

NOTES ON TABANIDAE (DIPT.) FROM PANAMA

VII. THE SUBGENUS NEOTABANUS AD. LUTZ^{1,2}

G. B. FAIRCHILD,
Junior Medical Entomologist,
Gorgas Memorial Laboratory,
Panamá, R. de P.

Subgenus *Neotabanus* Ad. Lutz

1909, Inst. Oswaldo Cruz em Manguinhos, p. 29. (Type, designated by Bequaert.)
1924, *T. trilineatus* (Latr.). Not *Neotabanus* Ricardo, 1911.
Taeniotabanus Kröber, 1930, Dipt. Patagonia and S. Chile, Part 5, fasc. 2, p. 140.
(Type, designated by Borgmeier, 1933, *T. occidentalis* L.).

Neotabanus was proposed by Adolfo Lutz in 1909 for a group of 18 Neotropical species of *Tabanus*. In subsequent papers (1913, 1914, 1914a, 1914b, 1922 and 1928), he defined the group by means of keys and added several species to it. Later workers have had some difficulty in deciding whether the name should be used in a generic or subgeneric sense or discarded altogether. Bequaert (1924, 1933, 1940), Enderlein (1925), Kröber (1933, 1934) and Stone (1938) have all discussed the matter to some extent. Kröber's statement (1933) that the color pattern of the abdomen is about the only character which can be used to separate the group seems to sum up the situation fairly well.

For the purposes of the present paper, the group may be characterized as follows: Eyes generally bare in the female, often hairy in the male. Frons narrow to rather broad. Third antennal segment with a dorsal tooth or angle, but without a long spine. Labella large and membranous. Subepaulet with macrotrichia, wing venation normal, but with a tendency to develop a spur vein or appendix on the upper branch of the third vein. Abdomen with markings in the form of longitudinal stripes or rows of contiguous truncated triangular spots, light on a dark ground. The color pattern of the eye in life is also quite distinctive, consisting generally of three green bands on a purple ground. In North America the group is connected with *Tabanus*, sensu stricto, by such forms as *T. vicarius*

¹Printing costs paid by the Gorgas Memorial Laboratory, Panamá, R. de P.

²No. VI. This journal, 34: 639-646, 1941.

Walk., *T. acutus* Big., and *T. fulvulus* Wied., while in Tropical America species such as *T. unistriatus* Hine, *T. angustivitta* Kröb. and *T. hookeri* Knab. form connecting links with other groups. In fact, it is difficult or impossible in some cases to decide whether a given species should be placed in the group or not. Thus although *T. hookeri* has a quite different eye pattern, and the abdomen is hardly striped, it is retained here for convenience, while *T. vicarius* and its allies which have striped abdomens, but eyes with but a single narrow dark band, are omitted.

Specific differentiation within the group is exceedingly difficult, as there appears to be a great deal of variation, while what differences there are seem mostly of degree. Eye characters of the male appear to offer the surest basis for separation, but this may be due to the small number of males available for study. The relative proportions of the frons, and color characters, especially of the abdomen and legs, have been the most useful in separating the females.

The nomenclature of the group is highly involved, as a great majority of the earlier descriptions are too brief to differentiate between closely allied species. The group as a whole is a dominant one, and its species generally furnish a goodly percentage of the specimens taken by any collector in the American tropics, so that nearly all the earlier dipterists described one or more species. I have been able to find 51 names which seem to apply to members of the group. Of these Kröber recognized 23 in his 1933 paper, and in 1934 listed 36, of which he claimed to have seen the types of 17. In Hine's collection there are a number of specimens labelled "comp. with Type," but for various reasons they do not help much in elucidating the tangle. Hine's other determinations for the most part do not agree with those of Kröber.

In selecting names for the Panama species, I have given priority to those names of which type material exists, or of which material determined by the author of the species exists, or on which there seems to be a general concensus of opinion. In many cases these are probably not the earliest names, but since the types of so many of the early names are lost or unrecognizable, it has seemed better to choose the moderate certainty of a possible synonym rather than the complete uncertainty of a Linnean or Fabrician name. Under each species, therefore, only those references which probably refer to the species con-

sidered are given. In addition to the Panama species, I have included a number of North and South American species of which I have material before me.

KEY TO NEOTABANUS FEMALES

1. Subcallus denuded, shiny. Frons narrow and convergent. Species small, less than 12 mm. 5. (*callosus* group)
- Subcallus pollinose, or if shiny, then frons very broad. 2
2. Size small, 11 mm. or less. Subcallus always pollinose. 4
- Size larger, generally from 12 to 18 mm. 3
3. Frons from $2\frac{1}{2}$ to about $3\frac{3}{4}$ times as high as wide, the callus at least as wide as high, nearly or quite as wide as frons. Median stripe a slender line or a series of triangles. Lateral stripes very markedly step-like, 9. (*hookeri* group)
- Frons variable, generally at least 5 times as high as wide, but if wider, then the median stripe broad, nearly parallel sided and the lateral stripes at most somewhat irregular. Callus never as wide as frons. 11. (*lineola* group)
4. Very small, about 9 mm. Frons narrow, over 5 times as high as basal width, convergent. Basal part of third antennal segment disc-like. Median abdominal stripe a series of broad triangles, laterals a series of broad patches. *enanus*
- Larger, 9-11 mm. Frons broader, antennae normal, abdominal stripes well marked and rather even. (See separate key) (*curtus* group)
5. Abdomen black with a uniform mid-dorsal white stripe; lateral stripes absent. Fore coxae and all femora black. *unistriatus*
- Abdomen with lateral stripes. 6
6. Wings smoky. Median abdominal stripe of narrow contiguous truncate triangles, lateral stripes not step-like, but formed of a series of short streaks in line. *fumatipennis*
- Wings hyaline. 7
7. Median abdominal stripe of narrow truncate triangles, lateral stripes of oval spots in line. Palpi brownish. Coxae and femora black. Abdomen dark brown. *callosus*
- Median abdominal stripe uniform, parallel sided. Lateral stripes continuous, parallel sided. Abdomen brownish yellow. 8
8. Fore coxae and basal halves of mid and hind femora black. *lucidecallosus*
- Fore coxae and mid and hind femora entirely reddish yellow. *restrepoensis*
9. Subcallus denuded, shiny. Frons convergent. Abdomen yellowish, a small integumental black patch on the first and second tergites. Median stripe a series of triangles; lateral stripes a series of oblique patches. *hookeri*
- Subcallus pollinose. Frons nearly parallel sided. 10
10. Coxae and femora largely black. Scutellum black. Median abdominal stripe a slender even line. *johannesi*
- Coxae and femora pale. Scutellum reddish. Median abdominal stripe a series of contiguous triangles. *angustivitta*
11. Median abdominal stripe of a series of narrow contiguous truncate triangles. Lateral stripes a series of oval or oblique rhomboid patches, which may or may not be contiguous. 12
- Median abdominal stripe even and parallel sided. Lateral stripes as above, or practically even and parallel sided. 16
12. Thorax striped, sometimes rather faintly so. Wings always entirely hyaline. Scutellum sometimes reddish. 13
- Thorax always unstriped. Wings variable, often faintly smoky, or costal cell yellowish, or with very faint clouds on cross-veins. 15
13. Frons nearly parallel sided, $6\frac{1}{2}$ times as high as wide. Coxae and femora largely blackish. Fore tibiae not prominently bicolored, the basal half light brown, the apical half dark brown. Scutellum black. Median abdominal stripe a series of rather broad white haired truncate triangles, lateral stripes a row of unconnected, oval white haired patches which are not oblique. *dunni* (Panama)

- Frons rather convergent below. Fore tibiae prominently bicolored.
Lateral stripes variable, but either the spots contiguous or oblique. 14
14. Scutellum black. Frons quite narrow. . . (North America) *lineola* var. *lineola*
Scutellum reddish. Frons quite broad. *lineola* var. *scutellaris*; *vittiger* var. *A.*
15. Wings with cross-veins faintly clouded. Palpi acutely pointed,
(Central America) *maya*
Wings hyaline, smoky, or costal cell yellowish, cross-veins not clouded.
Palpi rather blunt. (Southern South America) *triangulum*
16. Callus over twice as high as wide with a prominent raised ridge extending
from it over half way to vertex. Third antennal segment very slender,
four times as long as greatest width. Thorax striped. Median abdom-
inal stripe uniform, lateral stripes a series of unconnected oval spots
which are not oblique. Size very large for the group, 18 mm.,
(Southern Brazil) *strigimaculata*
- Size seldom if ever exceeding 15 mm. Antennae never so slender. Callus
broader, its dorsal extension shorter, weaker and usually unconnected. 17
17. Wings hyaline. Thorax striped, sometimes faintly, scutellum blackish.
Fore coxae and mid and hind femora entirely pale. Mid stripe broad,
even or slightly irregular, lateral stripes irregular, both always chalky
white. Whole insect grayish in tone. *amplifrons*
- Without the above combination of characters. 18
18. First antennal segment rather inflated when viewed from above. Frons
not or only slightly convergent. Callus square or rounded. Costal
cell often yellowish. First tergite and generally the second with a black
dorsal patch. Stripes variable, the mid-stripe nearly always quite
narrow, often irregular, the laterals usually step-like, never perfectly
even. Fore coxae and posterior femora at base always blackish.
Scutellum very rarely reddish. Color variable, yellow, red or black,
triangulum
- Without the above combination of characters. 19
19. Frons $3\frac{3}{4}$ to $4\frac{1}{4}$ times as high as wide, markedly convergent below.
Frontal callus large, yellow. Scutellum reddish at apex. Fore coxae
and posterior femora wholly yellow. Abdominal stripes broad, even,
yellow. Whole insect yellowish brown. Wings entirely hyaline,
(Central and S. America) *vittiger* var. *guatemalanus*
- Without the above combination of characters. 20
20. Whole insect rather grayish, thorax striped, scutellum reddish. Frons
about $4\frac{1}{2}$ times as high as wide, callus black, rectangular. Fore coxae
and posterior femora extensively black. Stripes white,
(North America) *vittiger* var. *A.*
- Without the above combination of characters,
(See separate key) *lineola* and vars.

