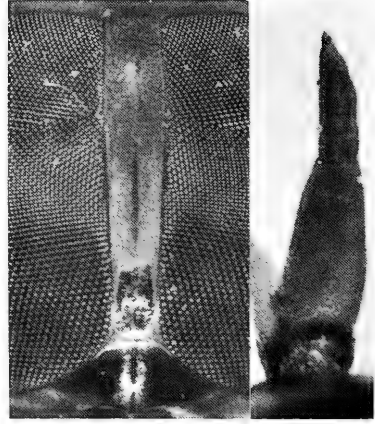
Fig. 12. T. minimus

Fig. 11. T. equicinctus

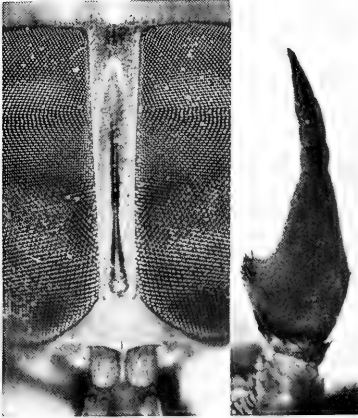
Fig. 13. T. ceylonicus



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Fig. 14. T. eurytopus

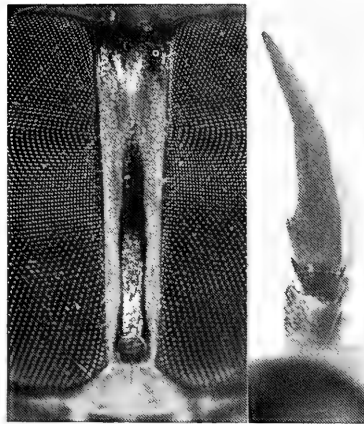
Fig. 15. T. mesogaeus

Fig. 16. T. nigrotectus

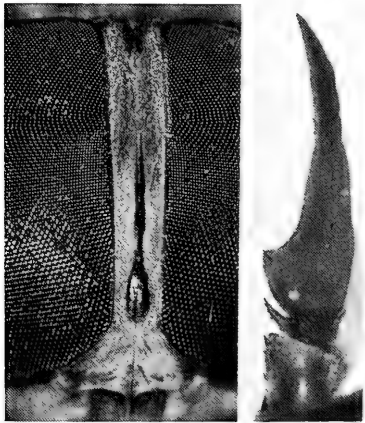
Fig. 17. T. oknos



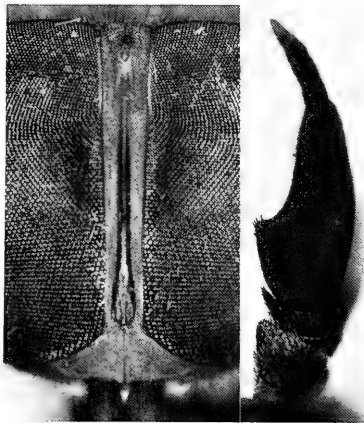
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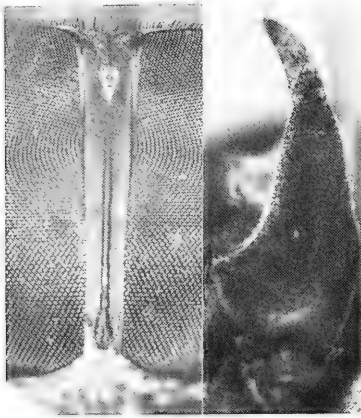
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Fig. 18. T. granti

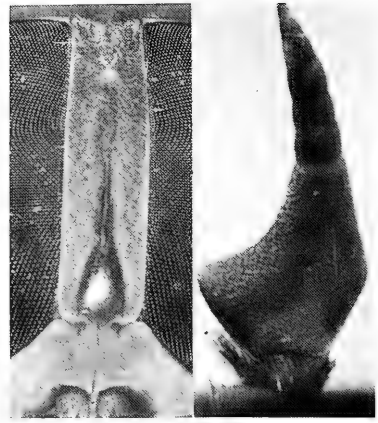
Fig. 20. T. toumanoffi

Fig. 19. T. geographicus

Fig. 21. T. salvazai



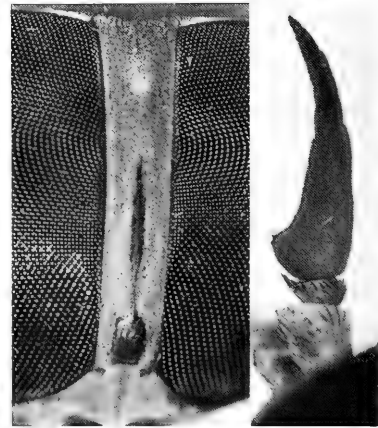
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Fig. 22. T. kakhyenensis

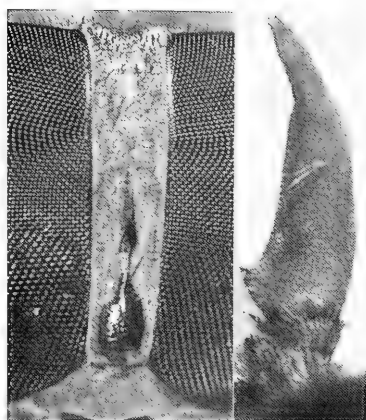
Fig. 23. T. rufiscutellatus

Fig. 24. T. fascius

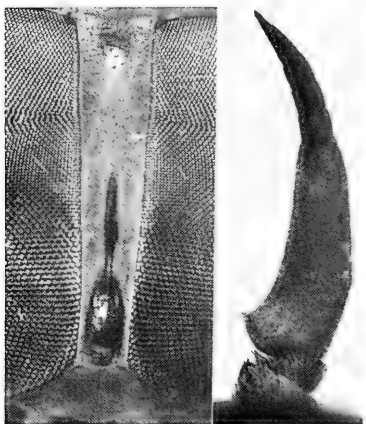
Fig. 25. T. alumnus



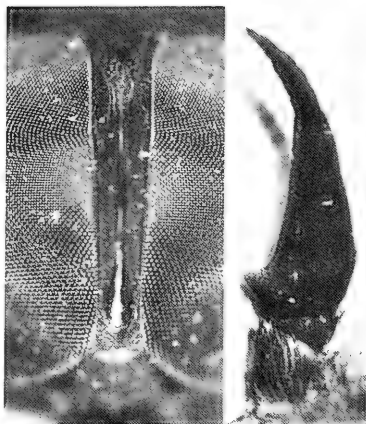
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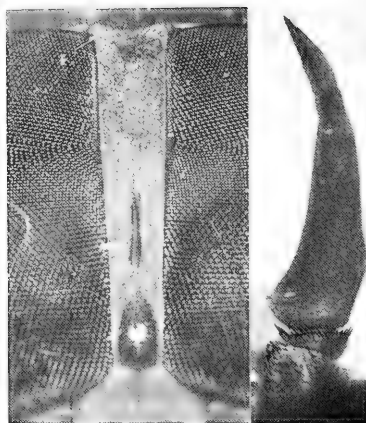
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Fig. 26. T. siamensis

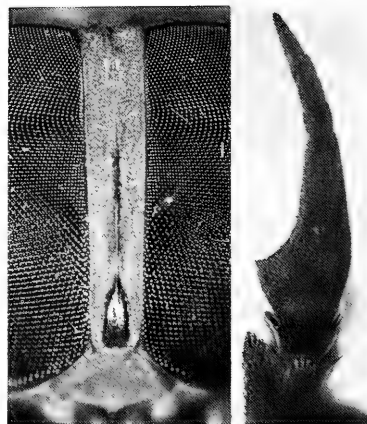
Fig. 27. T. anabates

Fig. 28. T. birmanicus

Fig. 29. T. abbasalis



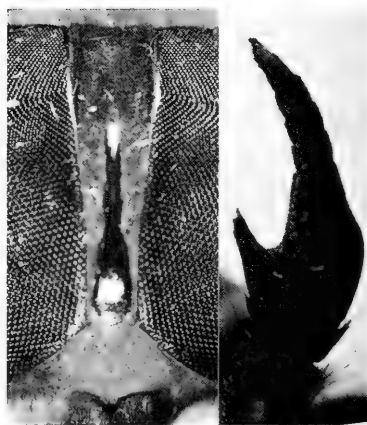
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Fig. 30. T. admelanopygus

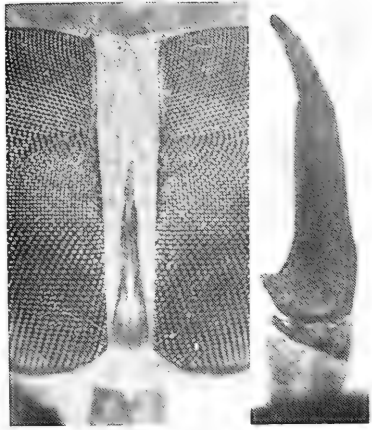
Fig. 32. T. paviei

Fig. 31. T. thurmani

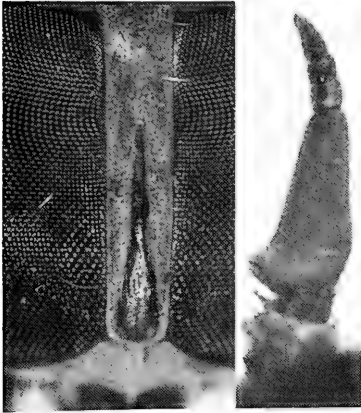
Fig. 33. T. praematurus



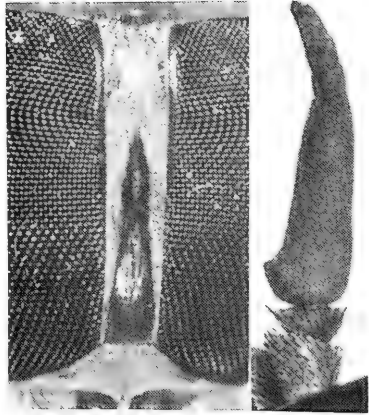
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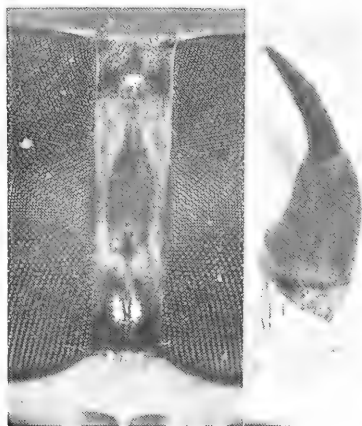
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Fig. 34. T. tamthaiorum

