

THE PAPATACI FLIES (*PHLEBOTOMUS*) OF THE
MALTESE ISLANDS.¹

By R. NEWSTEAD, M.Sc., A.L.S., &c.

(Continued from p. 41, vol. xix.)

SYNOPSIS OF MALTESE SPECIES OF PHLEBOTOMUS.

- A. Abdominal hair recumbent.
- (a) Integument black. Large species. Palpi with second segment slightly longer than the third. *nigerrimus*, n. sp.
 - (b) Integument ochreous. Small species. Palpi with second segment one half the length of the third. *minutus*, Rond.
- B. Abdominal hairs more or less erect.
- (a) Legs in both sexes relatively short; average length of hind leg, 3 mm. Terminal segment of superior clasper of male scarcely half as long as the inferior clasper. *perniciosus*, n.sp.
 - (b) Legs of both sexes relatively long; average length of hind leg, 4 mm. Terminal segment of superior clasper of male slightly longer than the inferior clasper. *papatasi*, Scop.

PHLEBOTOMUS NIGERRIMUS, n. sp.

FEMALE.—*Colour.* Head, thorax, and abdomen brownish black; hairs bright ochreous buff, those on the thorax being slightly paler and erect, those on the abdomen recumbent. Basal segment of antennæ dark brown. Palpi pale to dark brown, hairs similar in colour to those on the body. Legs pale ochreous buff, with ochreous white, *not silvery white*, refulgence. Wings ochreous buff or dull golden in some lights.

Head.—Proboscis long; eyes black, deeply emarginate in front. *Palpi* and *antennæ* very like those of *P. papatasi*. *Legs* very long, femur of hind pair nearly as long as the abdomen; tibia one and one-third times the length of the femur; tarsi longer than the tibiæ by about one-sixth, or nearly as long as the wing; ungues simple. *Wings* (fig. 5) with the hind margin strongly arched; sixth longitudinal vein short, terminating near the centre of the hind margin, the length equal to the distance, in a straight line, from its tip to the tip of the third longitudinal vein; the anterior branch of the second longitudinal vein twice the length of the distance between the two forks.

Length 2.50 mm.

The black or brownish-black colour of the integument of this

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insect will serve as a ready means of distinguishing it from any of its allies. It may also be separated from *P. papatasii*, to which it is closely related in its morphological characters, by the shape of the wing and the shorter sixth longitudinal vein. The only two examples which were secured were taken by Captain P. J. Marett; both are females, one of which bears the data: "Black species, Gozo, 20, X, 10"; the other *P. papatasii*, dark variety 17, VI, 10, F."

Captain Marett had evidently, therefore, noted the black or dark colour of this insect in life; and when questioned regarding this he was absolutely certain that the colour was not due to post-mortem changes. It is, undoubtedly, a rare insect in the Maltese islands, otherwise more specimens would have been secured. We trust that Captain Marett will be able to obtain examples of the males, so that the characters of the armature may be examined and described.

PHLEBOTOMUS MINUTUS, Rondani.

MALE. — *Colour.* Integument rather opaque, dull golden ochreous. Antennæ with black and ochreous hairs mixed. Head with the clypeal and occipital tufts of hairs pale ochreous. Thorax with a median main-like tuft, a lateral tuft in front of the insertion of the wings and also a tuft on the scutellum, all pale ochreous with a golden tinge, but with a few intermingled black hairs. Abdomen densely clothed with recumbent, dull, golden ochreous hairs; those covering the genital organs intermingled with black hairs. Legs covered with scales which appear smoky brown in some lights, silvery ochreous in others. Hairs of the wing mixed black and ochreous, those of the costa not darker than those on the surface of the wing.

Head. Proboscis relatively short; clypeus hairy. *Antenna* with the third segment a little longer than the fourth, but not nearly so long as the fourth and fifth together; the long verticillate hairs extending to the apical segment. *Palpi* (fig. 13) with the second segment one-half the length of the third; the latter much the stoutest and broadest; dorsally it appears incrassate towards the base; fourth segment not quite so long as the third; fifth much the longest.

Wings (fig. 7) very narrow, and bluntly lanceolate; divided into two almost equal halves by the third longitudinal vein; the upper or anterior branch of the second vein shorter than the distance between the two forks.

Legs. Hind pair a little more than three times the length of

the abdomen inclusive of the genitalia; tarsus a little longer than the tibia.

External genitalia (figs. 14, 15) small; superior claspers with four long spines: two apical and two subapical: inferior claspers very slightly swollen in the middle; intermediate appendage similar to that in *P. papatasii*; intromittent organ nearly three-fourths the length of the inferior claspers; genital filament not protruding.

Length 1.5 to 1.65 mm.

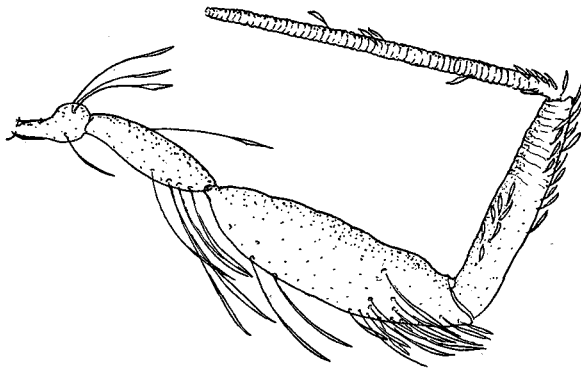


FIG. 13.—Palpus of *Phlebotomus minutus*.