KEY TO NEOTABANUS MALES

1. At least area of enlarged facets of eye definitely pilose under a hand lens. 2
Eye entirely bare, at most short scattered hair visible under high power
magnification. 7
2. Enlarged facets of eye much larger than small facets, occupying about $\frac{2}{3}$ of
total eye area, the line of demarkation between the two types very
abrupt. 3
Enlarged facets of eye at most only two or three times as large as small
facets, occupying about $\frac{1}{2}$ eye area, the line of demarkation not clearly
defined. 5
3. Frontal triangle bare and shiny. Median stripe a series of white haired
triangles, lateral stripes a row of unconnected oblique spots. Fore coxae
and posterior femora pale yellowish. *hookeri*
Frontal triangle pollinose. 4
4. Whole insect predominantly greyish. Stripes white, at least the laterals
step-like. Fore coxae and posterior femora extensively dark,
(Southeastern N. America) *vittiger* var. *schwardti*
Whole insect predominantly yellowish brown. Stripes yellowish, the
laterals at most slightly irregular. Coxae and femora all yellowish,
(Central and South America) *vittiger* var. *guatemalanus*

5. All coxae, and all femora, except extreme apices, black. Abdomen black, the median stripe a very slender line, the lateral stripes a series of oblique patches, both white haired. **johanneisi**
At least mid femora $\frac{1}{3}$ pale. Abdomen not so marked. 6
6. Whole insect greyish. Abdominal stripes broad and quite even, chalky white haired. **amplifrons**
Whole insect predominantly brown, yellowish to nearly black. Median stripe narrow, irregular, lateral stripes oblique, step-like, both yellow to orange haired. **triangulum**
7. Enlarged facets of eye much larger than small, occupying about $\frac{2}{3}$ of total eye area, the line of demarkation between the two types very abrupt. 8
Enlarged facets at most only two or three times as large as small, occupying about $\frac{1}{2}$ eye area, the line of demarkation not clearly defined. 9
8. Fore coxae and posterior femora wholly yellow. Abdomen yellow, brown haired, the median stripe broad and yellow, the laterals even, yellow, (Tropical America) **lineola** var. **carneus**
Fore coxae blackish, posterior femora blackish at base. Stripes and coloration rather variable. (North America) **lineola** var. **lineola**
9. Fore coxae and posterior femora wholly yellow. 10
Fore coxae and at least basal $\frac{1}{2}$ of posterior femora blackish. 11
10. Size small, less than 12 mm. Thorax brown. Abdomen yellowish brown, a small dark area beneath scutellum, often extending on to second tergite. Stripes even or slightly irregular, yellow haired, intervals black haired. Legs pale brown. **stuppeus**
Size larger. Whole insect greyish or brown. Thorax striped. Scutellum reddish. Abdominal stripes narrow, irregular and whitish, (North America) **lineola** var. **scutellaris**
11. At least the median abdominal stripe rather broad and even. Wings often smoky or brownish along veins. 12
Median stripe a series of contiguous triangles, lateral stripes of oblique step-like patches. Wings hyaline or with very faint clouds on crossveins. 13
12. Abdomen yellow, black haired. The stripes rich yellow. Median stripe rather broad, laterals reduced. Legs largely yellow, (Central and South America) **lineola** var. **stenocephalus**
Abdomen black or largely so, stripes white. Legs largely blackish, (Tropical America) **lineola** var. **plangens**
13. Abdomen with a broad mid-dorsal black stripe underlying the vestiture; sides reddish. Mid-stripe of white haired contiguous triangles, lateral stripes of oblique unconnected white haired patches. Wings entirely hyaline. **angustivitta**
Abdomen yellowish with a black triangle on the first two tergites underlying the vestiture. Stripes much as in *angustivittata*, but the laterals less disconnected and oblique, all yellow haired. Wings with very faint clouds on crossveins. **maya**

Tabanus (Neotabanus) enanus n. sp.

(Pl. I, fig. 8)

Female—Length 9 mm., of wing 7.5 mm.

Frons about $5\frac{1}{4}$ times as high as basal width, somewhat narrower below, yellowish grey pollinose above and below, with an area of darker pollinosity about the median callus. Basal callus approximately square, as wide as frons, black, and with a wrinkled surface. Median callus spindle shaped, reaching half the distance to the vertex and unconnected with the basal callus. Vertexal tubercle absent. Subcallus pollinose. Eyes bare, green, with a median and an incomplete upper purple stripe, and the lower, outer and upper margins purple.

First antennal segment white, cap shaped and clothed with black hair; second segment scale-like. Basal part of third segment as wide as

long, almost disc shaped, yellow, the dorsal angle very obtuse. Annulate portion about as long as the basal, black. Face and cheeks greyish white, white haired. Palpi yellowish, mostly black haired, and drawn out into a slender pointed apex. Proboscis black, short, the labella fleshy and occupying nearly three-fourths the length of the proboscis.

Thorax blackish grey, grey haired, and with scattered iridescent scale-like hairs. Scutellum and antecular tubercles concolorous with the dorsum. Wings completely hyaline, the stigma yellowish. A short stump on the upper branch of the third vein. Subepaulet with macrotrichia. All coxae, all of fore femora, and basal two-thirds of mid and hind femora black. Fore tibiae half black and half yellow. Mid and hind tibiae yellow; all tarsi brown.

Abdomen black, sides of the second to fourth tergites broadly reddish. A mid-dorsal row of yellow haired contiguous triangles, and a pair of lateral step-like yellow haired stripes overlie the ground color. The posterior margins of the tergites are also yellow haired. Beneath, the abdomen is dull reddish, with a black spot on the base of the first sternite, and the terminal sternites black.

Holotype ♀, Bejuco, Panama Province, Rep. of Panama, May 21, 1940.

This is quite the smallest *Neotabanus* known to me. It shows much resemblance to some species of *Stenotabanus*, but the subepaulet is hairy, and the eye pattern is like other *Neotabanus*. The specimen was taken in an extensive patch of mangrove swamp.

Tabanus (Neotabanus) curtus Hine

(Pl. I, fig. 11)

Tabanus curtus Hine, 1920, Ohio Journ. Sci., XX, 6, p. 190. Kröber, 1934, Rev. Ent., IV, 3, p. 292 (not recognized).

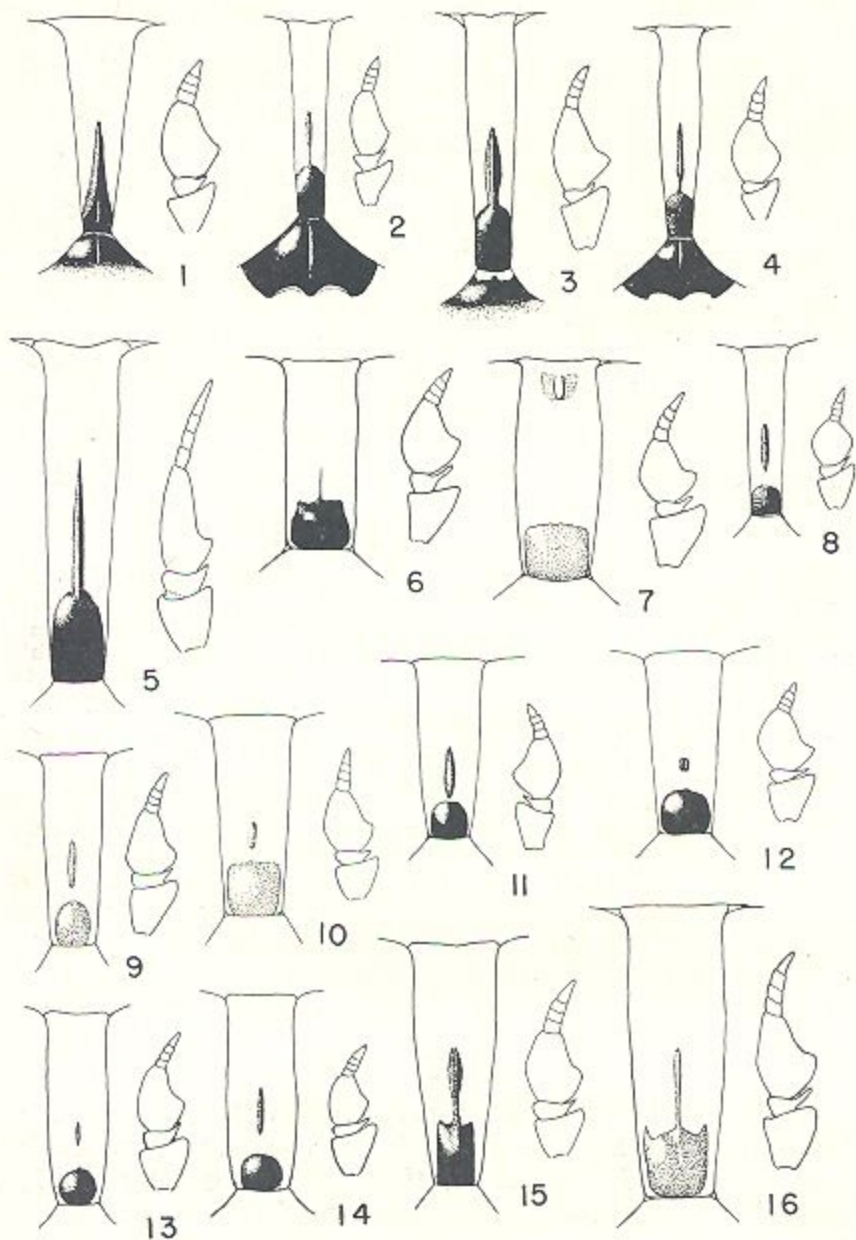
I have examined the types in the Hine collection and in the Philadelphia Academy of Natural Sciences, and a topotype is

EXPLANATION OF FIGURES

All figures are of the frons and antenna of female specimens, and all are to the same scale. The vestiture of hairs on the basal antennal segments has been omitted, as it is quite uniform throughout the groups, and would only obscure the shape of the segments.

PLATE I

Fig. 1. *T. (N.) lucidecallosus* sp. nov. Holotype. Fig. 2. *T. (N.) unistriatus* Hine. Chiriquí Panama. Fig. 3. *T. (N.) fumatipennis* Kröb. Canal Zone, Panama. Fig. 4. *T. (N.) callosus* Macq. Rio Branco, Amazonas, Brasil. Fig. 5. *T. (N.) strigmaculus* sp. nov. Holotype. Fig. 6. *T. (N.) johannes* sp. nov. Holotype. Fig. 7. *T. (N.) angustivitta* Kröb. Panama. Fig. 8. *T. (N.) enanus* sp. nov. Holotype. Fig. 9. *T. (N.) "pallidifemoratus* Kröb." Panama. Fig. 10. *T. (N.) despectus* n. sp. Rio Branco, Amazonas. Fig. 11. *T. (N.) curtus* Hine. Topotype. Fig. 12. *T. (N.) dorsiger* var. *longipilosus* Kröb. Matto Grosso, Brasil. Fig. 13. *T. (N.) stuppeus* n. sp. São Paulo, Brasil. Fig. 14. *T. (N.) columbus* n. sp. Rio Solimoes, Brasil. Fig. 15. *T. (N.) "traquii* Stone." Arkansas, U. S. A. Fig. 16. *T. (N.) vittiger guatemalanus* Hine. Panama.



before me. The callus is small, rounded, yellow. Thorax and abdomen nearly black, the stripes white, the median even, the laterals slightly irregular. I have seen specimens only from the type locality, Pedernales, Venezuela.

