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MONOGRAPHIC STUDY OF THE GENUS *TRITHEMIS* BRAUER (ODONATA: LIBELLULIDAE)

★

by

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PUBLISHED WITH THE AID OF A GRANT FROM THE DEPARTMENT OF CULTURAL AFFAIRS, REPUBLIC OF SOUTH AFRICA

MEMOIR No. 11

PRINTED IN THE REPUBLIC OF SOUTH AFRICA
BY CAPE & TRANSVAAL PRINTERS LTD., CAPE TOWN

CONTENTS

SUMMARY

This monograph deals primarily with the African species of the genus *Trithemis* Brauer. Thirty two species are described, at least eight of them having subspecies. Infraspecific variation is considered in detail, with descriptions of examples from different parts of the range. The few extra-African Oriental species are considered in less detail, except where they occur in the African region. The Oriental type species *T. aurora* (Burmeister) is described before the African species.

The generic diagnosis has undergone slight modification. The species are divided into nine subgroups and keys to both sexes are included. It is not practical to divide the species according to length of abdominal segments and the usual division into red or reddish species and the blacker or blue species appears to have been a natural evolutionary trend.

It has been necessary to place *T. risi* Longfield into synonymy with *T. furva* Karsch; *T. grouti* Pinhey and *T. leptosoma* Pinhey are found to be infraspecific to *T. atra* Pinhey. The difficult status of the *basilineta* group seems to have been satisfactorily solved by raising *nigra* Longfield to specific rank and by separating off two new species, *T. caruncula* spec. nov. and *T. congolica* spec. nov. Other new species described are *T. bifida, T. brydeni, T. falconis, T. hartwigi* and *T. jacksoni*; and new subspecies are *T. arteriosa ennediensis* and *T. monardi insuffusa*.

The deposition of types is mentioned under each taxon. Geographical distribution and ecology is included for species occurring in Africa. There is brief mention of tandem linkage factors and of life cycles; also a historical review of valid species.

The morphological aspects are discussed both comparatively and variationally. Important aspects are the development of black markings and maturation colours on head and body and the extent of amber fasciae on wings. The shape of abdominal segments is considered for both sexes in each species.

The genitalia are illustrated and discussed in detail. The male prophallus has been neglected in previous studies of this genus and it has been necessary to provide new terms, retinaculum and cornuti, for characteristic features. Still less has been known previously about the female bursa. It is found that it always has bursal arms and these are possible receptacles for the prophalline flagella. New terms are introduced here also from lepidopterous terminology, the dorsal and ventral sterigmata. Where paired these are found often to be asymmetrical. One peculiar female anomaly is that the median gonapophyses, normally present in Libellulidae, are absent in females examined of *T. werneri* Ris.

The genus is a colourful one and its members often form a dominant anisopteran population in their habitat. They are usually easy to recognize generically. The most widespread are *T. annulata* (Beauvois) and *T. arteriosa* (Burmeister), both tolerant of arid or well-watered areas.

INTRODUCTION

The necessity for a revision of the African *Trithemis* Brauer has long been realized. Although the genus as a whole is generally easy to recognize at a glance a few of the numerous species have become somewhat confused and the females are often not very easy to name. The genus is an important one on the African scene, the males being sometimes dominant and usually colourful.

In order to clear up the difficulties as far as possible the research, started in the latter half of 1968, was aimed at studying all possible morphological details as well as variability. Consequently, familiar structural details, common to many other Libellulidae, are discussed and illustrated here, mainly with a bias towards characters of the genus or its species. This detailed analysis has necessitated the examination of the prophallus or peneal organ and the bursa copulatrix scarcely studied in this genus until now.

The detailed revision of the genus has included notes on the Oriental species and the erection of new African species, subspecies and forms, and the introduction of some synonymy. Most of the material examined is in the National Museum, Bulawayo, Rhodesia.

Only the essential references to literature are recorded in the bibliography since references up to the end of 1959 are included in the author's catalogue (Pinhey, 1962c).

The following species and forms are described as new:

T. arteriosa (Burmeister)
T. a. socotrensis f. nov.
T. a. ennediensis subsp. nov.
T. bifida spec. nov.
T. brydeni spec. nov.
T. caruncula spec. nov.
T. congolica spec. nov.
T. falconis spec. nov.
T. hartwigi spec. nov.
T. jacksoni spec. nov.
T. kirbyi ardens Gerstaecker
T. k. ardens aurantiaca f. nov.
T. monardi Ris *insuffusa* subsp. nov.
T. pluvialis Förster *melanistica* ab. nov.

Included with the African species are details of the type species *aurora* (Burmeister) and the Oriental *festiva* (Rambur), the latter because of dubious African records. There are also a few subspecies, such as in *donaldsoni* and *stictica* which have not been given names here.

HISTORICAL REVIEW

The oldest known African species of the genus is *annulata* Beauvois, briefly described in 1805. In 1839 Burmeister followed with *arteriosa* and *stictica*, as well as the Oriental type-species *aurora*. Then Rambur named *dorsalis* and *festiva* in 1842. All these were prior to the introduction of the present generic title *Trithemis* by Brauer in 1868 and they were placed in "Libellula" Linnaeus which was at that time an "omnibus" name, not restricted, of course, in its modern generic status. Since then all except two genuine African species have been placed in *Trithemis* in their original descriptions. Brauer, himself, placed *africana* in *Tramea* Hagen and certainly from its general facies it more closely resembles one of that genus than a *Trithemis*. However, by venational and genitalial characters it is correctly placed in the genus under review. More surprising, however, is that Calvert originally considered *donaldsoni* to be a *Pseudomacromia* Kirby (a genus now placed in synonymy to *Zygonyx* Hagen). This again both venationally and genitalialy is a true *Trithemis* and its general appearance is not at variance with this diagnosis. In its pale blue pruinosity and largish wings, unmarked with amber, it has some slight resemblance to *Zygonyx natalensis* (Martin). In its flight it does not in the least resemble a *Zygonyx*.

Certain non-trithemine species have at times been placed in *Trithemis*. One of these is *lacustris* Kirby which has a superficial resemblance to *Trithemis kirbyi*. However, by venation, pterostigma, abdominal shape and habits this is a species of *Brachythemis* Brauer. In Kirby's catalogue (1890) *trivialis* (Rambur) was listed in *Trithemis*, whereas it is a species of *Diplacodes* Kirby. Certain others, such as *rubrinervis* Selys are genuine *Trithemis* species but have fallen into synonymy. Under *Tramea* Hagen, Kirby not only included *africana* Brauer but also *erythraea* by the same author. The latter is a synonym of *Trithemis annulata* (Beauvois), being the insular form or race, *haematina* (Rambur).

In the previous year (1889) both Kirby and Karsch reviewed the libellulid genera and Karsch erected the genus *Helothemis*. But the first and most important reviews of the genus were those of Ris (1912, 1919) who gave detailed references and descriptions. In 1921 the same author described seven species from South Africa and provided keys to these. Barnard (1937) detailed the four species of the south western Cape Province [*arteriosa*, *dorsalis*, *k. ardens* and *furva* (= *risi*)] and added to our knowledge by including brief notes on the prophallus and the bursa copulatrix, the first paper mentioning the bursae in African odonatology.

Fraser, among his many papers, reviewed the species of certain areas. The most detailed of these were those of the central Oriental region (Fraser, 1920, 1936) in which he described four species, the type-species *aurora*, *festiva*, *kirbyi* and *pallidinervis* (Kirby). Of the African fauna he illustrated the accessory genitalia of many of them (Fraser, 1953) and he mentioned ten of the Congo species (Fraser, 1955) in his papers on the Upemba National Park and the Madagascar species (Fraser, 1956). In the latter paper he covered eight species, together with *haematina*, which he mentioned as distinct from *annulata*. Lieftinck has dealt with some Oriental species and included a list of three South East Asian ones (Lieftinck, 1954), *aurora*, *festiva* and *lilacina* Förster (Lieftinck, 1953).

One paper briefly referring to the genus was that of Longfield (1936). It was important because of the disentanglement of the *dorsalis* and *risi* species and the elucidation of generic names erected by Kirby.

Pinhey has dealt regionally with the African species, including keys: Southern Africa (Pinhey, 1951), Eastern Africa (Pinhey, 1961a), Central Africa (Pinhey, 1961b); and a catalogue (Pinhey, 1962c) reviewing the generic features and giving a list of all known African species up to the end of 1959 with references to literature.

The more detailed accounts mentioned above, particularly those in Ris' catalogue are of considerable value in assessing the species but none of them were essentially revisional. In recent years several new species have been erected by the present author.

DIAGNOSIS

Genus ***TRITHEMIS*** Brauer

Trithemis Brauer, 1868, *Verh. zool.-bot. Ges. Wien* **18:** 176, 366, 735; type-species *Libellula aurora* Burmeister, 1839.
Helothemis Karsch, 1889, *Berl. ent. Z.* **33:** 370; type-species *Libellula dorsalis* Rambur, 1842.
Stoechia Kirby, 1898, *Ann. Mag. nat. Hist.* (7) **2:** 235; type-species *Stoechia distanti* Kirby, 1898.
Misthotus Kirby, 1905, *Ann. Mag. nat. Hist.* (7) **15:** 192; type-species *Misthotus marshalli* Kirby, 1905.

The type-species of the three listed generic synonyms are discussed below (p. 89) under *T. dorsalis* (Rambur). Published references to the genus may be found in Pinhey (1962c: 267).

The earlier diagnosis (Pinhey, 1962c: 267) is quoted here. Emendations to this diagnosis have become necessary and these follow the diagnosis.

"*Characters.* Small or moderate sized libellulids with abdomen often red, sometimes black with yellow markings; often pruinosed. Head small to medium, eye contact shortish. Frons with or without crest in male, rounded in female; furrow shallow or deep. Prothoracic hindlobe very small, rounded, depressed. Pterothorax (synthorax) small to moderate. Legs longish and thin. Tibial spines numerous, fine, shortish. Claw spurs stout, near middle of claw. Abdomen variable, slender or broad, depressed in male; cylindrical in female. Male accessory genitalia largish; hamulus with well developed hook, often large. 8th (segment) in female not widened; vulvar scales very small, rudimentary. Wings longish or moderate, broadish or broad; nodus in forewing distinctly nearer apex than base. t (triangle) in forewing rather narrow or rather broad, its basal edge transverse; slightly distal to t in hindwing. Sectors of arc (arculus) on longish pedicel. Arc proximal to second Ax (antenodal cross-vein). Cu_2 in hindwing at anal angle of t or slightly distal. 8½–15½ Ax, the last generally incomplete. t in forewing crossed, in hindwings free or rarely crossed; ht (hypertriangle) free; ti (subtriangle) of 3 cellules. No Bsq (bridge cross-veins). 1 Cuq in all wings (very rarely 2 in hindwing). Postdiscoidal field of 3 rows (very rarely partly 4 rows) to margin. t in hindwing at or slightly proximal to arc. R_3 generally nearly straight, sometimes rather sinuous, rarely strongly so (as in *africana* Brauer). 2 rows I R_3—Rspl; Cu_2 very straight. Anal loop longish or long, somewhat blunt apically, reaching 2 cellules beyond t. Anal field wide, 3–4 rows at start. Pt (pterostigma) small or large; membranule medium."

In general this diagnosis is adequate but some comments, modifications and additions are appended as follows:

Frons: The frontal furrow is nearly always shallow, but *kirbyi* is a distinct exception, having two dorsal, conical tumours with a consequently deep furrow between them.

Prothoracic hindlobe: This is actually more or less rectangular but concave, with the posterior margin similarly curved.

Tibial spines: These include long fine basal spines, shorter distal ones.

Abdomen: Segments 4 to 7, particularly of the male, are always triangular (triquetral) in cross-section. In those with slender abdomen the segments are proportionately longer than those with fairly broad abdomen.

Vulvar scales: Although small, the vaginal lip is specifically either straight or notched in the middle, thin or sometimes very thick.

Wing shape: The forewing is normally narrow, the hindwing broadish near the base but narrow in *africana*. The wing apices are usually fairly well rounded but they are narrow in *kirbyi*.

Antenodal cross-veins: In *africana* there are 16½–18½ Ax, but this is an exception.

Pterostigma: Normally shortish, sometimes long (not "large").

Prophallus (secondary penial organ): This is discussed in some detail and it has been necessary to introduce some provisional names for certain features. Specific differences are often quite considerable but it is sufficient here to say that flagella may be conspicuous or obsolete.

Bursa copulatrix: The bursa of the female and certain characteristic sterigmata are described in detail.

The genus in Africa is a distinctive one and can usually be readily determined at sight in the field, both by general facies and habits. By far the most prevalent species is *arteriosa*.

There have been two main evolutionary trends, those with red bodies and limited black markings and the predominantly black species with yellow markings. Both have subdivided into species with either short and broad or elongated slender abdominal segments, particularly in the males.

MORPHOLOGY

HEAD (figs 1–4)

Labium: Fig. 1 shows the underside of the face of *annulata* with the labium, maxillary palpi, mandibles (the teeth densely stippled) and the ventral edge of the labrum. Fig. 49 shows the maxilla of *fumosa*.

The posterior lobe (not to be confused with same term in prothorax and accessory genitalia) of the labium is small, with a partial central ridge from the apex. The black pattern, when present in its most limited form, follows this ridge as a medial line. The lateral lobes are much larger, broadly rounded, with a rim continuous along anterior and lateral edges. In limited black marking the fascia forms a line along the inner, non-rimmed margin of both lateral lobes, continuing forwards from the line on the posterior lobe. When the black on the small lobe is broad, or when it covers this posterior lobe, the band is thickened along the inner margins of the lateral lobes, often splaying outwards along the anterior margin. In dark species the labium may be more or less entirely black.

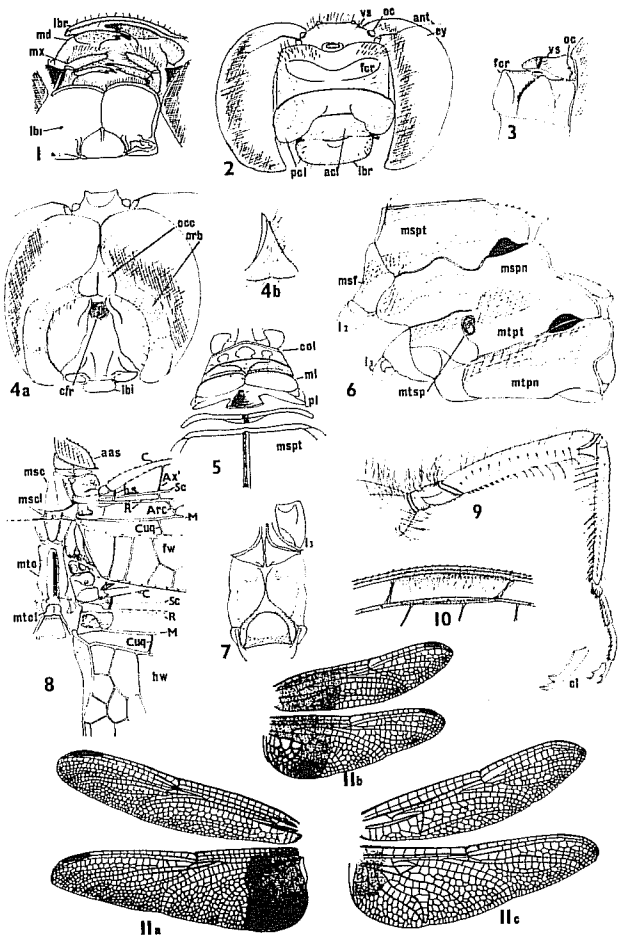
Labrum, epistome, frons, vertex: Fig. 2 shows these portions from the front. The labrum is a subrectangular plate, slightly curved, and with a centrobasal depression. Black fasciae usually start either along the ventral margin or centrally from margin upwards to the depression. A heavier fascia may be a large central macula or a T-shaped one.

The anteclypeus is well fused to the larger postclypeus and has small tufts of lateral hair which may have some minor use in sensitivity at the angles of the mouth.

The frons is in most species rather square with shallow dorsal groove and an anterior crest which is not well defined. The frons of *kirbyi*, however, has two conical peaks causing the groove to be abnormally deep. In males of most species the frons is entirely metallic above, whereas the females have a black basal band. In several of the red species, *arteriosa*, *pluvialis* and others, the male also has the band; also in the dark species *anomala*. In those males with broadly metallic frons this usually develops a violet or blue sheen at maturity but it is seldom seen in the teneral state. An exception is *stictica* which has the blue well developed in all stages. The pigment here may be con-

EXPLANATION OF FIGURES

Figs 1–11. *Trithemis* spp. 1. *T. annulata*, head, ventral. 2. The same, anterior. 3. *T. kirbyi ardens*, frons from left to show frontal crest. 4. *T. annulata*. a—Head, posterior. b—Occipital triangle, dorsal. 5. *T. annulata*, prothorax and part of mesothorax, dorsal. 6. *T. annulata*, synthorax from left, developing dark fasciae shaded. 7. *T. annulata*, metasternal pattern. 8. *T. annulata*, thoracic sinuses and wing bases. 9. *T. annulata*, right mesothoracic leg, oblique inner aspect. 10. *T. annulata*, right pterostigma, dorsal. 11. Wings of a—*T. africana tropicana*; b—*T. kirbyi ardens*; c—*T. annulata*; aas—ante-alar sinus; acl—anteclypeus; ant—antenna; b.s.—basal septum; cfr—cervical foramen; cl—claw with claw-spur; col—anterior collar; ey—compound eye; fcr—frontal crest; fw—forewing; hw—hindwing; l_1, l_3—bases of legs; lbi—labium; lbr—labrum; md—mandible; ml—median lobe; msc—mesoscutum; mscl—mesoscutellum; msf—mesinfraepisternum; mspn—mesepimeron; mspt—mesepisternum; mtc—metascutum; mtcl—metascutellum; mtpn—metepimeron; mtpt—metepisternum; mtsp—metathoracic spiracle; mx—maxilla; oc—ocelli; occ—occiput (occipital triangle); orb—back of orbit; pcl—postclypeus; pl—posterior lobe; vs—vesicle; wing veins indicated by usual symbols.



stitutionally different from other species. The vesicle or vertex is a ridge with two small peaks which are more pronounced in *kirbyi* (fig. 3). In descriptions the term vesicle will be used, not vertex.

Occiput, orbits: Fig. 4 shows the occiput, slenderly triangular dorsally, with a tuft of hair anteriorly and scattered hair on other parts; posteriorly rounded and with a central groove. Laterally and posterior to the compound eyes there are the rims of the orbits which generally show blackish bands. The hair-tuft on the occipital triangle, not always prominent, possibly helps to guide the inferior appendage of the male during tandem connection. Probably the tuft is worn off in time, perhaps during linkage.

Posteriorly the orbits are deeply concave, leading down to the foramen where the neck joins to the prothorax.

THORAX (figs 5–8)

Prothorax: Fig. 5 shows the prothorax of the female *annulata* (similar in the male), characteristic of the genus. The anterior lobe or collar has a central and two lateral depressions. Behind the collar there is a black groove (stippled) and it seems possible that the curved apices of the male's superior appendages fit in this groove during tandem linkage (q.v.). Fig. 24 shows the prothorax of *hartwigi*.

The median lobe consists of two convex ellipses in dorsal aspect, usually with black fasciae.

The posterior lobe is characteristically narrow laterally but strongly produced in the middle, this portion concave dorsally. In *hartwigi* the lateral margins of this extension are less abrupt, more oblique.

Behind this there is the anterior rim of the mesothorax, conjoined laterally to the metathorax, the two forming the usual synthorax or pterothorax of the Odonata.

Synthorax: Fig. 6 shows the shape of the synthorax and its lateral sutures. The shaded bands show the general trend of black bands in species of *Trithemis*, the cross-shaded areas being essentially nearly always more or less developed even in sparsely marked species. The two dorsal black spots at humeral and second lateral sutures are always more or less blackened depressions. All extremes are found from very sparse black marking, as in *kirbyi* to continuous and contiguous black bands in *nuptialis*. The main trends in black development commence at the small dorsal depression on humeral and second lateral suture, the laterodorsal end of the mesepisternum, a band on the mesinfraepisternum, a ventral spot on the mesepimeron and bands on the two lateral sutures. These are generally to be seen as black areas.

The anterior border of the mesepisternum has a well developed fringe of hair.

The metasternal plate (fig. 7) generally has a characteristic pattern of black. This takes the form of a lateral band on either side of the plate angled anteriorly inwards so that these bands more or less converge. Down the centre of the plate there is a narrow groove which broadens and bifurcates posteriorly and near the bifurcation there may be more black in the groove. At the posterior end of the plate there is a further black transverse band. Considering the black fasciae as a whole they tend to form a more or less complete quadrilateral with two convergent bars (in the grooves) within the posterior half of the figure. In subsequent illustrations of species this sternal pattern will be purely diagrammatic. Where the side, posterior and the anterior (inwardly directed) bars practically meet one another it will be said that the sternal black pattern is complete, with or without the addition of the central black branches (in the groove). Where there are wide gaps in the pattern it will be denoted as incomplete.