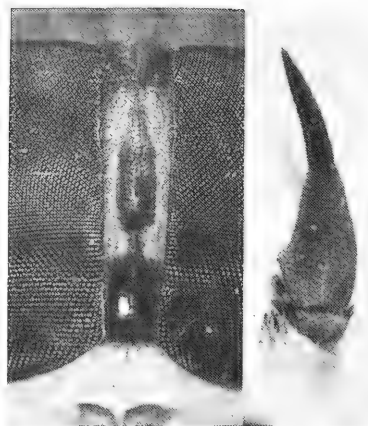
Fig. 36. T. helvinus

Fig. 35. T. longibasalis

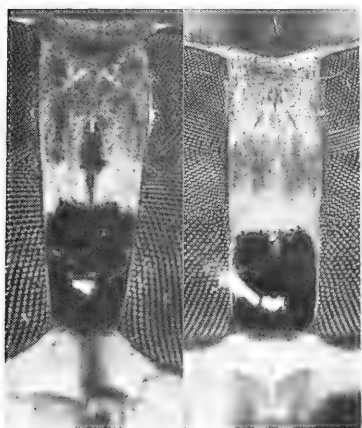
Fig. 37. T. aurilineatus



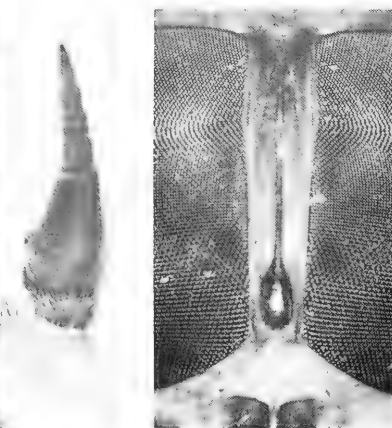
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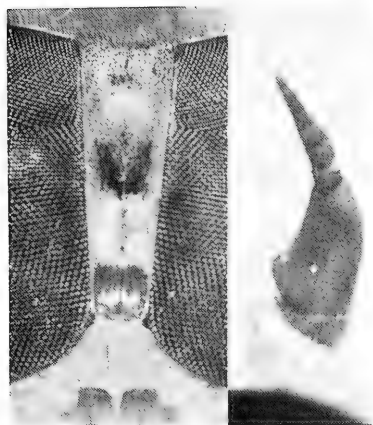
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Fig. 38. T. striatus

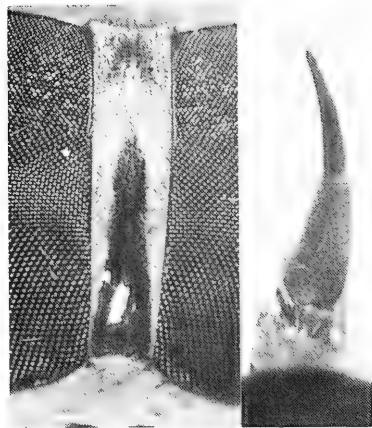
Fig. 39. T. megalops

Fig. 40. T. jucundus
(2 frons configurations.)

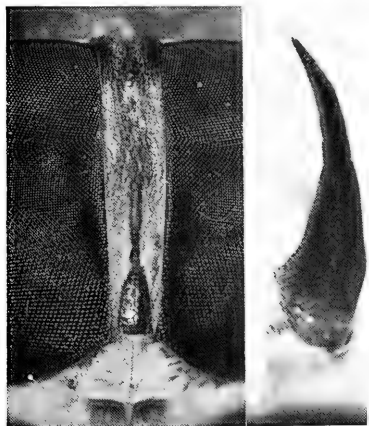
Fig. 41. T. lentis
(Antenna unavailable.)



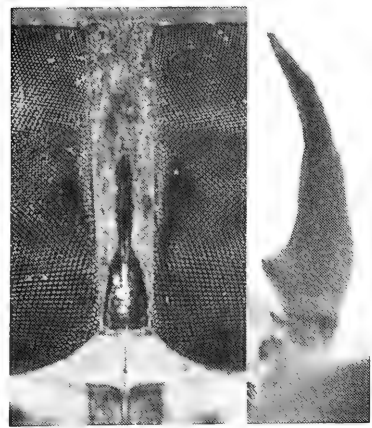
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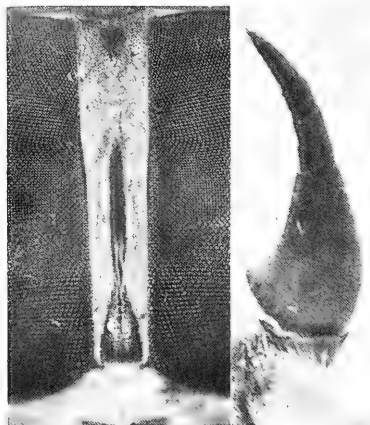
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Fig. 42. T. dorsilinea

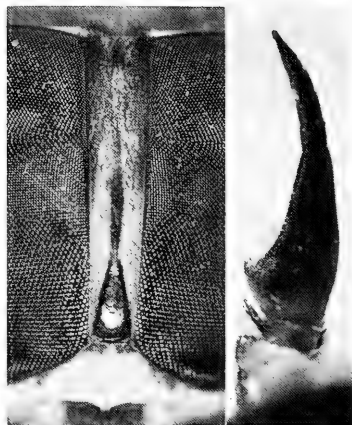
Fig. 44. T. rubidus

Fig. 43. T. brunnipennis

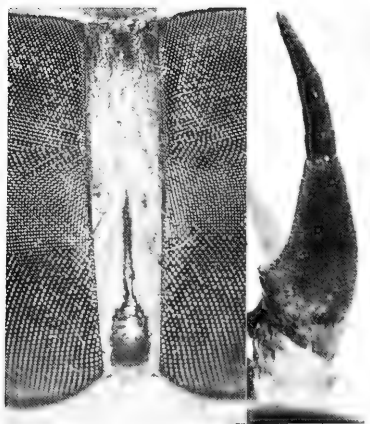
Fig. 45. T. virgulatus



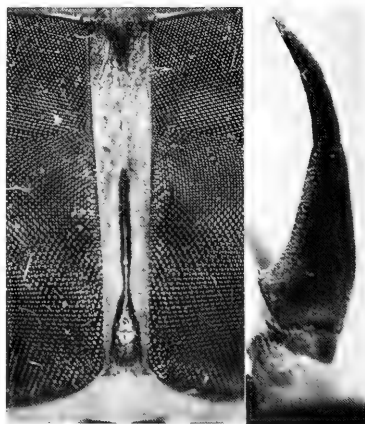
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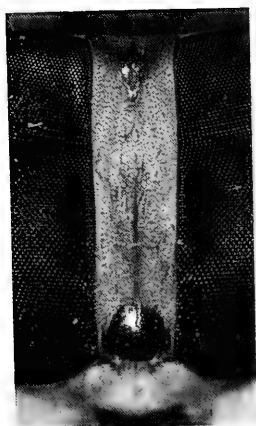
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Fig. 46. T. pristinus

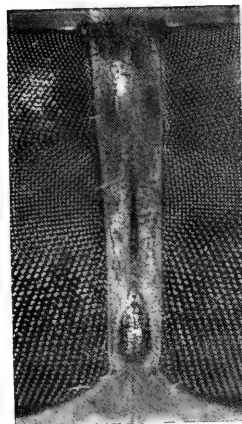
Fig. 48. T. rusticatus

Fig. 47. T. fontinalis

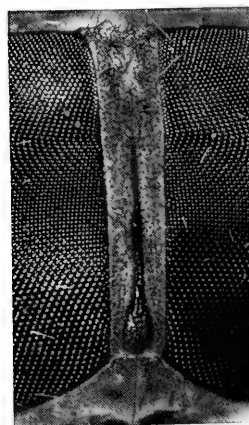
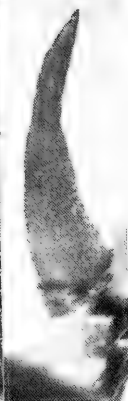
Fig. 49. T. quadrifocus



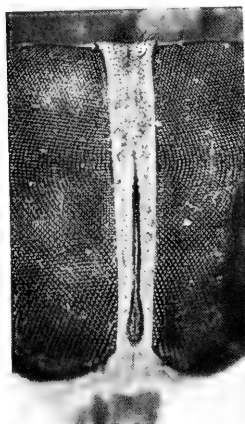
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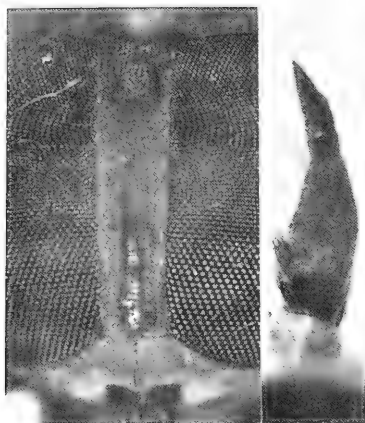


Fig. 50. T. subcanipus

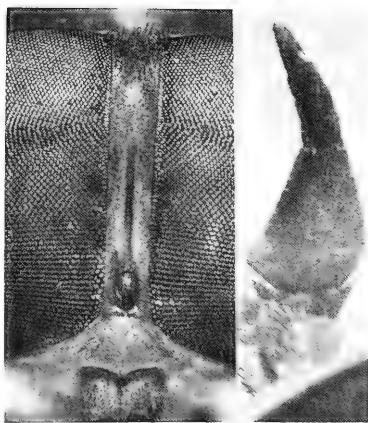
Fig. 52. T. systemus

Fig. 51. T. symmetricus

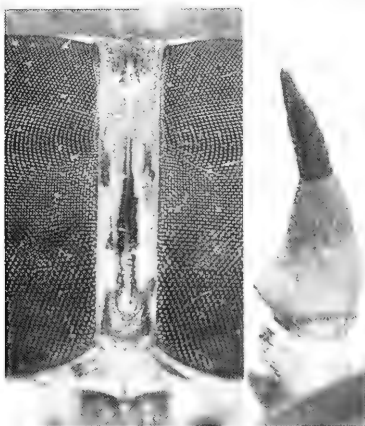
Fig. 53. T. taeniellus



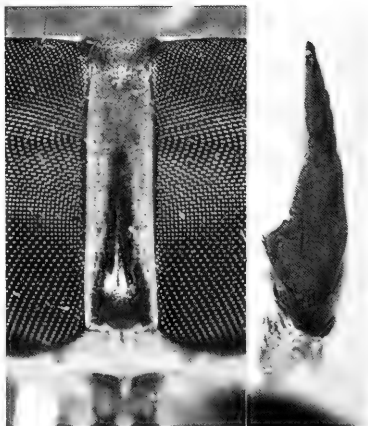
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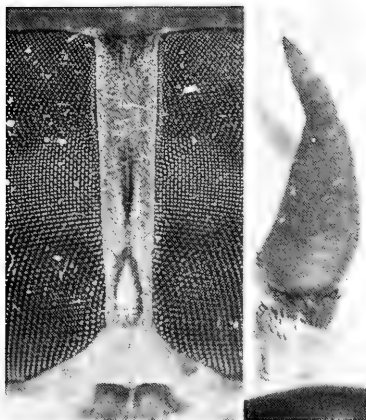
57