There seem to be a considerable number of small species related to *curtus* in South America, but I have no such extensive series of them as is available for the study of the *lineola* complex, in most cases only a few specimens from one or two localities. Some of these have undoubtedly been previously described, but I have been unable to associate most of the forms before me with any published descriptions. The males of most of these forms remain unknown, which makes the problem especially difficult. A key to the forms I have been able to distinguish is here given, together with short descriptions and figures. They are given specific names with much misgiving, mainly for ease of reference. The specimens will be available, and with the accumulation of more material, the problem may eventually be solved.

KEY TO FEMALES OF CURTUS GROUP

1. Fore coxae and posterior femora blackish, wholly or in part..... 2
Fore coxae and posterior femora wholly yellowish..... 4
2. Only extreme bases of posterior femora dusky. First and second tergites and sternites with an integumentary black patch, otherwise yellowish brown. Stripes yellow haired, even, fairly broad. Scutellum dark.... **cicur**
Posterior femora with only the apices light..... 3
3. Antennal tooth obtuse, short, the basal part of third segment $\frac{1}{2}$ longer than wide..... **curtus**
Antennal tooth acute, prominent, basal part of third segment about as wide as long..... **dorsiger** var. **longipilosus**
4. Frons broad but convergent. Callus yellow, square, nearly as wide as frons. Scutellum reddish, abdominal stripes broad, white and even **despectus**
Frons narrower. Callus round or square, but well separated from eye margins..... 5
5. Thorax brown, brown or yellowish haired. Abdominal stripes broad, even, creamy or white haired..... **columbus**
Thorax brown, brown or yellowish haired. Abdominal stripes narrow, the middle one even or irregular, the laterals generally step-like..... **stuppeus**

Tabanus (*Neotabanus*) **cicur** n. sp.

Two females from Restrepo, Dept. Meta, Colombia, collected by J. Bequaert and P. C. A. Antunes. They measure just under 11 mm. In addition to the characters given in the key, the callus is black, mesonotum and scutellum blackish, brownish grey and yellow haired, wings entirely hyaline.

Tabanus (Neotabanus) dorsiger var. **longipilosus** Kröber (?)

(Pl. I, fig. 12)

Two females from Maracajú, Matto Grosso, Brasil, April-May, 1937 (Shannon and Fairchild coll.). The callus in one is reddish, black in the other. Mesonotum and scutellum blackish, grey haired. Abdomen blackish, reddish on sides. Stripes medium the median narrower than intervals, whitish, the laterals broader, even, creamy. Except for the quite even stripes, this form agrees fairly well with Kröber's (1933, p. 351) description of *T. (N.) dorsiger* var. *longipilosus*.

Tabanus (Neotabanus) despectus n. sp.

(Pl. I, fig. 10)

This is the species recorded by Bequaert (1926, p. 229), and I have seen only his specimen from Vista Alegre, Rio Branco, Amazonas, Brasil, Sept. 6, 1924. The specimen measures 10 mm.

Tabanus (Neotabanus) columbus n. sp.

(Pl. I, fig. 14)

The small callus is black or yellow, and the whole insect quite pale and grey. 1 ♀, Isla Paloma, Orinoco delta, Venezuela, Feb. 11, 1935 (N. A. Weber); 1 ♀ Caicara, Rio Solimoes, Brasil, Aug. 2, 1935 (J. Serafim); 2 ♀, ? Bahia, Brasil. Length 9-10 mm.

Tabanus stuppeus n. sp.

(Pl. I, fig. 13)

3 ♂ and 27 ♀ from various localities in the states of São Paulo, Goyaz, and Matto Grosso, Brasil. The coloration is about as in *cicur* but the coxae and femora are wholly pale. The males have bare eyes, the facets not greatly differentiated, all three abdominal stripes well marked, yellow, intervals brown haired, laterals step-like.

Tabanus (Neotabanus) dorsiger var. **pallidifemorata** Kröber (?)

Finally, I have a considerable series of females from Panama (Pl. I, fig. 9) all under 11 mm. which I am unable to separate from *lineola* var. *carneus* except by their smaller size. These may be what Kröber (1933, p. 352) calls *dorsiger* var. *pallidifemorata*, at least they agree with his description better than any other Panama material. I have also 2 males which agree well, but they are from Venezuela and Trinidad. The eyes are bare, and the facets not greatly differentiated.

***Tabanus (Neotabanus) unistriatus* Hine**

(Pl. I, fig. 2)

Tabanus unistriatus Hine, 1906, Ohio Naturalist, VII, 2, p. 28. Kröber, 1933, Rev. Ent., III, 3, p. 365; 1934, Op. Cit., IV, 3, p. 294. Dunn, 1934, Psyche, XLI, 3, p. 174.

I have seen Hine's types, which consist of 3 females from Piedras Negras, Carillo, and San Carlos, Costa Rica (Schild coll.). There are also 3 females from Tela, Honduras, May, 1927 (Hubbel coll.) in the Hine coll. I have also seen 6 ♀ from Lancetilla, Tela, Honduras, and 1 ♀ from San Carlos, Costa Rica in Dr. Bequaert's collection.

Panama records. I have seen only a short series of the specimens taken by Dunn at Camp Pital, Chiriqui, July, 1929, and reported by him (1934).

***Tabanus (Neotabanus) fumatipennis* Kröber**

(Pl. I, fig. 3)

Tabanus (Neotabanus) fumatipennis Kröber, 1933, Rev. Ent., III, 3, p. 341; 1934, Op. cit., IV, 3, p. 293.

Tabanus trivittatus Hine, 1906, Ohio Naturalist, VII, pp. 22, 27. (? nec. Fab.?). Hine, 1920, Ohio Journ. Sci., XX, 6, p. 190. Bequaert, 1926, Med. Rep. Harvard Exped. Amazon, Pt. 3, p. 228.

There is a specimen in the Hine Collection labelled "*T. callosus* Macq. comp. with type," but I am inclined to accept Kröber's diagnosis in the present case. Fabricius' and Wiedemann's descriptions of *trivittatus* do not mention the bare subcallus. Bequaert (1926) gives *Tabanus primitivus* Wik., 1848, as a synonym of this species, but Kröber (1930, Zool. Anz., LXXXVII, p. 11, fig. 10) who states that he saw the type, places Walker's species in the subgenus *Macrocornus*.

Distribution: I have seen material from the states of Amazonas and Pará, Brasil, Trinidad, British Guiana, Panama and Costa Rica.

Panama records. Cabima, May 24, 1911 (Busck coll.); Cruces Trail, Madden Highway, C. Z., July 1, 1939; Moja Pollo, May 27, June 24, 1940; Summit, C. Z., June, 1930 (Dunn); Escobal, May 4, 1931 (Dunn).

***Tabanus (Neotabanus) callosus* Macquart**

(Pl. I, fig. 4)

Tabanus callosus Macquart, 1847, Dipt. Exot., Suppl. III, p. 11. Kröber, 1933, Rev. Ent., III, 3, p. 342; 1934, Op. cit., IV, 3, p. 292 (*Neotabanus*).

Tabanus sp. No. 1. Bequaert, 1926, Med. Rep. Harvard Exped. Amazon, Pt. 3, p. 229, fig. 7g. (Rio Branco, Amazonas.)

Kröber claims to have seen the type. Hine's specimen which he compared with the type is *fumatipennis* Kröber. The species

is very like *fumatipennis*, but the wings are entirely hyaline, and the structure of frons and antennae is quite different.

Distribution: Specimens are before me from San Alberto, Rio Branco, Amazonas, Aug. 25, 1924 (J. Bequaert), and Marajó Is., Pará, Brasil (R. Damasceno). Kröber records it from Surinam also.

Tabanus (Neotabanus) lucidecallosus sp. nov.

(Pl. I, fig. 1)

Female—Length 11 mm., of wing, 9 mm. Eyes bare, green with two purple bands and the margins purple. Frons yellowish grey, about eight times as high as basal width, and more than twice as wide at vertex as at base. Frontal callus higher than wide, brown. Subcallus shiny, yellow, not greatly inflated. The figure shows the subcallus black, but this is an error. Antennae orange, the annulate portion a little darker. Palpi white, sparsely black haired.

Mesonotum dark grey, vestiture of dark grey and shiny brassy hairs forming indistinct stripes. Scutellum concolorous. Pleura and sternum grey, with pale hairs. Coxae, all of fore femora, and basal two-thirds of mid and hind femora blackish. Fore tibiae bicolored, mid and hind tibiae and apices of femora yellow, tarsi blackish. Wings entirely hyaline; stigma narrow, yellow; no appendix on third vein.

Abdomen orange brown, blackish in the middle. Stripes even, median brassy haired, the intervals black haired. Venter orange brown, dusky along the mid-line, grey pollinose and whitish haired.

Holotype ♀, Maracajú, Matto Grosso, Brasil, April–May, 1937 (Shannon and Fairchild); Paratypes: 1 ♀, same date; 1 ♀ Cerro Pelado, Paraguay (F. Schade); 1 ♀ Villarica, Paraguay (F. Schade). To be deposited in the M. C. Z. Harvard University, Cambridge, Mass. There is also a specimen in the Hine Coll. from San Bernadino, Paraguay (Fiebrig coll.) which appears to be the same. This species differs conspicuously from *callosus* Macq. and *fumatipennis* Kröb. in the much lighter color, even, continuous abdominal stripes and much more convergent frons. Kröber's var. *brunniventris* seems to differ in having irregular lateral stripes and a different eye pattern, and seems to be correctly placed as a light form of *callosus*.

Tabanus (Neotabanus) restrepoensis sp. nov.

Female—Length 10 mm., of wing, 9 mm. Very close to *lucidecallosus*, of which it may be a local race, but differing in the following respects. Frons about seven times as high as basal width, vertex hardly one and one-half times as wide as base. Palpi less inflated basally. Mesonotum without indication of stripes. Coxae and femora wholly pale yellowish. Abdomen wholly yellow, the stripes broader, yellow haired. Otherwise as in *lucidecallosus*.

Holotype ♀ and 5 ♀ Paratypes, Restrepo, Dept. Meta, Colombia (J. Bequaert coll.). To be deposited in the M. C. Z., Harvard University, Cambridge, Mass.

***Tabanus (Neotabanus) hookeri* Knab**

Tabanus hookeri Knab, 1915, Ins. Ins. Mens., III, 1-4, pp. 48-49 (♂, ♀; Mayaguez, Puerto Rico).