FEMALE.—*Colour.* Wings with a distinct black costa and fringe; wing-area also with numerous black hairs intermixed with the ochreous ones. Legs with the femora ochreous beneath, darker above; tibiae and tarsi blackish, with silvery grey scales. Thoracic and abdominal hairs as in the male.

Antennae with the long hairs extending to the tip, the third to the ninth segments, inclusive, with geniculated and paired spines. *Palpi* as in the male.

Length 2 mm.

The distinguishing characters of this insect are its relatively small size, especially in the male; the recumbent abdominal hairs; the short third antennal segment; and the marked character of the palpi. The male may be easily distinguished also by the form of the external genitalia.

The first two examples were captured by Major F. L. Dibblee, Royal Marine Artillery, at his residence at Sliema, August 20, 1910; and two additional specimens were taken by myself, one at Casa

Leoni, in a rabbit-hutch, August 31; the other at Floriana, August 27.

In captivity *Ph. minutus* is much more active than any of the other Maltese species, and when confined to a small area was almost incessantly moving from place to place. Apart from its flea-like actions it also has the remarkable habit of whirling round and round with great rapidity, so rapidly at times as to render itself almost invisible.

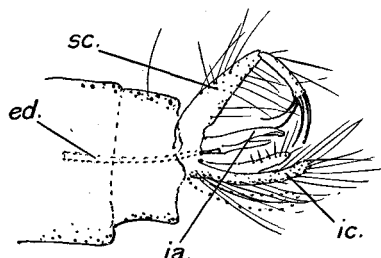


FIG. 14.—External genitalia of *Phlebotomus minutus*, ♂; *sc.*, superior claspers; *ic.*, inferior claspers; *ia.*, intermediate appendages; *ed.*, ejaculatory duct.

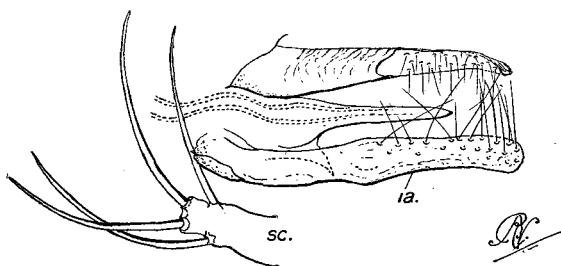


FIG. 15.—Superior clasper (*sc.*) and intermediate appendages (*ia.*) of *Phlebotomus minutus*, more highly magnified.

PHLEBOTOMUS PERNICIOSUS, n. sp.

MALE.—*Colour immediately after death.* Eyes black. Thorax with or without dull red-brown spots; when present they are arranged in a triangle, and there is occasionally a similar spot on the vertex of the head. Thorax and coxæ pale, translucent, ochreous; abdomen similar, but sometimes pale smoky grey. Hairs pallid. Wings faintly iridescent in strong light; pale drab in subdued light; costal fringe generally very dark or blackish grey, though examples with pale costal fringes are not uncommon.

Legs silvery grey, in a strong light presenting a distinct metallic lustre; in certain lights also those segments which lie in shadow appear almost black, and show up in marked contrast to those which are so placed that their surfaces refract the light. In some lights the under surface of the legs appears distinctly and regularly speckled, a character due evidently to the regular arrangement of the scales.

Head densely hairy, with generally two ill-defined tufts. Clypeus with a large tuft of hairs, some of which are directed forwards, others backwards towards the forehead.

Palpi with segments 2, 3, and 4 equal in length and collectively a little longer than the fifth. *Antennæ* with the second segment much longer than the two succeeding ones; the longest hairs on segment 14 almost equal in length to those on the preceding segment. *Thorax* densely hairy, usually with a tuft on the front portion and another on the scutellum. *Abdomen* densely hairy, the longest hairs arising from the apical margin of the segments, but no distinct tufts are found as in *P. papatasii*. The arrangement of the hairs is similar in both sexes, but blackish hairs are often intermixed with the pale ochreous ones on various parts of the body in the darker forms of this insect. *Legs* shorter than those of *P. papatasii*. *Wings* (fig. 6) with the posterior border much more strongly arched than the anterior border; the anterior branch of second longitudinal vein nearly as long as the stem between the cross vein and the proximal fork.

External genitalia (figs. 16, 17). Superior clasper with five very long, stout, curved spines; two apical, one external and two internal, placed a little in advance of the outer one; inferior clasper nearly twice the length of the intermediate appendage, and clothed to the apex with very long and slender hairs; intermediate appendage somewhat finger-shaped and hairy, proximal portion with a large keel-like extension ventrally, the distal margin of which bears several (5 to 6) hairs; apex of intromittent organ deeply divided or forked, with occasionally a minute central tooth; exposed portion of the genital filament about half the length of the intromittent organ.

FEMALE.—With the *palpi, antennæ and legs* similar to those of the male. *Wings* very slightly larger and broader than those of the male.