Fraser (1921; 1936: 383) indicated that this sternal black pattern is diagnostic of this genus. It is roughly a square, more or less blackened, with a central groove divided posteriorly which may often be partially black. There are exceptions in the genus where the blackening is much reduced, as in *bredoi, hartwigi, kirbyi* and *werneri;* whereas in *basitincta, stictica, pluvialis* and others it is very complete. It is not a true diagnostic feature.

MATURATION COLOURS (see also variation, p. 26)

As in many other libellulid genera, in many dark species a pruinescent exudation, said to be fatty and certainly easy to remove by heat, develops on the thorax and sometimes part of the abdomen, the underlying areas at the same time tending to darken and lose some of the clarity of their patterns. This pruinosity is generally pale or deeper blue, or greyish blue; ventrally, and on legs it may be whiter.

A few red species, such as *annulata*, develop a thin blue coating which on the red background gives the "port wine" or purplish red colour. This does not cover black areas and the pattern is not obscured.

Females when old may develop at least some pruinescence, but it is mainly in the males.

In a few black species, *atra, dichroa, aenea, brydeni*, the male at maturity does not become pruinosed but is heavily blackened, obscuring all markings. It is probably melanin pigment and perhaps spreads superficially like pruinosity but it is not removed by heat.

THORACIC DORSAL SINUSES AND AXILLARY SCLERITES

These will be briefly discussed although they have little specific significance. Fig. 8 shows these sinuses and the wing sclerites in *annulata*, only the right side being illustrated.

At the posterior end of the mesepisternum a pair of depressions, the ante-alar sinuses, are edged externally by the usual raised margin, armed with minute setae, the sinus terminating acutely. Posteriorly there are two small subsidiary triangular sclerites.

The central inter-alar sinuses (shaded) consist of a broad mesothoracic plate broadened posteriorly and blackened at the lateral angles, edged anteriorly and laterally by small sclerites. Posterior to this plate there is a pale bulbous structure, slightly constricted medially and laterally produced as ridges limiting the posterior edge of the mesothorax. The plate is dorsally and faintly grooved into three portions.

On the metathorax there are two main plates, the anterior one more deeply tripartite than on the mesothorax; the posterior plate forming two long broad ridges with a deep longitudinal groove between them. Posterior to this there is the pale bulbous tumour and its lateral ridges delineating the posterior margin of the metathorax. Posterior to this again there is a broad less chitinised plate terminating the thoracic region.

The axillary sclerites at the bases of the wings are raised above the inter-alar sinuses and repetitive in form at the bases of the main veins of the fore- and hindwing. Additional sclerites lie between the wing-bases. The axillary sclerites are more or less densely hirsute, particularly on their outer surfaces.

At the base of the costal veins of both wings there is a large basal sclerite folded back on itself, U-shaped, followed by a minute subbasal sclerite. On the hindwing this subbasal costal sclerite is prominently adorned on its anterodistal angle with a thick tuft of black hair which must have some sensory significance. A much smaller tuft is seen in the same position on the forewing.

On the sclerite at the bases of the radial veins there is a posterior tumour thickly hirsute in a dorsal manner, suggesting that this also has some sensory function.

In dorsal view, the long veins are alternately armed with minute spines, costal, radial, cubital and the posterior margin. In ventral view the intermediate veins, subcostal and medial are similarly armed. This evidently corresponds developmentally with the convex and concave veins.

At the base of the wings linking costal vein to radial veins there is a fine septum (b.s.).

The only significant features found under the heading of sinuses and sclerites are structural ones. Pruinosity is sometimes developed here.

LEG (fig. 9)

Fig. 9 shows a mesothoracic leg of a male *annulata*. The female is quite similar, but usually very slightly less hirsute. The broad, somewhat flattened coxa is attached to the mesinfraepisternum of the synthorax and is very hirsute. The trochanter is cylindrical, sharply constricted and also densely hirsute. The thick femur has rows of thick and thin hair; on the anterior surface an anterior row of hairs is replaced posteriorly by shorter seta-like hairs and then thick, short outwardly curved spines.

The tibia has rows of long and of short hair and a prominent row of setae. At the proximal end these setae are few in number and long; beyond this there is an asetal gap and then thick setae becoming progressively shorter and more curved to distal end of tibia.

Tarsus of three segments with two rows of short thick ventral setae, dense on the short first tarsal segment, more spaced on the others. Ungues (claws) ferruginous, laterally flattened, with ventrobasal convexity and the usual sub-apical tooth (claw spurs) or hooks.

The foreleg has the basal segments rather less hirsute and the hind leg much less so. The middle or mesothoracic leg has thick pilosity probably for sensitivity, such as in positioning the other legs during the seizing of prey.

In most species of *Trithemis*, at least in the males, the leg is more or less all black. In some of the darker species there are no pale areas on the femora, tibiae and tarsi, only on the basal segments. In many, however, the fore femur and sometimes the mesothoracic femur has the inner surface whitish or yellowish, generally dusted with white pruinosity at maturity.

Occasionally, as in *werneri* the tibiae are yellow on the posterior surface. In *hartwigi* the fore femur is ferruginous with a yellow inner stripe.

In *kirbyi* the legs are abnormally pale: ochreous with black lateral stripes on first and second femora, the hind femur mainly black.

In females the pale areas are generally more extensive.

In *dorsalis* there is a fine yellow exterior line on the femora. In the male it is prominent on the fore femur in the juvenile state but tends to become obsolescent at full maturity. In females it is to be seen on the mid and hind femora, but the fore femur has a basal yellow fascia instead of this continuous line.

WINGS (figs 10, 11)

The typical shape of wings in the genus is exemplified by *annulata* (figs 10, 11). The forewing, typically libelluline, is narrow with rounded apex. The hindwing is rather broad near the base, across the anal field to the tornus. In *congolica* and *basilincta* the width of the hindwing near the base is proportionately less. The extreme, among

African species, is *africana* in which the wings are long, the hindwing proportionately less broad in the anal area. In *kirbyi* there are two marked differences. The fore- and hindwings are distinctly narrowed apically and the hindwing is unusually broad near the base.

The pterostigma (fig. 10) is fairly constant in shape. In some it is either slightly thinner or slightly thicker, in others proportionately longer or shorter, but the real exception again is *kirbyi* in which it is both narrow and very short.

The venation within limits is moderately constant but the important factors rom a taxonomic aspect are the colour of the veins and the cross-vein nodal index. In most of the red-bodied species the veins are distinctly red or many of them are red. In the others the venation is very dark brown or black. In a few the antenodal and other cross-veins may be yellow, as in *dorsalis*.

Of the nodal index the antenodal cross-veins in the forewing are significant, again within limits. The last Ax should normally be incomplete, i.e. instead of extending from costa to radial vein across the subcostal vein it only reaches from costa to subcostal. This condition is aberrationally inconstant and, especially in *furva*, the last Ax may occasionally be complete. In *dorsalis*, placed at one time in its own genus *Helothemis* (on this and other characters) the last Ax is normally complete but not very infrequently it may be incomplete. In the original description of *serva* the last antenodals are inferred to be complete, but probably inaccurately.

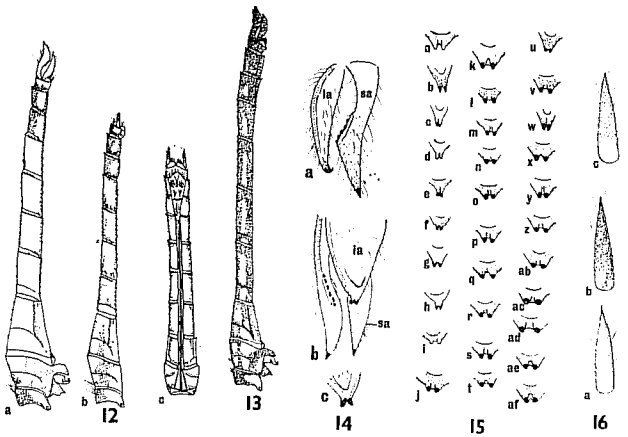
The number of Ax is of some value taxonomically. Generally it varies (in each forewing) from about 10½–12½ (11–13 in *dorsalis*). In some this antenodal index is lower, 9½–10½ or 11½: in *annulata*, *bredoi*, *werneri* and *stictica*, although in the last-named the lower figure (9½) depends on dwarfness in the examples. In *hecate* it is exceptionally low, 8½–9½, and it is therefore easy in the field to separate *hecate* from other slender-bodied dark species by a preliminary examination of the antenodal cross-veins with a lens. In those with low indices the veins are naturally more spaced out and easy to count.

A few have higher indices of 13½–14½: *aenea*, *basilincta* (up to 16½), *bifida*, *congolica*, *hartwigi* and *persephone*. With its exceptionally long wings *africana* has the highest index of 16½–18½. This increase both in length and in index is necessary support for species having sustained flight and is one reason why it is suggested that *africana* stays aloft for long periods.

In its basal wing markings *africana* is somewhat like a species of *Tramea* Hagen (*Trapezostigma* Hagen), with large coloured basal area on hindwings. It was probably one of the reasons Brauer originally placed this species in *Tramea*. In that genus long sustained flight is very noticeable. The wings are long, but the nodal index is not as high as in *Trithemis africana*. In *Urothemis* Brauer, which also has long wings, the nodal index is exceptionally low for such large species but they do not exhibit strong flight. They take short flights, frequently settling.

The basal colouring or the absence of it on the wings is of value in distinguishing species. In the dark species *atra*, *donaldsoni*, *nuptialis* and *pruinata* there is never any distinct basal or nodal amber; in *stictica* there is none at the base but often a sub-basal patch on the hindwing. In *furva* the basal amber is often obsolete. In a few, such as *basilincta* and *congolica* the basal markings are dark brown, either a fascia or short rays. In most instances the basal colouring is more or much more pronounced on the hindwing than on the forewing.

In a few, such as *kirbyi*, *monardi* and *imitata* there is a very broad basal amber zone on all the wings. Probably, the coloured basal area is of some recognition value to the sexes. In the long-winged *africana* the basal zone on the hindwing consists of a very



large dark brown area extending to the tornus, but the forewing has only a small coloured area.

In the rest the wings are most commonly hyaline, not coloured, but there are exceptions. In *anomala* there is a tendency to have somewhat fumose wings and *fumosa* is densely yellowish along the wings, deepening apically. In some other species the wing apices, as in *fumosa*, may be darkened: particularly in *aenea*, *atra grouti* and in some *monardi*. In *stictica* brown apices are exceptionally present and only in the female. In *africana*, as in *fumosa*, the wings are smoky yellowish with brown apices and this may have some recognition value for the opposite sex during flight. It is less likely that the brown tips in the other species are of any sexual significance for recognition purposes.

The bases of the wings and the short spines along the main veins are discussed above (p. 13) in connection with fig. 8.

The limited development of nodal amber in some females of certain species is discussed elsewhere (vide *dorsalis*) and appears to be either physiological or ecological. It is pronounced in southern examples of *dorsalis*, *arteriosa* and *furva*, but appears, surprisingly, in a few others such as *werneri*.

ABDOMEN (figs 12, 13)

Fig. 12 shows the abdomens of male and female *annulata* in lateral view. Segment 1 is always narrow and segment 2 in the male and most of segment 3 are necessarily deep, segment 2 housing the accessory genitalia. The middle segments 4–7 are triangular (triquetral) in cross-section, the end segments more cylindrical.

Both the shape and the black pattern are of the greatest importance in a study of the species of *Trithemis*. It would appear that the pattern of segments 1–3 is not of much significance, usually either pale or more or less black with pale lateral spots of various shapes. Segments 4–10 are all of more importance taxonomically. In the darker species these segments are mainly black with yellow lateral lines or streaks which are discontinuous. In the red species the black is more confined to the end segments.

In either case, whether black or red bodied, the abdominal segments may be long and slender in some species, short and broad in others. It may be remarked that although the tergites cannot of course be altered in shape the actual *width* of one segment,

EXPLANATION OF FIGURES

Figs 12–19. *Trithemis* species. 12. *T. annulata*, abdomen. a—Male and b—female, from left. c—Female, ventral. 13. *T. stictica*, male abdomen, from left. 14. *T. annulata*, anal appendages, male. a—Left. b—Ventral. c—Apex of inferior, ventral. 15. Apices of inferior appendages, ventral. a—*T. anomala*. b—*T. monardi*. c—*T. selika*. d—*T. bredoi*. e—*T. kalula*. f—*T. imitata*. g—*T. kirbyi ardens*. h—*T. arteriosa*. i—*T. pluvialis*. j—*T. Africana tropicana*. k—*T. fumosa*. l—*T. dichroa*. m—*T. atra*. n—*T. atra grouti*. o—*T. aenea*. p—*T. stictica*. q—*T. dorsalis*. r—*T. pruinata*. s—*T. furva*. t—*T. ellenbecki*. u—*T. hecate*. v—*T. festiva*. w—*T. werneri*. x—*T. persephone*. y—*T. falconis*. z—*T. nuptialis*. ab—*T. donaldsoni*. ac—*T. bifida*. ad—*T. basitincta*. ae—*T. congolica*. af—*T. caruncula*. 16. Left cercus, from left. a—*T. annulata*. b—*T. africana tropicana*. c—*T. kirbyi ardens*. 17. Prophallus, from left. a—*T. arteriosa*. b—The same after potash treatment. c—*T. furva*. d—The same after potash treatment. 18. Bursa copulatrix of hypothetical species (near *T. stictica*) 19. Hamules engaging vulvar lip (stippled) with hooks in *T. furva* (hypothetical). bs—bursa; bsa—bursal arm; cp—corpus; dst—dorsal sterigma; fl—flagella; gel—genital lobe; gl—glans; ham—hamule; ia—inferior appendage; ost—ostium; pf—preputial fold; proph—prophallus; ret—retinaculum; sa—superior appendage; st—stem; ves—vesica; vl—vulvar lip; vsp—vesicula spermalis; vst—ventral sterigmata; ♀8, ♀9—lateral margins of female segments.

particularly one of the middle ones, may be altered by internal muscular pressure and the flexibility of the sternal portions. Even whilst breathing sometimes the slight expansion or contraction of these segments may be visible.

In order to group these species for comparative study it was decided to consider ratios of the length of segments 4 or 5 in relation to one-half their breadth (Table 1), i.e. the width of one side of their triangular cross-section (left or right, but not the ventral surface). This is more convenient than the complete width and not affected by muscular action. They can then be tabulated, the males and females often in separate columns since the ratio of length to half-width is not necessarily the same in both sexes. For the measurements a micrometer eye-piece scale was employed in the microscope. It was necessary to use reasonably mature individuals, since in tenerals the segments can be slightly distorted. The eye-piece was focussed until the abdominal length or side rested clear against the scale.

TABLE 1. Ratios of length to breadth (one side of median carina) of segments 4 or 5

(a) 1 : 1	(b) 2 : 1 or 2.5 : 1		(c) 3 : 1	(d) 4 : 1
fumosa ♂♀	*annulata* ♂♀	*kirbyi* ♂♀	*aenea* ♂♀	*africana* ♂♀
hartwigi ♂*	*anomala* ♂♀	*monardi* ♀	*arteriosa* ♂	*basilincta** ♂ (?♀)
	arteriosa ♀	*nuptialis* ♀	*atra*—♂*	*bifida* ♂
	atra ♂♀*	*persephone* ♂♀	*bifida* ♀	*caruncula* ♂
	bredoi ♂♀	*pluvialis* ♂♀	*brydeni* ♂*	*congolica* ♂♀
	dichroa ♂♀	*pruinata* ♂♀	*caruncula* ♀	*donaldsoni* ♂
	dorsalis ♂♀	*selika* ♂♀	*donaldsoni* ♀	*falconis* ♂
	ellenbecki ♂♀	*stictica* ♀	*falconis* ♀	*hecate* ♂
	furva ♂♀	*werneri* ♀	*hecate* ♀	*nuptialis* ♂
	jacksoni ♀*		*imitata* ♂♀	*werneri* ♂
	kalula ♂♀		*monardi* ♂	
			stictica ♂	

In Table 1, the species listed in (a) and (b) have broad abdomens, the others slender. Of those marked with an asterisk *atra* male appears both in (b) and (c) because although normally with broad abdomen the male variety *leptosoma* is slender. In the case of *basilincta* the male correctly belongs to (d) but the female must be queried since no female was available for examination. In *hartwigi* and *brydeni* only the male is known, in *jacksoni* only the female. In *hartwigi* the ratio is actually nearer 1 : 1.5.

It is apparent from (a) and (b) that in the majority of African *Trithemis* of both sexes the abdomen is rather broad. The broadest of all is seen in *fumosa*. The majority of those with very slender abdomen are dark species, the red-bodied exceptions being *arteriosa* and its close relations *monardi* and *imitata* as well as *werneri*.

The abdominal segments exhibit transverse (segments 2–4) and sublateral carinae (fig. 12) on segments 3–8 as well as the dorsal carina on 3–10. These are only of significance in that the black pattern may start at these carinae and spread outwards. For instance, in *annulata* there is sometimes a black line edging the dorsal carina. The transverse carinae on segments 2–3 act as the partitions between groups of black-edged pale spots.

As far as sexual recognition is concerned it seems quite possible that either the black pattern or the pale spots enclosed by the black pattern on the distal half of the abdomen are guides for one sex or the other. The odonate antennae are extremely

short so it may be assumed that the large compound eye and its vision are the guiding factors in this respect.

In the red-bodied species with the black pattern concentrated distally or ventrally it would seem to the author that the selective feature may be whether the terminal segments are all black or whether they enclose red spots. The pattern is most often essentially the same in both sexes, the female differing in having a stouter abdomen without the ventral swelling on segments 2–3.

In the species with black abdomens the position may be similar, recognition being dependent on the presence or absence of yellow fasciae on the terminal segments. Generally the pattern again is similar in both sexes but occasionally they differ slightly. The most obvious difference is between the two sexes in *falconis*, *caruncula* and *africana*. Here, whereas the male has a single row of yellow lateral streaks the female has a double row. Would the male or female differentiate between single or double rows? Perhaps this is unlikely and it is merely whether the end segments have streaks or whether they are all black.

In both sexes there tends to be a noticeable pair of tufts of hair, dorsolaterally, on segment 1 and to a lesser extent on the basal half of segment 2. Possibly these hairtufts have some sensory function in relation to the bases of the hindwings or the membranule. This cannot be elaborated here.

There are spines on most segments as shown in the figures. Minute dorsal spines on the dorsal carina commence on segment 3, become more numerous on segments 4–6 and few again on segment 7. Terminal spines start sparsely at the distal end of segment 4, are more numerous on 5, more triangular and numerous on segments 6–10. Spines on the lateral carina extend from segments 4 to 7. In the female the spines tend to be more developed than in the male, particularly the terminal ones on the dorsal carina of segments 5–9.

In the underside illustration of the female *annulata* segment 1 is much restricted and shows an anterior fold. The soft sternal portion between enveloping tergites exhibits a continuing central ridge from segments 2 to 7. Segments 8–9 have the tergites spread out, the sternal covering becoming convex, with the vulvar lips on the distal end of segment 8, the posterior or median digitate gonapophyses showing near the base of segment 9. In *werneri* these gonapophyses are absent.

Fig. 13 shows the abdomen of male *stictica*, a dark species with slender abdominal segments. It is noticeable that in *annulata* segment 7 is approximately the same size as the previous segments, whilst in those with long narrow segments 7 is shorter than segments 4–6 but expands slightly at the distal end. Dorsal spines are sparse and the terminal spines commence at segment 5. Terminal spines are frequently absent, in fact, on segment 4. The spine pattern is not essentially different in any of the groups, even *fumosa*, *dorsalis*, *basilincta*, *africana* or *kirbyi*.

ANAL APPENDAGES AND CERCI (figs 14–16)

The superior appendage is similar to many other Libellulidae, tapering apically to an acute up-curved point and having before the apical region a ventral swelling with an armoured keel of five or six denticles. There does not seem to be much variation in this genus from fig. 14 of *annulata*.

The inferior appendage, considered to originate from a single larval structure (the appendix dorsalis) always, nevertheless, has two apical upturned teeth. The inferior is flattened dorsoventrally, wide at the base, narrowed apically and somewhat curved.

The width at the apex varies to some extent (see fig. 15) being narrower in *monardi, selika, werneri, annulata*, than in many others such as *anomala, fumosa, atra, stictica*, etc.

The apical teeth (fig. 15) of the inferior differ specifically, and also the gap between them may be very narrow in *selika, bredoi, kalula, imitata, arteriosa, hecate*. In the black-bodied species the gap is usually wide. In the red-bodied *pluvialis* it is much wider than in *arteriosa* which it superficially resembles in flight. In *dorsalis* the gap is not only wide but U-shaped, whereas in most of those with a wide gap the base of the gap is straight. In some the gap is also much shallower than in others, particularly *kalula, atra* and *hecate*.

The significance of the differences in these teeth is discussed under the heading "Tandem Linkage" (p. 28).