Tabanus filiulus Johnson, 1919, Bull. Amer. Mus. Nat. Hist., XLI, p. 428. Not *T. filiulus* Will. 1901.

Tabanus flavifrons Szilady, 1926, Biol. Hung., I, pt. 7, p. 22, Pl. 4, fig. 12 (♂, ♀; Cuba).

?*Tabanus rufiventris* Macquart, 1838, Mem. Soc. Sci. Lille, pt. 2, p. 145 (♂; Cuba). Not *T. rufiventris* Fab. 1805, not *T. rufiventris* Macq. 1845.

Tabanus (Neotabanus) hookeri Bequaert, 1940, Rev. Ent., XI, 1-2, pp. 361-365, fig. 32. (Cuba, Jamaica, Puerto Rico, Hispaniola, Barbados, Venezuela, British Guiana, Colombia, Trinidad, Brazil, Paraguay and Argentina.)

Bequaert (l. c.) has given a thorough discussion, excellent figures, and complete synonymy of this species, which there seems no need to repeat here. The bare subcallus and broad frons will easily separate it from other members of the group. The complete absence of such a wide ranging species from Central America is very curious.

***Tabanus (Neotabanus) johannesesi* sp. nov.**

(Pl. I, fig. 6)

Female—Length 11 mm., of wing, 9 mm. Eyes bare under a hand lens, but showing sparse and very short pubescence under magnification of 32 diameters. Eyes (revived) green, the upper and lower margins purple, and with a complete median and incomplete upper purple band. Frons a little less than three times as high as wide, parallel sided, dark grey pollinose. Frontal callus black, nearly as wide as frons and wider than high. Subcallus, fronto-clypeus and genae pale grey pollinose, beard white. Palpi white, sparsely black haired. Antennae as figured, the basal segments pale yellowish, black haired, the third segment orange.

Mesonotum blackish, the vestiture black and grey, forming indistinct stripes. Scutellum black. Pleura and sternum dark grey, white haired. Coxae, all femora except extreme apices, all tarsi, and apical half of fore tibiae black. Basal half of fore tibiae white, other tibiae and apices of femora dirty yellowish. Wings entirely hyaline, stigma pale yellow.

Abdomen black above, with an even, slender, white mid-dorsal line from first to sixth tergites. Lateral stripes white, extending to sixth tergite, and formed of oblique oval patches which do not overlap. Venter black, sparsely white haired, especially on the posterior sternal margins.

Male—Eyes contiguous, pubescent, especially on the large facets. Facets but slightly differentiated in size, the larger occupying about half total eye area and poorly demarkated from the smaller. Coloration

essentially as in female, but tibiae rather brownish, including basal half of fore pair. Antennae more slender, but still unusually broad for a male of this group.

Holotype ♀, Villarica, Paraguay (F. Schade coll.). To be deposited in the M. C. Z., Harvard University, Cambridge, Mass. Allotype ♂, Severinia, São Paulo, Brasil, Dec., 1940 (A. G. Silva coll.). In the collection of the Instituto de Hygiene, São Paulo, Brasil. 1 ♀ Paratype, Agua Limpia, Brasil, March 27, 1925, in Coll. J. Bequaert.

I had at first considered this species to be *pungens* Wied., but the description of the latter states that the abdomen has the mid-stripe of broad triangular spots, and the wing veins and costal cell (Randmal) brownish. The species seems rather closely related to *hookeri* and *angustivitta* of this paper.

Tabanus (Neotabanus) angustivitta Kröber

(Pl. I, fig. 7)

Tabanus (Neotabanus) dorsiger var. *angustivitta* Kröber, 1929, Ann. Naturh. Mus. Wien, XLIII, p. 250, fig. 9. (♀; Taperinha, near Santarem, Brazil); 1933, Rev. Ent., III, 3, p. 352 (redescribed as new!); 1934, Rev. Ent., IV, 3, p. 293.

I have used Kröber's name for this species, as his description conforms the most closely to my material, but it is very probable that an earlier name for the species exists, though I have been unable to find one which entirely fits. *Pungens* Wied. 1828, is the oldest name, but Kröber, who had seen the type, places it in *Agelanius* in his catalogue (1934, p. 302). I have not seen the original description of *desertus* Walk., 1850, but the figure given by Bodkin and Cleare (1916, p. 186) certainly resembles the present form closely. Kröber did not recognize the species. Two of Bellardi's descriptions are close, but *subsimitis*, 1859, seems to have a bare subcallus and blackish femora, while *propinquus* 1859, is stated to have the vestiture yellowish. *Furunculus* Will., 1901, reads much like the present species also, but the description is not sufficiently detailed for certainty.

Distribution: In the Hine collection there is a male from Tabasco, Mexico, and a number of females from Morales and Panzos, Guatemala, labelled *sallei* Bell., and a single female (Georgetown, Brit. Guiana, Cleare coll.) labelled *comitans* Wied. I have also seen specimens from Venezuela (Caripito, July, 1937); Isla do Marajó, Pará, Brasil; and São Paulo, Brasil (Juquia, Oct. and Dec., J. Lane); Bahia, Brasil; Mendoza, Argentina; Restrepo, Colombia; Guayaquil, Ecuador; Villarica, Paraguay, and Lima, Peru.

Panama records: One of the more abundant species throughout the Republic. Moja Pollo, practically throughout the year, but less abundant in Sept. and Oct.; Darien (Dunn); El Valle, Coclé Prov., Dec., 1939; Mt. Hope, C. Z., Nov., 1939; also bred from larvae on several occasions.

***Tabanus dunnii* n. sp.**

(Pl. II, fig. 18)

Female—Length 13–14 mm., of wing, 11–12 mm. Eyes bare, the color pattern (revived) consisting of a pair of median green stripes, the upper of which is broad and invaded by a purple spur from the frontal margin. The background is purple. Frons dark grey pollinose, with a darker patch at vertex, and covered with moderately dense dark hairs, between $3\frac{1}{2}$ and 4 times as high as basal width, very slightly wider at vertex than at base. Basal callus somewhat higher than wide, rounded, oval, brown, about half the width of the frons, and produced above in a fine line about one-third the distance to the vertex. Subcallus yellowish grey pollinose. Antennae dirty yellowish brown, the first segment lighter, the annulate portion darker. First segment inflated, beset with black hairs which are densest on the dorsal projection. Second segment scale-like, the dorsal tooth moderate and beset with black hairs. Third segment with a prominent dorsal angle and bowed ventrally, the basal part considerably wider than the first segment, but not as wide as long. The length of the annulate portion is to that of the basal portion as 3 to 4. Clypeus and genae light grey pollinose, the former with sparse pale hairs, the latter with long white hairs. Palpi strongly inflated basally, slender apically, dusty grey and with numerous black hairs, about as long as antennae. Proboscis dark brown, a little longer than palpi, the labella about half the length of the proboscis.

Mesonotum dark grey, rather thickly clothed with black and pale silvery hairs. The silvery hairs form a narrow mid-dorsal stripe, two dorso-lateral stripes, and a rather wide lateral border to the mesonotum. Prescutal lobe reddish, with black hairs. Scutellum concolorous with mesonotum, dark haired on the disk, light haired around the margin. Pleura and sternum dark grey pollinose with rather abundant pale hairs.

Wings completely hyaline, the stigma very pale straw colored, all cells but the anal widely open, no appendix on 3rd vein. Femora and coxae dark greyish, mostly with pale hairs, tibiae dusky yellowish with dark hairs on the outer surfaces, pale hairs on the inner. Fore tibiae darker apically, and with pale hairs on the proximal third. Tarsi dirty brownish.

Abdomen uniformly dull black or somewhat reddish on the sides of the first two or three tergites, covered with dense short hairs of black and silvery color, the silvery hairs forming a prominent mid-dorsal contiguous row of triangular spots, a dorso-lateral series of oval or oblong non-contiguous, parallel sided spots on the first to fifth tergites on each side, and narrow lateral margins to tergites one to six. Beneath the abdomen is dark slate grey, sometimes pinkish on the first few sternites,

with narrow lighter hind margins and clothed with grey pollinosity and sparse pale hairs.

Holotype ♀ and 3 ♀ Paratypes from Miraflores, C. Z., Jan. 10, 1930, (L. H. Dunn collector). 1 ♀ Paratype from Ancon, C. Z., (L. H. Dunn collector). Holotype and 2 Paratypes to be deposited in the M. C. Z., Harvard University, Cambridge, Mass. 1 Paratype in the U. S. N. M.

This species is similar to *amplifrons* on the one hand, from which it differs in largely black legs and irregular stripes, and to *maya* on the other, from which it differs in wholly black color, prominently striped thorax, whitish vestiture, and by the lateral stripes not being at all oblique.

Tabanus (Neotabanus) lineola Fab.

Under this name I include an abundant, widespread and polymorphic species, which in various forms and under a multitude of names, appears to range from Canada to the Argentine Republic. Although I have examined a good many hundreds of specimens from Southern Brasil, Panama and the United States, and a smaller number of specimens from perhaps 30 additional localities, I have seen practically no material from Mexico, from the area lying between Bahia and the mouth of the Amazon, from Western South America south of Colombia, or from Uruguay and Argentina. The lack of Mexican material is especially unfortunate, as it is there that the Neotropical and Nearctic forms would be expected to meet. The present arrangement of the various forms is thus in no sense to be taken as final.

In regard to the use of the terms "form," "variety" and "subspecies," perhaps a word of explanation is necessary. I regard subspecies as populations which are geographically separated from other similar populations, and which show morphological differences from those populations, but which freely interbreed, or are assumed to be able to interbreed, with the formation of morphologically intermediate forms, where their ranges overlap. This is essentially the definition of Bates (1935), but while he uses the term "Choromorph" as being more precise, "subspecies" seems now well established in many branches of zoology for this taxonomic concept. It follows from the above that two subspecies of the same species cannot occupy the same geographic area in toto. There may, of course,

be a fairly wide band of territory where their ranges overlap, or the barriers which kept them separate may have been removed sufficiently recently so that interbreeding has not had time to erase their morphological differences, but such cases must form a rather rare exception. For the morphologically distinct forms found occupying the same area, the choice must be made between considering the form a full species, or a "variety." I regard a variety as a morphologically distinct form found occupying the same range as the species, and showing all degrees of intermediacy with it.

In dealing with the present complex, many difficulties have arisen in applying these two definitions to specific cases. Lack of material from critical areas has made it difficult to define the ranges of the various forms, and forms which seem worthy of specific rank in one area, intergrade completely in another. For these reasons, I have concluded that it is best to treat all the forms as varieties for the present. Although a variety has no nomenclatorial standing, most of the names used here were proposed as specific names, and hence are available should later revision necessitate their return to subspecific or specific rank.