Length 1·9 to 2·2 mm.

This insect is widely distributed over the Island of Malta, and was extremely abundant during the month of August and the

beginning of September, though many examples were captured also in July. It was most abundant at Floriana, near the old bastion by the Grand Harbour, on the evenings of August 26 and 27, when, between the hours of 8.30 p.m. and 9.30 p.m. thirty-nine examples were captured as they came into a lighted room; of this total twenty-eight were males and eleven females.

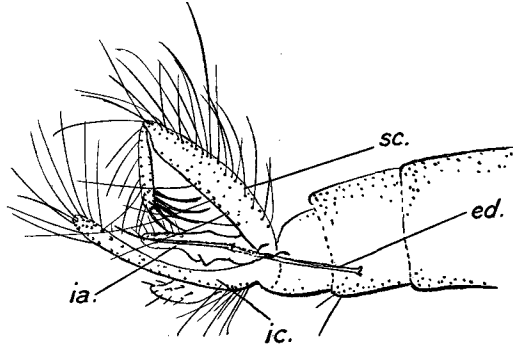


FIG. 16.—External genitalia of *Phlebotomus perniciosus*, ♂; *sc.*, superior claspers; *ic.*, inferior claspers; *ia.*, intermediate appendages; *ed.*, ejaculatory duct.

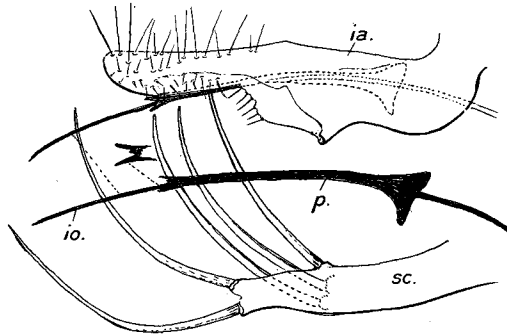


FIG. 17.—Portion of genitalia of *P. perniciosus*, ♂, more highly magnified; *sc.*, superior claspers; *ia.*, intermediate appendage; *p.*, penis; *io.*, intromittent organ.

Two examples of *P. minutus* were found in association with this species; but strange as it may seem, not a single example of *P. papatasi* was either captured or seen on these occasions.

It was common also during the last week in August at Casa Leoni, the residence of the Hon. E. C. Roupell, D.S.O., Acting Lieutenant-Governor. In this place it was found most abundantly in a large outhouse which was tenanted by a number of rabbits.

In the early mornings, shortly after 6 a.m., numbers of sand-flies were found chiefly in the corners of the room, but many were also seen sitting about the walls in various places, though chiefly at the junction with the ceiling. Later in the day they were rarely seen in these situations; but examples could always be found in the dark earthen pots which were used, and generally occupied by the rabbits as retreats.

The male is easily distinguished from that of *P. papatasii* by its generally smaller size, shorter legs, and much smaller genital armature, which is little more than half the width of the abdomen. The female may also be distinguished by its shorter legs, and generally darker colour. After a few hours in captivity it also becomes generally much less active than *P. papatasii*, though it has the same hopping flight so characteristic of these insects.

PUPA (Pl. II, fig. 4).—Abdomen distinctly and sharply curved upwards so that a somewhat S-shaped outline is produced; thorax gibbose; abdominal segments each provided with a pair of very large tubercles (Pl. II, fig. 5), the tips of which are furnished with a pair of broad, flat appendages; integument thickly covered with squamose spines (Pl. II, fig. 4).

The larval skin attached to the pupa does not present any morphological differences from that of *P. papatasii*, as far as one can gather from its shrivelled condition. It possesses the same kind of caudal bristles and hairy body-spines.

PHLEBOTOMUS PAPATASII (Scopoli).

Bibio papatasii, Scopoli. "Deliciae faun. et flor. Insubriciae," i, p. 55, Pl. XXII, fig. B. a. b. (1786).

Cyniphes molestus, Costa, "Storia dei lavori dell' Acad. Aspir. Natural., Artic. Zool." (1840); id., "Annali dell' Acad. Aspir. Natural.," i, p. 4 (1843).

Hermasson minutus, Loew (*nec* Rondani). "Stettin. Ent. Zeit." v, p. 115, Pl. I, figs. 1 to 5 (1844).

Phlebotomus papatasii, Grassi. "Mem. d. Soc. ital. d. Sci." (3), xv, p. 353 (1907).

This insect has been described so frequently that it seems unnecessary here to do more than add such particulars as have hitherto been overlooked, or imperfectly dealt with. In the first place it may be noteworthy to state that there are two distinct colour varieties of this common and widely distributed insect:—

- (1) A uniformly pale form, which may be considered typical;
- (2) A form which differs from the foregoing in having a dark

coloured fringe to the costa and hind margin of the wing; herein described as the dark form.

FEMALE.—*Typical pale form* (immediately after death).—Almost uniformly pale, translucent, ochreous, thorax with a long, dull red-brown median stripe, and a single spot of the same colour on either side, near the front margin of the thorax. Hairs on all parts of the body greyish, their arrangement similar to that of the male. Wing relatively broad (fig. 4). Wing fringe not markedly darker than the hairs on the disc of the wing.