The left cercus of the female is illustrated for three species *annulata, africana tropicana* and *kirbyi ardens*. The shape in this genus is more or less constant and the only essential differences are whether the cerci are all pale, or brown or black distally, or, again, all black.

ACCESSORY GENITALIA (eg. fig. 22)

On the ventral surface of segment 2 these, as in all modern Odonata, consist of hamules (hamuli) attached inside the lower edge of the tegumen and the secondary peneal organ or prophallus which lies attached to the soft ventromedian part of the segment. In addition, in Libellulidae, there is a hood-like anterior lamina and, posteriorly, a pair of genital (posterior) lobes, these last being extensions of the sides of segment 2.

These various features will be examined in some detail.

The hamule and hook, as in many other Libellulidae, is the inner hamule or 1A (of Ris), the outer hamules being obsolescent.

Anterior lamina: This is a hood-like structure at the anterior end of segment 2. It may help, in conjunction with the hamules, to protect the outer surface of the prophallus when retracted. It is well developed and often heavily chitinised as may be seen from the dotted areas in the various figures. In general shape the lamina is rounded on the outer or anterior surface and generally slopes up to a narrowed apex. But in some there is a distinct bifurcation at the apex, particularly in *caruncula, bifida, brydeni* and *donaldsoni*. Sometimes, as in *caruncula* and *africana*, there is a partition or septum inside. In *persephone* there is a very characteristic pair of apical tumours. In *caruncula* and *congolica* the apical portion is folded back, i.e. anteriad.

The outer surface may be more or less evenly covered with hair, sometimes long hairs. In others such as *basitincta, dorsalis, pruinata, furva, werneri, bredoi, kalula, dichroa* or *ellenbecki* there is a more or less isolated tuft of long hair, occasionally setose, which is characteristic. In some the hair is sparse. In a few, such as *stictica*, there are very short setae as well as the hair, but not at the apex.

It is difficult to suggest the purpose of these hairs. But the inner surface of the lobe often bears long protruding hairs which are probably stimulatory or for guiding, either the prophallus or some portion of the female's abdomen.

Is the divided apex of the few species, the central partition of some and the double tumour of *persephone* indicative of a paired origin in the past? This suggestion is discussed further under *persephone* (p. 55).

Hamules: In these Libellulidae it is the inner hamule which is well developed. In this paper it will be alluded to simply as the hamule.

The extent of chitinisation varies, but it is usually the darker species which have the blackest hamules. The shape varies to some extent but it is mainly the hook and the ridges at the base of hook and of the hamular stem which are the most divergent. Although externally the hamule appears solid it is actually more or less hollowed out internally, probably to allow the prophallus to be easily protruded. The hook itself, whether large or small has its gape limited by a membrane but the gape can be reduced, as in the process of coition (see *furva*, fig. 19), by the hook being brought down nearer the stem: the hook is more or less hinged on an angular portion of its basal ridge.

It seems possible that during coition the hooks may grip the lateral margins of the lip of the female's vulvar scale. On the other hand this would infer that those species with longer hooks would either fit more deeply or the lips would be thicker or deeper. There seems to be no definite correspondence between length of hook and thickness of lips. The males with extra long hooks are as follows: hook long and well curved—*ellenbecki, hartwigi* (of which there is no known female) and *furva;* hook more gradually curved, sickle-shaped—*bifida, bredoi, brydeni, donaldsoni, kalula, kirbyi ardens, persephone* and *werneri;* hook nearly straight—*africana, basitincta* (no female examined), *caruncula* and *congolica*.

Of the known females corresponding to the long-hook males which have thick or deep vaginal lips: *kirbyi ardens, furva* and *werneri* have very thick lips, well extended, as seen in exposed surface ventral view; *ellenbecki* and *persephone* have rather thick lips in ventral view; *kalula* and *donaldsoni* have deepish lips only from internal, dorsal view.

Yet, *dichroa* and *pruinata* have very thick, deep lips in the female; *dorsalis* and *pluvialis* have moderately thick lips from ventral aspect, *hecate* and *selika* similarly from dorsal view. These, in the males, do not have long hamular hooks.

Then, again, it has not been found that certain long-hook species have correspondingly thick lips in the female. These are *africana, bifida, bredoi, caruncula* and *congolica*. The female *basitincta*, closely allied to the last two, may be here too, but it has not been investigated.

From this it must be concluded that the shape of the hamular hook is not paralleled by the shape of the vulvar lips. It is possible, however, that the hooks do engage under the lips at the sides. This possibility is diagrammatically suggested in fig. 19 for *furva*.

One more aspect of the hamules, as in other parts of the accessory genitalia, is the development of setae on the outer edge of the hamular hook. There are always hairs on the basal part of the hamulus and on the other organs and some of these may have a sensitive, guiding function. The outer apical setae are short and are well developed in most species, particularly *aenea, africana, anomala, annulata, arteriosa, atra, dichroa, dorsalis, ellenbecki, festiva, fumosa, furva, hartwigi, hecate, imitata, kalula, nuptialis, pluvialis, pruinata, selika, stictica* and *werneri*.

The purpose of these setae is not clear unless they stimulate some part of the female's 8th or 9th segments.

Genital or posterior lobes: The posterior or genital lobes are paired extensions of the lateral body wall and are considered to help in guiding the mating process and to lie on either side of the female's 8th abdominal segment. To avoid confusion in terms with the posterior lobe of the labium and prothorax they will here be called genital lobes.

They are variable in extent of chitinisation, as can be seen from the dotted areas in the different figures; they vary much in shape; and they may extend close to the hamules or well posterior to them.

They often have apical setae instead of hair but *only* if they extend close to the hamules. If they are away from these they have no apical setae, only hair. Species with prominent apical setae are *aenea*, *anomala*, *annulata*, *arteriosa*, *atra*, *dorsalis*, *ellenbecki*, *falconis*, *festiva*, *fumosa*, *hartwigi*, *hecate*, *imitata*, *kalula*, *monardi*, *nuptialis*, *pluvialis*, *pruinata*, *stictica* and *werneri*.

Species with the lobes extending well away from the hamules are *africana*, *bifida*, *donaldsoni*, *basitincta*, *caruncula* and *congolica*. Perhaps the apical setae in most of the others may have some stimulatory or guiding effect in connection with the hamules and are thus unnecessary if hamules and lobes are far apart. In these species the lobes are slender or robust, short or long, but tending to taper.

In the remainder the lobes may be long, broad at the base, curved in towards the hamules at the apex for instance in *nuptialis*. In *persephone* or *werneri* they are very weakly developed. In some, such as *persephone*, *fumosa*, *dichroa*, *kalula*, etc, they taper distally; in others they are more parallel-sided, as in *selika*, *kirbyi* or *anomala*, or partially so, as in *monardi*. Some of these, however, show a certain amount of variation, particularly n the distal width. One remarkable exception is *annulata* in which the lobe is broader distally than at the base where it leaves the body wall. In *hecate* the lobe is uniformly very broad.

Prophallus (*penis or peneal lobe*) (fig. 17): As in all modern Odonata this is a secondary structure. In *Trithemis*, as in other Libellulidae, it is highly complex. The terms for the various parts, required here for comparisons in the different species, are taken from Fraser (in Tuxen, 1956: 25–28).

In *arteriosa* (fig. 17a, b) the main prophallus is short, rounded in outline. The corpus or body is short, there are no flagella, the glans is short and broad. Below the glans there is an elongated scoop-like structure which is here called a retinaculum which appears to be a sort of sheath or holder for flagella when these are present.

When this prophallus was masticated in caustic soda and cleared with alcohol and xylol, further internal structures were visible, these being partly spread out in fig. 17b. The two slender roots of the retinaculum are visible. Within the two somewhat valve-like portions of the glans is seen a broad structure here called a vesica (ring-dotted). This vesica has an upturned root and along its lower edge is a finely spinous portion which evidently lies at rest in the retinaculum.

In *furva* (fig. 17c, d) the corpus is more robust, the glans more elongate, the vesica broad, irregular, exposed, very spinous. Flagella are well exposed, the retinaculum flat rather than scooped. After maceration in caustic soda the vesica is seen to be double and contains a well-chitinised crescentic object in each portion. The root of the retinaculum is rather bulbous.

In some species there are curved horns from the apex of the corpus which will be called cornuti. These species with cornuti are *africana*, *anomala*, *bifida*, *brydeni*, *caruncula*, *congolica*, *dichroa*, *dorsalis*, *hecate*, *nuptialis*, *persephone*, *pluvialis* and *stictica*.

It was thought that there might be some connection between the existence of cornuti in the male prophallus and the form of arms to the bursa in the female. This is not the case. In most of those with cornuti the bursa has broad arms but in *anomala*, *dorsalis*, *nuptialis*, *persephone* and *stictica* the bursal arms are long and slender.

The majority of the species have conspicuous flagella and it might be supposed that the bursal arms will be receptacles for these during coition. This may be the case but there is no direct connection between long flagella and whether the bursal arms are hick or slender.

The following males have long flagella: *aenea*, *africana*, *anomala*, *bifida*, *caruncula*, *dorsalis*, *ellenbecki*, *fumosa*, *furva*, *kirbyi ardens*, *nuptialis*, *persephone*, *pluvialis*, *pruinata*, *stictica* and *werneri*.

Of these some have thick bursal arms: *aenea*, *africana*, *bifida* and *caruncula*; the others have slender bursal arms: *anomala*, *dorsalis*, *ellenbecki*, *fumosa*, *furva*, *kirbyi ardens*, *nuptialis*, *persephone*, *pluvialis*, *pruinata*, *stictica* and *werneri*.

Two others, *congolica* and *donaldsoni* have short flagella. *T. congolica* and *donaldsoni* have thick bursal arms. *T. basitincta* also has short flagella but no female was examined.

Those clearly without flagella on the prophallus include *arteriosa*, *annulata*, *atra*, *bredoi*, *brydeni*, *dichroa*, *hartwigi*, *imitata*, *kalula*, *monardi* and *selika*. Most of these are red-bodied species with red venation, but *atra*, *brydeni* and *dichroa* are dark species.

In *hartwigi* and *brydeni* no female is known; in *jacksoni* no male is known; in *festiva* no female was available for examination; in *nigra* only the male is known and the prophallus was not examined.

The prophallus may be studied from various aspects, such as presence or absence of conspicuous flagella or cornuti (Table 2).

TABLE 2. The occurrence of flagella or cornuti on the prophallus of *Trithemis* species

Flagella		Cornuti	
present	absent	present	absent
aenea	*annulata*	*africana*	*aenea*
africana	*arteriosa*	*anomala H*	*annulata*
anomala	*(aurora)*	*bifida*	*arteriosa*
atra	*bredoi*	*brydeni H*	*atra*
basitincta	*brydeni*	*caruncula*	*(aurora)*
bifida	*donaldsoni*	*congolica*	*basitincta*
caruncula	*hartwigi*	*dichroa H*	*bredoi*
congolica	*hecate*	*dorsalis H*	*donaldsoni*
dichroa	*imitata*	*hecate H*	*ellenbecki*
dorsalis	*kalula*	*nuptialis H*	*falconis*
ellenbecki	*monardi*	*pluvialis H*	*(festiva)*
falconis	*werneri*	*stictica H*	*fumosa*
(festiva)			*furva*
fumosa			*hartwigi*
furva			*imitata*
kirbyi		"rolled" "horns"	*kalula*
nuptialis			*kirbyi*
pluvialis			*monardi*
pruinata			*pruinata*
stictica			*werneri*

Most of the dark bodied species have conspicuous flagella (Table 2) with a few exceptions such as *hecate*, *brydeni* and *donaldsoni*, the latter thus separated from its near relative *bifida* which has flagella. The red *annulata-arteriosa* group nearly all lack the flagella but they are present in the conspicuously red *kirbyi*.

Cornuti are possessed by only a very few species, all except *africana* and *pluvialis* being dark species. This character not only separates *pluvialis* from other red species but it again separates *bifida* from *donaldsoni*; and *dorsalis* from *furva* and *pruinata*.

Further subdivision might be possible. For instance, in those with cornuti, some have these horns directed away from the body of the prophallus (curved "upwards" in the figures): *africana*, *bifida*, *caruncula*, *congolica*, *dichroa* and *pluvialis*.

Another subdivision could be on general shape. For example, the *arteriosa* group all have the apical portion of the prophallus somewhat rounded and of similar appearance: *arteriosa, bredoi, hartwigi, imitata, kalula, monardi.*

FEMALE GENITAL APERTURE AND THE BURSA (fig. 18)

The vaginal or vulvar lips, often known as the vulvar scale, are generally easily observed on the underside of the 8th abdominal segment near the distal end (see *annulata*). The thickness and shape of the lip has already been discussed under the male accessory genitalia and is mentioned again under each species.

The bursa can be examined by removal of the soft ventral portion of segment 2. It is often found to have a pair of arms at the anterior end and, protecting the ostial aperture, there are characteristic plates, more or less chitinised. In an example of *furva* from the Chimanimani Mountains the ostium has been shown, surrounded by these plates or sclerites.

For convenience in this paper these sclerites can be named here by comparison with those found in Lepidoptera. Each is there referred to as the *sterigma* (Bryk, 1918; vide Diakonoff, 1954). Dorsally, there are the posterior sterigmata or lamellae postvaginalis (Kusnezov, 1915), which will here be called the dorsal sterigmata since they are not necessarily posterior in *Trithemis* species. Similarly, the ventral lamellae antevaginalis (of Kusnezov) will be simply the ventral sterigmata.

The bursal arms are long and slender in many species, such as *anomala, dorsalis, ellenbecki, fumosa, kirbyi ardens, nuptialis, persephone, pruinata* and *stictica;* and thick, often short, in *aenea, africana, annulata, bifida, bredoi, caruncula, congolica, donaldsoni, hecate, imitata, monardi, pluvialis, selika* and *werneri.* In *persephone* the slender arms appear to be banded.

There is a tendency for asymmetry in the sterigmata, particularly in the coiled ventral plates.

In most species the dorsal sterigma is a single, solid, rather flask-shaped structure. It may be conical in *atra, nuptialis* and *stictica;* very slender in *jacksoni* and *kalula;* broad, often bifid posteriorly, in *congolica, dorsalis, donaldsoni, hecate* and others; sometimes slightly bifid anteriorly, as in *donaldsoni, bredoi, kalula,* etc; sometimes somewhat fan-like, more or less completely divided, in *pruinata, furva* and *ellenbecki.*

The ventral sterigmata are generally paired, often more or less connected to the posterior end of the dorsal sterigma in *atra, arteriosa, anomala, kirbyi ardens* and others; or as broad, elongate straps in *pruinata* and *furva.* In teneral females these processes may be *less* complete as in *dorsalis* depicted from Bulawayo. In a few there are divergent, slightly hirsute or plumose anterior ventral sterigmata: in *arteriosa, jacksoni, hecate, selika, annulata, monardi* and *bredoi.*

Posterior to the vulvar lips, on segment 9, are the vestigial median gonapophyses, in the form of two digitate processes (fig. 19). If these have any residual function they may, perhaps, be sensitive structures guiding the position of the anterior lamina of the male. In *werneri* these gonapophyses appear to be obsolete, with only the crescentic depression in evidence.

SEPARATION OF SPECIES ON FEMALE GENITALIA

1. The most pronounced invagination of the vulvar lip is seen in *dichroa, furva, jacksoni, pluvialis, pruinata* and *werneri.* Rather less excised are *bredoi, dorsalis, hecate* and *selika.* The rest have rather straight lips.

2. Bursal arms short and thick: *aenea, africana, annulata, arteriosa, bifida, bredoi, caruncula, congolica, donaldsoni, hecate, imitata, monardi, pluvialis, selika* and *werneri.* The *arteriosa* group of species are all in this section and it also shows the affinity between *donaldsoni* and *bifida* which, on penecal grounds are very different. The remainder mostly have long, slender bursal arms.
3. Dorsal sterigma more or less conical. This includes most species: *aenea, africana, arteriosa, atra, bifida, bredoi, caruncula, donaldsoni, dorsalis, hecate, imitata, kirbyi, monardi, nuptialis, persephone, selika* and *stictica.* This again confirms the link between *bifida* and *donaldsoni,* but it separates *caruncula* from *congolica* (in group 5); and *arteriosa* can fall into this or the next group.
4. Dorsal sterigma mainly slender. Not a well defined group: *anomala, arteriosa, falconis, fumosa, jacksoni, kalula* and *werneri.*
5. Dorsal sterigma consisting of paired fan-shaped plates more or less connected. Distinctive in appearance: *congolica, dichroa, ellenbecki, furva, pluvialis* and *pruinata.* This separates the closely allied *ellenbecki, pruinata* and *furva* from *dorsalis;* and, as stated above, *congolica* from *bifida.*
6. With divergent anterior ventral processes, sometimes hirsute or ctenose. A distinctive feature, found in *annulata, arteriosa, dichroa, dorsalis, hecate, imitata, jacksoni, monardi* and *selika.* It shows a peculiar relationship, seen also in the male genitalia between *dichroa* and the *arteriosa* group of species. And it separates *dorsalis* from the *furva* relatives.

VARIATION

(see also Thorax, p. 12)

Most of the variation seen in the genus is of a minor nature. It consists firstly of the extent of black markings on lips, sometimes on postclypeus and frons, and on thorax and abdomen.

Sometimes these developments are purely ageing criteria, particularly as it affects lips, thorax and abdomen. These are discussed under the various species.

Quite often in the male the more adult examples become coated with pruinescence, particularly the species with blacker abdomens. This pruinosity may be of a pale shade of blue or more often in this genus a deeper shade, almost violet at times. If the pruinescence is removed by heat, since it is a fatty exudation, the underlying thorax will be found to be more extensively blackened than before pruinosity started. In a few, however, there is no pruinescence but the body becomes more or less entirely black, as in *atra* and *dichroa*.

Among the red-bodied species there may also be a development of thin blue coating in the mature male giving a reddish purple effect, as in *annulata*, *kalula* and to a lesser extent in *arteriosa*. In these the removal of pruinescence does not show extensive blackening.

It cannot really be considered that the pruinose blue species with heavy underlying of black, nor the black species like *dichroa* are melanic tendencies since their blackness is a normal late development. In one of the red species, *pluvialis*, however, a true melanic aberration with much more black than usual is described under that species.

On the other hand some *Trithemis arteriosa* are much paler, with less black than average. These are discussed under that species as forms or subspecies. A Socotra male shows less black on segments 4–5; an Ennedi subspecies has only traces of black on segments 4–6; and the extreme of form *stuhlmanni* has segments 4–7 almost entirely red. Some of these paler examples may result from more arid territories. In *annulata* from desertic areas in North Africa a general paleness is seen. Arabian examples may be very extensively amber.

Sexual dimorphism in colour and pattern is not very evident because generally the female body markings are very similar to the teneral or juvenile male. There is, however, a difference in the frons, often heavily metallic with coloured sheen in the male, but the corresponding female having a black basal band sometimes emitting some colour. In the females of a few of those with black abdomen there is a doubling of the yellow lateral streaks where the male has only one row of fasciae. This is seen, for instance, in *caruncula* and *falconis*. It is not a criterion, however, for a dark species with one row of fasciae in the male to have two rows in the female.

Wing colouration can be very variable in some species. In the many species with basal amber this may vary in extent or in darkening, particularly in the red-bodied species such as *annulata*, *arteriosa* and *kirbyi*. In *arteriosa* the variation may have some significance in racial differentiation. In *kirbyi ardens*, the African race of *kirbyi*, the large amber area of the male is apparently less uniform in the more arid zones. In this species the female shows distinct dichroism or even polymorphism. In the normal female there is an isolated patch of amber in the anal area of the hindwing. In some from Nigeria and Madagascar the female is andromorphic with extensive basal amber as in the male.

In a few species, notably *arteriosa*, *dorsalis* and *stictica* the nodal regions are normally hyaline, yet specimens, particularly from the Cape or sometimes Natal may show strong nodal and costal amber development. It is suggested that this is due to ecological or climatic conditions.

Another form of variation is in the infuscation at the wing apices. In the western race of *monardi* the apices are normally brown, but not in the eastern race. In *stictica*, however, the female may sometimes, in Mozambique or Ngamiland, have pronounced brown apices where this is not the normal development. The significance of this is not clear since these two regions are widely different ecologically. Such variation in the females of the common dragonfly, *Hemistigma albipuncta* (Rambur), appears to be incidental, occurring frequently in the same locality. It is rarer in *stictica* to have brown apices.

Brown apices are developed narrowly in *atra grouti* but not in the nominotypical race. Subspecific differences are well marked in the basal coloured zone of *africana*.

As in all dragonflies except those with very pallid pterostigmata the pterostigma darkens with age from the pale yellow of many tenerals. There is very little noticeable variation however.

Lastly, size is a variable factor although the variation is not generally considerable. Yet in *stictica* dwarfs of both sexes may be found and a long series of these was taken at the Victoria Falls in small rain pools close to the river. Along the river bank the *stictica* were of normal size. It would appear that the small specimens found less nourishment in the larval stage and hastened their metamorphosis. One result of the diminished size was a reduction in width of the discoidal field of the forewing.