The problem of assigning a name to a given specimen of this group, especially a female, is exceedingly difficult, as the various varieties often intergrade completely, while some varieties are difficult to distinguish from closely allied species. The species as a whole may be characterized as follows:

Eyes bare in both sexes, those of the male with the two types of facets very little or very greatly differentiated in size. Frons from four to seven times as high as wide, nearly always widest at vertex, sometimes widest in the middle. Frontal callus square, rounded, or somewhat higher than wide, yellow to black. Coloration exceedingly variable, ranging from pale yellowish brown to nearly black. Vestiture of the thorax yellow, grey, unicolorous or obscurely striped, often with iridescent scale-like hairs. Legs variable, wholly yellow to nearly all black, but the fore tibiae always bicolored. Abdomen always three-striped, but the lateral stripes sometimes faint or reduced. Stripes white or yellow, broad or narrow, even or irregular.

The various varieties may be separated by the aid of the following keys, except that there will always be a residuum of specimens of intermediate character.

KEY TO MALES

1. Enlarged facets of eye very much larger than small facets, and occupying at least $\frac{2}{3}$ of eye area, the line of demarkation between the two types very abrupt. 2
- Enlarged facets of eye at most only two or three times as large as small facets, and occupying only about $\frac{1}{2}$ eye area, the line of demarkation between the two types not very clearly defined. 3
2. Fore coxae and mid and hind femora wholly yellow. Thorax yellowish brown pollinose, yellowish haired, unstriped. Scutellum, at least apex, yellowish red. Abdomen yellowish brown; no dark on first or second tergites. Median stripe broad, parallel sided, yellow haired. Lateral stripes narrow, obsolescent, yellow haired. Between the stripes the vestiture is orange brown, with a few black hairs on the terminal segments. Venter immaculate, yellow. var. **carneus**
- Fore coxae and bases of mid and hind femora at least $\frac{1}{5}$ blackish. Thorax grey pollinose, whitish haired, rather faintly dark striped. Scutellum dark. Abdomen yellowish to brown, with a more or less well defined blackish patch beneath the scutellum and on the middle of the second tergite. Median stripe broad, parallel sided, white haired. Lateral stripes well defined, either parallel sided or slightly irregular, white or creamy haired. The abdomen is mostly black haired between the stripes. Venter pale yellowish or brownish, with occasionally a dark median patch or patches on the anterior sternites, and the terminal sternite black. var. **lineola**
3. Fore coxae and at least basal third of mid and hind femora black. 4
- Fore coxae yellowish, the mid and hind femora at most slightly dusky at base. 5
4. Thorax blackish, brown to yellowish pollinose, and with an unusual number of iridescent scale-like hairs mixed with the vestiture. Abdomen yellowish brown, the rather prominent, parallel sided stripes rich yellow haired, the intervals between them black haired. First and second sternites with a prominent black median patch, and terminal sternites black, otherwise venter clear yellow. Wings markedly smoky. var. **stenocephalus**
- As above, but whole insect darker, nearly black, the abdominal stripes pure white to somewhat creamy, the legs extensively black, the venter with a broad mid-ventral black band. var. **plangens**
5. Median abdominal stripe very narrow. Abdomen brownish, with a black spot on first two tergites. Lateral stripes faint, broken up into spots. Stripes yellowish white haired, intervals blackish. Thorax blackish or dark grey, rather prominently striped. Scutellum reddish. Venter pale, with a more or less distinct dark patch on first two sternites. var. **scutellaris**
- Median abdominal stripe rather broad; lateral stripes prominent, continuous. Abdomen all yellow, light brown haired, the stripes pale yellow haired. Thorax grey, with yellowish grey tomentum and hairs, unstriped. Scutellum concolorous or slightly lighter than thorax. Venter pale, with or without a small dark spot at base. var. **ochrophilus**

KEY TO FEMALES

1. Fore coxae and mid and hind femora pale or yellowish, never more than a slight infuscation at base. Scutellum reddish, yellowish or concolorous with mesonotum. 2
- Fore coxae and mid and hind femora at least $\frac{1}{5}$ black at base. Scutellum always concolorous with mesonotum. 3
2. Wings always hyaline. Ground color pale brown to black. Frons rather broad, with a large square basal callus, and generally rather large oval median callus. Mesonotum obscurely striped. Scutellum reddish apically. Median abdominal stripe white, generally somewhat irregular. Lateral stripes often creamy, usually irregular and step-like. var. **scutellaris**

- Wings often smoky, or the veins brown margined. Ground color yellow to brown. Frons rather narrow, convergent, the basal callus small, rounded, the median callus slender or absent. Mesonotum unstriped. Scutellum concolorous with mesonotum, or reddish or yellowish, wholly or in part. Median stripe yellow or white, generally quite broad and even. Lateral stripes variable. var. *carneus*; var. *ochrophilus*
3. Wings always entirely hyaline. Body color pale brown to black, the stripes white, greyish, or creamy, often irregular. Frons rather narrow to broad, convergent. var. *lineola*
- Wings always somewhat smoky, the veins generally narrowly brown margined. 4
4. Whole insect black or predominantly blackish, the lighter pollinosity mostly greyish. Legs extensively blackish. Stripes white or greyish. var. *plangens*
- Whole insect predominantly yellow, the lighter pollinosity yellowish. Legs extensively yellow. Stripes rich yellow, the intervals black haired. var. *stenocephalus*

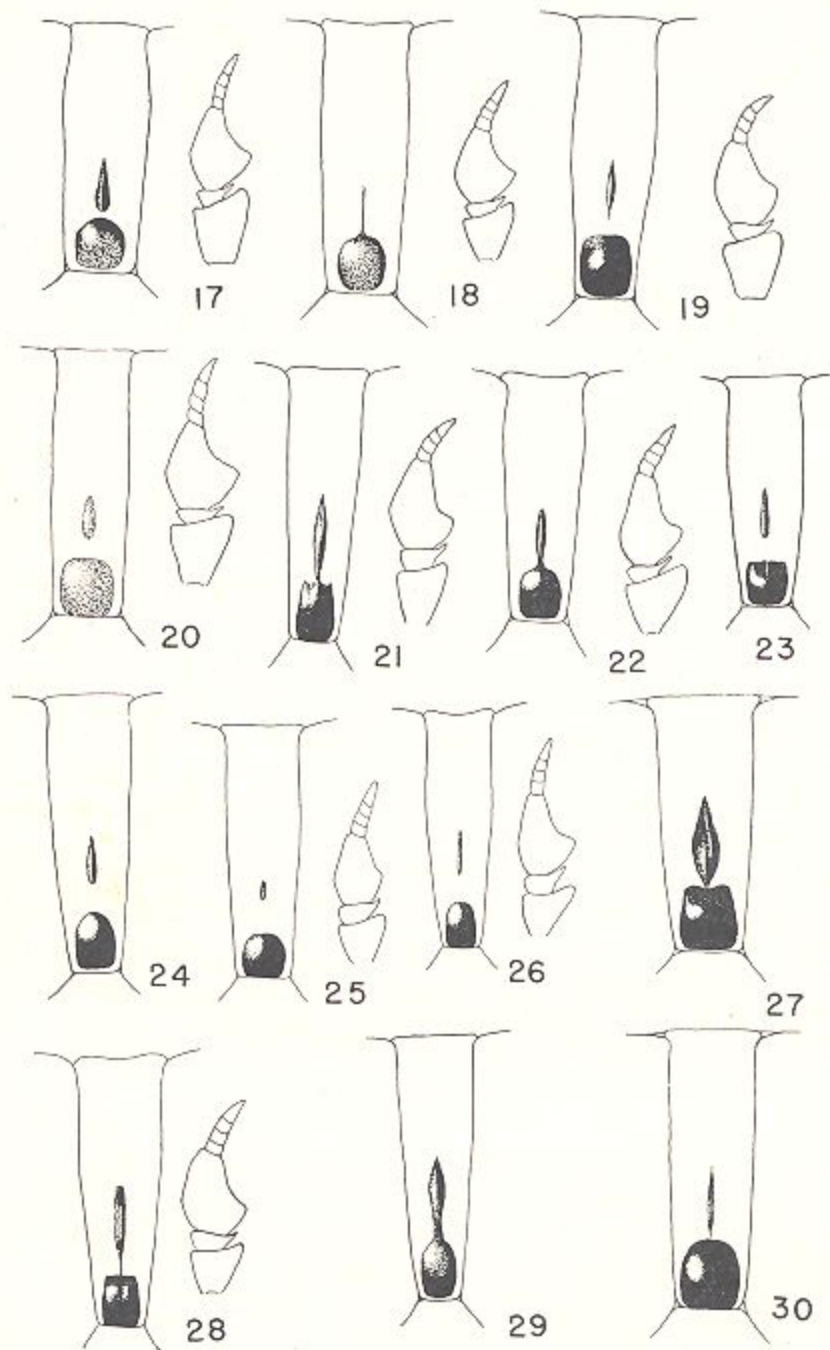
In regard to the names used for the various varieties, I have endeavored to list under each variety the names which seem definitely to refer to that form. Names preceded by a query, I consider probably to refer to the form in question. By using *lineola* Fab. 1794 for the whole complex and treating the various forms as varieties, all other names except *occidentalis* Linn. 1767, which may have been used for a member of this complex, become synonyms; and since varieties have no nomenclatorial standing, I have felt free to choose names on the basis of the availability of types or completeness of description, without regard to priority. In regard to *occidentalis* Linn. considerable confusion seems to exist. The original description is quite inadequate. Kröber (1933, p. 359) refers to a male in the Vienna Museum as type, with a query. This was probably one of the specimens used by Wiedemann, as it bears a label in his handwriting, according to Kröber. It may or may not have been the same as Linnaeus' species, but was almost certainly not his type. In the Hine collection there is a female from

EXPLANATION OF FIGURES

(Also see page 158)

PLATE II

Fig. 17. *T. (N.) amplifrons* Kröb. Panama. Fig. 18. *T. (N.) dunnii* sp. nov. Holotype. Fig. 19. *T. (N.) maya* Beq. Panama. Fig. 20. *T. (N.) triangulum* Wied. São Paulo, Brasil. Fig. 21. *T. (N.) lineola* var. *carneus* Bell. Moja Pollo, Panama. Fig. 22. *T. (N.) lineola* var. *carneus* Bell. Matto Grosso, Brasil. Fig. 23. *T. (N.) lineola* var. *carneus* Bell. Mt. Hope, C. Z., Panama. Fig. 24. *T. (N.) lineola* var. *carneus* Bell. Mt. Hope, C. Z., Panama. Fig. 25. *T. (N.) lineola* var. *carneus* Bell. (grey form). Moja Pollo, Panama. Fig. 26. *T. (N.) lineola* var. *stenocephalus* Hine. Moja Pollo, Panama. Fig. 27. *T. (N.) lineola* var. *scutellaris* Wlk. Wyoming, U. S. A. Fig. 28. *T. (N.) lineola* Fab., typical form. Arkansas, U. S. A. Fig. 29. *T. (N.) lineola* Fab., typical form. Rochester, N. Y., U. S. A. Fig. 30. *T. (N.) lineola* Fab., gulf coast form. Munroe Co., Florida, U. S. A.