MALE.—*Typical pale form* (immediately after death).—Colour similar to that of the female. Clypeus with a tuft of eight to ten hairs; head with a loose tuft, some of the hairs curving forwards, others backwards; tuft on nape of slightly longer ones, chiefly curved forwards. Thorax densely clothed; the hairs arranged in loose tufts. Wing much narrower than in the female (fig. 4). Abdomen uniformly hairy, with small tufts on the dorsum arising from the apical margin of each segment; superior claspers densely hairy, with a few black hairs intermixed with the pale ones; these hairs are easily deciduous, with the exception of a large tuft, which is more or less permanent in examples mounted in Canada balsam.

FEMALE.—*Dark form*.—General colour similar to that of the pale form. Wing fringes distinctly smoky grey; some of the hairs on the veins are dark grey or smoky grey.

MALE.—*Dark form*.—Not observed.

This form is not uncommon; but is very much rarer than the dark form of *P. perniciosus*. It does not differ structurally from typical pale examples, so that the following description of the palpi and antennæ applies to both varieties.

Palpi of five segments: 1 very short, slightly dilated distally; 2 a little longer than the succeeding one; 3 decidedly broader than the rest; 4 a little shorter than 3; 5 as long as or slightly longer than 2; 1 to 3 hairy; 4 and 5 scaly and with a few fine hairs. *Antennæ* (fig. 2) of sixteen segments: 1 and 2 the stoutest, the former with one side longer than the other, the latter bead-like; 3 much the longest, being equal in length to the last five segments together; 4 to 13 each very slightly shorter than the preceding one respectively; 14 to 16, inclusive, more strongly incrassate (swollen) basally than the rest; all the segments with the exception of 1 and 2 densely clothed with hairs, the longest of which arise from the incrassated portion of each segment, except on the terminal segments, which are furnished with hairs of equal length; 4 to 15,

inclusive, also furnished with a pair of stout spines (fig. 2), which are suddenly elbowed or bent at right angles to their insertion, so that for nine-tenths of their length they lie practically parallel with the surface of the segment to which they are attached.

The external genitalia of the male are much larger than those of any of the other Maltese species; a character which may be readily recognized in life, under a low magnification. The morphological characters are shown in the accompanying illustration (fig. 18). Length, 2.5 to 2.65 mm.

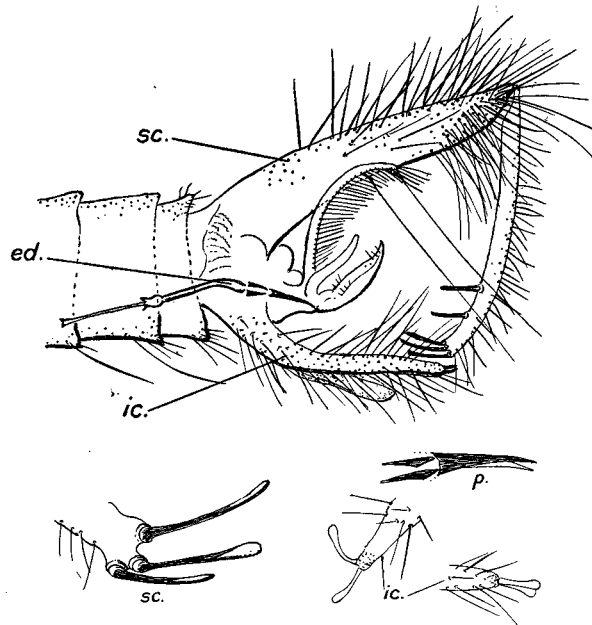


FIG. 18.—External genitalia of *Phlebotomus papatasi*, ♂; *sc.*, superior claspers; *ic.*, inferior claspers; *ed.*, ejaculatory duct; *p.*, penis.

In captivity this insect is much more restless than *P. perniciosus*, so much so that after a few hours one may readily distinguish the two species by this alone, apart from the other characters—i.e., the generally larger size, paler colour, and much longer legs of *P. papatasi*.

OVUM (Pl. I, figs. 1 to 5).—When forcibly expelled from the body a day or so before the cuticle has become opaque the interior (oolemm) can be seen; and in such examples also the micropyle is distinctly visible as a short ring-like extension at the anterior pole

of the egg. The oolemm at this stage is filled with globular particles of fatty matter, suspended in a structureless matrix. When first laid the egg is translucent white and covered with a thin coating of viscous matter, by which it readily adheres to the surface upon which it may fall; five hours after it has been laid