Fig. 54. T. fulvilinearis

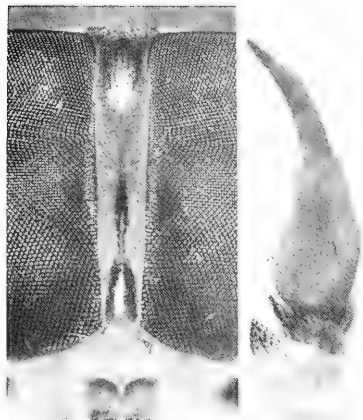
Fig. 56. T. diversifrons

Fig. 55. T. vernus

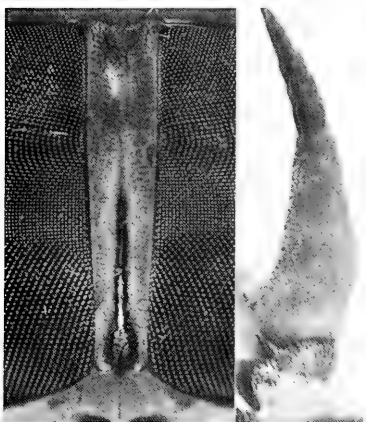
Fig. 57. T. konis



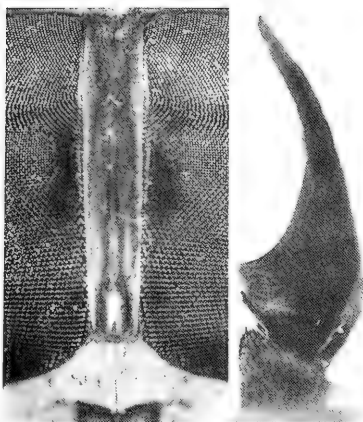
58



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Fig. 58. T. agnoscibilis

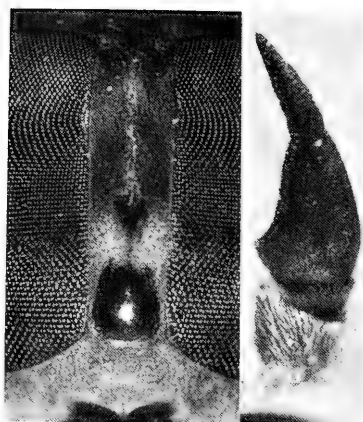
Fig. 59. T. pugiunculus

Fig. 60. T. oxybeles

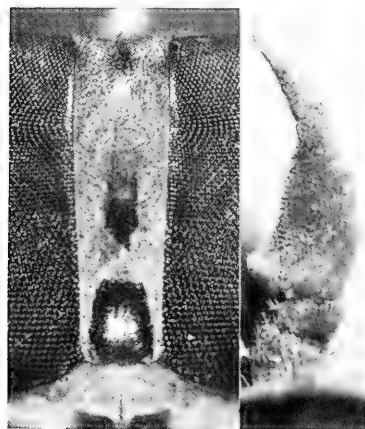
Fig. 61. T. monilifer



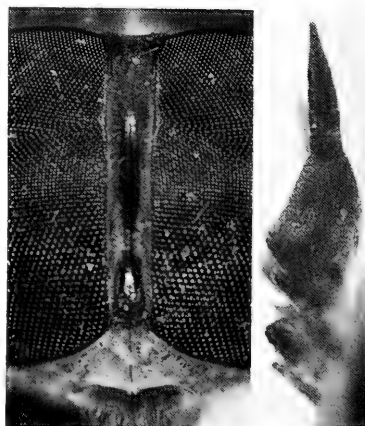
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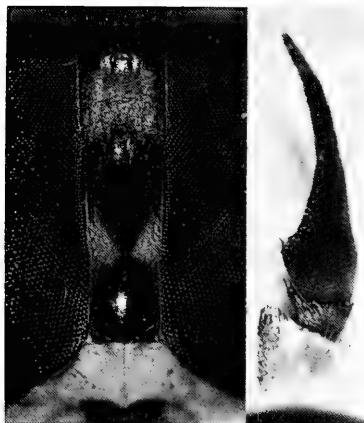
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Fig. 62. T. rubicundus

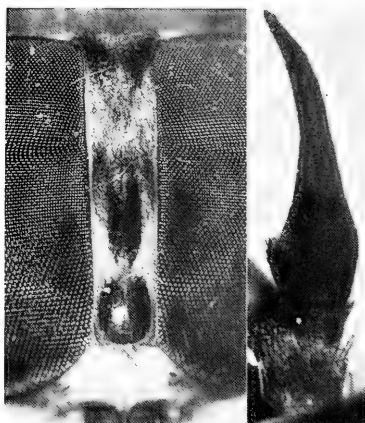
Fig. 64. T. thermarum

Fig. 63. T. cepuricus

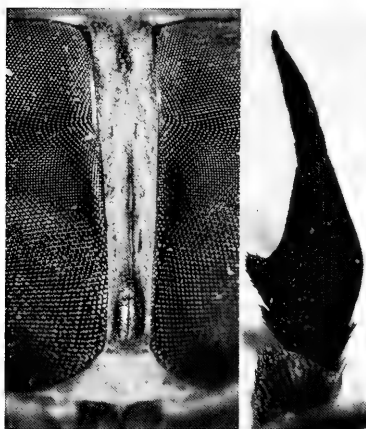
Fig. 65. T. zoster



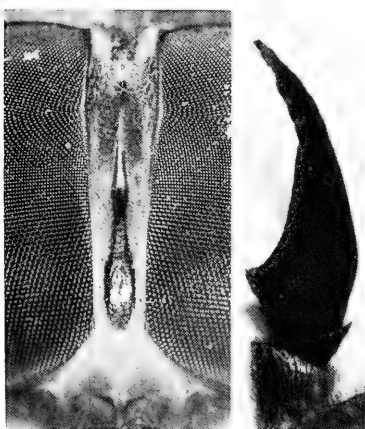
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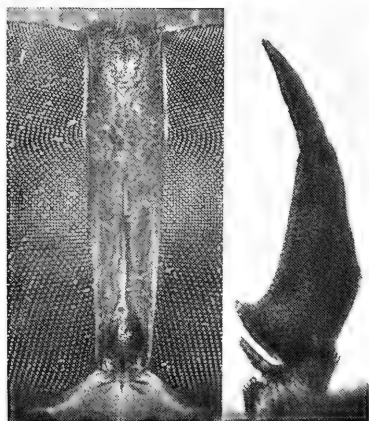
69

Fig. 66. T. crassus

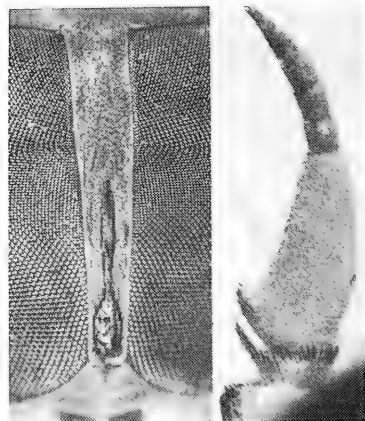
Fig. 67. T. larvatus

Fig. 68. T. hypomacros

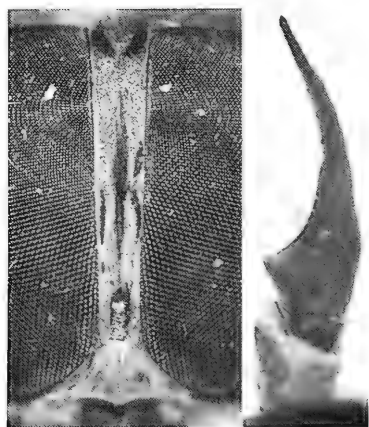
Fig. 69. T. euphanes



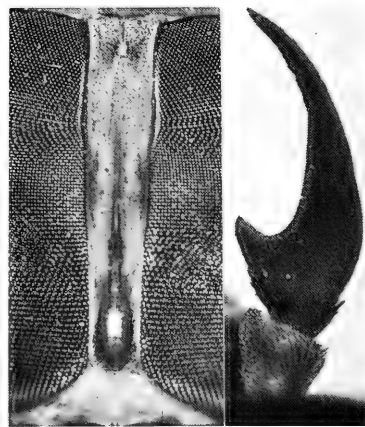
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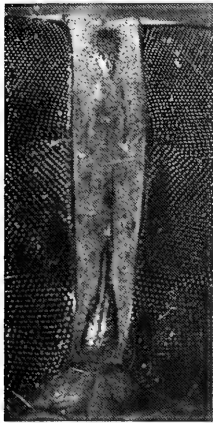
73

Fig. 70. T. unicus

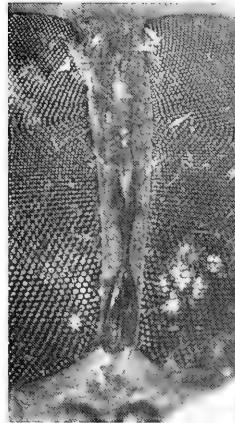
Fig. 72. T. jeanae

Fig. 71. T. nyctops

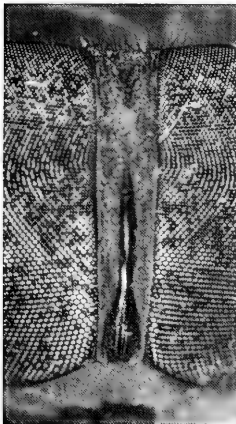
Fig. 73. T. borealoriens



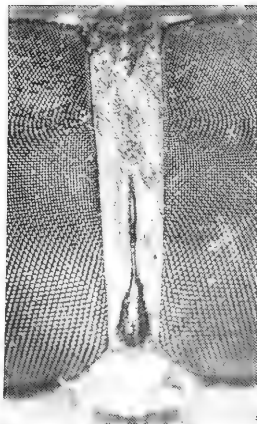
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Fig. 74. T. ballmeri

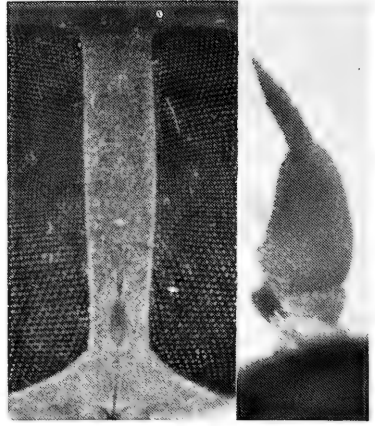
Fig. 76. T. soubiroui

Fig. 75. T. xanthochrus

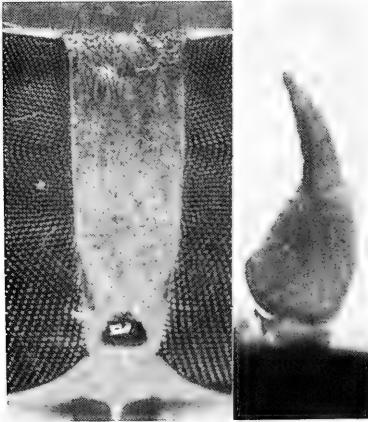
Fig. 77. T. firmus



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80

Fig. 78. T. griseilineis

Fig. 80. A. lotus

Fig. 79. A. cryptotaxis

Other Species Involved or Implicated in the Indochina Area

This section contains discussions of those species which are known to occur or are said to occur in that part of the Indochinese Subregion which lies to the east of Thailand but which are not known from, or thought to occur in, Thailand. Many species which fall into this category are dis-

cussed in connection with their Thailand relatives in treatments under the latter, and are not given separate consideration here. In some cases, species occurring only northwest of Thailand are also discussed.

Tabanus abbreviatus (Bigot) and *T. conicus* (Bigot); *T. semirufus* Szilády

The types of *T. abbreviatus* (Bigot), *T. conicus* (Bigot), and *T. calidus* Walker were all seen in BMNH. I do not believe any of them to be conspecific with any material considered herein. After coming to that conclusion, I did not further explore the morphological relationships among the 3. But since the reported distribution surrounds Thailand, I shall point out some of the incongruities in the literature.