TANDEM LINKAGE

In the link process it appears that the inferior appendage of the male slides posteriorly along the grooves at the inner edges of the contact line of the compound eyes of the female until the dorsal apical teeth of this appendage can lock against the lateral slopes of the female's occipital triangle.

The superior appendages have a hold on the back of the female occiput by virtue of the row of short ventral spines on the superiors. The upcurved apices of the superiors dip into the glossy black depression behind the anterior collar of the female prothorax and the rough dorsal surfaces of the appendages may press back against the hirsute posterior margin of this depression, which is the anterior edge of the middle lobe. The female's head might be able to help the lock against her prothorax.

The two apical teeth of the male's inferior appendage are variable in shape and their distance apart (fig. 15). This suggests that the triangular occiput of the female may vary in width in the apical portion. The occiput does not appear, however, to exhibit very much variation in this respect and presumably those males with the teeth very close together, as in *selika*, *bredoi*, *kalula*, *hecate*, etc, must link with the triangle close to its apex, whilst those with a marked gap between the teeth must slip further back from the apex of the occiput. In a few species such as *dorsalis* and *furva* with a wide gap between the teeth the female occiput is rather flat close to the apex, without much of a slope on either side. Hence the necessity for the wider gap to allow the inferior to slip back to where the slopes are more pronounced.

Abnormal pairing may occasionally be noticed. For instance, at Vila Paiva, Mozambique, September 1957, a male *Diplacodes lefebvrei* (Rambur) was taken after it linked in tandem with a female *Trithemis arteriosa* (Burmeister). These two genera are closely allied but the superior appendages of the male *Diplacodes* Kirby are straighter than in *Trithemis*, less up-curved apically and subapically without the ventral swelling.

ECOLOGY

The majority of African species breed in slow-flowing reedy streams or lakes, pools and swamps which have plenty of reeds or fringe vegetation. The adults generally take short flights from one perch to another or back to one particular perch if, perhaps, it is more suitable in strength, height or position than other reeds. If the resting place commands a narrow channel of water or if it is on a prominent stem amongst fringe vegetation on the bank of a river the adult will often exhibit territorial claim, chasing off other males approaching the perch.

When first alighting the wings may be more or less level. In sunshine the wings are then characteristically sloped downwards and forwards in many species, particularly for instance the red-bodied species *annulata* and *arteriosa*, and the blue *stictica*. This down-sloping of the wings soon after settling on a warm, sunny day, is of course, seen in various other libellulid genera when settling in the open. Sometimes these *Trithemis* species will settle on twigs of trees or shrubs, particularly leafless twigs. These are mostly females and immature males.

Species very commonly found at quiet reedy pools, streams or swamps include *annulata*, *arteriosa*, *dorsalis*, *furva* and *stictica*. These are widespread, often abundant, especially the first two. In fact *annulata* and *arteriosa* are adaptable to most dragonfly habitats except forest. Consequently they are found almost throughout Africa, even in semi-arid localities.

Other species favouring quiet reedy waters are more local, for instance *anomala*, *falconis* and *hecate*. Immature males or the females may be found on twigs of trees away from the water. On one occasion in the Okavango swamps the author collected nine *hecate* (of mixed sexes) on one twig near the base of one leafy tree. As soon as one was "netted" another would take its place. In south central Africa a locally abundant species in swamps or reedy streams and pools is *monardi*, a peculiar species, with its broad, brown-spotted amber-based wings. In flight it tends to flutter slowly, occasionally darting forwards more rapidly, then settling with wings half-raised; later dipping them. It is very like a species of *Rhyothemis* Hagen in its flight. The closely related *imitata* is found locally further north on reedy pools or reed-fringed rivers but its flight is quite normal. In similar areas *bredoi* may be found.

The brightly coloured *kirbyi ardens* generally prefers rivers and well-flowing streams, particularly if there are rocks in the water or close to it. They settle readily on stones, rocks or sand. Exposure to sun and warmth seems to be important to this species. Consequently it is found in hot dryish or semi-arid country and is widespread, like the nominotypical race. On the other hand *donaldsoni* likes rather similar territory, but less arid. Fast flowing streams or rivers, especially strong ones, in dry bush country, attracts this species.

Closely allied to *donaldsoni* is *bifida* but it is so little known at present. It appears to prefer moister areas. The red-bodied *pluvialis* is more widespread and gregarious, favouring either rocky or reedy streams. Another species of dry bush country, in low-lying areas, is the slender red-bodied *werneri*. It is found in numbers near the larger rivers where they flow through bush in their lower reaches. To find *werneri* it is necessary to search twigs a short distance from the river.

The species *caruncula* is again locally common on rivers fringed with thick bush, gallery forest. It is somewhat shy and settles on trees where it can dart quickly to cover. Its close relatives *basitincta* and *congolica* have similar shy habits but they prefer equatorial forests rather than bush. Equatorial or similar forests are the haunts of the black species, *atra*, *dichroa* and *aenea*, as well as of the dark blue *nuptialis*. The species *atra*, however, is more adaptable and may also be found in tropical Africa over open fast running water, settling on reeds on the bank. Again, *pluvialis* may be found in forest in tropical Africa.

I have not seen *africana* in life but it would appear from its long narrow wings, large numbers of antenodal cross-veins and the large basal patch on the hindwing that it must be capable of long sustained flight, probably in fairly open country over swamps. Also not seen in life are *ellenbecki* of Ethiopia, *fumosa* and *kalula* of equatorial Africa and the purely insular species *hartwigi*, *nigra*, *persephone* and *selika*.

DISTRIBUTION

The genus is spread mainly over Africa and neighbouring islands and territories, with a small number of species in Asia.

The distribution of some species is limited by their ecological preferences as discussed above. For instance, the dark species *basitincta* and *congolica* are very wary species seeking the protection of forest trees on the banks of rivers or streams in tropical Africa, whilst *nuptialis* is more generally dispersed in such forests.

On the other hand, the dark *hecate* and *falconis* prefer open swamps. The black species are mainly found from equatorial to south central Africa. The blue species *ellenbecki*, *dorsalis* and *furva* are most prevalent in the east and south of the continent.

Most of the red-bodied species occur in open pools or streams. Arid conditions do not deter *arteriosa*, *annulata* and *kirbyi* so that these are the most widespread of all, the latter two extending, in fact, into Asia. The most abundant throughout Africa is *arteriosa*, frequently a dominant in any odonate locality. The fluttering species *monardi* is confined to swamps and pools in south central Africa. The species *bredoi* and *kalula* are only found in equatorial Africa. Yet *pluvialis*, found locally sometimes in pools or open streams may also be seen in heavy forest.

In Mauritius the only representative of *Trithemis* is *T. annulata haematina* which, however, is a dominant libellulid there. It occurs also in Madagascar together with other species including the endemic *persephone* and *selika*. In the Comoro Islands there is a local race of *selika*. But no *Trithemis* species are found anywhere in the Seychellian island groups, or on Cosmoledo, Gloriosa or Aldabra. Two other insular endemics on the other side of Africa are known, however, *nigra* on Principe Island and *hartwigi* on Fernando Po Island, in the Atlantic Ocean.

The general distribution of the African species is shown in Table 3, in which fifteen regions are employed, representing the following areas:

Equatorial West Africa: Gabon and Cameroons to Nigeria and westwards to Liberia and Sierra Leone.

Equatorial Congo: Congo (Brazzaville) and the northern half of Congo (Kinshasa).

Sudan.

Ethiopia: Abyssinia, Somalia, Eritrea.
East Africa: Uganda and Kenya (except the northern provinces); Tanzania, Zanzibar.

Central Africa: Angola, Katanga, Zambia and Zambezi Valley, Malawi, Mozambique, northern Ngamiland (Botswana), Eastern Rhodesia, Natal.

Karoo: Most of Rhodesia, southern Botswana, Transvaal, Free State.

Cape Province and S.W. Africa.

North Africa: Territories north of the Sahara, Morocco, Algiers, Tripolitania, Libya, Egypt.

Guinea Gulf Islands: Fernando Po and Principe islands.

Cape Verde Island: Off N.W. African coast.

MADAGASCAR.

MAURITIUS: Mauritius, Réunion and Rodrigues.

COMORO ISLANDS.

ORIENTAL: By this heading is meant any Oriental country in which an African species of *Trithemis* occurs, between Arabia eastwards to Philippines and Indonesia.

The most productive areas (Table 3) for species of the genus are, as would be expected, Equatorial West Africa (19 species), Equatorial Congo (22), East Africa (17) and Central Africa (20). The lowest numbers of species are found in the islands, other than Madagascar, North Africa and the Oriental section.

By far the most widespread species in Africa are *annulata* and *arteriosa*, with *kirbyi* and *furva* following them. The distribution of *arteriosa*, however, although undoubtedly the commonest *Trithemis* species in Africa, does not extend far into Asia and from this aspect *annulata* is of wider distribution than both *kirbyi* and *arteriosa;* and it extends into southern Europe as apparently the sole northern representative of the genus.

As far as known at present the most restricted in distribution are *anomala*, *bifida*, *brydeni*, *congolica*, *ellenbecki*, *falconis*, *fumosa*, *hartwigi*, *jacksoni*, *monardi*, *nigra*, *persephone* and *selika*. The species *kalula* may be known only from Sierra Leone and Congo but these territories are both equatorial and they are far apart. In all probability it occurs in many places in between. Naturally the endemic insular species *hartwigi*, *nigra*, *persephone* and *selika* are even more confined in distribution than some of the others, but in the present state of knowledge *bifida*, *ellenbecki*, *falconis*, *fumosa* and *jacksoni* are also extremely limited geographically.

The more arid localities only have the widespread red species *arteriosa* and, if a suitable place, for instance with rocks, then *kirbyi ardens* may frequent it.

The distribution of the species on the African continent is broadly as follows:

1. Heavy forest of equatorial bias: mainly dark, slender-bodied species with close venation, high antenodal index, such as *aenea*, *basitincta*, *congolica*, *nigra*, *nuptialis*, with the thicker bodied black *dichroa* as a variant. In such forests *nuptialis* is often the dominant *Trithemis*.
2. Lighter forest areas and thick bush: may contain some dark species, such as *atra*, *brydeni*, *dichroa* and the thin-bodied *caruncula;* also the red species *pluvialis* and, in clearings, *arteriosa*.
3. Open swamps or slow-flowing waters with plenty of low vegetation: the dark-bodied *anomala*, *stictica*, *hecate* and *falconis;* the red-bodied *arteriosa*, *annulata* and *monardi*.
4. Streams and rivers fast or slow, with some bush or at least plenty of low vegetation: the dark-bodied *dorsalis* and *furva;* the red-bodied *arteriosa* and *annulata*.
5. Arid or semi-arid conditions, especially where there are rocks: the dark-bodied *donaldsoni*, and the red-bodied *annulata*, *arteriosa* and *kirbyi*.

TABLE 3. Distribution of African species of *Trithemis*. For definition of areas see text (p. 31)

	Equat. W. Africa	Equat. Congo	Sudan	Ethiopia	East Africa	Central Africa	Karoo	Cape Prov., S.W. Africa	North Africa	Guinea Gulf Islands	Cape Verde Island	Madagascar	Mauritius	Comoro Islands	Oriental (African species)
aenea	+	+													
africana	+	+	+												
annulata	+	+	+	+	+	+	+	+	+		+	+	+		+
anomala						+									
arteriosa	+	+	+	+	+	+	+	+	+		+	+		+	+
atra	+	+			+	+									
basitincta	+	+			+										
bifida						+	+								
bredoi	+	+													
brydeni						+									
caruncula	+	+			+	+	+			+					
congolica		+													
dichroa	+	+	+		+	+									
donaldsoni	+	+		+	+	+	+								
dorsalis		+			+	+	+	+							
ellenbecki				+											
falconis						+									
fumosa		+													
furva	+	+	+	+	+	+	+	+				+			
hartwigi										+					
hecate	+	+			+	+	+					+			
imitata	+	+			+										

TABLE 3 (Continued)

	Equat. W. Africa	Equat. Congo	Sudan	Ethiopia	East Africa	Central Africa	Karoo	Cape Prov., S.W. Africa	North Africa	Guinea Gulf Islands	Cape Verde Island	Madagascar	Mauritius	Comoro Islands	Oriental (African species)
jacksoni	+														
kalula	+	+													
kirbyi	+	+	+	+	+	+	+	+				+		+	+
monardi						+	+	+							
nigra										+					
nuptialis	+	+			+	+									
persephone												+			
pluvialis		+			+	+	+								
pruinata	+	+			+	+									
selika												+		+	
stictica	+	+		+	+	+	+								
werneri			+		+	+	+								
Total	19	22	7	7	17	20	13	6	2	3	2	7	1	3	3

DEVELOPMENT

Very little has been published hitherto on the development of African species of the genus and only a preliminary generic diagnosis can be attempted here. References to the descriptions of the larvae of only four species will be included and consequently no key or revisional notes can be satisfactory. Fig. 20 illustrates the dorsal aspect of a typical *Trithemis* larva.

GENERIC DESCRIPTION (from available material)

Total length 12–18 mm.

Head: straightish posteriorly, rounded at lateral margins. Compound eyes large, postlaterally prominent. Antennae of moderate length, at least twice as long as the distance between their bases.

Mask: fairly deeply concave; reaching posteriorly to coxae of middle legs. Median lobe conical. Lateral lobes not crenulate at inner margins. Moveable spine slender. Mentum with 7–11 setae, some or all of which may be long and slender or a few very short. Lateral lobes each with 6–8 setae.

Legs: rather long and slender, generally banded or spotted with dark brown fasciae. Claws long and slender.

Body: sparsely haired, with few setae.

Abdomen: broadly ovate, short and triquetral. With pronounced dorsal keel of strong hooks on segments 3 or 4–9. Segments 8–9 with short postlateral spines.

Appendages: dorsal appendage well developed, longer than segments 9+10; cerci equally long. Cercoids short or very short.

Published descriptions of larvae are as follows: *T. annulata:* Conci & Nielsen, 1956: 276, 277; *T. arteriosa:* Barnard, 1937: 257; Pinhey, 1962b, 231; *T. dorsalis:* Barnard, 1937: 254; Pinhey, 1961c: 169; *T. kirbyi ardens:* Pinhey, 1961c: 167.

The ova of those examined are sub-elliptical and are laid, as in most Libellulidae, on the surface of water, either clear or reedy, depending on the species. The eggs sink down to the nearest solid object which will detain them.

SPECIES AND SPECIES GROUPS

SPECIES

The species of *Trithemis* recognized in this revision (without subspecies and synonyms) are:

aenea Pinhey
africana (Brauer)
annulata (Beauvois)
anomala Pinhey
arteriosa (Burmeister)
atra Pinhey
[*aurora* (Burmeister), Oriental only]
basitincta Ris
bifida spec. nov.
brydeni spec. nov.
caruncula spec. nov.
congolica spec. nov.
dichroa Karsch
donaldsoni (Calvert)
dorsalis (Rambur)
ellenbecki Förster
falconis spec. nov.
[*festiva* (Rambur), Oriental]
fumosa Pinhey
furva Karsch
hartwigi spec. nov.
imitata Pinhey
jacksoni spec. nov.
kalula Kirby
kirbyi Selys
(*lilacina* Förster, Oriental only)
monardi Ris
nigra Longfield
nuptialis Karsch
[*pallidinervis* (Kirby), Oriental only]
persephone Ris
pluvialis Förster
pruinata Karsch
selika (Selys)
stictica (Burmeister)
werneri Ris

SPECIES GROUPS

It is possible to separate some of the species into several distinctive groups, but some are not very homogeneous. It seems, therefore, inadvisable to suggest subgeneric names even for the more distinct groups.

Ten species groups are defined below. For convenience they may be separated into two sections, A and B, on abdominal colour and pattern. These sections are not entirely natural divisions. A different approach would be to place together those with very slender abdomens having long segments as opposed to those with thicker abdomens, but this method does not work satisfactorily at all. For instance, those with very slender abdomens include such dissimilar species as *africana*, *basitincta*, *stictica*, *monardi* and *werneri*.

SECTION A: Species groups with segments 4–6 predominantly red or reddish at least in the dorsal half.

Group 1: AURORA-ANNULATA. Not homogeneous. Anterior lamina without apical tubercle and the apex undivided. Hamular hook well curved, generally smallish. Abdomen slender or broadish. Apart from the type species, *aurora*, this includes *annulata*, *arteriosa*, *hartwigi*, *imitata*, *jacksoni*, *monardi*, *pluvialis* and *selika*. Some of these are very widespread but *selika* is confined to the Malagassic islands and *hartwigi* only to the island of Principe.

Group 2: KIRBYI. A most distinctive group. Anterior lamina without apical tubercles but the apex divided. Hamular hook straightish, sickle-shaped. Posterior lobe paddle-shaped. Legs mainly ochreous not mainly black. Frons with high tubercles. Wing apices narrow. Includes *kirbyi* and races. Widespread in the drier belts of Africa and Western Asia.

Group 3: KALULA. Anterior lamina without apical tubercles, the apex undivided. Hamular hook sickle-shaped. Includes *bredoi*, *kalula*, *werneri*. The first two are from equatorial African forests, but the slender *werneri* is from low-lying dryer bush fringing rivers in the eastern half of Africa.

Group 4: PERSEPHONE. Anterior lamina with a pair of prominent apical tubercles. Hamular hook sickle-shaped. Includes *persephone*. Madagascar only.

SECTION B: Species groups with segments 4–6 normally black with slender lateral yellow stripes or conjoined stripes.

Group 5: DORSALIS. Last antenodal cross-vein usually complete. Thoracic bands usually discontinuous. One or other of the femora with yellow external line. Hamular hook rounded, shortish. Abdominal segments broadish. Includes only *dorsalis*. Widespread, particularly in the south and eastern parts of Africa. Not in forests.

Group 6: STICTICA. Not homogeneous. Last Ax usually incomplete. Thoracic bands usually contiguous. Femora without yellow external line. Hamular hook rounded, shortish. Abdominal segments slender or broadish. Includes *aenea*, *anomala*, *atra*, *dichroa*, *ellenbecki*, *falconis*, *festiva*, *furva*, *hecate*, *nuptialis*, *pruinata*, *stictica*. Some of wide distribution, some very local. Of these species, *ellenbecki* appears to be a transition to Section A. In general features it is close to *pruinata* and *furva* but the abdominal segments are mainly yellow in the dorsal half in juvenile males and in females.

Group 7: FUMOSA. Distinctive in its very short thick abdominal segments, deep amber wings with brown apices and small hamular hooks. Includes only *fumosa*. Equatorial only.

Group 8: BASITINCTA. Long, slender abdominal segments; hamular hooks sickle-shaped; genital lobe directed obviously away from the hamules, not close to them. All the species have been at one time or another confusedly placed under the omnibus name of "*basitincta*". Includes *basitincta*, *bifida*, *caruncula*, *congolica*, *donaldsoni*, *nigra*. Mostly equatorial but those with bifid anterior laminas (*bifida*, *donaldsoni*) are mainly from southern or eastern Africa.

Group 9: BRYDENI. Only a single dark slender-bodied species is known for this group. Superficially like *dichroa* of Group 6 the hamular hook is more sickle-shaped as in Group 8 and the anterior lamina is apically bifid. Genital lobe as in Group 6. It is really a link between Groups 6 and 8. Includes only *brydeni*. N. Zambia.

Group 10: AFRICANA. Long, very slender abdominal segments. Basal area of hindwing dark brown to beyond the tornal angle, the hindwing long and narrow. Hamular hook sickle-shaped. Includes only *africana*. Equatorial only.

An analysis of these groups suggests that there were probably several divergent lines from ancestral stock. Primarily there were probably the red stock and the dark stock, like sections A and B.

Possibly the ancestral forms had short thickish segments, as in *fumosa*, *kirbyi*, *annulata*, *dorsalis* and others. Later developments may have sometimes involved the lengthening and narrowing of segments for lighter and stronger flight. The darkest species may frequently have been sciaphilous and this is the case in the shy, alert species *basilincta*, *congolica* and *caruncula*. For desertic areas the red species are generally prevalent and *kirbyi* is typical of this terrain, with its red venation and body, amber wings and small pterostigmata. The darker species would be too conspicuous.

Insular species, *hartwigi*, *nigra*, *persephone*, *selika* and certain races were potentially able to develop some differential characters in more isolated conditions, particularly the first two, which had limited libellulid competition.

The long-winged *africana*, although not seen in flight by the author, is presumably a development for gliding over long distances or, more likely, for staying air-borne in a small area for a long period.

One feature which is puzzling is the differential shape of the hamular hook in Libellulidae (not only species of *Trithemis*), whether well-curved or sickle-shaped to almost straight. Elsewhere in this monograph it is suggested that the hook is fastened during coition to the vulvar lip.