South America bearing a label, "occidentalis? comp. at B. M." and a yellow "Comp. with type" label, which is the same as *carneus* or *ochrophilus* of the present paper. The *occidentalis* of Wiedemann (1828) and Kröber, who followed him, seems definitely to have been *stenocephalus* of the present paper. Kröber placed *stenocephalus* Hine as a "species dubia." If Hine's specimen was really conspecific with the specimen he saw at the British Museum, and the latter was really Linnæus' type, then *occidentalis* becomes the correct name for the species. However, *lineola* is now well established in the literature, and Fabricius' type, or what remains of it, has been examined by recent students, so there seems to be no useful purpose served by reverting to the older name.

***Tabanus (Neotabanus) lineola* Fabricius, typical form**

(Pl. II, figs. 28, 29, 30)

Tabanus lineola Fabricius, 1794, Ent. Syst., V, 4, p. 369. (♀; America Boreali.)
Stone, 1938, U. S. Dept. Agric. Misc. Publ. No. 305, p. 122, fig. 57A. (♂, ♀;
Maine to Florida, Westward to Texas.)

This and the following variety will be discussed in a forthcoming paper by Dr. C. B. Philip, to whom I owe the loan of much valuable material and innumerable helpful suggestions and criticisms. I am not in a position to allocate the various references to "lineola" to their proper varieties, and will leave that to Dr. Philip. This variety appears to range over most of Eastern North America as far west as eastern Texas. Specimens from the Gulf coast of Louisiana have the stripes exceedingly broad and pale, and the frons as broad as in *scutellaris*, but are connected by a series of intergrades to the typical form. This local variant is what Hine called *T. quinquevittatus* Wied. (1906, Ohio Naturalist, VII, p. 26).

***Tabanus (Neotabanus) lineola* var. *scutellaris* Walker**

(Pl. II, fig. 27)

Tabanus scutellaris Walker 1850, Insect. Saunders., Dipt., V, 1, p. 27. (♀; Bolton,
North America.)

Tabanus lineola var. *scutellaris* Stone, 1938, U. S. Dept. Agric. Misc. Publ. No. 305,
p. 123. (British Columbia to Massachusetts, south to Arizona and Georgia.)

This form occurs with the typical form throughout most of its range, but replaces it almost entirely in the western part of North America. The typical form is said to be more common along the coast, the present form dominant inland. Specimens from the southwest are very pale, with broad stripes, but this appears to be but a variant perhaps due to environmental factors.

Tabanus (Neotabanus) lineola var. carneus

(Pl. II, figs. 21-25)

- Tabanus carneus* Bellardi, 1859, Ditt. Mess., I, p. 62. Hine, 1906, Ohio Naturalist, VII, 2, pp. 21, 23; 1925, Occ. Pap. Mus. Zool., Univ. Michigan, No. 162, p. 53. Kröber, 1933, Rev. Ent., III, 3, pp. 340, 341, 355; 1934, Op. cit., IV, 3, p. 292. Bequaert, 1940, Bull. Ent. Res., XXX, pt. 4, pp. 451, 453.
- Tabanus appendiculatus* Hine, 1906, Ohio Naturalist, VII, 2, p. 22. Bequaert, 1926, Med. Rep. Harvard Exp. Amazons, Pt. II, p. 227. Kröber, 1933, Rev. Ent., III, 3, p. 357.
- Tabanus (Neotabanus) carneus var. appendiculatus* Kröber, 1934, Rev. Ent., IV, 3, p. 292.
- Tabanus trilineatus* Bequaert, 1926, Med. Rep. Harvard Exped. Amazons, Pt. II, pp. 227, 228. Hine, 1906, Ohio Naturalist, VII, 2, pp. 21, 27.
- Tabanus truquii* Kröber (nec. Bell., nec. Hine, nec. Stone), 1929, Ann. Naturhist. Mus., Wein, XLIII, p. 248 (the white striped variety).
- ?*Tabanus fur* Williston, 1901, Biol. Cent. Amer., Dipt., I, Suppl., p. 261. (nec. *T. fur* Will., 1887.)
- ?*Atylotus eutaeniatus* Bigot, 1892, Mem. Soc. Zool. France, V, p. 664 (♂; Brasil). Kröber, 1933, Rev. Ent., III, 3, p. 357. (Type seen, no other specimens.)
- ?*Tabanus dorsovittatus* Macq., 1855, Dipt. Exot., Suppl. V, p. 30 (♀; South America). Kröber, 1933, Rev. Ent., III, 3, p. 356. (Type seen.)
- ?*Tabanus (Neotabanus) dorsiger var. pallidifemorata* Kröber, 1929, Ann. Naturhist. Mus. Wein, XLIII, p. 249 (♂, ♀; Amazonas); 1933, Rev. Ent., III, 3, p. 352 (Amazonas, Peru, Honduras, Canal Zone).
- ?*Tabanus conseqna* Walker, 1850, Newm. Zool., VIII, Appendix, p. 121; 1854, List. Dipt. Brit. Mus., V, p. 213. Kröber, 1933, Rev. Ent., III, 3, p. 353 (♀; Brasil. Type seen.)

The color of the thorax varies from strongly yellowish brown to pale steel grey, and of the abdomen from honey yellow to nearly black. The abdominal stripes may be yellow or practically white. The size is also quite variable, some specimens being less than 9 mm. long while extra large examples may reach 15 mm. Kröber's (1933) description of his *dorsiger var. pallidifemorata* may have been based, at least in part, on such small specimens.

I have examined Hine's types of *appendiculatus* in Columbus, Ohio, which consist of 7 ♀ from various localities in Guatemala, and 1 ♂ from Belize, Br. Honduras. They seem to represent a darker segregate with rather whitish stripes. There are also specimens of the variety here called *carneus*, labelled as *subsenex* Walk., *trilineatus* Latr., and *eutaeniatus* Bigot by Hine. *Tabanus truquii* Kröber, 1929, seems also to have been based on the whitish striped form of this variety. *T. fur* Williston may or may not be the same, the striped thorax would suggest some other species. Hine (1925, p. 33) suggested the synonymy, and at any rate there is an earlier *T. fur.* of Williston.

Distribution: I have seen specimens from Guatemala, British Honduras, Panama, Colombia, Venezuela, Surinam, Trinidad, Peru, Paraguay and the states of Pará, Bahia, Goyaz, Rio de Janeiro, São Paulo and Matto Grosso in Brasil. The

variety was described from Mexico, and Kröber reports it also from Costa Rica and Ecuador.

Panama records: The form is abundant throughout the Republic, flying at all seasons of the year. At one locality, Moja Pollo on the Chagres River above Gamboa, where collections on horse bait have been made every two weeks for the past year, over 5600 specimens have been taken, about 49% of all *Tabanidae* collected at this station.

***Tabanus (Neotabanus) lineola* var. *plangens* (Walker)**

Tabanus plangens Walker, 1854, List. Dipt. Brit. Mus., V, p. 199. Kröber, 1933, Rev. Ent., III, 3, p. 347.

?*Tabanus modestus* Wiedemann, 1828, Auss. Zweifl. Insect., I, p. 146. Hine, 1906, Ohio Naturalist, VII, 2, pp. 22, 25.

I have seen no males of this form, but from Kröber's description I gather that the eye is like *stenocephalus*. The frons and antennae of the female are also as in *stenocephalus*. In Central America it seems to be rather uncommon, but in Southern Brazil it is quite abundant. There is also what I consider to be a dark form of *triangulum* in Southern Brazil, and the two are very close in appearance. *Plangens* may be distinguished by the callus being oblong, or higher than wide, and the lateral abdominal stripes being parallel sided or slightly irregular, while in *triangulum* the callus is rounded or square, and the lateral stripes a series of markedly oblique spots.

The description of *T. modestus* Wiedemann fits the present form quite well, and the synonymy has been often suggested. Kröber (1933), however, says that the types are apparently lost. He compared material with Walker's type of *plangens*. What Lutz (1928, Pl. 9, fig. 12) calls *modestus* looks more like the dark form of *triangulum* to me. In the Hine collection there is a female from São Paulo, Brazil, det. Lutz, which is labelled *modestus*, and this agrees with what I call *plangens*. Also in the Hine collection are 2 females, both labelled "plangens Wlk." and "comp. with type." One of these (Pto. Cortez, Honduras II-23-06) is *carneus* Bell. of the present paper, the other (Atrato Valley, Colombia) agrees with the present interpretation of *plangens* Wlk. Bequaert (1926) recognized both names as applying to distinct species. His *modestus* seems to fit the present species best.

Distribution: I have seen material from Honduras, Panama, Colombia and the Brazilian states of Bahia, Goyaz, Rio de Janeiro, São Paulo, Paraná and Matto Grosso. Kröber records

it in addition from Costa Rica, Peru, Paraguay, and Bequaert from Amazonas and Pará. Walker's type was from Pará.

Panama records: Darien (Dunn); Juan Mina Station, Rio Chagres, Jan. 3, 1939; El Valle, Coclé Prov., Dec. 17, 1939, June 30, 1940; Fort Randolph, C. Z., Jan. 23, 1929 (Curran); Rio Pequeni Police Sta., May 11, 1940.

Tabanus (Neotabanus) lineola var. stenocephalus (Hine)

(Pl. II, fig. 26)

Tabanus stenocephalus Hine, 1906, Ohio Naturalist, VII, 2, p. 27. (♂, ♀; Puerto Barrios, Morales, and Panzos, Guatemala.)

I have examined the types of this form in the Hine collection at Columbus, Ohio. They consist of 4 ♀ and 2 ♂ Cotypes, so labelled, and 2 ♀, 4 ♂ additional specimens, probably also types, all from various localities in Guatemala, taken in 1905. Kröber's *occidentalis* (1933) probably includes this variety, as he mentions specimens from Yucatan and Costa Rica. In Central America this form is quite distinct, and I have seen no specimens showing intergrades to *carneus*, but in Southern Brazil the situation is very different. There both small and large faceted males occur, and the females show every intergrade between those with entirely light coxae and femora, and those with dark coxae and the femora dark at base. The small faceted males before me, from Brazil (São Paulo), have the fore coxae dark, the femora $\frac{1}{2}$ black at base and a dark patch on the first 2 sternites, while of 5 large faceted males, 2 have the coxae and femora entirely yellow, 2 have the femora slightly dusky at base, and 1 has the femora extensively dark. All have a blackish spot on the first and second sternites. The large faceted, dark legged males agree well with *eutaeniatus* Big.