Tabanus conicus was originally described from a single ♂ in *Atylotus* by Bigot (1892:650-651), with the type locality given as "Inde." It was quickly reassigned to *Tabanus* by van der Wulp (1896:63), but the first major change was made by Ricardo (1911:153, 154 & 232), who placed it as a questionable synonym under *abbreviatus*. Bigot described the latter in the same paper (1892:670), from 2♀♀ specimens from Java, also in *Atylotus*. Then Schuurmans Stekhoven (1926:210) showed *conicus* as a full synonym under *abbreviatus* at the top of the page, but directly contradicted himself in the middle of the same page by stating, "The male [i.e. the type] of *T. conicus* Bigot is to my opinion probably a male of *rubidus* Wied." Hence this should be taken as his true opinion, with the listing under *abbreviatus* simply a reiteration of Ricardo. He also changed the *conicus* type locality to "Cambodja". Then Senior-White (1927:37) catalogued *abbreviatus* in synonymy under *conicus* rather than vice versa. There is no apparent reason for this reversal, except that perhaps his intention was to give seniority to the name which held strict page priority rather than adhere to the selection of the revisers. Then Philip (1960b:55) listed *conicus* as a questionable synonym under *rubidus*, and indicated that he had examined the type of *conicus*; however, he pointed out twice on that page that this latter type came from Malaya. Stone (1972:638) noted the difficulty of properly associating *conicus*, since the type is a ♂, and suggested a geographic argument for refraining from considering *conicus* to be a synonym under *calidus* Walker. A label on the *conicus* type does indeed show "Camboge", but this is not on the original label, and may have come to be erroneously affixed subsequent to Bigot's work. Since this is at odds with the original description, and since the original description of *calidus* showed only "Asia?" as locality (though Stone suggested it could be [east central]

China based on agreement in available characters with specimens from Hangchow), any such geographic argument must be assessed accordingly. *T. abbreviatus* whether or not it is a synonym of *conicus*, has itself come to be reported in the literature from widespread localities. The synonymy of *abbreviatus* under *rubidus* is, like *conicus*, left open to question by Philip (1960b:55); and it is not commented upon by Stone (1972:638), though he did state his viewpoint on other names which he believed synonymous with *rubidus*. My interpretation of *rubidus* does not include the types of *abbreviatus* and *conicus*, and I do not consider them synonyms of it.

Finally, it should be noted that Szilády (1926:14), in his original description of *T. semirufus*, stated that, "Possibly this form is the previously unknown male of *T. abbreviatus* Big." His inadequate description is based on the presence "In the Vienna Museum [of] some ♂♂ collected by Fruhstorfer at Manson Mountain, 2-3000 m elevation in Tonking" (=N. Viet-Nam). The description has several peculiar aspects. Although it is very brief, no less than 5 other species are contrasted; and although only ♂♂ of *semirufus* are indicated, the comparisons he made with 2 of the other species involve the frons! Either unrecorded ♀♀ were before him, or, perhaps more likely, he was actually comparing the fronses of the others with that of *abbreviatus*, in which case there is an almost implicit admission of synonymy of his new species with it. Also, he indicated that the ♂ of *abbreviatus* was previously unknown even though Schuurmans Stekhoven's (1926:210) work was in front of him and plainly reported 2♂♂ (one of which was the controversial *conicus* type). Furthermore, for one of the contrasted species, *T. fusciventer* Schuurmans Stekhoven, credit for the comparison is given to Stekhoven himself. This is quite surprising, since Stekhoven would not have known about *semirufus*, and the only comparison which Stekhoven ever made with *fusciventer* in published form was with a species which Szilády never mentioned. Szilády's publication followed close on the heels of Stekhoven's, and personal correspondence between them can perhaps be ruled out not only because of the timing but also because of apparent negative feelings by the former toward the latter

(Szilády 1926:2 & 10). Thus it is not at all clear why *fusciventer* is mentioned under Szilády's description. *T. semirufus* was not mentioned in print again until it was listed by Travis & Labadan (1967:

477) and by Stone (1975:69), who gave the altitude of the type locality as "2-300m", which is 1 decimal place off from the original description (see above).

Tabanus abscondens Walker

The locality data on the type of *abscondens*, seen in BMNH, is simply "Burma". The species which it represents might also be expected to occur in Thailand, but it did not seem to match, nor come especially close to, any of my material. The specimen has a striate pattern on the abdomen, a strongly yellowed costal cell, and the subcallus tomentum is brown but its dark color may in part

be due to greasing. The specimen is in very greasy condition and will make accurate association difficult. Indeed, at least 3 of the 4 specimens in BMNH which now stand in association with this type are, I think, not conspecific with it; and the species records published by Ricardo (1911:161) and repeated by various authors will need to be reassessed.

Tabanus amoenatus Séguy

This species was described from "Kou-ling," China. The only such place name I can find in China gazetteers is located at 23°47'N 113°11'E, thus about 70 km north of Canton. The description began with a single ♂ symbol, so the sex of the material which was before the describer is known; and presumably only a single specimen was involved, but this is not absolutely certain because for some other species in the same paper, although a single sex symbol is used, a size range of lengths is indicated and attests to the presence of at least 2 specimens. Hervé-Bazin is given as the collector of *amoenatus*. His collection is curated separately in the Paris Museum, but a thorough search of this as well as the general collection by Mr. Matile during my visit failed to reveal any specimens so labeled, so I was deprived of an examination of this almost totally neglected nominal

species. A subsequent personal communication from Mr. Matile stated that the missing type has now been found, however.

T. amaenus Walker, with which Séguy compared his new species, was described from a ♂ from Hong Kong and has since been widely reported from China, Taiwan, Korea, and the Ryukyu Islands of Japan. The type of *amaenus* (seen in BMNH) is not conspecific with anything I have seen from Thailand. The type of *brunnitibiatus* Stekhoven (= *fenestratus* Stekhoven) is also a ♂ from Hong Kong (seen in BMNH). Stone (1972) has synonymized *brunnitibiatus/fenestratus* under *amaenus*, and I am in agreement with this synonymy. The eyes of the 2 dried types have retained quite different coloration, but this is not seen as taxonomically significant.

Tabanus annamensis Philip

Philip (1960a:10) described this species from a single ♀ from "Annam Prov., Haut Donai, Col de Blao" (type seen in USNM). Col de Blao was the French name for Deo Bao Loc or Bao Loc Pass, located at 11° 28'N 107° 44'E, just SW of the town of Bao Loc, thus about 3/5 of the way from Saigon to Da Lat in S. Viet-Nam. The collector's name is corrected to M. Poilane.

This species is related to *T. paviei*, as the general coloration of the face, thorax, wings, legs, and tergites 1 & 2 are quite similar. But *annamensis* differs in having tergite 3 concolorous orange with 1 & 2, and 4 mostly orange also, though it is darkened basally. Tergite 5 and beyond black as in *paviei*. Sternite 2 mostly black but with a yellow periphery (unlike *paviei*, in which it is black except for the apical band).

Tabanus annamiticus Surcouf

Surcouf (1911:42-44) described this species from a type series of 277♀♀ and 6♂♂. Despite the length of the original series, the species has been something of a mystery from the outset and remains so today. The description is peculiar in that there is no separate heading announcing the new species, and its name is introduced only after lengthy comparative notes on other species are

given. These notes in turn are of very doubtful value, as in 2 out of 3 cases the inadequate original descriptions are quoted, indicating a lack of firsthand familiarity with them on Surcouf's part. The third compared species is the one which he might have thought it closest to: "Ses affinités le rapprochent de *Tabanus sinicus* Bigot: mais celui-ci est un *Bellardia*;" but he therefore did not

pursue the comparison further because he did not believe them congeneric. The description of both sexes is not overly brief, but the species described seems to lack highly distinctive features and would not be easy to identify accurately without corroborative specimens. (Surcouf later mentioned characteristics of ♀ genitalia (1921:16-17).) Nevertheless, the characters given show a suspiciously good fit with *T. rubidus* Wiedemann. *T. rubidus* is indeed reminiscent of *sinicus* (Bigot) (= *amaenus* Walker), except that the closed 1st P cell distinguishes the latter immediately. The Wiedemann species was one of the 3 "contrasted" by Surcouf, but he was clearly unfamiliar with it, quoting only 10 words of its original description, thus not safeguarding against the creation of a synonym. Also, both the distribution and commonness of *rubidus* are very much in keeping with the long original series of *annamiticus* from central Viet-Nam. I shall stop short of positively declaring them synonyms in the absence of the *annamiticus* type material, but am listing *annamiticus* as a questionable synonym of *rubidus* due to the circumstantial evidence which I consider to be good.

Unfortunately, more conclusive evidence may never become available. Surcouf was at that time the "Chef des travaux de Zoologie au La-

boratoire Colonial du Muséum d'Histoire Naturelle de Paris." Although he did not clearly state that the type series of *annamiticus* was being deposited there, this was almost certainly the case since he ended his paper (1911:44) with a plea for colonial collaborators to send insects of public health importance back to that institution. Mr. L. Matile of the Paris Museum has told me that the Laboratoire Colonial du Muséum is no longer in existence. The logical place for its insect collection to have gone would be the Paris Museum, but we could not find any specimens labeled *annamiticus* there. Nor did Dr. Grenier of the Institut Pasteur de Paris know anything about the whereabouts of the collection in question.

The original description of *annamiticus* was further wanting in that no precise collection data was presented. No date is given, though it is reasonable to assume that the specimens were taken about 1910, as the collector, Monsieur Bauche, was a veterinary inspector whose duty station was Hué and who was at the time attempting surra transmission experiments. Nor is a specific locality given, beyond stating that Bauche did his research in the environs of Hué. The question is of little significance if the species is synonymous with *rubidus*, as the latter is extremely widespread.

Tabanus annamiticus (Bigot)

This species was described from a single ♂ (seen in BMNH) from Saigon (S. Viet-Nam). Bigot (1892: 630) described it in genus *Bellardia* due to the closed 1st P cell. Van der Wulp (1896: 62) reassigned it to *Tabanus*, and Enderlein (1925:394) reassigned it to *Phyrta*. All other authors have kept it in *Tabanus*. Stone (1972: 637) has suggested the possibility of synonymy under *amaenus* Walker, but left it as doubtful, and pointed out morphological differences between their types. Though I did not directly compare the 2 types myself, I think it is best to retain *annamiticus* as a separate species unless further evidence to the

contrary is discovered. In addition to the differences which Stone pointed out, there is a geographical consideration. The *amaenus* type is from Hong Kong, and the species has a wide China-Korea distribution. But it has never been reported from the Indochina countries, and I collected neither of the 2 species from Thailand. Therefore it would seem that jumping the *amaenus* distribution as far south as Saigon (assuming the *annamiticus* type label is correct) should be avoided, and there seems to be sufficient morphological reason for the avoidance.

Tabanus aublanti Toumanoff

The only data which the type bore, according to Toumanoff's description (1953:204-205), was "capturé en Indochine." The type was said to be preserved in the Institut [des] Recherches Agronomiques de l'Indochine. This institute was located in Saigon, S. Viet-Nam, and was eventually superseded by the Centre National de Recherches Scientifiques et Techniques. I understand that this organization is still in existence (1974) at 30 Le Thanh Ton, Saigon; I do not know of the status of its insect collection.