TAXONOMY AND KEYS

In the following keys and descriptions the length of the abdomen does not include the anal appendages. This falls in line with the author's previous works on Odonata. Where characters of abdominal segments are mentioned in the keys, the reference is to one side of the median dorsal carina.

In the key to males *jacksoni* has to be omitted since the male is unrecorded. In the key to females *hartwigi* and *brydeni* are unknown in the female, *basilincta* is only tentatively included since no female was examined by the author and no female of *festiva* was available.

page text/figures

KEY TO MALES OF TRITHEMIS SPECIES

1. Hindwing narrow at base and with very large dark brown basal area extending beyond t ornus and beyond triangle. Segments 4–5 four times as long as the half-width (one side of median carina). Hamular hook long and nearly straight . . . . . **africana** 148/146
— Hindwing proportionately broader at base; basal coloured zone, if so extensive, is then only amber or amber with some brown cell-fillings 2
2. Abdominal segments 4–7 pruinose blue, or black, usually enclosing one or two rows of yellow streaks 3
— Abdominal segments 4–5 (usually 4–7) not pruinose blue, but mainly red, orange or yellow, at least the dorsal half up to the median carina (sometimes a black line at this carina); sometimes with some pruinosity giving a reddish purple effect but not obscuring the pale pattern 24
3. Genital lobe directed more or less posteriad, away from hamule. Hamular hook sickle-shaped 4
— Genital lobe directed more nearly at a right angle to the body, close to the hamule. Hamular hook not sickle-shaped 9
4. Frons metallic blue. Thorax not pruinosed blue but heavily black, without a yellow subhumeral stripe on mesepimeron. Only Principe Island . . . . . **nigra** 139/132
— Frons metallic violet. Thorax usually pruinosed blue and not so densely black, with a more or less complete yellow subhumeral stripe on mesepimeron. Not Principe Island 5
5. Anterior lamina distinctly bifid at apex 6
— Anterior lamina not bifid at apex 7
6. Abdominal segment 4 with two yellow stripes (sometimes linked). Pruinosity of adult dark blue. Genital lobe short and broad at base . . . . . **bifida** 136/132
— Segment 4 with only one (upper) thin stripe. Pruinosity of adult pale blue. Genital lobe long, slender throughout . . . . . **donaldsoni** 131/132
7. Apex of anterior lamina broad, black, not turned over anteriad. Abdominal segments 4–7 with 2 yellow stripes . . . . . **basilincta** 138/132
— Apex of anterior lamina yellow, curved well back anteriad. Abdominal segments 4–7 all black or only showing 1 row of yellow stripes 8
8. Forewing with 12½ Ax. Hindwing with small brownish patch but without distinct rays. Smaller species (except on Fernando Po), abdomen about 25 mm. . . . . **caruncula** 141/140
— Forewing with 14½ Ax. Hindwing with distinct dark brown basal rays. Larger species, abdomen about 30 mm. . . . . **congolica** 144/140
9. Abdomen very slender, segments 4–5 three or four times as long as the half-width . 10
— Abdomen not slender, segments 4–5 less than 2.5 times as long as the half-width . 17
10. Frons bronze. Abdominal segments 4–5 with two yellow stripes . . . . . **aenea** 111/108
— Frons metallic blue or violet. Segments 4–5 all black or with only single yellow stripes 11
11. Frons steely blue. Thorax bright yellow or bright yellow and pale blue pruinose **stictica** 125/124
— Frons with violet or purple sheen. Thorax ochreous or reddish or black, or if blue then it is dark blue 12

12. Forewing with only 8½ or 9½ Ax. Hamular hook massive, genital lobe large, very broad throughout . . . . . **hecate** 117/114
— Forewing with 10½ Ax or more, rarely 9½. Genital lobe either very short, rounded or slender, tapering 13
13. Hindwing without any distinct basal amber 14
— Hindwing with distinct basal patch, amber or dark amber 15
14. Thorax in adult all black. In juveniles the black bands not or partially contiguous. Hamular hook slender . . . . . **atra** 103/100
— Thorax in adult blue pruinose. In juveniles with heavy black contiguous bands **nuptialis** 121/124
15. Labium yellow with fine brown median line. Thorax with quite separate black stripes and only thin reddish violet dorsal pruinosity. Hindwing with pale basal amber **falconis** 113/114
— Labium mainly black. Thorax very dark, with contiguous black stripes or all black. Hindwing with dark basal amber 16
16. Thorax with dark blue pruinosity. Anterior lamina not bifid. Hamular hook with moderate gape. Genital lobe long, setose apically . . . . . **festiva** 116/114
— Thorax more or less black. Anterior lamina distinctly bifid at apex. Hamular hook long, almost sickle-shaped. Genital lobe short, asetose . . . . . **brydeni** 147/146
17. Frons quite black above or ochreous with black basal band 18
— Frons above metallic violet or purple. Segments 4–6 all black or with only one row of yellow stripes 20
18. Abdominal segments only about as long as broad. Wings all strongly amber with brown apices . . . . . **fumosa** 130/124
— Abdominal segments at least twice as long as broad. Wings hyaline or slightly fumose but not amber; apices not brown 19
19. Frons with black basal band. Thorax never mainly black. Abdominal segments 4–8 with two yellow streaks . . . . . **anomala** 110/108
— Frons all black above. Thorax either with thick black bands or all black. Segments 4–8 with one row of stripes . . . . . **dichroa** 106/108
20. Last antenodal cross-vein in forewing normally complete. Fore femur with yellow external stripe. Thoracic black bands commonly not contiguous . . . . . **dorsalis** 89/88
— Last Ax *normally* incomplete. Femora without external pale line. Thoracic black bands most frequently contiguous (except in *atra atra*) 21
21. Thorax all black at maturity. Anterior lamina without apical setae or tuft of hair. Hamular hook short and narrow . . . . . **atra** 103/100
— Thorax more or less darkish blue at maturity. Anterior lamina with apical setae or tuft of hair 22
22. Apex of anterior lamina notched, slightly but distinctly divided. Dorsal black markings on thorax sparse, on most of abdomen only a black dorsal line . . . . . **ellenbecki** 93/88
— Apex of anterior lamina broad, not divided. Dorsal black markings on thorax, if visible, more or less complete; abdominal segments 4–7 black with one row of yellow streaks, more ventral in position 23
23. Labium all black. Pterostigma dark brown without yellow posterior line. Abdominal segment 9 all black. Hamular hook small . . . . . **pruinata** 101/100
— Labium partly yellow. Pterostigma with yellowish posterior line. Abdominal segment 9 with yellow streak. Hamular hook large . . . . . **furva** 95/100 (?88)
24. Venation distinctly black, not reddish. Labrum all black. Abdominal segments 4–5 not very slender, not or not much more than twice as long as broad 25
— Venation distinctly red (reddish brown in *werneri* but this has very slender abdomen, the segments four times as long as wide). Labrum rarely all black 26
25. Thorax with very discontinuous black markings; abdomen red with sparse black markings on segments 4–8, 9–10 all black. Fernando Po Island . . . . . **hartwigi** 58/60
— Thorax with contiguous black lateral bands; abdomen black with broad yellow dorsal or subdorsal bands on segments 4–9, 10 mainly black. Known only from Ethiopia . . . . . **ellenbecki** 93/88
26. Anterior lamina broad, with two prominent apical tumours. Forewing with 13½–14½ Ax. A red species with metallic violet frons. Hamular hook with a long slender curve. Madagascar . . . . . **persephone** 87/88
— Anterior lamina without apical tumours. Forewing usually with fewer Ax 27
27. Hamular hook long and slender not sharply curved, tending to be extended distad or even straightish 28
— Hamular hook short and well curved 31

28. Abdomen orange-red, very slender, segments 4–5 about four times as long as wide. Anterior lamina very rounded and surmounted by a large dense tuft of hair **werneri** 84/82
— Abdomen red, thickish, segments 4–5 only twice as long as wide. Anterior lamina with at most only a small hair tuft 29
29. Frons all red with high peaks, deep groove. Legs mainly ochreous with black streaks. Pterostigma very short, 2 mm or less. Wings with very broad basal amber to well beyond the triangles in all wings . . . . . **kirbyi** 76/68
— Frons metallic violet or purple, without high peaks. Legs mainly black. Pterostigma 2.5 mm or more. Forewing only slightly amber, at base, hindwing with amber or brown not extending far beyond triangle 30
30. Labium mainly ochreous. No pruinosity on thorax. Pterostigma yellowish brown. Forewing with about 9½–10½ Ax. Anterior lamina broad, not all black, abruptly narrowed at apex. Hamule with very little darkening . . . . . **bredoi** 80/82
— Labium broadly black in middle. Thorax often with purplish red pruinosity. Pterostigma black. Forewing with about 11½–13½ Ax. Anterior lamina tapering to a narrow apex and all black. Hamule black . . . . . **kalula** 83/82
31. Abdomen very slender, segments 4–5 three times as long as broad. Frons with black basal band 32
— Abdomen broader, segments 4–5 twice as long (two and a half times in *pluvialis*) as broad. Frons metallic violet or (in *pluvialis*) with black basal band 34
32. Amber at wing bases smaller on forewing often more extensive on hindwing, but not nearly reaching tornus. Abdominal segment 6 varying from plain red to red with black ventral band, but without the black being concentrated into a large spot at the distal end. Anterior lamina without separate apical hair-tuft. Genital lobe with many very short apical setae . . . . . **arteriosa** 59/60
— Amber on all wing bases extensive and on hindwing more or less reaching the tornus. Abdominal segment 6 red with the black concentrated in a distal spot. Anterior lamina with distinct apical hair-tuft. Genital lobe with only about 3 to 5 apical setae 33
33. Basal amber without brown fillings. Labium and labrum all or mainly ochreous. Segment 7 with continuous black ventral band. Hamular hook very little darkened, genital lobe broadly rounded at apex . . . . . **imitata** 69/68 jacksoni: 67/68
— Basal amber on hindwing with brown fillings in the cells. Lips mainly black. Segment 7 with the black concentrated at distal end. Hamular hook blackened, genital lobe narrowed at apex . . . . . **monardi** 71/68
34. Frons with black basal band. Thoracic bands very discontinuous. Abdominal segment 9 with distinct red bar. Anterior lamina with broad apex and a hair-tuft. Apex of genital lobe slightly narrowed . . . . . **pluvialis** 73/68
— Frons violet or bronze with violet sheen. Thoracic bands laterally more or less continuous. Anterior lamina narrowed apically and without hair-tuft. Apex of genital lobe broad 35
35. Segments 8–9 with continuous red lateral band. Genital lobe not all black, very broad distally, slightly narrowed at base. Widespread in Africa and Madagascar . **annulata** 46/45
— Segment 8 with short red rectangle, 9 all black or with only a trace of red. Genital lobe uniformly broad. Madagascar and Comoro islands only . . . . . **selika** 56/45

KEY TO FEMALES OF TRITHEMIS SPECIES

1. Hindwing narrow at base and with very large dark brown basal area extending beyond tornus and beyond triangle . . . . . **africana**
— Hindwing proportionately broader at base; basal coloured zone, if so extensive, is then only amber or amber with some brown cell-fillings 2
2. Abdominal segments 4–7 black with yellow lateral stripes (in some tenerals the dorsal black may not be heavily developed) 3
— Abdominal segments 4–5 (and nearly always 4–7) mainly yellow or reddish, at least on the dorsal half of each side of the median carina (at most, only a black line on this carina) 4
3. Abdominal segments 4–5 with two yellow stripes (each side) 14
— Segments 4–5 with one yellow stripe (segment 4 occasionally with trace of second stripe) 4
4. Segments 4–5 very slender, the half (one side of median carina) at least three times as long as broad 5

— Segments 4–5 not more than about twice as long as half-width 9
5. Labrum all black 6
— Labrum pale with black T or median line 7
6. Frons with basal black band narrower than distance between central and lateral ocelli **aenea**
— Frons with band broader than this distance . . . . . **bifida**
7. Abdominal segment 8 all black, or at most with small yellow triangle . . . **caruncula**
— Segment 8 with two yellow stripes 8
8. Basal band on frons glossy blue-black, strongly discontinuous at lateral ends . **donaldsoni**
— Frontal band glossy black, entirely continuous at sides . . . . . **falconis**
9. Segment 9 with distinct yellow lateral stripe 10
— Segment 9 all black or at most with only a minute yellow trace. Vulvar lip shallow 11
10. Frons with narrow black basal band. Vulvar lip straight . . . . . **anomala**
— Frons with very broad band. Vulvar lip with deep U . . . . . **pruinata**
11. Frontal band narrow. Wings fumose-amber, deeper coloured in apical region. Labrum all black . . . . . **fumosa**
— Frontal band broad. Wings mainly hyaline, sometimes brown at apices 12
12. Labium all yellow (or with trace of black in northerly examples). Labrum with narrow black T . . . . . **donaldsoni**
— Labium black down centre. Labrum with broad T or all black 13
13. Segments 4–5 twice as long as wide. Labrum all black . . . . . **nuptialis**
— Segments 4–5 shorter than this. Labrum usually with yellow laterally, but all black in ssp. *grouti* . . . . . **atra**
14. Segments 4–5 very slender, at least three times as long as broad 15
— Segments 4–5 barely twice as long as broad 16
15. Labrum all black, frons with very broad black basal band. Forewing with at least 11½ Ax (*basitincta* is probably near here) . . . . . **congolica**
— Labrum yellow laterally, frontal band narrower than distance between central and lateral ocelli. Forewing with only 8½–9½ Ax . . . . . **hecate**
16. Vulvar scale with straight or only slightly curved lips 17
— Vulvar scale with deep U 18
17. Frontal black very broad, generally with strong blue-green sheen . . . . **stictica**
— Frontal black narrow . . . . . **kalula**
18. Forewing with last Ax usually complete. Thoracic lateral bands often not contiguous. Sternal black enclosing two pale posterior spots. Mid and hind femora with yellow external line . . . . . **dorsalis**
— Forewing with last Ax usually incomplete. Thoracic lateral bands always contiguous. Sternal black enclosing only one long elliptical posterior pale spot. Mid and hind femora without sharp external line 19
19. Labrum mainly black; frons with broad basal band . . . . . **dichroa**
— Labrum mainly pale or at most with black T; frons with narrowish basal band not broader than distance between central and lateral ocelli . . . . . **furva**
20. Abdominal segment 8 black with two pale lateral stripes or pale with two lateral black stripes 21
— Segment 8 black with at most only one pale stripe 23
21. Hindwing either with isolated amber spot in anal field and basal traces; or pronounced amber basal streaks or a very broad amber basal band. Vulvar lips very deep **kirbyi ardens**
— Hindwing without any clear amber patches, merely either basal traces or cloudy . 22
22. Segment 9 all black or with merely a ventral pale dot. Vulvar lips shallow **persephone**
— Segment 9 black with two pale lateral stripes. Vulvar lips deep . . . . . **werneri**
23. Frons with very broad black basal band, broader than the distance between central and lateral ocelli. Thoracic black bands all broadly contiguous . . . . . **selika**
— Frontal band narrower than or scarcely as wide as this ocellar distance. Thoracic bands sparse of if well developed they are only narrowly contiguous 24
24. Pterostigma brown or black with pale posterior line. Vulvar lips with rather deep incision 25
— Pterostigma brown without pale posterior line except in tenerals. Vulvar lips usually straight or nearly so 26
25. Wing apices hyaline. Thoracic black stripes narrowly contiguous . . . . **ellenbecki**
— Wing apices broadly and distinctly brown. Thoracic black markings sparse, unconnected . . . . . **jacksoni**

26. Abdominal segment 9 with pale lateral band 27
— Segment 9 all black 28
27. Pterostigma pale brown. The pale band on segment 9 is very broad . . . **annulata**
— Pterostigma almost black. The band on segment 9 is a short, narrow bar . . **pluvialis**
28. Basal amber smallish, not nearly reaching tornus 29
— Basal amber very broad, reaching to and beyond tornus 30
29. Labium normally with black median band, except in tenerals. Thoracic sternal black moderately developed . . . . . **arteriosa**
— Labium without any black. Sternal black vestigial . . . . . **bredoi**
30. Abdominal segment 7 reddish with continuous black ventral band, segment 8 black with small round pale spots . . . . . **imitata**
— Segment 7 with only a black spot at ventrodistal end, segment 8 with small pale triangle. . . . . **monardi**

DESCRIPTIONS OF SPECIES

Section A. Red-bodied species.

GROUP 1. AURORA-ANNULATA. Includes *annulata*, *arteriosa*, *hartwigi*, *imitata*, *jacksoni*, *monardi*, *pluvialis*, *selika*.

Trithemis aurora (Burmeister), fig. 21

Libellula aurora Burmeister, 1839, *Handb. Ent.* **2:** 859 (Philippines); Fraser 1936: 383.
Trithemis soror Brauer, 1868, *Verh. zool.-bot. Ges. Wien* **18:** 179, 735 (Philippines etc.).
Trithemis adelpha Selys, 1878, *Mitt. Mus. Dresden:* 315 (nom. nov. pro *soror* Brauer).
Trithemis fraterna Albarda, 1881, *Veths Midden Sumatra, Neur:* 4 (Sumatra).
Trithemis intermedia Kirby, 1886, *Proc. Zool. Soc. Lond.:* 327 (India).
Trithemis congener Kirby, 1890, *Cat. Odon.-Neur.:* 18 (nom. nov. pro *fraterna* Albarda).
Trithemis yerburyi Kirby, 1890, *Cat. Odon.-Neur.:* 18.
Trithemis liturata Selys, 1891, *Annali Mus. civ. Stor. nat. Giacomo Doria* **30:** 464.

This species has not been found in Africa but as it is the type-species of the genus a brief description of the male is included. In the National Museum there is only a damaged male from Burma. Type ♂ in Museum of Comparative Zoology, Harvard.

MALE

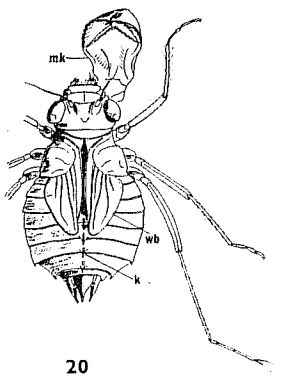
BURMA ♂ (mature): Labium yellowish, very broadly black in centre; face orange-brown; a large black fascia on lower margin of labrum extending nearly to base. Frons and vesicle metallic brown with violet sheen.

Prothorax pale to dark brown with black markings. Synthorax reddish brown with the black marking somewhat like *annulata*. In maturer examples this is overlaid with reddish violet as in the latter species. Sternal marking as in *annulata*. Legs black, tibia paler posteriorly.

Venation red. Pterostigma short, reddish brown, between black veins. All wings with an amber basal patch, on forewing to first Ax, on hindwing to second Ax, to base of triangle and almost to tornus. Also on hindwing there are short dark amber rays in subcostal and cubital spaces. Forewing with 13½–15½ Ax, 11 Px. The antenodals of the forewing can vary from 11½ to 15½ Ax.

EXPLANATION OF FIGURES

Figs 20–23. *Trithemis* species. 20. Larva. 21. *T. aurora*, male accessory appendages, from left. 22a–j. *T. annulata*. a—Head and synthorax (♂, Victoria Falls). b—Accessory genitalia. c—Pterostigma, left forewing. d—Abdomen, from left (teneral ♂, Victoria Falls). e—Segment 9 of a variety (Victoria Falls). f—Segments 8–10 (♀, Victoria Falls). g—Prophallus, left ventral aspect. h—Occipital triangle (♀). i—Vulvar lip (♀, Khartoum). j—The same (Victoria Falls). k-l *T. a. scorteccii*. k—Synthorax (♂, Fayid, Egypt). l—Bursa (♀, Ndola). 23. *T. selika*, abdomen. a—Male (forêt de Fanovana). b—Male (forêt d'Anvarafantsi). c—Female (forêt de Fanovana). d—Accessory genitalia (forêt d'Isaka) and apex of anterior lamina. e—Prophallus, left ventral aspect. f—Vulvar scale. g—Bursa (Ranohira, Madagascar). al—anterior lamina; gel—genital lobe; ham—hamule; k—keel; mk—labium or mask extended with setae visible; wb—wing buds.



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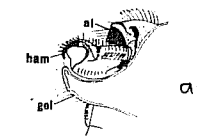
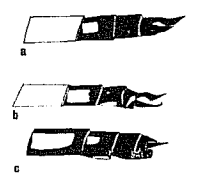


aurora

21



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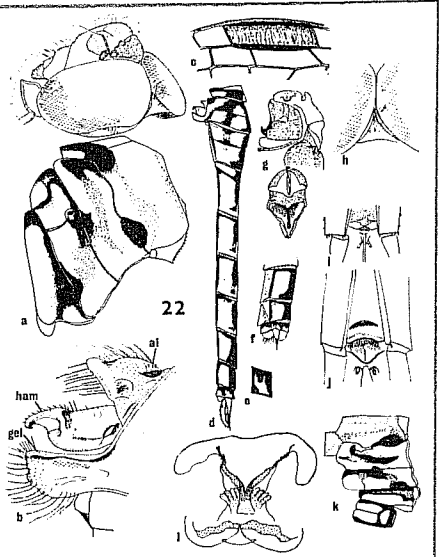

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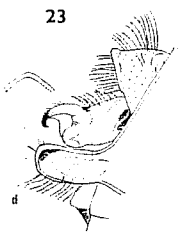
annulata



selika

23

annulata

Abdomen shaped and coloured as in *annulata*. Segment 9 has a lateroventral and 10 a basal black band. Anterior lamina rounded, undivided apically and without setae. Hamular hook slender, with rather wide gape and with small outer setae. Genital lobe with narrowed curved apex.