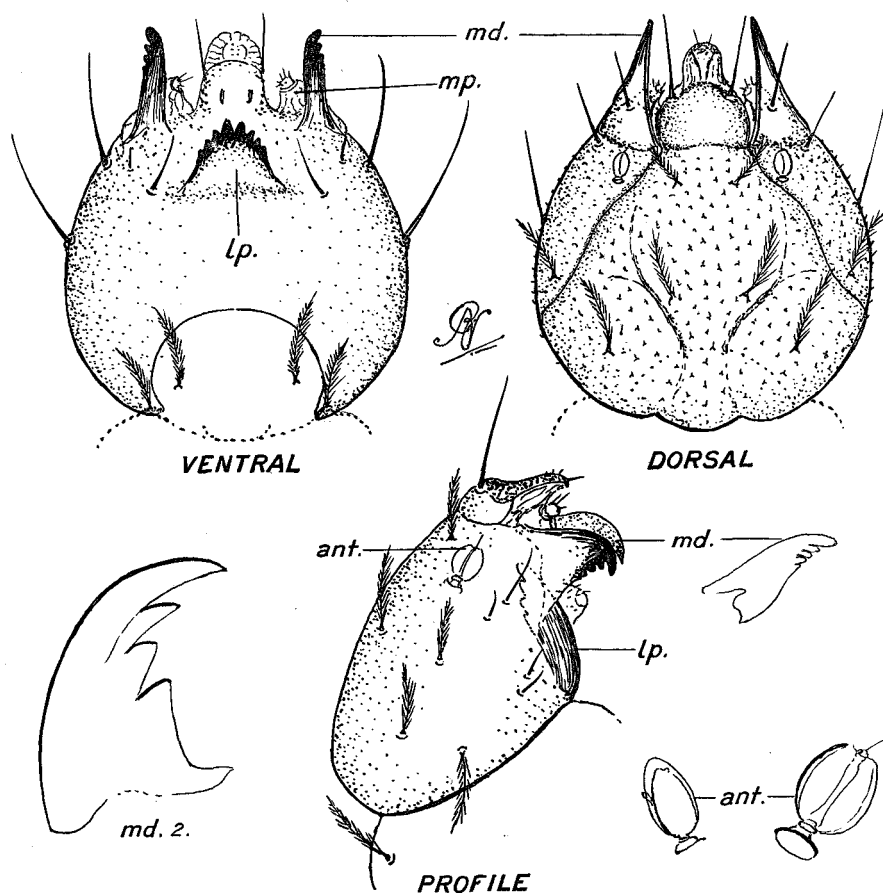


FIG. 19.—Head of larva of *Phlebotomus papatasi*. *ant.*, antenna; *md.*, mandible; *mp.*, maxillary palpus; *lp.*, labial plate.

it assumes its normal form and colour, which may be described as follows: Form very elongate, dark brown, shining, with longitudinal black wavy lines, which in certain lights give the periphery of the egg a faintly rugose appearance; these black lines are slightly raised, and are joined by slender cross-lines, so that a faint but rather coarse reticulation is formed. The transverse lines are,

however, very difficult to trace unless they are illuminated by a strong beam of light.

The incubation period lasts for about nine days; but unless kept in a moistened atmosphere the eggs will not hatch.

LARVÆ.—First instar (Pl. I, fig. 8). Cylindrical and distinctly caterpillar-like in its general form; head black; body white or ochreous white; caudal bristles, long, black. Head (fig. 19) very broadly pyriform; frontal hairs two in number; simple; dorsally there are three similar hairs on each side; one arising from the mid-region of the mandibles, one near the base; and a slightly longer one towards the centre of the head, near the margin; besides these there are at least four hairy spines on each side, arranged as shown in the illustration. Antennæ (fig. 19, *ant.*) composed apparently of three segments, the first two being quite rudimentary and ring-like; third segment broad, flat and ovate in outline, the anterior edge faintly emarginate and furnished with a centrally placed hair. Mandibles (fig. 19, *md.*) large and provided with four distinct but rather blunt teeth, of which the apical one is much the largest. Labial plate (fig. 19, *lp.*) somewhat triangular in outline with four teeth on each side, the median ones being much the largest; in its general form the labial plate resembles those found in the larvæ of the *CULICIDÆ*. Articulations of the body clearly defined; each segment bears from four to five hairy spines on each side, all of which are broadly dilated apically. Caudal bristles in two pairs, one of which is much the longer, almost equalling the length of the body, the other pair are extremely short.

Last instar (Pl. I, fig. 7).—Form resembling that of the first instar; colour pale ochreous white; head black; caudal bristles black, arranged in two pairs, each pair being attached to a large tuberculous process; the inner bristle is much the longer, almost equalling one-half the length of the body of the larva; all of these bristles, under a high magnification, present a number of extremely fine, equidistant, and intensely black surface lines, the intervening spaces being distinctly pale; it is highly probable, therefore, that these bristles are finely striated, but as no sections were cut it is impossible to determine their true structure by examining them in optical section only. Thoracic and abdominal spines (Pl. I, fig. 10) much longer and stouter than those in the earlier stages; apices *narrowly dilated* and transparent, the remaining portion clothed with minute stiff hairs; these hairy spines are arranged in more or less regular transverse rows, there being four or five on each side of the median line. Head with several large spines

similar to those on the abdominal segments, but they are pointed instead of being dilated at the apex; besides these hairy spines there are also several rather long stout hairs, four of which are frontal. Sucker feet similar to but relatively larger than those in the first instar.

Length, 2 to 3.28 mm.