I saw the paratype in Pasteur Institute, Paris. It is in poor condition, being greasy and rubbed. Frons and callosity are as figured originally; antennal flagellums now missing but also figured originally. Palpi with black hairs; costal cell

strongly yellowed, rest of wing lightly tinted. I think it was the paratype which Toumanoff drew, as it has a mechanically (not naturally) inward-telescoped abdomen just as figured. Its condition will make the species difficult to recognize accurately. Philip (1960a:13), working with Toumanoff's article and not the specimen, was misled into an inappropriate characterization: its abdomen is compact only due to maltreatment; the middle and hind legs are uniformly yellow-brown but the forelegs have darker femora than tibiae; it is not related to Philip's *cambodianus*; it is not Malaysian.

I do not think it is the same as any Thailand species I have seen.

Tabanus burmanensis Schuurmans Stekhoven

This species was originally described as *T. burmanense*, (Stekhoven 1926:245-246), but since "ense" is a neuter ending, Szilády, (1926:10) was correct in emending it to its present form. The authorship remains with Stekhoven.

The type ♂ and 2 other ♂♂ which were part of the original series were seen in BMNH, but none of the "original" 3♀♀ were seen. It may be instructive to note that Stekhoven's entire treatment of the ♀♀ consisted of quoting Senior-White's (1922:105) diagnosis of the 3 specimens from Mohnyin Reserve in northern Burma near Katha, which the latter thought to be *hirtistriatus* Ric. Since it was Stekhoven's habit to thoroughly describe both sexes when they were at hand, I wonder how thoroughly, if at all, he studied these

specimens. He refrained from declaring any of them to be the type (again contrary to habit), so his notation that they were in BMNH may have been erroneous from the start.

The locality from which the type ♂ was collected is Dawna Hills, Burma, a mountain range between 16° and 17°30'N, running NNW-SSE and parallel to the Thailand border on the other side of the Mae Moei River from Tak Province. I do not believe that this species has been collected in Thailand. Since the type is a ♂, association may prove difficult. It is closest to *T. agnoscibilis* Austen of all the species treated herein, but *burmanensis* differs in various ways, e.g., there is a trace of costal infuscation even beyond the costal cell; all femora and tibiae are concolorous orange.

Tabanus flaviscutellus Philip

This species was described by Philip (1962: 300-301) on the basis of a holotype ♀ and paratype ♀ from the same locality in Viet-Nam and an allotype ♂ from Borneo. These types were seen from Bishop Museum. The data labels on the holotype show "VIET NAM/DiLinh (Djiring)/1200m, 22-28.IV.60" and "S. Quate/Collector". This locality is at 11°35'N 108°04'E. The allotype label shows "MowongW. Borneo/F. Muir, VIII, 1907". I have been unsuccessful in finding this locality. It could be in either the Indonesian or Malaysian portions of Borneo, perhaps more likely the former since the British called their (Malaysian) portion North Borneo. Philip's type designation labels on both the holotype and allotype show "*Tabanus flaviscutellatus*". This name is pre-occupied by Schuurmans Stekhoven for yet another species with bare and shining subcallus, from Sumatra. But since Philip did not publish

the name spelled thus, no homonymy was created.

I can neither confirm nor deny the conspecificity of the holotype and allotype. The morphological differences between them are slight, and may be entirely sexual rather than specific. Females from Borneo are needed to resolve the question. The distribution is highly suspect, however. And since the original description, Philip (1970:449) has added Sikkim to the pattern, based on a single specimen. Such a bizarre distribution for only 4 known specimens is very hard to believe. Thailand would fall within such a pattern, but none have been collected from there. It is distinguished from all known Thailand species by a combination of its almost entirely orange venter, all femora orange, and tergites 1-4 mostly brownish, not black.

Tabanus fulvemedius Walker & *T. orientis* Walker

The name *T. fulvemedius* has had a stormy publication history, and after having seen most of the specimens involved (in BMNH), I think a review here is necessary. Walker's original description (1848:152) indicated that the type locality was unknown. This was duly recorded in various succeeding lists, until in 1911 Ricardo on one page (1911:232) showed "unknown locality", and on another page in the same paper (1911:198) showed "Nepal (Hardwicke Bequest)". Thus it was perhaps not until the time of Ricardo's study, that the type-designation label came to be affixed. The ♀ specimen in BMNH which is now labeled as type has the following data label: "India./Nepal./Hardwicke/Bequest". A lower label, handprinted by Oldroyd, states the confusion: "There is no evidence that this is the type, which was from

unknown locality. H.O. 8.XI.1939". There have been no reports clarifying the status of the type specimen, and it seems that there is now little choice but to regard the BMNH specimen as the true type.

Over the years, however, there have been a number of specimens identified as, or synonymized with, *fulvemedius*, giving rise to a most peculiar reported distribution pattern. It began with Ricardo (1911:198), who synonymized *Atylotus melanopygatus* Bigot and *Atylotus pagodinus* Bigot, both from India, under *T. fulvemedius*. This synonymy has been accepted (with the exception of Kröber (1924:26), subsequently reported by Philip (1959:594)) ever since, and my own brief examination of the 3 types (assuming

the *fulvivedius* type to be correctly designated) confirms the synonymy. However, in the same discussion Ricardo (1911:198) reported a series of *fulvivedius* from Formosa, and subsequent reports on that fauna, up to and including Shiraki (1918:399-407) added further records. Then Austen (1922a:451) revealed that the Formosa population was not conspecific with the Nepal type specimen, by allying his new *T. pugnaz* with "*Tabanus fulvivedius*, Ric. (...-nec Walk.), of Formosa". That might have been the end of it, but unfortunately his discovery has been completely overlooked (with the exception of Senior-White's catalog (1927:40), in which Austen's finding is shown as "*Ric. nec. Wlk.*" but with Formosa distribution listed as usual), and the Formosa listing has persisted to the present day (Stone, 1975:65). The specimens in question still stand associated with *fulvivedius* in BMNH. In the meantime, Ricardo apparently examined some specimens in the Amsterdam museum, determining one from Sumatra as *fulvivedius*. This record never got into print, and Schuurmans Stekhoven (1926:244) soon described the specimen as a new species, *T. paralleliventer*. In a later paper Stekhoven (1929(1931):503) was responsible for adding China to the reported distribution of *fulvivedius*. It is not at all unreasonable that the species might be found there if its type locality is, in fact, Nepal; but of the two China records reported in his paper, both are faulty. It is necessary to present his listing just as published in order to appreciate one of the difficulties:

China, Yunnan, Mhan Hsien,
N. China Hills, Burma, For-
mosa, mountainous regions.

Thus it can be seen that he stated the country first, then the place(s) within it. But it is certain that, in the case of "N. China Hills," the editor of the Chinese journal in which he published derived this notation from what should accurately have been reported as "N. Chin Hills, Burma," a locality which had been given for the species beginning with Ricardo (1911:198). As for the second China locality given above, Mhan (=Man) Hsien is a place within Yunnan Province (i.e., only one locality was being reported above, not two). I have seen the specimen which I believe Stekhoven was reporting. It was found in BMNH, and although it bore no determination label, was associated with the rest of the series of *fulvivedius*. It is my

opinion that it does not agree with *fulvivedius*, and have instead associated it with *soubiroui* elsewhere in this paper.

Japan joined the published distribution in 1962, likely based on a misunderstanding akin to the situation with the Formosa specimens, and has similarly persisted to the present (i.e., Stone (1975:65), in which Japan is shown as part of the distribution of "*orientis*" on the basis of the "*fulvivedius*" records.)

I have attempted to show that the range of *T. fulvivedius* should be restricted to Nepal (presumed type locality), India (type localities of synonyms *pagodinus* and *melanopygatus*), and northern Burma (non-type from N. Chin Hills). Chvála (1969:49) has added another Nepal record. It is not known from, nor expected to occur in Thailand.

The latest twist of fate for *fulvivedius* has been the placement of it as a junior synonym of *T. orientis* Walker by Stone (1975:65) without further explanation. I cannot endorse this synonymy. The *fulvivedius* type has 2 blackened, conspicuous spots on the abdomen, at the midline of tergites 2 and 3; while the *orientis* type has not the slightest trace of such spots, despite the fact that it is in a better state of preservation than the *fulvivedius* type, and hence it is not a question of having lost any previously existing spots from "wear" or "age." The types of *pagodinus*, *melanopygatus*, *perlinea*, and *consocius* all have a midline spot at least on tergite 2 if not on tergite 3, and the same is true (though the spot(s) may be much weaker) of all of the good series present in BMNH (except for those specimens which are obviously misassociated on grounds quite apart from this character). Thus I do not now believe that *orientis* is the correct name to assign to *fulvivedius* and its earlier synonyms, as the *orientis* type stands alone in being totally spotless at the midline; a quick look at the other characters did show general agreement among all the types discussed here, however. Future workers on fauna of the range detailed above are encouraged to take a closer look.

There is admittedly a lingering question about the BMNH specimen being the true type of Walker. Even the name "*fulvivedius*" does not seem appropriate for it.

Tabanus fuscomaculatus & *T. altermaculatus* Ricardo

T. fuscomaculatus was described by Ricardo (1911:183-184) from Sima, a town in northern Burma adjacent to the Yunnan border at 25°N latitude. She later described *altermaculatus* as a subspecies of *fuscomaculatus* (1913a:544), from Ukhrul in the Indian state of Manipur not too far away (as little as 300 km) and at the same latitude. Senior-White (1922:106) suggested that *fuscomac-*

ulatus "is probably variable and *altermaculatus* is possibly not a valid subspecies but only an extreme variation." Philip (1970:450), in a discussion of *fuscomaculatus*, stated, "A variety, *atrimaculatus*, was described later from western India by Ricardo based on antennae." This latter spelling is a lapsus for *altermaculatus*, though its original taxon, the section of India from which it

came, and even the most important morphological criterion originally used by Ricardo were mis-reported by Philip. Stone (1975:52) elevated *altermaculatus* to full specific rank, but offered no explanation for his measure.

After direct comparison of the 2 types in BMNH, I conclude that both forms are quite sufficiently distinct to be separate species, and herewith substantiate Stone's action. The grounds are as follows: (1) *T. fuscocomaculatus* does have a large and conspicuous dorsal tooth on the antennal plate, but its configuration is "normal" for large teeth; while in *altermaculatus*, the tooth has become very much elongated, slender, and forward-projecting. (2) Tintorially, the 2 taxa can be separated at a glance from the abdomens. *T. fuscocomaculatus* has a large black spot on tergite 2 at the midline, a smaller one on 3, and none on 4 (though some associated specimens have a trace of one here), and abdominal dorsum black beyond 4. In *altermaculatus*, the dark spots at the midline appear fairly even on tergites 2-4 (though there is some greasing on 3 and 4 which may cause the dark areas to be more outstanding than in nature). Tergites 5 and 6 are darker than the preceding tergites, but the contrast between 4 and 5 is modest, not stark as in *fuscocomaculatus*. This feature by itself would qualify *fuscocomaculatus* for, but exclude *altermaculatus* from, inclusion in the *basalis* group, which may prove to be an artificial assemblage of species as currently construed.