Distribution: I have seen specimens from Guatemala, British Honduras and Panama. Kröber (1933) records it (as *occidentalis*) from Yucatan and Costa Rica.

Panama records: Moja Pollo, Chagres River region, March to January (probably throughout the year); El Real, Darien, Feb. 7, 1940, and Aug. 15, 1930 (Dunn); Ft. Randolph, C. Z. Feb. 11, 1930 (Dunn).

Tabanus (Neotabanus) lineola var. ochrophilus (Ad. Lutz)

Neotabanus ochrophilus Lutz, 1914, Mem. Inst. Osw. Cruz, VI, 1, p. 49; 1928, Est. Zool. Parasit. Venezolanas, p. 56, Pl. IX, fig. 10.

This variety is only distinguishable in the male sex, being a pale legged form with small faceted eyes. As noted under

stenocephalus, the four tropical American forms all occur in Southern Brazil, and seem there to intergrade perfectly with one another. My identification of the male is based on a specimen from Manguinhos, Rio de Janeiro, det. Lutz, in the Hine collection. The female of the pair, same data, is indistinguishable from *carneus*. I have also a male from Petropolis, Rio de Janeiro, which agrees, except that the hind femora are slightly dusky at base. Lutz' figure (1928) is poor, and probably misled Bequaert (1940), Bull. Ent. Res., XXX, 4, pp. 451, 452). It might be best to drop the name altogether, but I prefer to retain it until the relationships of the South American forms can be better worked out.

Distribution: I have seen males only from Southern Brazil (States of Rio de Janeiro and São Paulo).

***Tabanus (Neotabanus) maya* J. Bequaert**

(Pl. II, fig. 19)

Tabanus maya J. Bequaert, 1932, Jour. New York Ent. Soc., XXXIX, (1931), p. 546, fig. 2 (♀; Chichen Itza, Yucatan, Mexico).

Tabanus (Tabanus) maya Kröber, 1934, Rev. Ent., IV, 3, p. 311. (No material seen.)

Material in the Hine collection from localities in Mexico and Guatemala is labelled *subsimilis* Bell., and the description fits fairly well, except for the phrases "ad radican antennarum subcastanea" which would seem to indicate a bare subcallus, and "scutello ad basim cinerascete, ad marginem carneo" which is not true of the present species.

A male specimen before me from Pacora, R. de P., March 26, 1939, (Allotype), is easily associated with the female on color characters. The abdomen is largely yellowish, the lateral stripes not so pronounced as in the female, and there is a prominent black triangular spot on the first two tergites. Eye holoptic, bare, the large facets not much larger than the small, and not sharply demarkated from them.

Distribution: Southern Mexico to Panama.

Panama records: Juan Mina and Moja Pollo, Chagres River region, December to July, most abundant from April to June; Miraflores, C. Z., Jan., 1930 (Dunn). Apparently rather local.

***Tabanus (Neotabanus) triangulum* Wied.**

(Pl. II, fig. 20)

Tabanus triangulum Wied., 1828, Auss. Zweifl. Ins., I, p. 143 (♀; Brasil).

Tabanus (Neotabanus) lineola Kröber, 1933, Rev. Ent., III, 3, p. 344 (nec. *T. lineola* Fab., 1794).

?*Tabanus (Neotabanus) uruguayensis* Kröber, 1933, Rev. Ent., III, 3, p. 346 (nec. *T. uruguayensis* Arribalzaga, 1882).

?*Tabanus (Neotabanus) uruguayanus* Kröber, 1934, Rev. Ent., IV, 3, p. 294.

Wiedemann's description fits the present species, especially since he states his specimen was much rubbed, which would bring into prominence the black triangular mark on the first two abdominal tergites. Kröber (1933, p. 361) was unable to locate the type, and did not recognize the species. Lutz used the name a number of times in lists, but with no descriptions, and I have not seen this species determined by him. I have, however, a specimen determined by Dr. Oliveria Castro, who collaborated with Lutz, and had access to his collection, so that it is probable that his references were to the present species.

Kröber's descriptions of *lineola* and *uruguayanus* apply almost equally well to my material, except that *uruguayanus* is said to have the mid-dorsal stripe of a series of triangles. This is true of a few of my specimens, but they differ in no other way from those with a uniform mid-dorsal stripe. Both the color of the abdomen and the width of the abdominal stripes are very variable, very narrow to quite broad. The lateral stripes show a tendency to be markedly step-like, but in some specimens they are nearly parallel sided.

Distribution: I have seen material from the Brazilian states of Goyaz, Rio de Janeiro, São Paulo, Paraná and Matto Grosso, and from Paraguay. Kröber lists Uruguay, Peru, Bolivia and Argentina in addition.

Tabanus (Neotabanus) strigimaculus sp. nov.

(Pl. I, fig. 5)

Female—Length 18 mm., of wing, 14 mm.

Frons and antennae as figured. Frons yellowish grey pollinose, callus dark brown, nearly black. Face and cheeks grey, beard sparse, white. Palpi yellowish, mostly black haired. Eyes bare, dark purplish with three narrow green bands, one below and two above the middle. Mesonotum chocolate brown, grey pollinose and with dark and light hairs forming indistinct stripes. Scutellum concolorous. Pleura grey pollinose and white haired. Legs reddish brown, the coxae and all posterior legs largely white haired, the fore femora, apical half of fore tibiae and all tarsi blackish and black haired. Base of fore tibiae white and white haired. Wings hyaline, the veins all blackish, faintly brown margined. Fork of third vein with a short appendix. Abdomen chocolate brown, with a continuous white haired mid-dorsal stripe of medium width, (.75 mm.) on segments one to six. Dorso lateral stripes formed of a series of more or less oblong, unconnected white haired patches which are not oblique, and which extend from tergites two to five inclusive. The dorsum of the abdomen is otherwise black haired. Sternites and extreme sides of tergites pale chocolate, white pollinose and white haired.

Holotype ♀ Vera Cruz, São Paulo, Brasil (A. Ramalho coll.). To be deposited in the collection of the Instituto de Hygiene, São Paulo, Brasil.

This species is the largest *Neotabanus* known to me, with the possible exception of *T. attenuatus* Wlk., which is described as a yellowish species with a quite different eye pattern.

Tabanus (Neotabanus) amplifrons Kröber

(Pl. II, fig. 17)

1933, *Rev. Ent.*, III, 3, p. 354 (♀; Venezuela); 1934, *Op. cit.*, IV, 3, p. 292.

?*Tabanus truquii* Bellardi, 1859, *Ditt. Mess. Pt. 1*, pp. 64-65 (♂; Mexico).

Tabanus truquii Hine, 1906, *Ohio Naturalist*, VII, 2, pp. 22, 28 (♂, ♀; Guatamala).

Tabanus trilineatus Bequaert, 1940, *Bull. Ent. Res.*, XXX, pt. 4, pp. 450, 452 (Trinidad). ? Not *T. trilineatus* Latreille, 1811.

The earliest name for this species seems quite impossible to determine at present, but a brief resumé of opinions will perhaps serve to explain the conclusions expressed in the present paper. Bellardi's description agrees very well, but it is impossible to tell from it whether the large eye facets were much or only slightly larger than the small facets, so that I prefer for the present, following the suggestions of Drs. C. B. Philip and Alan Stone, to leave the name in abeyance. Bequaert stated that Major E. E. Austen had identified the species as *trilineatus* Latr. Through the kindness of Dr. C. B. Philip, I have been provided with a copy of Latreille's (1811) description. As was to be expected, it might fit almost any trivittate species. The description of the head is, however, very peculiar. "Les yeux sont d'un brun noirâtre, et séparés dans toute leur longueur, ce qui me fait presumer que l'individu que je decris est une femelle; l'intervalle compris entre eux est uni, et offre en devant une petite éminence d'un brun luisant portant les yeux lisses." Wiedemann (*Auss. Zweifl. Insekt.*, I, p. 169, 1828) also was unable to identify the species, and called attention to the peculiar description of the head. It is possible that *trilineatus* was one of the *callosus* group, but it would be difficult to tell which. Kröber places *trilineatus* Latr. as a synonym of *lineola* Fab., though, as will be shown later, his *lineola* is not the same as the *lineola* of North American authors. In 1929 (*Ann. Nat. Mus. Wien*, XLIII, p. 248) Kröber describes under *truquii* Bell. a dark, greyish white striped form from the Amazon, which is not the same as his later *amplifrons*, but appears to be a greyish form of *carneus* close to what Hine called *appendiculatus*, at least in part. Later (1933, 1934) he placed Bellardi's name as a probable synonym of *occidentalis* Linn. In the Hine collection,

specimens of the present species are labelled *dorsiger* Wied., while specimens labelled *trilineatus* "comp. with type" are what I here call *carneus*.

The species seems to be relatively uniform throughout its range. The frons is relatively wide, and parallel sided. The callus nearly square, yellow to brown, and the whole insect of a definitely grey tone, greyer than any of the other species familiar to me. The abdominal stripes are for the most part chalky white, but when underlain by a more than usually reddish ground, assume a pinkish tone. The wings are always completely hyaline, the stigma pale yellow and very slender. The hind femora of all females I have seen are entirely pale, those of the male always extensively blackish at base. The female venter always bears a large median dark patch on the first and second sternites, and often a complete broad black mid-ventral stripe or band. The eyes of the male have the facets very little differentiated, the larger merging imperceptibly into the smaller. The eyes are also densely pubescent, the pubescence thickest and longest on the larger facets, becoming sparse, short and barely visible on the smaller facets.

The species may be distinguished from the forms of *vittiger* by its greyer color, narrower frons, black scutellum and pure white stripes, as well as the male eye characters. From *lineola* and its forms the yellow callus, pale femora, grey color, black ventral patch, and glass clear wings should serve to separate it, as none of those forms has all these characters.

Distribution: I have seen material from Trinidad, Venezuela, Amazonas, Colombia, Panama, Guatemala and Texas.

Panama records: Ancon, C. Z. (Dunn); Miraflores, C. Z., Jan. 10, 1930 (Dunn); Panama City, May 16, 1930 (Dunn); Moja Pollo, Chagres River region, Feb., April, May, June, July and September, 1940.