PUPA.—(Pl. I, figs. 11, 12).—When empty, clear ochreous buff. Eyes in life black. Abdomen curved upwards distally in varying degrees, but not apparently so distinctly S-shaped as in *P. perniciosus*; considerably wider in the thoracic region than at the distal segments of the abdomen; integument clothed with minute squamose spines (Pl. I, fig. 15), which are most conspicuous on the abdominal segments. Thorax with two tubercles on each side, the anterior one bearing two or three long slender spines. Abdominal segments each with one (possibly two) extremely minute tubercles, at the apex of which is a minute, broad, flat spine; those on the seventh and eighth segments more conspicuous than the rest; but all of these processes are so minute as to be easily overlooked. Wing-sheaths pointed apically and extending subventrally as far as the base of the seventh abdominal segment. Head distinctly elongated and somewhat triangular in outline; in the empty pupa this often breaks away in the process of mounting, when the outline may be seen to bear a striking resemblance to the head of an ox in miniature (Pl. I, fig. 13). Antennal sheaths distinctly segmented, lying curved behind the eyes, and subsequently following the costa of the wing-sheath. Palpal sheaths originating near the centre of the frons, extending backwards and then curving suddenly forward so that the apex rests against the antennal sheath and lies pointing in the same direction. Legs extending slightly beyond the wing sheaths.

REFERENCES.

- [1] ANNANDALE, N. (1910). *Records of the Indian Museum*, vol. v, Pt. 3, Nos. 13 and 14.
- [2] BIRT, C. (1910). "Phlebotomus Fever in Malta and Crete," *JOURNAL OF THE ROYAL ARMY MEDICAL CORPS*, vol. xiv, pp. 236-258.
- [3] GRASSI, B. (1907). "Ricerche sui Phlebotomi," "Memorie della Società italiana delle Scienze," Ser. 3a, xiv, pp. 353-395.
- [4] GRASSI, B. (1908). "Intorno ad un nuovo Phlebotomo," "Rend. Reale Accademia dei Lincei," Ser. 5a, xvii, pp. 618-682.
- [5] HOWLETT, F. M. (1909). "Indian Sandflies," "Indian Medical Congress," Section III, pp. 239-242.
- [6] MARETT, P. J. (1910). "Preliminary Report on the Investigation into the Breeding places of the Sand-fly in Malta," *JOURNAL OF THE ROYAL ARMY MEDICAL CORPS*, xv, 3, pp. 286-291.
- [7] NEVEU-LEMAIRE, M. (1906). *Bulletin de la Société de France*, p. 65.
- [8] SPEISER, P. (1910). *Zoologische Jahrbücher*, Supp. 12, Heft 3, Taf. 22.

PLATE I.

Phlebotomus papatasi, Scop.

- Fig. 1.—Eggs, approximately natural size.
 „ 2.—Egg, a few hours before extrusion, showing micropyle.
 „ 3.—Egg, freshly extruded.
 „ 4.—Egg, a few hours after extrusion.
 „ 5.—Egg, much enlarged, to show reticulated surface.
 „ 6.—Larva, approximately natural size.
 „ 7.—Sketch of adult larva, enlarged.
 „ 8.—Larva ; first instar, enlarged.
 „ 9.—Stigma of larva with spine.
 „ 10.—Hairy spine of larva.
 „ 11.—Pupa, approximately natural size.
 „ 12.—Pupa enlarged : *ls*, larval skin with anal bristles attached.
 „ 13.—Front view of the head of the pupa : *e*, eye ; *a*, antenna ; *p*, palpus.
 „ 14.—Thoracic tubercles of pupa.
 „ 15.—Squamose body-spines of pupa.
 „ 16.—One of the abdominal pupillæ of the pupa.

PLATE II.

Phlebotomus papatasi, Scop.

- Fig. 1.—Imagos, approximately natural size.
 „ 2.—Male enlarged ; from life.