Tabanus gertrudae Philp (= *T. flavicinctus* Ric.) & *T. fulvicinctus* Ricardo

Ricardo described both *T. flavicinctus* (1911, from Assam), and *T. fulvicinctus* (1914a, from Formosa), as members of her "Group II," which forms part of Philip's "biannularis group". The proximity of these two names for closely related species has given rise to confusion. Philip (1960a:16) stated that Szilády, in proposing the subgenus *Callotabanus*, "listed four species (the first of which was *T. flavicinctus* Ricardo) 'as well as group I of Ricardo,' but actually probably intended to include her group II to which the listed species are more closely related." A reading of Szilády (1926:10) makes it clear that he did, in fact, include Ricardo's group II in his new subgenus, and the first species which he listed by name was not *flavicinctus* but *fulvicinctus*. Philip (1962:293) came later to realize that Szilády had included Ricardo's group II, but persisted in

Cohér (1962(1963):157-158) included both forms in his interpretation of the *basalis* group. The chances are that neither are closely related to *basalis*, but instead represent southern extensions of the sizeable Palearctic assemblage which includes *rufidens* (Bigot). (3) In *fuscocomaculatus*, sternite 1 is yellow, 2-3 mostly yellow but darkened in middle, 4 partly yellow, the rest darkened; in *altermaculatus*, the color of the entire abdominal venter is an even gray with pale apices on the sternites (not with mostly yellow basal sternites).

For further discussion of relationships, see under *T. borealoriens* elsewhere.

Toumanoff (1941:1076-1077) created a Cambodia record for *fuscocomaculatus*. Cambodia's lowland physiography and low latitude are incompatible with those of the type locality. It is by no means clear how this determination was made, e.g., Toumanoff was unable to cite the author of the name, though he did so for the other species. The specimen(s) is/are said to have been sent to France, though I did not find them there in the 2 museums visited. The fact that the species has not been found in Thailand also makes a Cambodia record extremely unlikely. This combination of evidence leads me to believe that a simple mis-identification is involved, and I move to delete the Cambodia record.

calling *flavicinctus* the first listed species. The confusion deepened when in his key couplet 12 (1962:295), the end-point for keying out both of these species, the names were, I believe, transposed, so that the characters attributed to *fulvicinctus* are actually those of *gertrudae=flavicinctus*, and vice versa. This is certainly the case with the localities attributed to each in this key couplet, and from what I can find in the literature is also the case for the morphology (e.g., Philip in the same paper on p. 297 shows *gertrudae* with a frontal index of 1:3.7, thus obviously falling in the first half of the couplet). Later, Philip (1969:198) was himself trapped by this transposition when he contrasted *T. cestus* new species with *fulvicinctus* and *gertrudae* as they were diagnosed in the erroneous 1962 key couplet 12.

Tabanus ictericus Surcouf

This species was described from a single ♀. As noted elsewhere under the Vitalis de Salva collection discussion, the type locality is northernmost N. Viet-Nam; and the type, which should be in the Paris Museum, could not be found there. Surcouf's brief description (1921

(1922):287) shows it to be one of the subregion's most distinctive species. Characters include orange wings with apparently a darker crossband and hyaline apices, closed 1st P cell; antennae with dorsal tooth prolonged and hooked; length 23 mm. I have found no such strange combination in

Thailand, though it may perhaps share ancestors with *praematurus* Austen and its relatives.

Toumanoff (1941:1076-1077) showed Laos as the provenance of *ictericus*; but as the listing

was based on material collected by Vitalis de Salvaza and not on more recent material, it is surely only an erroneous rendering of the country containing the type locality. Laos is therefore deleted from the known distribution of this species.

Tabanus indianus Ricardo

This species has yet to be demonstrated from Thailand, but its reported widespread Oriental distribution causes it to require brief review here.

First of all the matter of type specimens must be dealt with. Ricardo (1911:175-176) originally designated and described a type ♀ from southwestern India and a type ♀ from Taiwan. The type ♀ (seen in BMNH) bears a single data label showing, "Kadra./N. Canara./India./13.V.1907./T.R. Bell/1908-49." Although there are no type designation labels on any specimens other than the type ♀, it appears that 9 of the other 15 specimens now associated under the name *indianus* in BMNH were part of the original series, as their data agrees insofar as Ricardo gave it, and the collection dates predate the description. Only 1 of the 15 is a ♂ (1 specimen lacks head and abdomen), and the morphology and collection data of this ♂ agree with Ricardo's description of the type ♂. I believe that it is in fact her type ♂, and I have affixed an annotation to it accordingly. Its 3 data labels show, "Takao/1907.VII.7./Formosa/Sauter/Pres. by/Dr. Kertesz./1909." However, this specimen as well as the other Taiwan specimens are not conspecific with the India type ♀. Schuurmans Stekhoven (1926:367) has already stated the same conclusion. Ricardo's type ♀ from

India is herewith designated as lectotype, for obvious reasons. The 7♀♀ from India associated in BMNH are conspecific with it.

The literature contains records of *indianus* from widely separated localities in India as well as East Bengal, upper Burma, Taiwan, southern China, Hong Kong, N. Viet-Nam, Philippines, and Celebes. It is possible that *indianus* occurs in Indochina, but the majority of the above reports are almost certainly based on specimens which are not conspecific with the lectotype. Taiwan has been deleted as noted above, and the Foochow (China) record was generated by Ricardo's synonymizing *mentitus* Walker "under" *indianus* (but long since reestablished as separate species by Stekhoven). Although other records cannot be so objectively refuted, I believe it can be safely stated that the Philippines and Celebes records are so far out of range that they can be ignored, and the species has from the beginning been so misunderstood that the best course is to view with skepticism all records outside of the Indian peninsula until further confirmation is available.

A Thailand relative of *indianus* is *hypomacros* Surcouf. See under the latter for comparative notes.

Tabanus khasiensis Ricardo

This species was described by Ricardo (1909:487) from Khasi Hills, Assam, India. I would have preferred to let it go entirely unremarked here, but Thailand has been insinuated in the distribution on various occasions and an explanation may be desirable. The type series specimens (holotype ♀ and 3 others) were all from India. The next record was provided by de Meijere (1924:203), who reported seeing 4 specimens from "Sinabang (Simalur)" in a list of new records of "malayischer Dipteren." Schuurmans Stekhoven (1926:289) identified the Sinabang locality as part of Isle Sumatra, and added a record from Penang, [Malaya]. Senior-White (1927:43) then reported Sinabang and Penang as part of the distribution, but his records were based on firsthand observation of specimens in BMNH and not from Stekhoven's monograph, which he had not seen before writing his catalog (since he did not include Stekhoven's new Indian species in it). Thus he did not know that Sinabang was Isle Sumatra (broadly speaking), and for some reason came to record this locality as "Sinabang

(Siam)" rather than "Sinabang (Simalur)," and this error was repeated by the authors of a later list. Then Philip (1960b:50) noted, concerning records of this species, that Thailand was "not recorded, but should occur since it has been taken on both sides." Stone (1975:62) included "Thailand" as part of the distribution, apparently based on the Senior-White misunderstanding. In fact, Sinabang is a town on the Indonesian island of Simeulue (=Simalur), at 02° 29'N 96° 23'E, off the southwest coast of northwestern Sumatra. Therefore Thailand should actually never have been construed as the source of any of these specimens.

The question remains whether all of the specimens reported as *khasiensis* are truly conspecific with the type. If they are, then of course Thailand should someday be part of the distribution. Unfortunately I did not investigate this question while at BMNH, but contented myself only with the conclusion that the *khasiensis* type was not conspecific with any of the Thailand material treated herein.

Tabanus maurus Philip

This species was described by Philip (1974: 395-396) from 3♀ specimens. The holotype was seen from Bishop Museum. Its handwritten data label shows "Viet Nam, Kon-tum N. Pleiku/13.V. 1960 - 530m/S. & L.W. Quate". Kontum is a town in S. Viet-Nam's Central Highlands, off the eastern end of the Laos-Cambodia border.

This species has a very close relative in *T. tinctothorax* Ricardo, even to the extent that the 2 green eye bands of both species can roughly be traced even without relaxing them. Both are large, brown to black species with tinted wings, black legs and broad black antennae. The points of difference observed are: in *maurus*, the midline of tergites 1-4 have low patches ("triangles") of whitish yellow hairs, while in *tinctothorax* although occasional specimens may have narrow apical fringes of dark yellow hairs, these remain inconspicuous. The pale fringe of hairs at the apices of sternites 2-4 are whitish yellow in *maurus*, not pure white as in examined specimens of *tinctothorax*. The wing tint of *maurus* is paler

than in nearly all *tinctothorax*, there is a quantity of pale (yellow to whitish) hair on the periphery of scutum and scutellum, and the callosity (of the type) is brownish orange. There is a geographic separation between known localities for the 2 species of about 1100 km across the Gulf of Thailand.

I believe there has been a transposition of antennal figures in Philip (1974). The antenna of the holotype itself and the text of the original description of the *maurus* antenna do not fit the antenna illustrated in Fig. 5 (p. 396); rather, they fit the antenna illustrated in Fig. 6, which is captioned as *caligneus*. Likewise, the antenna of the holotype of *cnecus* and the text of the original description of its antenna do not fit the antenna illustrated in Fig. 4 (p. 395); rather, they fit the antenna illustrated in Fig. 5, which is captioned as *maurus*. In turn *T. caligneus*, described as new from the Philippines and not seen by me, has an antenna which fits that illustrated in Fig. 4, as confirmed by a sketch kindly made by Dr. Tenorio.

Tabanus melanognathus (Bigot)

Bigot (1890:204) originally described this species in genus *Atylotus* from "Laos". The species was recombined with *Tabanus* by Bigot (1891a: 272), and the type locality was corrected to Cambodia by Bigot (1904:254). Hervé-Bazin (1919:291) added another Cambodia record, but there have since been no new records published from known localities anywhere east of India. All mentions of Laos and Thailand have simply been misrepresentations of the type locality. Schuurmans Stekhoven (1926:541-543) synonymized *nonoptatus* Ricardo under this, stating however that "I have not seen this specimen [the type ♂ of *melanognathus*] but trust upon Austen's definition." Stekhoven's description of the ♀ of "*melanognathus*" is based on the syntype ♀ of *nonoptatus* and must be judged accordingly. This latter syntype is from unknown locality; the syntype ♂ is from Bihar State, India (deposited in the Indian Museum and not seen by writers since Ricardo). India listings of *melanognathus* are based on the syntype ♂ of *nonoptatus*.

I have seen the syntype ♀ of *nonoptatus* in BMNH. It differed from the short series of Thai

rufiscutellatus compared in having the frons, face, beard, palpus, and thoracic venter whitish, some darkening of apical abdominal segments, and abdomen tapered. I have also seen the type ♂ of *melanognathus* (in Paris Museum). It bears a label including the data, "CAMBODGE/Pavie 1886", another showing the acquisition number "2904/86" (Mr. Matile and I verified the data from the acquisition books), and a type designation label entirely in Bigot's handwriting. There were also 2 correctly associated ♀♀ present, showing the number "211/91". The acquisition books indicated "Indo-Chine (Cochinchine)" and "par Mr Delestre", 1891, for this number. See under *rufiscutellatus* for comparative notes. All 3 nominal species are very close and require further study. My comparison of *nonoptatus* with *melanognathus* was only indirect (through Thai *rufiscutellatus*), but since they did not differ in the same way from the latter, I doubt that they are synonyms. For the time being I propose removing *nonoptatus* from synonymy and hence restricting the known range of *melanognathus* to Cambodia and S. Viet-Nam.