Tabanus (Neotabanus) vittiger Thomson

(Pl. I, figs. 15, 16)

- Tabanus vittiger* Thomson, 1868, Svensk Freg. Eugenies Resa, Vet. Iakttag., 2, Zool., Pt. 1, Insekter, Heft 12, p. 451. Coquillett, 1901, Proc. Wash. Acad. Sci., III, p. 373. Johnson, 1924, Zoologica, V, p. 87. Curran, 1932, Norwegian Zool. Exped. Galapagos, Medd. Zoologiske Mus., Oslo, No. 30, p. 349; 1934, Proc. Cal Acad. Sci., Ser. 4, XXI, 13, pp. 150-151. Bequaert, 1933, Proc. California Acad. Sci., (4) 21, p. 136. (Galapagos Is.)
- Tabanus guatemalanus* Hine, 1906, Ohio Naturalist, VII, 2, p. 24. Kröber, 1933, Rev. Ent., III, 3, p. 358; 1934, Op. cit., IV, 3, p. 293.
- Tabanus truquii* Bequaert (nec. Bell.), 1940, Rev. Ent., XI, 1-2, pp. 352-357, fig. 30. Stone, 1938, U. S. Dept. Agric. Misc. Publ. No. 305, p. 123.
- Tabanus appendiculatus* Bequaert, 1940, Bull. Ent. Res., XXX, Pt. 4, pp. 451, 453 (♂ only, the ♀ is either *carneus* or *ochrophilus*).

I have seen Hine's types in Columbus, Ohio. They consist of 3 ♂ and 3 ♀ from San José, Guatemala, Feb. 5, 1905, and an additional female, not labelled as type, but with the same data. There is also a male from Mazatlan, Mexico. In addition to these, I have material from Panama and Trinidad which I have compared with the types. I believe also that *truquii* Stone, 1938, and *truquii* Bequaert, 1940, as well as *vittiger* Thomson, 1868, and an unnamed variety recently sent to me by Dr. Philip from the Southwestern United States are but varieties, subspecies or local races of the same thing. All, with the exception of *vittiger*, whose male is apparently unknown, have the male eye differentiated into large and small facets, the large facets very much larger than the small, and bearing rather dense and long pubescence. The females vary much in color, but seem always to have a relatively broad frons. While it may seem unwise to base the differentiation of this group almost wholly on the structure of the male eye, I have been unable to find any other character which seems to be anything like as consistent. The determination of female specimens is very much like trying to name the species of *Culex* from females alone, but the following key may be of some assistance in separating the various forms. These forms, incidentally, are probably what I consider true subspecies, i. e., geographical races, as from the limited material at hand, no two of them appear to occur in the same area.

KEY TO FORMS OF VITTIGER

1. Mid and hind femora dark or dusky at base. Coloration essentially black and white, with little brown or yellow. 2
Mid and hind femora wholly pale. Coloration often yellowish or brownish. 3
2. Mid abdominal stripe rather broad and white. Frontal callus brown, (Galapagos) *vittiger*
Mid abdominal stripe rather narrow. Frontal callus black, (truquii Stone, 1938) (Southeastern U. S.) *subsp. A*³
3. Coloration essentially black and white, the thorax grey, the abdominal stripes white or pale grey, (truquii Bequaert, 1940) (Puerto Rico and Cayman Is.) *subsp. caymanicus*
Coloration essentially yellowish and brown. Thorax yellowish grey, abdominal stripes yellow. 4
4. Coloration pale, washed out, vestiture mostly whitish, (Southwestern U. S.) *subsp. B*³
Coloration yellowish brown, darker, vestiture yellowish to brown, (Trinidad to Mexico) *subsp. guatemalanus*

The different forms, except *vittiger*, fly in company with various forms of *lineola*, and must be distinguished from them.

³Subspecies A will appear in the 1942 Psyche, described by Philip as *schwardti*. Subspecies B will appear in the same article by Philip as *nippontucki*. The above elements of the key which concern these forms and any descriptive item in the above text are by C. B. Philip. The two subspecies are thus described by Philip whether they appear first in Psyche, 1942, or whether the above descriptive references appear first in these Annals.—G. B. F.

Thus "*truquii*" Stone may be distinguished from *lineola* by the reddish scutellum and from *scutellaris* by the basal infuscation of the hind femora. Var. B., which I know only in the male, must be extremely difficult to separate in the female from pallid forms of *scutellaris*, since the femora are said to be pale. "*Truquii*" Bequaert and *guatemalanus* are separable from the *lineola* forms found with them by the much wider frons. *Vittiger* is apparently the only Tabanid found in the Galapagos.

Some explanation is perhaps necessary for the use of the name *vittiger*, since it is not known in the male; and the species as a whole is distinguished mainly on the condition of the male eye. Females of *vittiger* are, however, so like *guatemalanus* and *caymanicus* in structure, and are not closely approached by any other neotropical forms, that it seems highly probable that they belong here.

The West Indian form treated by Dr. Bequaert (1940) as *T. (Neotabanus) truquii*, is, I believe, a distinct race, for which the subspecific name, *caymanicus*, is here proposed. I have seen the following material in his collection. 1 ♂, 4 ♀, Cayman Is., April 17–August 26, 1938 (C. B. Lewis and G. H. Thompson). 1 ♀, Sta. Tomas, P. de Zapata, Cuba, May 5–9, 1927 (Bruner and Acuña). Since Bequaert has fully described and figured the form (l. c.), it is only necessary to point out a few characters in which it differs from other forms. The whole insect is rather dull and greyish, the mid abdominal stripe rather irregular, in some cases formed of truncate triangles. Lateral stripes quite irregular, almost step-like. Both stripes are greyish and not very well defined. The frons and callus are just like *guatemalanus*, but the callus brown rather than yellow. The male and a female from the Cayman Island lot are selected as Allotype and Holotype.

The two⁴ North American varieties will be treated by Dr. C. B. Philip in a forthcoming paper, and I am much indebted to him for allowing me to examine his material.

In Panama, only *guatemalanus* occurs, where it seems to be confined to the drier areas along the Pacific coast, and appears to be rather uncommon.

Panama records: Miraflores, C. Z., Jan. 10, 1930 (Dunn); Balboa, C. Z., Dec. 7, 1929 (Dunn); Chepo, Jan., 1930 (Dunn); Old Panama (Dunn); El Real, Darien Prov., July 15, 1930

⁴See footnote No. 3, p. 180, this article.

(Dunn); West side Ferry landing, opposite Balboa, C. Z., May 7, 1940.

REFERENCES

- Bates, Marston. 1935. The Butterflies of Cuba. *Bull. Mus. Comp. Zool.*, LXXVIII, 2, pp. 63-258.
- Bellardi, Luigi. 1859. Saggio di Ditterologia Messicana. Part 1, pp. 1-80, Pls. I-II, Turin.
- Bequaert, J. 1924. Notes upon Surcouf's Treatment of the Tabanidae in the Genera Insectorum and upon Enderlein's Proposed New Classification of This Family. *Psyche*, XXXI, 1, pp. 24-40.
1926. Medical Report of the Hamilton Rice Seventh Expedition to the Amazon. Contributions from the Harvard Institute for Tropical Biology and Medicine, No. IV, Part II, Medical and Economic Entomology (Tabanidae, pp. 214-234). Cambridge, Harvard University Press.
1933. The Templeton Crocker Expedition of the California Academy of Sciences, 1932. No. 11. The Hippoboscidae of the Galapagos Archipelago (Notes on the Hippoboscidae, 8) with an Appendix on the Tabanidae. *Proc. California Acad. Sci.*, 4th Series, XXI, No. 11, pp. 136-137.
- 1940a. Tabanidae of the Island of Trinidad, B. W. I. *Bull. Ent. Res.*, XXX, Pt. 4, pp. 447-453.
- 1940b. The Tabanidae of the Antilles (Dipt.). *Rev. Ent.*, Rio de Janeiro, XI, fasc. 1-2, pp. 254-369, figs. 1-33 and 1 map.
- Bodkin, G. E., and Cleare, L. D. 1916. Notes on Some Animal Parasites in British Guiana. *Bull. Ent. Res.*, VII, pp. 179-190.
- Enderlein, G. 1925. Studien an Blutsaugenden Insekten. 1. Grundlagen eines neuen Systems der Tabaniden. *Mitt. Zool. Mus. Berlin*, XI, 2, pp. 256-409.
- Hine, James S. 1925. Tabanidae of Mexico, Central America and the West Indies. *Occ. Papers, Mus. Zool., Univ. Michigan*, No. 162, pp. 1-35.
- Kröber, O. 1933. Dos Subgenus Neotabanus der Tabaniden gattung Tabanus s. lat. *Rev. Ent.*, Rio de Janeiro, III, 3, pp. 337-367.
1934. Catalogo dos Tabanidae da America do Sul e Central. Incluindo o Mexico e as Antilhas. *Rev. Ent.*, IV, fasc. 2, pp. 222-276, fasc. 3, pp. 291-333.
- Latreille, M. 1811. Insectes de l'Amerique equinoxiale, recueillis pendant le voyage de M.M. de Humboldt et Bonpland. In: Humboldt and Bonpland, *Recueil d'observations de Zoologie et d'anatomie comparée*, Vol. II, Paris. (The date of publication is variously stated as 1811, 1814, 1817 or 1833.)
- Lutz, Adolfo. 1909. Instituto Oswaldo Cruz em Manguinhos. Rio de Janeiro. (A guide book containing lists of the Institute's collections.)
1913. Sobre a Systematica dos tabanideos, sub-familia tabaninae. *Brazil Medico*, No. 45, Dec., 1913. Reprint pp. 1-7.
1914. Sobre a Sistemática dos tabanideos, sub-familia Tabaninae. *Mem. Inst. Oswaldo Cruz*, VI, fasc. 3, pp. 163-168. (A reprinting of the previous paper.)
- and Neiva, Arthur. 1914a. As "Tabanidae" do Estado do Rio de Janeiro. *Mem. Inst. Oswaldo Cruz*, VI, fasc. 2, pp. 69-80.
- 1914b. Notas Dipterológicas. Contribuição para o conhecimento dos primeiros estadios de tabanideos brasileiros. *Mem. Inst. Oswaldo Cruz*, VI, fasc. 1, pp. 43-49.
1922. *Zoologia Medica*. Publ. Sep. da "Folha Medica," Rio de Janeiro. pp. 1-17.
1928. Estudios de Zoología y Parasitología Venezolanas, 138 pages, 26 plates. Rio de Janeiro. pp. 51-64, and Pls. 8 and 9 concern Tabanidae.
- Stone, Alan. 1938. The Horseflies of the Subfamily Tabaninae of the Nearctic Region. U. S. Dept. Agric. Misc. Publ. No. 305, 171 pages, 79 text figures.