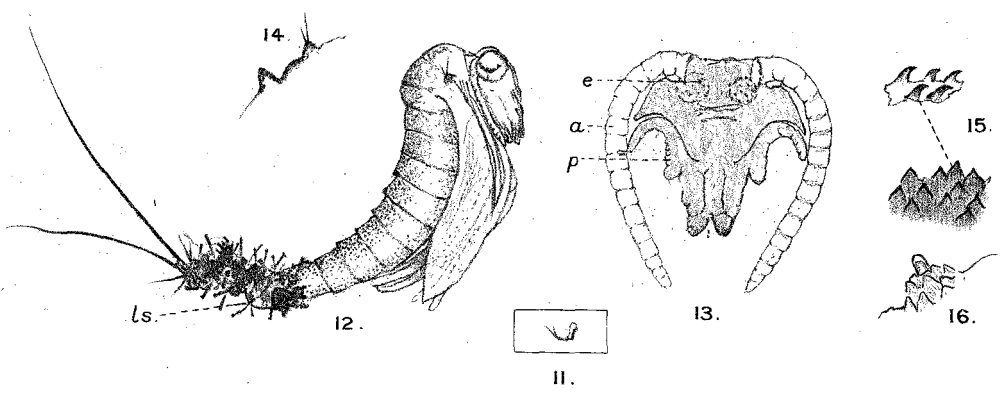
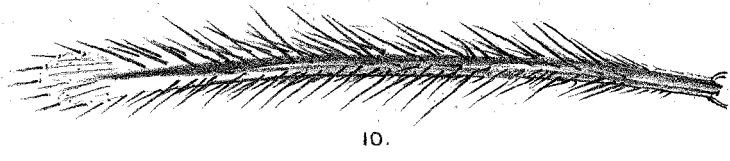
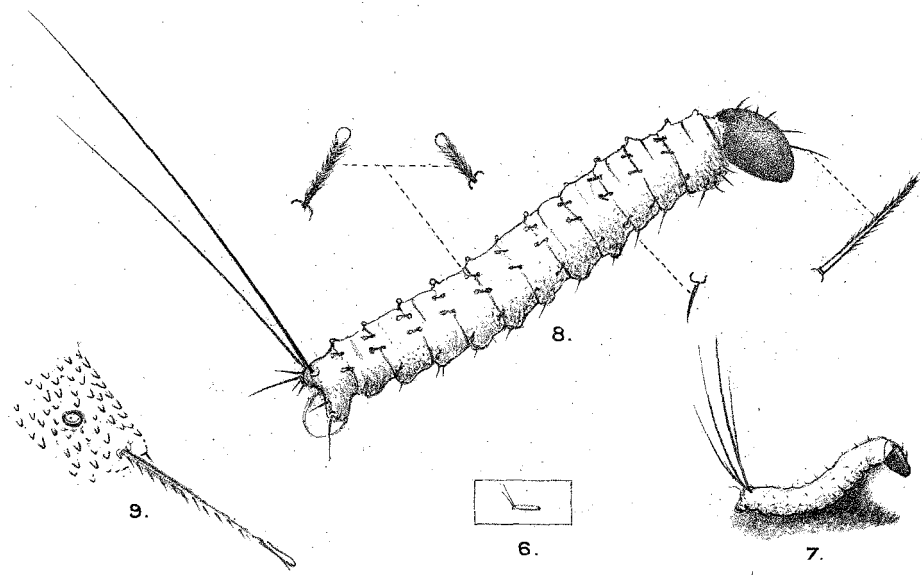
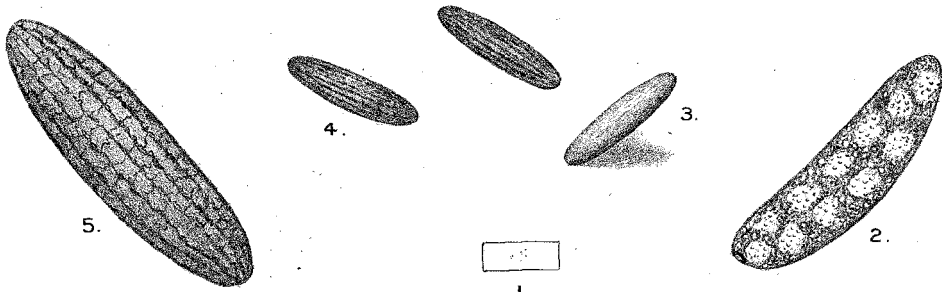
Phlebotomus perniciosus, Newst.

- „ 3.—Pupa, approximately natural size.
 „ 4.—Pupa, enlarged.
 „ 5.—One of the abdominal tubercles of the pupa.
 „ 6.—Squamose spines of the abdominal segments of the pupa.

PLATE III.

- Fig. 1.—*Phlebotomus papatasi*, Scop., female, enlarged ; from life.
 „ 2.—*Phlebotomus perniciosus*, Newst., female, enlarged ; from life.
 „ 3.—*Phlebotomus perniciosus*, approximately natural size.