Tabanus nantae Toumanoff

This is a gorgeous species, at 27 mm in length, perhaps the largest in Indochina. It is known only from a single ♀ (seen by me in Pasteur Institute, Paris). The illustrations by Toumanoff in the original description (1950a Plate 4 Fig. 3, and

Plate 5 Fig. 7) provide an accurate representation. He did not show antennal flagellums because the specimen lacks both of them. Toumanoff gave the type locality as Quang-Tri (Annam), 1922, communicated by M. Nanta. But the data cannot be

checked, as this author did not affix any labels to his material other than the name and the type designation.

The puzzle involved here is that, although the species was described and is still known from only a single specimen, the type-designation label now on the specimen in Pasteur Institute shows "paratype". I am certain a transposition of labels

has occurred here: the specimen labeled *Tabanus flavioculatus* in this collection, which according to the original description should be the paratype, is now labeled as "Type". Therefore, the single specimen of *nantae* is certainly the type, and the specimen of *flaviooculatus* is almost as certainly the paratype, and should be so regarded despite the present labels.

Tabanus perileucus Philip

This species was described by Philip (1974: 393-394) from 2♀ specimens. The holotype was seen from Bishop Museum. Its labels show "VIET NAM/Blaio (Balao) 500m/14-21.X.1960" and "C.M. Yoshimoto/Collector". This locality is probably the same as Col de Blaio or Bao Loc Pass, at 11°28'N 107°44'E, just SW of the town of Bao Loc.

This species is another peripheral member of the *basalis* group. Its abdominal coloration includes basal orange and apical black, and the tibiae are whitish over most of their area, but the abdominal color transition is less abrupt and the wing tint is paler brown than in "pure" members of the group.

Tabanus quatei Philip

This species was described by Philip (1962:298) from 2♀ specimens. The holotype was seen from Bishop Museum. Its label shows "VIET NAM. Dak Song/76 km SW of/BanMe Thuot, 870 m/19-21.V.1960". "S. Quate/Collector" and "L.W. Quate/Collector" are shown on 2 separate labels. Dak Song is located very close to the Cambodian border at 12°49'N 107°35'E.

T. quatei is a very attractive member of the *biannularis* group, which can be distinguished at a glance from all other members I have seen by the

Tomentum of the frons is dark, and the thorax is essentially brown with no orange hairs. Tergite 2 could be regarded as transitionally colored since the tomentum is clearly darker than that on 1, and most of the hairs on it are black (except along apical and lateral margins), making for a general brown appearance. Apical whitish bands are present on tergite 3 and beyond but are especially conspicuous on the apices of sternite 2 and beyond. The species is reminiscent of *T. siamensis*, but *perileucus* is quickly distinguished from it by having a dark frons and palpus, pale tibiae, and the contrasting black and white abdominal venter.

fact that the "triangles" at the midline of tergites 3-5 are so large that they combine to form an orange tomentose, orange haired jagged central patch. This patch is in turn connected to an orange stripe down the midline of 1 and 2 (very narrow on 1). Also, all pale hairs throughout (including virtually the entire venter) yellow to golden orange, except those on tibiae, which are white (some yellow on hind tibia).

The species remains known only from the 2 original specimens.

Tabanus rufiventris Fabricius

I have seen the type of *T. rufiventris* Fabricius on loan from Copenhagen Museum, through the kindness of Dr. Lyneborg. It is in satisfactory condition. Briefly, the type has the costal cell strongly tinted brown, abdominal dorsum mostly reddish brown, small and inconspicuous apical spots at midline of 2-5 (rather rubbed), thoracic dorsum gray, frons slender and with a narrow callosity and linear dorsal extension. Dr. Philip (personal communication) has told me about a conflict in specimens between the "Copenhagen collection" and "Kiel collection" which he noted during his visit to Copenhagen in 1953. I have inquired of Dr. Lyneborg about this and he has explained (personal communication) why the Kiel specimen is not to be regarded as the type of

rufiventris [it is Neotropical]. He has loaned me the Copenhagen specimen, and since this agrees in its essentials (with allowances made for differences in color concepts) with Fabricius' (1805:96) description and those of Wiedemann (1821:66-67; 1828:118), most of which Ricardo (1911:185-186) has translated into English, then there is no reason to think that it is not the type. It bears an old handwritten label showing "*T. rufiventris*/... Ind: or: ", plus a modern red label showing "TYPE". The "*rufiventris*" of authors since 1925 certainly does not fit these old descriptions.

The misinterpretation of *rufiventris* which has existed through extensive literature is apparently all traceable to a single bizarre error,

which will now be explained. Isaac (1924:62) had done rearing work in India and was the first to associate *crassus* (formerly known only in the ♂ sex) with *sanguineus* (formerly known only in the ♀ sex). Stekhoven had heard of Isaac's work, but stated that he had not seen Isaac's paper. Unfortunately, Stekhoven thought that Isaac had identified the reared India ♀♀ as *rufiventris*, and Stekhoven therefore placed *rufiventris* as the senior synonym of *crassus*. Where did Stekhoven get his information? During this same time, Senior-White had the manuscript of his Indian tabanid catalog in process. While he was preparing the listing for *rufiventris*, I submit that his notes became confused, and instead of proceeding on to *sanguineus* (which would have been the next heading in alphabetical order after *rufiventris*), he accidentally incorporated *sanguineus* and its 2 synonyms into the listing for *rufiventris*. This was almost certainly an accident, as he would not have seen the type, and the original description and other descriptive statements by former authors about *rufiventris* would not have given him reason to create new synonymy. Thus, when Stekhoven was told (either by Senior-White himself or by someone who had access to his manuscript) about Isaac's work, the person who told him simply made the substitution of

rufiventris for *sanguineus* since the former was soon to be published as senior synonym. Stekhoven's monograph (1926) was published some months before Senior-White's catalog (1927), so it is Stekhoven who formally initiated the synonymy, but it is, I believe, traceable to Senior-White's manuscript. This is the most likely scenario I can offer for explaining why *crassus/sanguineus* would ever have been placed under a species so unrelated as *rufiventris*; and why it was done without recourse to the latter type and without any explanation. Subsequent workers have adopted the Stekhoven/Senior-White synonymy, and a sizeable literature has been published on distribution, morphology, biology, and disease transmission capability of "*rufiventris*". Nearly all of this published after 1925 does not apply to the true *rufiventris*, and it is not to be assumed that this literature can automatically be reassigned to *crassus* because this latter is part of a distinctive but poorly known species group which is, and has been, subject to misinterpretation. True *rufiventris* must be regarded as known to date only from the type locality of "India orientalis" (i.e., eastern India), and records of "*rufiventris*" of authors should be reconfirmed before assigning them to *crassus*.

Tabanus subcallosus Ricardo

Ricardo (1911:227-228) established a ♀ and a ♂ as types of this species, both of which are from Mussoorie, India. This locality is just north of Dehra Dun in the northwestern part of Uttar Pradesh State. Ricardo described it in subgenus *Theriopectes*, based on the fact that the eyes are hairy, conspicuously so in the ♂. The species has since been treated by some authors in genus *Tabanus*, by others in genus *Theriopectes*; and after the latter taxon came to be more narrowly interpreted such that its included species were all Palearctic, Chvála (1969:49) moved *subcallosus* into genus *Hybomitra* as a procedural matter.

I have examined the 2 types as well as other specimens of *subcallosus* in BMNH. The type ♂ is indeed conspicuously hairy over both the large and small faceted areas. I did not record the degree

of eye-hairiness in the ♀ type, but it is certainly not conspicuous as in the ♂. In any case, I see no reason why the criterion of eye hairs alone should determine the generic placement of this species. In its other characters (including both sexes) it has the bare and shining subcallus, the abdominal banding, the black-and-white legs, and the general small size of the members of the *biannularis* group. I believe it should be placed with them, thus a true *Tabanus*. In fact, the conspecificity of *subcallosus* with *sexcinctus* Ricardo has been debated in the literature (Shiraki 1918:239; Philip 1962:294), clearly underscoring their species group affinities.

I believe the type ♀ and type ♂ of *subcallosus* are correctly associated, and I herewith establish the type ♀ as lectotype of this species.

Tabanus szechenyianus Szilády

This species was described from "Tonking" (=N. Viet-Nam above the Ca River) by Szilády (1926:12), from a single ♂ specimen in the Budapest [Hungarian National] Museum. All of the Calyptratae in that museum are known to have been destroyed in the 1956 crisis, and it must be assumed that the type and only known specimen of this species was among the losses.

Szilády's description, however, seems adequate. I have looked through the full series of

specimens treated in the main section here, and find that none of them compare at all closely with the description of *szechenyianus*. If any specimens with the following combination of characters should turn up among collections from Indochina or southern China, they should be checked further against Szilády's description: essentially black or brown species with wing heavily infuscated over basal 2/3 but hyaline over apical 1/3 and hind margin, 1st P cell widely open; antennal flagellum yellow to orange.

Tabanus tuberculatus Ricardo

This species was described by Ricardo (1911:220) from a series of 3♀ and 1♂. She established 1 of the ♀♀ and the single ♂ as types (seen in BMNH). The species is peculiar in that the ♀ (but not the ♂) possesses a bare and shining subcallus (pale yellow in color), which is one of several distinguishing features of the *biannularis* and *ceylonicus* groups, yet *tuberculatus* does not otherwise fit into these groups. The condition of the ♀ subcallus was found to be a natural one, not due to any mechanical rubbing damage.

I did not investigate the question posed by

Stone (1972:640) concerning the conspecificity of the ♂ and ♀ syntypes except to confirm his observation that the ♂ does not share the ♀'s bare subcallus. In any case, his designation of the ♀ syntype as lectotype is the obvious best choice, not only because ♀♀ are far more desirable taxonomically, but also, in this case, the abdomen of the syntype ♂ is missing.

The type locality of the lectotype ♀, as read from its label is: "India: Assam, Sylhet, Companiganj. 11. V. 1909." This locality is now in the northern part of East Bengal, which became Bangladesh in 1971.

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Taxonomic Index

[Junior synonyms and homonyms are in *italics*. New species are preceded by an asterisk. Species are *Tabanus* unless shown otherwise; multiple genera shown after a species name indicate different combinations noted herein, with the currently recognized combination given first. The page on which a species appears in a heading is **bold faced**. Species belong to the Oriental Region unless shown otherwise. Lapsus spellings are not indexed.]