Abdomen approximately 25 mm, hindwing 28 mm, pterostigma 2–2.5 mm.

From *annulata* it can be distinguished by having less dorsal black marking on abdomen; a smaller pterostigma, 2–2.5 mm instead of 2.5–3 mm; higher nodal index, forewing with 11½–15½ Ax, instead of 9½–11½ in *annulata*; and the genital lobe narrower, more curved apically. Except in Arabian examples *annulata* has less basal amber on the wings, particularly the forewings.

Distribution. Pakistan, India and Ceylon eastwards to Hong Kong, Philippines and Indonesia.

Trithemis annulata (Beauvois), fig. 22 p 45

Libellula annulata Beauvois, 1805, *Ins. Afr. Amér.:* 69 (♂, Oware).
Libellula rubrinervis Selys, 1841, *Rev. Zool. Guer. Mer.* Paris: 244 (Sicily).
Libellula haematina Rambur, 1842, *Névroptères:* 84 (*pars:* Mauritius; *pars:* Senegal, Sicily).
Libellula obsoleta Rambur, 1842, *Névroptères:* 83 (♀, *sine patria*).
Tramea erythraea Brauer, 1867, *Verh. zool.-bot. Ges. Wien* **17:** 814 (Mauritius).
Trithemis ramburii Kirby, 1890, *Cat. Odon.-Neur:* 19.
Trithemis violacea Sjöstedt, 1899, *Bih. K. svenska VetenskAkad. Handl.* **25:** 13 (♂, Cameroons).
Trithemis scortecii Nielsen, 1935, *Atti. Soc. ital. Sci. nat.* **74:** 375, 381, 382 f. (Tripolitania).
Trithemis annulata: Pinhey, 1962c, *Publções cult. Co. Diam. Angola* **59:** 268.

Types: *annulata* ♂ in Bruxelles Museum; *rubrinervis* ♂♀ in Bruxelles Museum; *haematina* in Bruxelles Museum; *violacea* ♂ in Stockholm Museum; *scortecii* ♂ in Nielsen Collection.

This species, one of the two most widely distributed in Africa and Asia, exhibits considerable variation and evidently some subspeciation. Variability will be considered for this species and *arteriosa* in more detail than for the others. Except in the desertic subspecies *scortecii*, which is distinctly paler, the mature males are distinguishable in the field (in Africa) by the purplish red or "plum-coloured" bloom on the thorax and abdomen which is produced by thin blue pruinescence overlying the red body. The mature male of *kalula* is often similarly coloured but it is more restricted in distribution, being found only in equatorial west Africa. It is easily distinguished from *annulata* by the accessory genitalia. In parts of Asia the "plum" or "port wine" coloured males are also seen in the species *aurora* (Burmeister) and the more easterly *lilacina* (Förster).

For the synonymy of *rubrinervis*, *obsoleta*, *erythraea* consult Ris (1912: 769, 774).

Subspecies *annulata* (Beauvois)

MALE

S. Nigeria ♂ (mature): This example is chosen from the nearest available locality to that of the type. The abdomen is actually slightly narrower than in those from most localities except for a Karamoja male.

Lips and face all ochreous. Frons with shallowish groove and covered dorsally by metallic bronze, this colour not extending beyond the crest. Occipital triangle ferruginous, posteriorly orange. Orbits posteriorly yellow with two brown bands.

Synthorax pruinosed to a pinkish violet dorsally ("port wine"); laterally with black bands moderately complete; sternal black marking only peripheral. Legs blackish, fore and mid femora yellow internally.

Wings hyaline, venation red. Pterostigma ferruginous between black long veins and red cross-veins. Forewing without basal amber; hindwing with complete plain basal amber fascia to first Ax, to beyond Cuq and on basal cells of anal field. Membranule pale grey, white at base. Forewing with 9½–10½ Ax, 6–7 Px.

Abdomen moderately broad, red. Segment 1 with U-shaped black dorsal saddle; segment 2 with traces of a brown dorsolateral band; 3–7 unmarked; segments 8–9 with dorsal black band but with the dorsal carina narrowly red; 10 red, unmarked. Anal appendages pale brown, the superiors greyish distally.

Accessory appendages *without* blackened, thickly chitinised areas. Anterior lamina slightly produced at apex, which is undivided and has no prominent tuft of hair. Hamular hook small, having short outer setae. Genital lobe broader in apical half than at base and armed with apical setae. Prophallus short, squarish, somewhat pendant. Glans not large. In an example from Hofuf (Arabia) the prophallus is similar.

Abdomen 19.5 mm, hindwing 26.5 mm, pterostigma 2.5 mm.

Congo Kinshasa: A male from Rutshuru is larger and has the normal wide abdomen. Labium broadly dark brown medially; labrum with broad black band on lower margin. Frons above and vesicle bronze with violet sheen. Thoracic markings sparse and discontinuous. Amber on hindwing as in the Nigerian male but with slightly darkened cubital ray. Pterostigma 3 mm. Forewing with 10½–11½ Ax. Abdominal segment 10 mainly black in basal half. Hook of hamule darkened apically.

Sudan: A small male from Khartoum (leg. C. D. Happold) has the hindwing 27.5 mm. Labium with broad dark brown median band, labrum black with red centro-basal spot. Lateral black bands on thorax well developed, continuous but not contiguous. Amber on hindwing to first Ax, almost to base of triangle and nearly to tornus. Abdominal black as in the Rutshuru specimen. Hamule rather narrower than usual.

In tenerals from Khartoum the lips are all pale and the pterostigma is yellow, between brown veins.

N. Uganda: A small Karamoja specimen has the hindwing 25.5 mm and the abdomen is narrower, as in the Nigerian male. Labium with broad black band, labrum black with reddish basal band. Frons bronze, not violet. Hindwing with plain amber fascia as large as in the Sudan example and forewing with a cubital trace. Abdominal marking similar. Accessory genitalia all darkened brown. In another mature male of same size from Karamoja there is only linear median brown on the lateral lobes of the labium, the posterior lobe all brown; labrum only black on lower margin. Otherwise similar. One from Jinja (S. Uganda) is larger, the hindwing 30 mm. Labium narrowly dark brown, labrum black on lower half. Frontal bronze with some violet reflection. Thoracic markings reduced to small black traces. Hindwing with plain amber to just beyond Cuq. Abdomen with segment 7 dorsally black. Another from Jinja is similar but the basal amber has dark spots in the cells, approaching f. *violacea*, and segment 7 is only dorsally black at the base. Accessory genitalia not darkened. An Entebbe specimen has a thick black labial band, labrum black except at base, frons and vesicle with strong violet sheen. Thoracic bands more complete but not joined (contiguous) laterally. Basal amber on hindwing small but the cells are darkened as in *violacea*. Segments 7–10 are marked with black. Anterior lamina blackened. Another from Bugalla Island, Sesse Group (Lake

Victoria) has a narrow brown suffusion on labium, the labrum half black; frons and vesicle with violet sheen. Thoracic black reduced to traces. Basal amber dark. Segment 7 with partial black dorsal band. Accessory genitalia all pale.

W. Tanzania: Labium all pale, the labrum with only a black line on lower margin. Frons bronze, without violet. Thoracic black as in the figure. Basal amber slightly darkened. Abdominal black as in the Bugalla specimen. Accessory genitalia all pale. Angola: An example from Luanda has the lips all pale except a trace of black on lower edge of labrum. Frons without violet. Thoracic black reduced. Hindwing amber cells filled with brown as in *violacea*. Segments 7–10 with black pattern. Anterior lamina blackened.

Zambia: An Ndola male has narrow median black on labium, the posterior lobe mainly black; labrum black on distal third. Frons and vesicle with trace of violet. Thoracic black as in the figure. Amber fascia not darkened. Abdomen with a complete dorsal black band on segments 5–10. Anterior lamina dark brown. Another Ndola specimen is similar but has no black on segments 5–6. A Samfya specimen has only traces of labial black, the labrum black on lower third. Otherwise similar.

Mozambique: A Dondo forest example has the labium all pale, labrum black on lower margin. Basal amber extensive but not darkened. Abdomen only black dorsally on segments 8–9. Anterior lamina darkened. One from Lourenço Marques has only a trace of black on labium, the labrum black on lower third; frons and vesicle with strong violet sheen. Thoracic markings as in the figure. Amber fascia with brown in only the mos. basal cells (verging towards *violacea*). Dorsal black on segments 8–10 and a trace on 7f Anterior lamina blackish.

Victoria Falls: A series show narrow or no black on labium; labrum with from a trace to a one third band on lower margin. Frons bronze, sometimes with faint violet sheen. Thoracic black more extensive than in the figure, the bands more or less contiguous laterally. Cells of amber zone generally well filled in with brown (f. *violacea*). this zone variable in extent. Segments 8–10 with black marking, occasionally with dorsal traces on 6–7; and in one variety segment 9 (figured) has more black than normal. In a teneral male from Victoria Falls the labium has a brown band, labrum black on lower third. Abdomen with almost continuous blackish dorsal band as in figure. Amber fascia *not* filled in with brown.

A male from further up the Zambezi at Shasheki has no black on the lips; frons with violet sheen. Thoracic black discontinuous. Amber fascia small but well filled in with brown. Abdominal black as in Victoria Falls specimens. Another has the thoracic lateral bands nearly contiguous.

Rhodesia: One from Lake Kariba has the lips pale except a trace of black on lower margin of labrum. Frons with violet sheen. Thorax as in the figure. Amber area partly filled with brown. An example from Limpopo River has linear black on labium, a band on lower margin of labrum. Frons with slight violet sheen. Thoracic lateral black almost contiguous. Amber zone filled with brown. A black dorsal band on segments 7–10 and traces on 5–6.

Botswana: A Maun male (f. *violacea*) has black only on posterior lobe of labium and a central bar on lower margin of labrum. Frons with violet sheen. Abdominal black only on 8–10. One from Sepopa is narrowly black on labium, broadly so on labrum; very dark bronze on frons, violet on vesicle. Amber fascia with brown centres. Abdomen with

distal black also on segment 7. In an example from Mohembo there is only a trace of black on the lips; amber area partly filled with brown. Only segments 8–10 black dorsally.

Natal: A male from Kosi Bay has the labium all pale, only a trace of black on lower margin of labrum; frons and vesicle thinly bronze. Amber zone not filled in with brown. Abdominal black on 8–10 and traces on 5–7.

f. *violacea* Sjöstedt

The type male has the labium black on posterior lobe and a central stripe on lateral lobes. Frons and vesicle with some violet sheen. The hindwing amber zone is deep, with the cells brown-centred. Forewing with 11¼–12¼ Ax. Hindwing 32 mm.

It is a large specimen with high nodal index but in all essentials (as will be seen later in the comparative analysis) it does not differ from normal *annulata*, which is an exceptionally variable species as mentioned above. It is evident that *violacea* is only a *male* variety, since females taken in areas of predominantly male *violacea* do not differ from series of female *annulata* from other localities. It is probable that the darkening in the amber cells, the only important criterion for *violacea*, is merely an ecological condition principally developed in mature males breeding in either fast-flowing rivers like the Zambezi or in large expanses of water as in Lake Victoria where, perhaps, wave action can agitate the water at times.

FEMALE

Victoria Falls ♀: Lips all yellow except a double black spot on centre of lower margin of labrum. Face all yellow. Frons with shallowish groove and a narrow black basal band, narrower than the distance between central and one lateral ocellus. Vesicle yellowish. Occipital triangle orange-brown. Back of orbit with three brown bars.

Prothorax yellow on collar, black in the groove; median lobe ochreous brown with black lateral ellipses; posterior lobe black with pale posterior line. Synthorax rather sparsely black but with contiguous brown lateral bands as in the blacker male pattern. Sternal black narrowly complete on periphery. Legs black, fore and mid femora pale interiorly.

Venation red. Pterostigma as in male, pale or ferruginous brown between black veins. Amber on hindwing reduced, reaching Cuq, a trace in subcostal zone and in four anal cells. Membranule grey, with white basal spot. Forewing with 10¼ Ax.

Abdomen triquetral but rather more cylindrical; marked sparsely with black as in most males. Dorsal black incomplete on segment 1; 2 with brownish lateral band; 8–10 with black dorsal band and a trace on segment 7. Cerci mainly dark brown. Vulvar lip with shallow U-shaped depression.

Bursa with dorsal sterigma (central plate) bifid anteriorly, forming twisted, divergent, tapering branches. Ventral sterigmata ribbed, somewhat fan-shaped. Vulvar lip (dorsal or internal view) only narrowly thickened.

Abdomen 22 mm, hindwing 29.5 mm, pterostigma 3 mm.

Rhodesia: In a large female from Chirundu Bridge (Zambezi River), hindwing 31 mm, the lips are entirely pale; frontal band very narrow. Cerci pale. Otherwise similar. In another from this locality the hindwing is 28 mm. Lateral bands at base of abdomen black and distinct (as in the male); dorsal black on segments 8–10 and on base of 7, traces on 5–6.

One from Umtali has a narrow black, continuous labial line; labrum all yellow. Thoracic marking reduced, discontinuous. Pterostigma with a pale posterior line. Abdomen dorsally black on 7–9, segment 10 nearly all black except a small lateral dot. In another from Umtali the lips are similar. Thoracic markings and wing amber more developed. Abdomen with continuous black dorsal band on *all* segments. One from Vumba Mts (Umtali) has only a black line on posterior lobe of labium; abdominal black only on 8–10. A specimen from below Inyanga Mts has the posterior lobe of the labium all black and a median line on the lateral lobes. Abdominal dorsal black continuous on segments 2–10. A teneral female from Mt Selinda has the lips all pale. Thoracic bands faint but darker at the usual black primary positions (as in figure of male). Complete dorsal band on abdomen.

BOTSWANA: An old female from Maun has a trace of black on lower margin of labrum. Amber on hindwing darker than in less old specimens. Abdominal black dorsally on 8–10 only.

ZAMBIA: A female from Mwinilunga is different. Labium with broad black median band. labrum with a triangle on lower margin. Basal band on frons slightly wider than usual. Thoracic black and brown markings almost contiguous. Dorsal abdominal black only on segments 2, 8–10. Pterostigma dark brown with pale posterior line. Vulvar lip with rather deepish U. Another has a narrower labial band. A specimen from Ndola has the labium all pale, labrum with large black triangle. Thoracic bands contiguous. Abdomen with additional dorsal traces on segments 5–7. Pterostigma brown, between black veins. Another has the labium all yellow, labrum with only a narrow line on lower margin. Wing amber reduced. Pterostigma similar. Abdomen with less black than in the first Ndola example.

MALAWI: In a female from Monkey Bay the labium is all pale, labrum with black line on lower margin. Thoracic bands discontinuous. Pterostigma normal. Abdominal dorsal black on 8–10. In one from Mpatamanga Gorge the lips are similar; the thorax has heavier black but not contiguous; a smaller amber fascia. Segment 9 all black. An immature example from Nkata Bay has the posterior lobe of the labium all black, a line on lateral lobes and on lower margin of labrum. Amber more extensive. Abdomen with complete black dorsal band.

SUDAN: One from Khartoum is small, the abdomen 18.5 mm, hindwing 25.5 mm, the abdomen rather slender. Lips pale. Frons with only linear black basal line. Thoracic bands well developed laterally but not contiguous; dorsally the bands are very reduced on mesepisternum. Sternal mark only on periphery, narrow and nearly complete. Amber markings typical. Forewing with 9½ Ax. Abdomen all pale except the usual black saddle on segment 1, a narrow dorsal band on 8, a thicker band on 9, segment 10 only with traces. Vulvar lips pale, with the usual U-shaped invagination. Others from Khartoum are larger, of normal size. These show black traces on the labium, a triangle on the labrum, a wider basal band on the frons. Thoracic bands again well developed at sides but not contiguous. Pterostigma yellow, between brown veins

SOUTH ARABIAN FORMS

Specimens from southern Arabia in the National Museum are distinguished by the very extensive amber fasciae on all wings. There are, however, Arabian specimens in the British Museum (Nat. Hist.) with amber of normal extent. Unless these are from geographically isolated areas, the broad-amber specimens may be considered as ecological forms rather than subspecies.

The short National Museum series is of two distinct forms:

1. Auck, Qatif, Saudi Arabia ♂: Very pale and approaches the forms considered later under *scortecii*. Labium with brown median line on posterior lobe, a diffuse faint brown cone, narrowed anteriorly, on lateral lobes. Labrum with narrow brown line on lower margin. Face and frons pale yellow, with greenish brown on base of frons. Thoracic markings and legs like the *scortecii* group. Venation also similar; pterostigma darker. Forewings with complete basal amber patch almost to first Ax, to beyond Cuq and for some distance in anal field; on hindwing to beyond third Ax, to distal end of triangle, halfway along anal loop and to beyond tornus. Forewing with 10½ Ax. Abdomen with nearly complete blackish dorsal band on all segments; broadly black on segments 8–9, also some black on 10, but on all segments the dorsal carina remains red. Accessory genitalia pale but normal, but the hamule is partly blackened. Abdomen 20 mm, hindwing 22 mm, pterostigma 3.5 mm. No female of this form is available.
2. Hofuf ♂: This is much darker. Lips and face reddish, labium all red, labrum with black trace on lower margin. Frons and vesicle above bronze with a strong pinkish violet sheen. Occipital triangle ferruginous above. Thorax ferruginous, with dorsal black markings obsolete, lateral bands well developed but not completely contiguous. Sternal black nearly complete. Legs similar. Venation red, pterostigma short, between black long veins, the distal cross-veins black, the proximal red. Basal amber dark; on forewing halfway to first Ax, to Cuq and extending well distal in anal field; on hindwing almost to third Ax, nearly to distal end of triangle, halfway along anal loop and to beyond tornus. Abdomen red. Segment 1 all black above; traces of subdorsal black bands on 5–7; 8–10 with the normal dorsal black (cf. figure of Victoria Falls example). Accessory genitalia normal. Prophallus normal. Abdomen 21 mm, hindwing 28.5 mm, pterostigma only 2 mm.

Another male from Al Aasa, 'Ain Hagl, is very similar but the deep amber of the hindwing has the cells filled in with brown (cf. f. *violacea*). Abdomen similar. Distal half of superior appendage very distinctly blackened, much darker than in normal *annulata*. Accessory genitalia as in the Hofuf male. Hindwing 31 mm.

Hofuf ♀: Posterior lobe of labium with black line, a small triangle at disitl-median ends of lateral lobes. Labrum pale. Face, frons and vertex yellow; frons with moderate basal band as in most *annulata*. Thoracic bands as in male. Wing amber as extensive as in the Hofuf male but slightly paler. Abdomen with more or less complete black dorsal band, particularly on segments 6–10. Vulvar lip all dark with shallow U. Abdomen 21 mm, hindwing 30 mm, pterostigma 2.5 mm.

Subspecies *haematina* (Rambur)

The name *haematina* is used here for the insular subspecies of the Indian Ocean. Ris (1912: 774) and others gave it specific rank, but in all essentials it is very close to *annulata* and cannot be specifically separated. As Ris points out the nomenclature is not fully clarified since Rambur's series was confused between specimens from Mauritius, Senegal and Sicily. Kirby (1890: 19) introduced the name *ramburii* for the insular *haematina* but, as Ris indicates, if *haematina* is unacceptable then the Mauritian-described *erythraea* (Brauer) has priority.

Unfortunately, I have not traced the type of *erythraea*. But there is only the one species of *Trithemis* on Mauritius.

MALE: The subspecies *haematina* (Mauritius, Bourbon; and Madagascar) differs from typical *annulata* in its larger size, the hindwing over 30 mm; greater number of antenodal cross-veins, 13½–14½; smaller amber fascia on hindwing and more robust accessory hamular hook. The pterostigma is normally darker. Segment 9 of the male abdomen is almost all black. Prophallus essentially similar to *annulata*.

FEMALE: A Mauritian female has more black on the lips and on the terminal three segments of the abdomen, and segments 9–10 and the cerci are almost all black. Venation darker red than in the male.

A Madagascar female from D'Ambré has no black on the labium and only a trace on the labrum. The venation is darker brown and there are brown tips to all the wings, unlike the Mauritian females. Abdominal markings blacker. Segment 8 black with two yellow lateral spots, 9 all black except a small yellow lateral spot, 10 and cerci all black. Vulvar scale as in *annulata*.