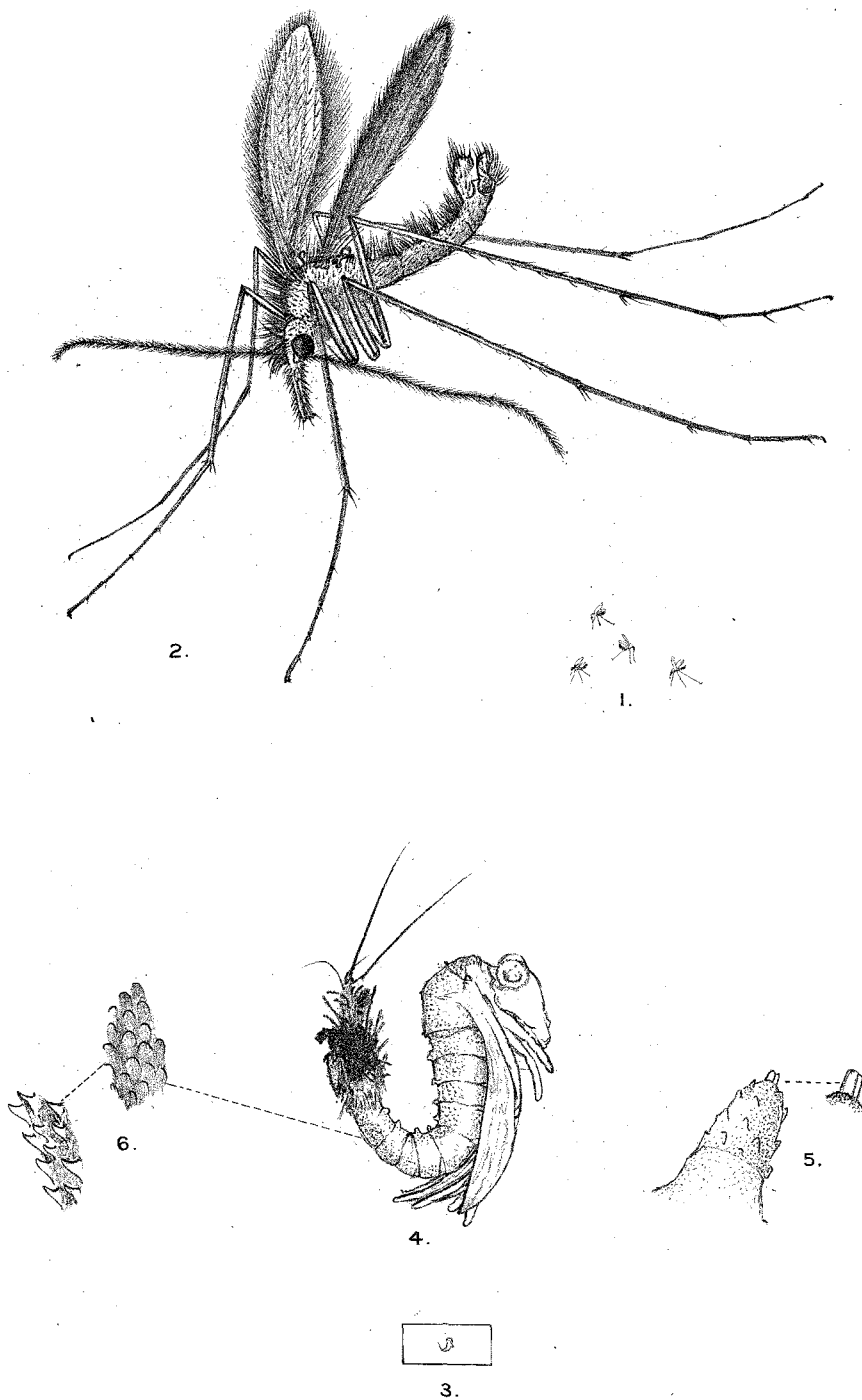
[NOTE.—The above enlarged figures and that of the male shown on Plate 2 are all drawn to the same scale.]



R. Newstead, *ad. nat. del.*

Bale & Danielsson, Ltd., *lith.*

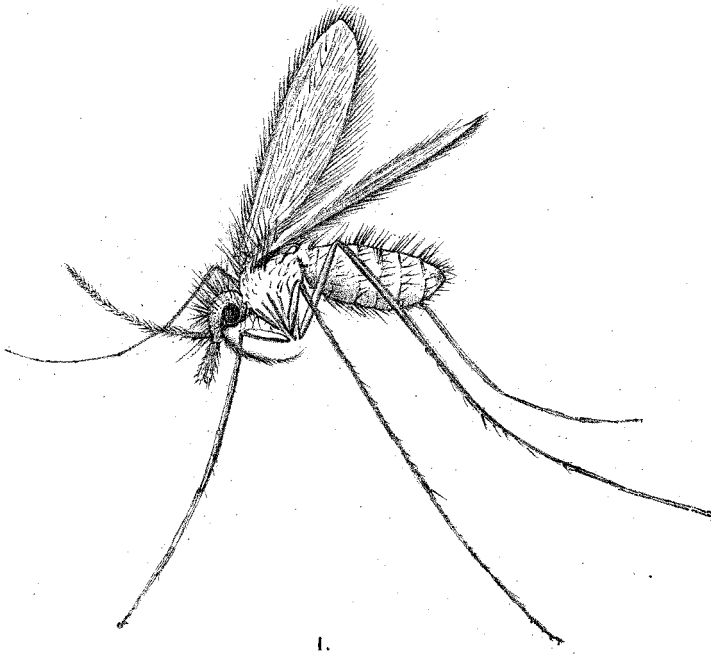
PHLEBOTOMUS PAPATASII



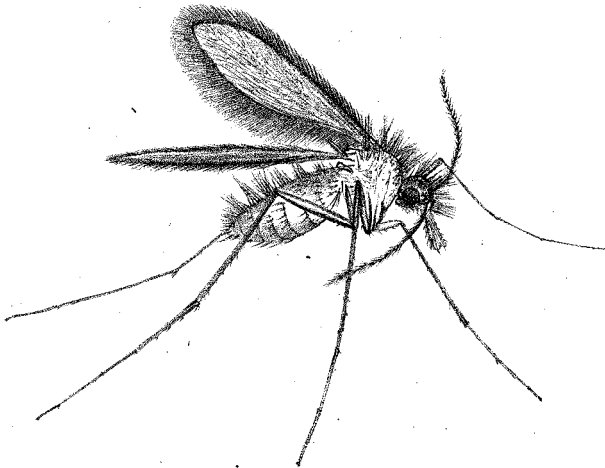
R. Newstead, *ad. nat. del.*

Bale & Danielsson, Ltd., *lith.*

PHLEBOTOMUS PAPATASII AND P. PERNICIOSUS.



1.



2.



3.

R. Newstead, *ad. nat. del.*

Bale & Danielsson, Ltd., *lith.*

PHLEBOTOMUS PAPATASII AND P. PERNICIOSUS.