- abaculus*, 110, 112
abauristriatus, 100, 101
 abbasalis, 16, 20, 59, **60**, 61, 134
 abbreviatus (*Tabanus*, *Atylotus*), **148-149**
 abscondens, **149**
acuminaris, 99, 100, 102
 admelanopygus, 20, 59, **60-61**, 135
aequeinctus, 35
 agnoscibilis and "allies", 99
 agnoscibilis, 15, 20, 99, **100-101**, 102, 103, 104, 142, 151.
albimediis, 80, 82, 86
 albiscutellus, 32
 albivittatus, 32
 albocostatus (*Tabanus*, *Atylotus*), 116
albocreus, 58, 59
 albulus (*Atylotus*, *Tabanus*), 127
 altermaculatus, 119, **152-153**
 *alumnus, 23, **54-55**, 56, 121, 133
 amaeus, 149, 150
 amoenatus, **149**
 anabates, 19, **56-58**, 134
 annamensis, 64, **149**
annamiticus, 81, 83, **149-150**
 annamitus(=annamita) (*Tabanus*, Bellardia, Phyrta), 14, **150**
ardalus, 100, 101
 assamensis, 3, 112, 113
atrimaculatus, 152
 ATYLOTUS, 3, **13**, 14, 125
 aublanti, 9, **150**
 aureus (=aurea), 7, 56
 aurilineatus, 19, 65, 66, 67, **68-69**, 136
aurilineatus gilvilineis, 66, 67
 aurisetosus, 46
 auristriatus, 67
 *ballmeri, 20, **119**, 146
barnesi, 8, 43, 44
 basalis group, 59, 61, 63, 153, 156
 basalis, 6, 59, 61, 64, 153
 BELLARDIA, 13, 14, 43, 49
 biannularis group, 14, 17, **23**, 36, 110, 153, 156, 157, 158
 biannularis, 14, 15, 28
bicallosus, 3, 78, 79, 80
bicinctus, 14, 28
 bicinctus (=2cinctus) (*Diachlorus*, *Tabanus*) (Neotropical Region), 14, 28
 bicolor (*Atylotus*, *Tabanus*) (Nearctic Region), 13
 bicoloratus, 32
 birmanicus (*Tabanus*, *Atylotus*), 20, **58-59**, 134
 *borealoriens, 23, **118-119**, 145, 153
 brunniipennis, 19, **70-71**, 138
brunntitibiatus, 149
 burmanensis (=burmanense), 151
 *caduceus, 18, **27-28**, 128
 caeruleus, 43
 calidus, 148
 caligneus, 155
 CALLOTABANUS, **14-15**, 23, 153
cambodianus, 100, 101, 150
cambodiensis, 71, 74, 87
 cepuricus, 7, 22, **107-108**, 109, 110, 143
 cestus, 32, 153
 ceylonicus group, 17, **36**, 37, 41, 42, 158
 ceylonicus, 14, 18, 37, **38-40**, 130
 ceylonicus (*Cydistomyia*, *Neotabanus*), 40
 chinensis, 74
 chrysater, 63
 cilipes (*Haematopota*), 6, 7
 cingulata (*Haematopota*), 6
cnecus, 49, 50, 155
 cnemidotus, 15
confligens (Neotropical Region), 76
 confucius (Palearctic Region), 119
 conicus (*Tabanus*, *Atylotus*), **148-149**
consocius, 152
 costalis, 71
 crassus, 3, 22, **110-112**, 113, 144, 157
 *cryptotaxis (*Atylotus*), 22, **125**, 126, 127, 147
 CYDISTOMYIA, 15, 40
 *discors, 18, **30-31**, 129
 diversifrons, 20, **97-99**, 141
 dorsilinea, 3, 21, **78-80**, 138
 effilatus, 75, 104
 equicinctus, 15, 22, **35-36**, 110, 130
 euphanes, 7, 8, 19, **115-116**, 117, 121, 144
 *eurytopus, 18, **40-41**, 42, 131
 exoticus, 115
 fascius, 19, 52, **53-54**, 133
fenestratus, 149
finalis (Nearctic Region), 91
 *firmus, 21, 82, **122-124**, 146
flavicinctus, 14, 32, 153
 flavioculatus, 9, 121, 122, 156
 flaviscutellatus, 151
 flaviscutellus, 151
flaviventris (*Tabanus*, *Atylotus*), 97, 98, 99
 flaviventris (*Stibasoma*, *Tabanus*) (Neotropical Region), 97, 98
flavocinctus (*Hybomitra*, *Tabanus*) (Nearctic Region), 14, 32
 fontinalis, 21, 82, **86-88**, 139
 fulvicinctus, 15, 153
 fulvilinearis, 20, **95-96**, 141
 fulvimediis, 3, 121, 122, **151-152**
 fumifer group, 107
 fuscibarbus, 107
 fusciventer, 148, 149
 fuscomaculatus, 119, **152-153**
 *geographicus, 19, **46-47**, 48, 132
 gertrudae, 14, 15, 32, 153
 gilvellus (*Atylotus*, *Tabanus*), 3, 17, **125-126**

- gilvilineis*, 66, 67
granti, 19, 44, 45-46, 132
gratus (Ethiopian Region), 79
griseifacies, 126
griseilineis, 23, 82, 123, 124-125, 147
griseipalpis Sch. Stek., 28, 68
griseipalpis Toumanoff, 67, 68
**gyrchus*, 18, 25-26, 128
HAEMATOPOTA, 6
**helvinus*, 19, 65, 66, 67-68, 69, 136
hilaris, 71, 73, 74
hirtistriatus, 93, 151
humillimus (Atylotus, Tabanus), 3, 13
HYBOMITRA, 13-14, 157
hypomacros, 7, 22, 113-115, 144, 154
ictericus, 7, 8, 153-154
**idulis*, 18, 26-27, 128
immanis group, 107, 124
indianus, 3, 115, 154
indosinensis, 19, 47
infamis, 3, 38
insidiator, 32, 33
internus, 3, 105
**jeanae*, 22, 117-118, 145
joidus, 62
jucundus, 21, 71, 77-78, 137
kakhyenensis, 3, 19, 49, 50, 51-52, 133
kershawi, 38, 40
khasiensis, 154
konis, 20, 99-100, 102, 141
lacrymans (Tabanus, Atylotus), 80, 82
lageniferus, 80, 82
laotianus (Tabanus, Atylotus), 6, 7, 106, 107
**larvatus*, 22, 112-113, 144
lata (=latus) (Sceptia, Tabanus) (Neotropical Region), 14
latus (Hybomitra, Tabanus) (Region uncertain), 13, 14
lentis, 21, 91, 92, 101, 137
leucocnematus, 30
leucosparsus, 6, 7, 110, 112
Lissimodes, 40
longibasalis, 8, 19, 65, 66-67, 68, 69, 136
**lotus* (Atylotus), 22, 125, 126-127, 147
macer (Tabanus, Atylotus), 78, 79, 80
macrocera (Haematopota), 6
manilensis, 74, 76
manipurensis, 64, 65
maurus, 155
megalops, 3, 21, 71, 72, 73, 74-77, 137
melanognathus (Tabanus, Atylotus), 6, 7, 53, 155
melanopygatus (Tabanus, Atylotus), 151, 152
mentitus, 106, 154
**mesogaeus*, 18, 41-42, 131
minimus, 18, 36-38, 130
monilifer (Tabanus, Atylotus), 3, 8, 22, 104-106, 107, 142
monotaeniatus (Tabanus, Atylotus), 123
multicinctus, 110
muscoideus, 103
nantae, 9, 122, 155-156
NEOTABANUS, 38, 40
nephodes complex, 49
nephodes (Tabanus, Atylotus), 49, 50
nigrinus, 29, 30, 32
nigrotectus (=nigrotecta) (Tabanus, Bellardia), 6, 7, 14, 19, 42-43, 131
nilakinus, 113, 114, 115
nitidulus, 38, 39
nitudulus, 38, 39
nonoptatus, 3, 155
**nyctops*, 19, 117, 145
ochrogaster, 97, 99
OCHROPS, 13
oknos, 7, 19, 43-45, 46, 131
ophthalmicus, 71
optatus group, 53
**orbis*, 18, 34-35, 130
orientis, 151-152
**oxybeles*, 20, 103-104, 142
oxyceratus (Tabanus, Atylotus), 108
pachycera (Haematopota), 6, 7
pagodinus (Tabanus, Atylotus), 151, 152
pallidepektoratus, 7, 56
pallidiscutum, 15
parallelienter, 152
partitus, 74, 76
**paviei*, 6, 7, 20, 59, 63-64, 65, 135, 149
perakiensis, 43, 117
perileucus, 156
perlinea, 152
Phyrta, 150
plauta (Hybomitra) (Region uncertain), 14
POTISA, 6
praematurus, 20, 64-65, 135, 154
priscoides, 81, 83, 86
priscus, 80, 82, 86
**pristinus*, 21, 81, 82, 83, 84-86, 124, 139
pseudopallidepektoratus, 7, 8, 62, 63
pugunculus, 20, 99, 100, 101, 102-103, 104, 142
pugnax, 120, 121, 122, 152
pullomaculatus, 119
pusillus (Tabanus, Atylotus), 3, 127
puteus, 96
**quadrifocus*, 21, 82, 89-91, 139
quatei, 156
rara (=rarus) (Hybomitra, Tabanus), 14
reducens, 123
rhinargus, 18, 29-30, 129
roubaudi, 107, 108
rubicundulus, 3, 8, 113, 114, 115
rubicundus, 22, 105, 106-107, 143
rubidus, 3, 22, 76, 80-83, 84, 85, 86, 88, 89, 90, 123, 138, 148, 150
rufidens (Tabanus, Atylotus) (Palearctic Region), 119, 153
rufiscutellatus, 19, 52-53, 54, 133, 155
rufiventris, 111, 112, 156-157
rufocallus, 74, 76
**rusticatus*, 21, 82, 88-89, 139
salvazai, 3, 7, 19, 49-50, 51, 132
sanguineus, 110, 111, 112, 157
semirufus, 148-149
sexcinctus, 18, 24-25, 26, 27, 128, 157
siamensis, 23, 55-56, 57, 62, 134, 156
simplissimus, 38
sinicus Walker, 76, 80, 82
sinicus Bigot (Tabanus, Bellardia), 14, 149, 150
soubiroui, 3, 7, 8, 23, 120-122, 146, 152

- speciosus*, 3, 82, 89
sphinx, 107, 108
striatus complex, 71, 78, 80
striatus, 21, 71-74, 75, 76, 77, 80, 137
strophiatius, 74, 76
stygius (Nearctic Region), 116
subcallosus (*Tabanus*, *Hybomitra*), 3, 14, 25, 157
subcanipus, 21, 91, 92, 140
**symmetrus*, 21, 92-94, 95, 140
**systemus*, 21, 93, 94-95, 140
szechenyanus, 157
TABANUS, 3, 5, 13, 14, 15, 157
taeniellus, 21, 93, 95, 140
**tamthaiorum*, 19, 23, 65-66, 136
tenasserimi, 23
tenens, 71, 73, 74, 75, 76, 77, 83, 87
tenens (Neotropical Region), 74, 76, 83
THERIOPECTES, 13, 14, 157
**thermarum*, 22, 108-109, 143
thurmani, 20, 23, 56, 59, 61-63, 135
tinctothorax, 155
tonglai, 7, 18, 32-34, 35, 129
toumanoffi, 19, 47-48, 132
triceps, 75, 76
trichinopolis, 78, 79, 80
trimaculatus (Nearctic Region), 91
tuberculatus, 15, 158
umbrosus, 80, 82
**unicus*, 19, 116-117, 145
uniformis, 118
vagus Walker 1850a, 3, 80, 83
vagus Walker 1850b, 80, 82, 83
**vernus*, 20, 96-97, 99, 141
violaceus, 81, 83, 86
virgo (*Atylotus*, *Tabanus*), 127
virgulatus, 21, 82, 83-84, 138
**xanthochrus*, 22, 120, 146
xanthoimus, 68
**zodiacus*, 18, 25, 31-32, 119, 129
zoster, 22, 39, 108, 109-110, 143





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