Subspecies *scortecii* Nielsen

The two original males described by Nielsen as a distinct species came from Elbarkat in Fezzan (Tripolitania), March 1934. In general characters they are like the paler forms of *annulata* but they have a narrower hamule, nearer the condition of *arteriosa* or *stictica*. Examples collected by K. M. Guichard in Libya (Tripolitania) differ only slightly from the description of *scortecii*. In the National Museum there is, unfortunately, only a single example, a female, from Tripolitania.

Diagnostic features in Nielsen's description of the males may be given here.

MALE

Face all pale except a median dark streak on labrum. Frons and vesicle metallic bronze.

Thorax greyish brown with bronze lines along median suture and a bronze antehumeral streak; three lateral grey streaks, contiguous. Legs blackish with femora externally yellowish.

Venation and pterostigma reddish yellow, the latter between black veins. Hindwing with amber basal fascia to first Ax and to just beyond Cuq. Membranule pale grey. Forewing with 9½–10½ Ax.

Abdomen yellowish brown with black mid-dorsal stripe on 3–10 and lateral stripes. Hamule and genital lobe more like *stictica*, the lobe narrow, not broadened apically as it is in *annulata* (the anterior lamina, however, is quite unlike *stictica*, more like *arteriosa*).

Abdomen 17 mm, hindwing 20 mm, pterostigma (short) only 2 mm.

Nielsen compares it to *stictica* in accessory genitalia and to *arteriosa* in general features. The colour of the body and wings is, of course, very different from *stictica* and so is the anterior lamina (as indicated above by the present author). The abdominal markings, the lack of an amber basal patch on the forewing and the number of antenodal cross-veins are closer to *annulata* than to *arteriosa*.

From the description it appears to the present author that the original males may have been rather immature or else stained. The main differences from *annulata* are the pallid coloration of body and wings, the dark line on the labrum, the narrow genital lobe. The hamular hook does not appear to be very different from *annulata*.

The Fezzan males collected by Guichard were certainly conspecific with *annulata*. The abdomen had short, broadly triquetral segments, quite unlike the slender

segments of *arteriosa* and *stictica*. The genital lobe was narrower than in typical *annulata* but slightly broader distally than at base; apically they resembled Nielsen's illustration.

Without actually examining the type it would seem advisable to place *scortecii* as a subspecies of *annulata*.

Males from Egypt are also tentatively placed here.

EGYPT (Fayid) ♂: Lips and face pale yellow. Frontal groove shallow. Frons and vesicle above metallic bronze with green sheen. Occipital triangle yellow, orbit yellow, with two narrow brown lines.

Thorax cream, with well developed, completely dark contiguous bands. Sternal marking narrowly complete except anteriorly. Legs black, fore- and mid-femora yellow interiorly.

Wings hyaline, venation all orange-yellow. Pterostigma yellow, between black long veins. Membranule greyish white. Hindwing with pale amber basal fascia reaching first Ax, to beyond Cuq and to beyond membranule.

Abdomen broadly triquetral, pale yellow to yellowish brown, with continuous dorsal band, which is mainly grey-brown but black on segments 8–9; 10 with black basal annulus. Anal appendages yellow, the superiors greyish distally. Accessory genitalia more or less normal but pale and the genital lobe is narrowish.

Abdomen 21.5 mm, hindwing 29 mm, pterostigma 2.5 mm.

An Egyptian male from Moascar differs only in lacking the dorsal band on the abdomen, except segments 8–10; sides of segments 1 to base of 3 with a brown stripe.

One from Ismailia has a broad blackish median band on labium, labrum black on lower third. Abdomen with more or less continuous blackish dorsal band but leaving most of the median carina yellow. Anterior lamina and apex of genital lobe dark grey.

FEMALE

LIBYA (Taguira, Fezzan, 10 June 1951, K. M. Guichard): Lips, face, frons and vesicle entirely pale yellow; frontal groove moderate, with only traces of a dark basal line below the anterior ocellus. Occipital triangle yellow, the declivities rather steep. Back of orbit yellow with two narrow brown lines.

Thorax creamy yellow with pattern of dorsal and lateral brown bands moderately developed and contiguous, giving an impression of reticulation. Sternal pattern incomplete, the thin peripheral lines disconnected. Fore- and mid-femora mainly yellow, brown externally; hind-femora dark brown with short yellow interior streak.

Venation pale brown, costal edge and antenodal cross-veins yellow. Pterostigma yellow, between dark brown long veins. Membranule white. No amber fasciae. Forewing with 9½ Ax.

Abdomen very pale yellow on segments 1–3 and base of 4, the rest brownish yellow. The first three with typical brown stripes; 4–7 with only mere traces; segments 8–9 with black dorsal band; segment 10 and cerci all yellow. Vulvar lips with shallow invagination.

Abdomen 19.5 mm, hindwing 26 mm, pterostigma 2.3 mm.

If, as considered here, *scortecii* is conspecific with *annulata*, it seems possible that the pallid Egyptian and even the pale Arabian ones extend its range across that of true *annulata*. In other words, *scortecii* in that event is an ecological form bred of arid conditions.

VARIATION OF *T. ANNULATA*

With such a variable species it is of interest to study the characters from a comparative aspect.

SIZE: As a measure of size the length of the hindwing is more accurate than measuring the abdomen. The end partitions of each abdominal segment are slightly flexible and can, taken together, mount up to appreciable discrepancies. Sometimes the abdomen is somewhat curved and unless it is straightened, exact measurement is not easy.

Length (in mm) of hindwing in 8 ♂♂, Victoria Falls: 27.5–31.5 (average 29.6). Hindwing of 14 ♂♂ from various localities: 28.0 (Kosi Bay), 31.0 (Maun), 30.5 (Limpopo River), 30.0 (Dondo Forest), 30.5 (Ndola), 31.0 (Catete swamp, Luanda), 32.5 (Rutshuru), 30.5 (Entebbe), 29.0 and 25.5 (Karamoja), 27.5 (Badogri, S. Nigeria), 27.5 (Khartoum), 32.0 ('Ain Hagl) and 30.0 mm (Hofuf). The extremes are 26.5 and 32.5, but the average, 29.8 mm, is close to the Victoria Falls figure of 29.6.

It might be expected that those from the most arid localities would be of smallest dimensions through inadequate food supply. These would include the specimens from Arabia, Sudan and Karamoja, giving an average of 29.0 mm, scarcely less than the other averages. This figure is mainly due, however, to the Arabian examples, of large size. Possibly their haunts are not so arid. Omitting these, the Sudan-Karamoja average is only 27.3 mm for arid localities.

Taking the high rainfall localities, Rutshuru, Entebbe, Dondo, Ndola and Southern Nigeria the average is 30.2 mm, a little higher than normal. Longer selections would probably raise this average.

Hindwing of eight Mauritius ♂♂ (*haematina*) measures 30.5–33.5 mm with the distinctly high average of 31.9 mm.

PTEROSTIGMA: For most localities the length of the pterostigma in male forewing or hindwing is approximately 3 mm.

In the Southern Nigerian ♂ it is 2.5. In *scortecii* it is 2–2.5 mm. In Arabian examples from Hofuf and Qatif it is 2–2.5 (♀) mm, but 3.5 mm in the one from 'Ain Hagl.

MARKINGS ON LIPS: These seem to be individually variable, from obsolete to moderate black markings. The blackish areas may be present even in teneral examples, so they develop early. A wide range of variation is shown above in specimens from Victoria Falls. In the Luanda and Mohembo examples the markings are obsolete, but a Sepopa specimen has the labrum mainly black. In arid conditions the Karamoja ♂ may have narrow or broad black on labrum, broad in the Khartoum ♂. In the Arabian ♂ the lips have very little black. In the Egyptian ♂ *scortecii* from Moascar the lips are almost entirely pale.

In *haematina* the black is emphasized, the lips being broadly black.

MARKINGS ON THORAX: These vary from sparse to contiguous bands. Usually the dorsal markings are discontinuous and indistinct, but the lateral ones are more developed, as in the Victoria Falls series. The pruinosity of the male adult obscures the dorsal fasciae. The ground colour is usually ferruginous but in *scortecii* it is very pale, with greyer bands.

MARKINGS ON ABDOMEN: In Victoria Falls specimens there may be a discontinuous dorsal band, at least on segments 2–6, and a thick band on 8–10. In one Falls example as well as in *haematina* segment 9 is unusually black. In examples from other localities, mentioned above, there may be a more or less continuous black dorsal band on all segments. In paler examples the abdominal markings are much reduced.

SUPERIOR ANAL APPENDAGE: Usually the superior is pale basally, darkened distally, even in Egyptian and Sudanese specimens. In those from Karamoja and one Sudan example it is all pale.

WIDTH OF ABDOMEN: The maximum diameter (mm) of segment 4 of the male in six examples not obviously distorted is: 3 (Kariba), 2 (Maun), 2.5 (Rutshuru), 3 (Victoria Falls), 2 (Karamoja) and 3 (Mauritius).

As remarked above, however, the diameter can vary to some extent under muscular action of the individual.

BASAL AMBER ON WINGS:

Male. This is the most variable feature in the species. It may be pale amber in *scortecii*, deeper amber in most examples, brown-filled in f. *violacea*. In extent it varies from a small fascia mainly along the hindwing membranule to an extensive zone, reaching, in Arabian examples to the tornus of the hindwing and in these Arabian ones also spreading noticeably on to the forewing. In some mainland examples with plain amber hindwing fascia there may be darker subcostal and cubital rays, rather like the distinctive Madagascar species *selika*.

In the commonest continental form the hindwing amber reaches more or less to the first Ax and about three quarters of the distance to the tornus. In various examples from Zambezi River, Nigeria and Uganda the fascia is less extensive, only extending halfway to tornus.

The f. *violacea*, with brown fillings, is variable, with intermediates showing only traces of brown in some of the amber cells. The full darkening is seen in specimens from Botswana, Limpopo River, Zambezi River (especially Victoria Falls), Angola, Rutshuru and Entebbe. The Victoria Falls series, however, shows a range of extent both of the amber fascia and the brown fillings. In a *violacea* in the British Museum (Nat. Hist.) from Dahomey the brown-spotted fascia reaches almost to the arculus and tornus.

The Arabian examples with extensive amber on *all* wings may not, as stated above, be of racial significance since the British Museum series shows Arabian variations with diminishing amber to normal *annulata*. Sudanese, Tripolitanian and Egyptian specimens have the amber pale but of average extent on the hindwing. In Mauritian *haematina* males the colour varies from amber to brownish amber but it is generally much restricted in extent, often only a trace along the membranule.

Female. In females the amber fascia is also variable in extent, matching the over-all variation of the males but without the cells being centrally darkened. In old females, however, the periphery of each cell may darken. In the Hofuf Arabian female the amber on all wings corresponds in extent to that of the male. In Mauritian *haematina* there is only a mere trace of basal amber; and none at all in the Fezzan *scortecii* female.

ANTENODAL CROSS-VEINS IN FOREWING: Ris (1912: 759) gives the antenodals for *annulata* as 9½–11½, *violacea* 11½–12½, *haematina* 13½–15½.

In examples from the National Museum there is the following forewing antenodal index (left or right): Kosi Bay 10½, 10½; Limpopo River 10½, 11½; Kariba 10½, 11½; Victoria Falls 10½, 10½ and 11½, 11½; Maun 11½, 11½; Dondo 10½, 11½; Ndola 10½, 10½; Luanda 10½, 11½; Rutshuru 10½, 11½; Entebbe 10½, 10½; Karamoja 9½, 9½ and 9½, 9½; S. Nigeria 9½, 10½; Sudan 9½, 9½; Egypt 9½, 9½; Arabia, 'Ain Hagl 12½, 12½ and Qatif 10½, 10½; and 7 Mauritian *haematina* mainly 13½, 13½, rarely 14½.

selika

Many of the above are form *violacea* and it would seem that the average for both *annulata* and its form *violacea* is 10½ or 11½, and that 12½ is exceptional. Similarly, 13½ is average for *haematina*, sometimes 14½, rarely 15½.

The low figure 9½ is mostly in pallid or smallish males from arid regions, such as Karamoja, Egypt and Sudan. When the examples are small in size from arid regions the inference is that they have insufficient food in the larval state. When they are larger from these places it may mean that in such arid wastes the species has tended to remain near permanent or semi-permanent water sources and does not migrate far. This would mean that less wing-strengthening is required. Or perhaps in the more static conditions, with less sudden climatic changes, wing-strengthening is not vital. The large Arabian 'Ain Hagl specimen, with its high index may be in a well-watered oasis. These hypotheses may not prove correct but would, in any case, require a study of long series and a better acquaintance with these localities than is the case with the author.

DISTRIBUTION

The normal race is found in nearly all parts of Africa, from South West Africa, Botswana and Natal northwards to the Mediterranean coast, with subspecies or form *scortecii* frequenting some of the North African territories and possibly Arabia; with at least one other form in Arabia. Beyond these borders it extends to Italy, Sicily, Rhodes, Syria, Iraq and Cape Verde. Subspecies *haematina* occurs in Madagascar, Mauritius and Réunion.

HABITS

Found on or near rivers, streams and pools, settling frequently on reeds, grasses or rocks and sand. Females less frequently over the water, generally amongst vegetation further away.

MATERIAL EXAMINED

The localities listed, nearly all from the National Museum: Natal, Botswana, Rhodesia, Mozambique, Malawi, Zambia, Angola, Congo (Kinshasa), Uganda, Tanzania, S. Nigeria, Sudan, Egypt, Tripolitania, Arabia, Mauritius and Madagascar.

Trithemis selika (Selys), fig. 23 p 45

Libellula selika Selys, 1869, in Pollen et van Dam, *Rech. Faune Madag. Ins.* **25:** 16 (Madagascar).
?Libellula flavipennis var: Selys, 1869, in Pollen et van Dam, *Rech. Faune Madag. Ins.* **25:** 16 (Madagascar).
Trithemis selika maia Ris, 1915, *Ent. Mitt.* **4:** 145 (Comoro Isl.).
Trithemis selika: Pinhey 1962c, *Publções cult. Co. Diam. Angola* **59:** 273.

Types: *selika* ♂ in Bruxelles Museum; *maia* lectotype ♂♀ in Ann Arbor, Michigan.

Closely allied to *annulata*, this is another red species with broadish abdomen, but at maturity the male remains red with little or no pruinosity. The dark cubital ray on the hindwing of the male is characteristic.

The type of *Libellula lateralis* Burmeister (1839: 850) was a female, from Comoro Islands, described in some detail by Calvert 1898: 64. Ris (1912: 772) thought it was probably the same as *selika*. If this is so it would have priority over *selika*. On the other hand Ris later described subspecies *maia* from Comoro Islands. This complicates the problem since *lateralis* might become the species with *selika* as the Madagascar race.

Fraser (1956: 99) says *lateralis* female is probably *selika* (i.e. *maia*) since this and *arteriosa* are the only known species of *Trithemis* on the Comoro Islands. (Since that date Fraser has described a form of *kirbyi* from Comoro Islands). However, Buchholz (1959: 89) believed *lateralis* to be conspecific with *arteriosa*, and Calvert's description confirms this.

Subspecies *selika* (Selys)

MALE

MADAGASCAR (Forêt de Fanovana): Labium all ochreous, labrum with black bar on ventral margin; face ochreous, to red on frons. Frons above and vesicle metallic violet, not extending over the crest. Eyes in contact for a shorter distance than in *annulata*.

Thorax reddish brown with black markings more or less like *annulata*, laterally complete. Sternal black incomplete anteriorly. Legs black, fore femur with yellow posterior line.

Venation red. Pterostigma dark brown between black veins. All wings with amber basal patch, on forewing only halfway to first Ax; on hindwing to first Ax, not reaching triangle or tornus; with blackish brown cubital ray to beyond Cuq. Forewing with 11½ Ax.

Abdomen bright red with faint, sparse grey markings on basal segments; segments 4–7 all red; 8–10 and anal appendages black, with red lateral rectangle at base of 8. Accessory genitalia similar to *annulata*. Anterior lamina short, rounded, with short lip, with hair but no setae; hamular hook moderate, curved basad towards segment 2 and having outer setae. Genital lobe uniformly broad, very black, with apical hairtuft but only 1 or 2 setae. Prophallus with very short corpus, broad glans.

Abdomen 22 mm, hindwing 27 mm, pterostigma 3 mm.

Other males from same locality are similar except that the amber basal areas on the wings may be slightly larger or smaller. Pterostigma varies from 2.5–3 mm. Hindwing length varies up to 30 mm.

A male from Forêt d'Isaka has a broad black T on the labrum. Abdominal markings as above. Anal appendages chocolate-brown instead of black.

One from Forêt d'Anvarafantsi has no black on labrum; end segments of abdomen paler: segment 8 has a much larger red area covering most of the sides; 9 has a red sub-dorsal dot and a red sub-lateral bar; 10 has an anterio-lateral red stripe.

An example from Nossi-Bé has a narrow black stripe on lower margin of labrum, almost severed medially. Terminal abdominal segments as in the previous specimen.

FEMALE

MADAGASCAR (Forêt de Fanovana): Labium with fine black median line; labrum with slender black T, a narrow stem and narrow stripe along ventral margin. Frons with deepish furrow and a broad black, metallic violet basal band as wide as the distance between anterior and lateral ocelli. Vesicle yellow with metallic violet lateral spot. Occipital triangle as in *annulata*.

Thorax with prominent but typical broadish black pattern, complete laterally; sternal pattern almost closed anteriorly. Legs black, fore femur yellow on inner (anterior) surface.

Venation black. Pterostigma as in male. Amber basal fasciae more extensive but without dark ray: in forewing to second Ax and as far as the end of each cubital

hartwigi

space; in hindwing to or beyond fourth Ax and beyond distal end of triangle. Forewing with 11½–12½ Ax.

Abdomen broadly pale, with single pale lateral stripe; continuous narrow black dorsal and sub-lateral stripes and, on basal segments, a short black lateral line. Segments 8–10 and cerci all black except a small ochreous lateral spot (as in male) on 8. Vulvar scale rather like *annulata*.

Bursa (slightly oblique in figure) with dorsal sterigma showing two pectinate branches, their minute apices slightly detached. The central dorsal plate itself is bulbous, well chitinised, and terminates in a curved and grooved hook. Two folded ventral sterigmata, each terminating in a dentate process which is well chitinised. Lips not very thick. The bursa is rather like *monardi*.

Abdomen 20 mm, hindwing 27 mm, pterostigma 3 mm.

Two females from Ranohira differ in lacking all trace of black on labium and labrum and having less violet on the vesicle. Abdominal segments and other features as above.

Subspecies *maia* Ris

No examples are available. Ris says the Mayotte males and a female described from the Williamson collection are similar to *selika* but the male has partly black or dark red venation, particularly in the region of the discoidal cell (triangle). Also reduced amber basal fasciae: on hindwing only a trace in subcostal, medial and cubital spaces and only a short distance (2–3 cells) along the membranule. Also the metallic violet is more extensive on the frons.

Female with black venation (as in typical *selika*) and a distal grey suffusion; an even smaller amber basal area on hindwing than in male. Violet on frons almost reaching anterior edge. Thorax with broader black stripes.

The size in both sexes is approximately that of *selika* and the number of antenodal cross-veins (12½ in female) is not apparently different.

DISTRIBUTION

Madagascar and Comoro Islands.

Trithemis hartwigi spec. nov., fig. 24 p 60

?Trithemis longistigma Fraser (ined.); Pinhey, 1966, *Revue Zool. Bot. afr.* **73:** 306.

♂-Holotype in Museum König, Bonn.

This description is based on a single male of a remarkably robust red-bodied species from Fernando Po island collected by Dr W. Hartwig, after whom it is named. The late Dr. K. Buchholz had examined the specimen at Museum König without deciding its status.

Fraser's undescribed *T. longistigma* labelled as a "holotype" is in Paris Museum. It is immature and from a brief examination in 1964 it was thought to be allied to *werneri* because of its red body and large hamular hook. It was collected in the same locality, Moka, on Fernando Po (1700–2000 m).

In all probability this is the same species, but Hartwig's example is mature and illustrates its robustness and the difference in the hamules of this and *werneri*. Without re-examining *longistigma* it seems safer to give the species a new name than to legalize Fraser's name.

arteriosa

MALE

♂-Holotype (mature): Labium ochreous with broad black median band, as wide as the posterior lobe, which it covers; labrum all black; face ochreous. Frontal groove moderate. Frons above and vesicle dark red with violet sheen. Occipital triangle brown; back of orbit brown inwardly, outwardly black with yellow bar.

Prothoracic frontal lobe glossy black with only a linear yellow anterior margin; median lobe glossy ferruginous with dull blackish, hirsute anterior slope; posterior lobe ferruginous, not projecting so abruptly in centre as usual (see figure). Synthorax ferruginous with only sparse, faint darker markings: at the dorsal concavity on humeral suture, diffuse bands on first and second lateral sutures. Sternal pattern diffuse at sides, not developed posteriorly. Legs mainly black; fore femur ferruginous with short yellow inner stripe.

Venation black, pterostigma dark brown between black veins. Wing bases with dark brownish amber, on forewing only traces in subcostal and median spaces; on hindwing not reaching first Ax but spreading posteriorly across median to cubital space as far as Cuq, and on base of anal field to just beyond the dark grey membranule. Antenodal formula of forewing: 12–14½, 13½–11, thus having 13½–14½ Ax.

Abdomen robust, triquetral, the segments short, segments 4–6 being slightly less than twice as long as the width of one side. Red with black markings as figured; segment 8 with red dot, segments 9–10 black. Superior appendage black, inferior reddish, thickly margined with black. Anterior lamina small, rounded, with pronounced apical projection; hamule with large hook having small outer setae; genital lobe with apex narrowed and curved, and having long, thin setae.

Prophallus very like *bredoi* or *arteriosa*. No flagella or cornuti.

Abdomen 27.5 mm, hindwing 36 mm, pterostigma 3.8 mm.

FEMALE

Not seen. From a comparative study with other species of the genus it is probably equally robust, rather paler; frons probably with black basal band. Thoracic and abdominal markings presumably sparse as in the male.

Holotype in Museum König, Bonn, from Moca See (1900 m), 4 November 1962, leg. W. Hartwig.

The species is nearest to *bredoi* and *kalula* but far more robust and differs in markings.

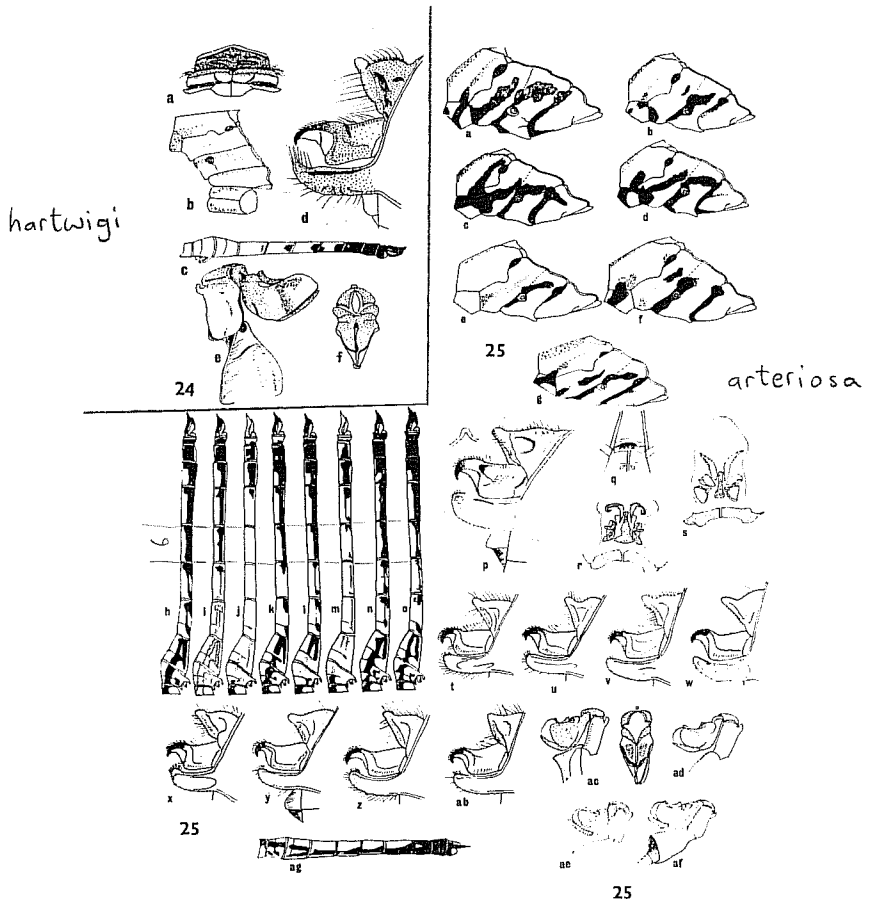
DISTRIBUTION

Known only from Fernando Po island.

Trithemis arteriosa (Burmeister), fig. 25 p 60

Libellula arteriosa Burmeister, 1839, *Handb. Ent.* **2:** 850 (Port Natal).
Libellula lateralis Burmeister, 1839, *Handb. Ent.* **2:** 850 (St Johanna Isl.); Buchholz, 1959: 89.
Libellula distincta Rambur, 1842, *Névroptères:* 85 (Cape).
Libellula rubella Brullé, in Webb & Berthelot, 1844, *Hist. nat. Canar. Ent.:* 82.
Libellula conjuncta Selys, 1849, in Lucas, *Algérie* **3:** 121, f. (Algeria).
Trithemis arteriosa syriaca Selys, 1887, *Annls. Soc. ent. Belg.*, **31:** 23 (Syria).
Libellula stuhlmanni Gerstaecker, 1891, *Jb. hamb. wiss. Anst.* **9:** 6 (Zanzibar).
Trithemis penelope Fraser (ined.).
Trithemis arteriosa: Pinhey, 1962c, *Publções cult. Co. Diam. Angola* **59:** 269.

Types: *arteriosa* ♂ in Museum Halle; *distincta* ♂ in Bruxelles Museum; *stuhlmanni* lectotype ♂ in Museum Hamburg.



Certain of these names might be regarded as varietal or subspecific, others are synonyms. It seems that the *lateralis* female type, described from Comoro Islands, is this species not *selika* (q.v.). Buchholz (1959: 89) considered it the same as *arteriosa*. Calvert's (1898: 64–65) description indicates that there were two original females of *lateralis*, one in Museum Halle, the other, larger, in the Museum of Comparative Zoology, from the Island of St Juan. Both these he described in detail. An adjusted extract of the description follows:

FEMALE: Face and lips yellow; *narrow* black basal band on frons; black median line on labium and on labrum. Vertex luteous (yellow-brown). Synthorax luteous above, yellowish laterally; incomplete and separate black stripes. Fore and mid femora yellowish inferiorly. Wings slightly fumose. Pterostigma blackish brown. Forewing with 11½–12½ Ax. Abdomen luteous; segments 2–3 with dorsal and two lateral black stripes; lateral black stripes on segments 3–7; 8 black with two small, basal luteous spots; 9–10 all black; cerci blackish. Vulvar scale "neither produced nor excavated", evidently straight.

Abdomen 20–23 mm, hindwing 25–28 mm, pterostigma 3 mm.

The above description is almost certainly of a form of *arteriosa*.

The undescribed *penelope* in the British Museum (Nat. Hist.) has been identified with *arteriosa* by Kimmins and the author; *distincta*, *conjuncta*, *syriaca* and *stuhlmanni* are probably no more than forms, perhaps at times influenced by ecological conditions. It is not easy to separate them as geographical subspecies, and Ris, Selys and Buchholz have discussed such possibilities. The type of *rubella* has not been examined but Ris (1912) was apparently satisfied when Kirby (1890: 18) placed it in synonymy with *arteriosa*.

Although certainly a variable species the development of amber on the wings is not a satisfactory basis for racial differences, except, perhaps, those from the South Western Cape Province. Abdominal markings also show much diversity (Buchholz, 1959: 91) and here at least there may be some grounds for separation: especially the series with sparse markings from Ennedi Mountain, in the arid north east corner of the Central African Republic.

Ris was at first uncertain whether *monardi* was distinct from *arteriosa* but later he decided it probably was distinct. The present author recognizes these as different species but for reasons stated later the more northerly insect *imitata*, at first considered subspecific to *monardi* is now regarded as another separate species. Morphologically and genitalialy there is not very much difference between *arteriosa*, *monardi* and *imitata*. In habits *monardi* is quite distinctive and its much smaller range of distribution is entirely covered by the widespread *arteriosa*. In the swamps of Botswana, for instance, both occur plentifully and the possibility of an ecological variant is quite ruled out. Sibling species with little to separate them on genitalial grounds are found in other insect groups, such as the Lepidopteran genus *Charaxes* Ochsenheimer.

EXPLANATION OF FIGURES

Figs 24–25. *Trithemis* species. 24. *T. hartwigi*, ♂-holotype. a—Prothorax. b—Synthorax. c—Abdomen. d—Accessory genitalia. e–f. Prophallus. e—Right and f—Ventral aspect. 25. *T. arteriosa*. a-g. Male synthorax. a—Pietermaritzburg. b—Wadi Mait. c—forma *socotrensis*. d—Golal. e—Morocco. f—*T. a. ennediensis*. g—Bulawayo. h–o. Male abdomen. h—Pietermaritzburg. i—Matopos (teneral). j—Wadi Mait. k—Forma *socotrensis*. l—Golal. m—*T. a. ennediensis*. n—Katanga. o—Tiassale. p—Accessory genitalia and anterior lamina (Pietermaritzburg). q—Vulvar lip (Bulawayo). r–s. Bursa (Ndola). t–ab. Accessory genitalia. t—Forma *socotrensis*. u—Golal. v—Morocco. w—*T. a. ennediensis*. x—Issia. y—Victoria Falls. z—Stellenbosch. ab—Wadi Mait. ac–af. Genitalia. ac—Matopos. ad—Abidjan. ae—Boukoko. af—*T. a. ennediensis*. ag—Female abdomen (Bulawayo)

Subspecies *arteriosa* (Burmeister)

MALE

TRANSVAAL (Pretoria) ♂: Labium with broadish black median band, expanded posteriorly to cover the posterior lobe; labrum reddish with short black central bar on lower margin. Face ochreous. Frons with moderate groove; above reddish brown without the usual broad metallic area but with a narrow black basal line, narrower than the distance between central and lateral ocellus.

In this detail, having a black basal band or line on the frons, *arteriosa*, *imitata*, *monardi* and others are like the females of most other species.

Vesicle darker, bronze-brown. Occipital triangle dark brown.

Synthorax purplish red on mesepisterna due to thin pale blue pruinosity; reddish brown laterally with the black bands slightly contiguous, almost like the Pietermaritzburg example figured here. Sternal black pattern complete. Legs black, fore femur ochreous on inner surface.

Venation darkish red; pterostigma black with faint brown posterior line, between black long veins. Amber basal patches sparse and discontinuous; in forewing, traces in subcostal and cubital spaces, not reaching the cross-veins; in hindwing, subcostally to first Ax, cubitally to just beyond Cuq, anally covering about 5 cells. Membranule pale grey. Forewing with 11¼–12½ Ax.

Abdomen very slender after the basal segments; red, with black markings very like the Pietermaritzburg example figured here, each segment having a black lateral or sublateral black band except 9–10 which are nearly all black. Superior appendage black, red at base; inferior red, black-edged and black on apical third. Accessory genitalia as shown in the Pietermaritzburg example. Hamular hook small, with numerous short outer setae; anterior lamina smallish, well chitinised except at the produced, undivided apex which is armed with short, thick outer setae; genital lobes broadish, with a large cluster of small apical setae which are usually well developed in this species. Note that unlike *monardi* and *imitata* the anterior lamina has no apical hair-tuft.

Prophallus short and broad, with large glans, hidden vesica; no flagella.

Abdomen 22 mm, hindwing 26.5 mm, pterostigma 2.5 mm.

VARIATION OF *T. a. arteriosa* (males)

In this variable species with some prevailing uncertainty about subspecific separation it seems more satisfactory to consider variation in males across its specific range rather than to select specimens for individual variation. Forms and subspecies will be discussed later. Females are less satisfactory and will be treated separately from the males.

SIZE: The species shows some size variation in any one area but those from humid equatorial Africa appear to be predominantly smaller than the average. As in *annulata* the size measurement is based on the hindwing: 6 specimens from Cape Province, 25–27 mm; 6 from Rhodesia, 25–28 mm; 8 from Zambia, 25–28 mm; 5 from Ivory Coast, 24–26.5 mm; 3 from S. and E. Nigeria, 23.5–26.5 mm; 3 from Gabon, 24–27 mm. For Santa Cruz Ris (1912: 764) gives 28 and 30 mm, somewhat large individuals.

PTEROSTIGMA: Normally black in mature males, but in *ennediensis* it is pale. In length it is generally 2.5, varying from 2–2.8 mm.

MARKINGS ON LIPS: In Zambian examples the labial black can be similar to the Pretoria male (*supra*) but it is usually broader on the median lobes and tends to be splayed out on the anterior margins. In a juvenile Ndola example it is much narrower than in mature males. A teneral from Mazabuka has no black on labium or labrum.

The same absence of black is seen in tenerals from Rhodesia and N.W. Angola. Yet in an immature Socotra male (*socotrensis*) there is a broad brown band on the labium and an almost bifid distal fascia on the labrum.

The labial black in equatorial examples (N. Congo—Kinshasa, Gabon, Central African Republic, S. Nigeria, Ivory Coast) is generally broad at maturity, splayed out anteriorly, as in Zambian specimens; but in a mature male from Ibadan (S. Nigeria) it is narrowed anteriorly and not splayed. This last example has the face and lips unusually bright red (perhaps immersed in fumes of ethyl acetate—this ester often reddens the body of pale-coloured Libellulidae). In *ennediensis* the labium and labrum are entirely pale.

Labral black is as variable as that of the labium. In Cape Province mature males it may be a very small anterior marginal fascia (Paarl) or an elongate, fusiform macula (Malmedy). From Swaziland a long narrow band; from Abercorn (Mbala) (Zambia) a small semicircle, but from Mwinilunga all broadly black except a basal line.

In other parts of Africa there are similar variations, from absence of black in *ennediensis* to generally broad black in equatorial males. In a Katanga male there is no fascia on the labrum, only a trace on the labium.

In general it may be said that black on the lips is individually variable and that when present at maturity it may be less developed in juveniles. In *socotrensis*, however, it develops early. In *ennediensis* no fasciae are present.

MARKINGS ON THORAX: Generally the markings are distinct and black, as in the Pietermaritzburg male figured here; often more or less contiguous laterally. This applies to examples from South, Central and Equatorial Africa.

From the more arid regions, but also the type of *stuhlmanni* from the moist Tanzanian coast (Zanzibar) (Buchholz, 1959: 91) the markings are much reduced, sometimes faint and grey, not black, not contiguous. This particularly applies to examples from Wadi Mait (Somalia) and Morocco (presumably *conjuncta*), both of them figured here. In the series of *ennediensis* (vide Buchholz) some have extensive markings, others faint ones.

As with its well developed lip markings the somewhat juvenile *socotrensis* male has very well developed dark bands (probably black at maturity).

MARKINGS ON ABDOMEN: Examples from Cape Province, Natal, Rhodesia, Central and Equatorial Africa generally have the black pattern figured for the Pietermaritzburg male, with only insignificant variations. The immature Socotra male is rather similar.

In tenerals, such as the Matopos (Bulawayo) example illustrated, the basal markings are faint but the distal black markings evidently develop early, possibly for sexual recognition.

In the mature Golal (Sudan) males the basal segments have diffuse markings. In the Wadi Mait example (*stuhlmanni*) and in the series of *ennediensis* (*teste* Buchholz) the abdominal markings are very greatly reduced.

SUPERIOR ANAL APPENDAGE: The superior appendage is usually all black (greyish in tenerals) but they are entirely pale in the Wadi Mait and Ennedi specimens.

BASAL AMBER ON WINGS: In typical *arteriosa* from Natal, Swaziland and Transvaal the amber basal fasciae of all wings are very small and somewhat discontinuous. This is also the case in some Cape Province examples. However, Cape females, as will be shown,

have striking nodal amber maculae, so that *distincta* (Rambur), described from the Cape, must depend on female wing features if it is a separate form.

The small amber patches of the above males do not warrant regional separation since occasional examples are found elsewhere, for instance, in specimens from Matopos (Rhodesia) and Katanga.

North of the Limpopo River (and sometimes to the south of it) the amber fasciae are usually more extensive and continuous: Eranchi (Swaziland, well south of Limpopo), on forewing to first Ax, well beyond Cuq, on hindwing to beyond second Ax. to base of triangle, and on four rows in anal field; Victoria Falls examples similar but variable in extent. In a Golal (Sudan) specimen the hindwing amber is more extensive and reaches third Ax, well into triangle and almost to tornus. This condition is found in *stuhlmanni* (Zanzibar) and elsewhere in East Africa, as well as Equatorial Africa; and exceeded in one from Gagnoa (Ivory Coast).

A Moroccan male has small patches and is probably f. *conjuncta;* similarly one from northern Somalia. Yet the small continuous amber area is seen in examples from Rhodesia, Malawi, Mozambique and Zambia.

FEMALE

RHODESIA (Bulawayo) ♀ (mature): Labium with complete, not very broad black band, not covering the posterior lobe but leaving yellow lateral spots; labrum with very narrow black stripe on lower margin. Face ochreous. Frons with moderate groove, yellow, with black basal band nearly as wide as the distance between central and lateral ocelli. Vesicle yellow, with only minute crests, the lateral ocelli encircled with black.

Synthorax ochreous brown, with two faint brown antehumeral stripes and blackish lateral and ventral bands similar to most males. Legs black; mid femur with yellow inner stripe, fore femur yellow with black exterior stripe.

Venation red, browner posteriorly. Pterostigma brown, between black long veins. Forewing with subcostal amber to first Ax, cubital to beyond Cuq; hindwing with amber in equivalent positions and in anal field not reaching halfway to tornus. Forewing with 9½–10½ Ax.

Abdomen broader, more cylindrical than male; with black markings on most segments similar: on segments 1–3 as in male; 4–7 with broad sub-lateral band; segment 8 with latero-basal yellow triangle; 9 black, 10 with pale mid-dorsal line. Cerci black. Vulvar scale with shallow invagination.

Bursa with dorsal sterigma narrowed anteriorly, well chitinised; anteriorly with two detached, curved or angled, divergent, hirsute branches. Ventral plates curved. Lip moderately thick.

Abdomen 21 mm, hindwing 26 mm, pterostigma 3 mm.

VARIATION OF *T. a. arteriosa* (females)

There is less variation in black markings on lips and body than in the males but the wing-amber is more variable.

SIZE: There is some variation which is probably individual. The hindwing may be only 23.5 (Mamfe, Nigeria) or 24 (Empangeni, Natal), up to 27 mm (Bulawayo).

MARKINGS ON HEAD AND BODY: Labial markings develop later in maturation than the abdominal black. On the posterior lobe of tenerals the yellow lateral spots may be larger or much larger than at maturity. The most important body feature in the female

may be the pale basal triangle on segment 8 which varies a little in size and shape. Segment 9 always seems to be black and this is a means of distinguishing the female *pluvialis* which has a pale lateral band on 9.

AMBER ON WINGS: As stated above there is more variation in wing-amber than in males. An Ikom (Nigeria) specimen has only mere traces, none on forewing, on hindwing a trace in cubital and anal zones. Many mature females are like the Bulawayo specimen (*supra*), but the amber is more extensive in a very slightly immature one from Lubumbashi (Katanga), on hindwing nearly reaching the tornus.

Teneral females from Rhodesia, Zambia and Natal are as broadly amber as in the Katanga specimen. There may be traces of amber at the nodes in these tenerals, linking up sometimes to the bases of the wings.

Mature Cape Province females (the area for the type of *distincta*) have reduced but sharp, discontinuous basal amber as well as sharp nodal fasciae (more developed than in teneral females mentioned in previous paragraph). In the juvenile Cape females the nodal amber spreads distad and basad and is deep in colour. Males from the Cape are not essentially different from Natal or Transvaal males, but these strong nodal amber markings of the females are distinctive. Perhaps it is due to some physiological or ecological factor in southern females of *arteriosa*, *furva* and *dorsalis*, as suggested previously in this revision.

VARIETIES AND SUBSPECIES OF *T. ARTERIOSA*

It is here considered that most infraspecific taxa of *arteriosa* are forms, with *ennediensis* as a probable subspecies.

typical f. *arteriosa* (Burmeister) (Natal)

Characterized by body markings and small, discontinuous basal amber on the wings. The amber fasciae intergrade with other forms.

f. *distincta* (Rambur) (Cape Province)

Only different from typical (Natal) form in the sharp nodal amber of the females, even the mature examples.

f. *conjuncta* Selys (North and North East Africa)

Rather reduced body and wing-amber markings. Insufficient material examined to be sure of its status.

f. *stuhlmanni* Gerstaecker (Zanzibar, Tanzania to Sudan)

Probably intergrades with *conjuncta* but tends to have larger basal amber.

f. *syriaca* Selys (Syria)

Very reduced basal amber on hindwing in male and none in female.

f. ***socotrensis*** forma nov. (Socotra)

The type in the National Museum is a juvenile male from Socotra island. It is more heavily marked with black (even in immaturity) than the East African form *stuhlmanni*.

♂-Holotype: Labium yellow, the posterior lobe all black, a broad brown band on lateral lobes, expanded at anterior end. Labrum with blackish band on lower margin. Face pale yellow. Frons with moderate groove, a blackish basal band narrower than the

distance between central and lateral ocelli and a thin metallic *bronze sheen* extending nearly to the crest; vesicle also bronze. Occipital triangle yellow.

Prothorax yellow, with the usual dark areas reduced. Synthorax pale yellow with distinct brown bands, all continuous, laterally nearly contiguous. Sternal pattern complete on periphery. Legs black, fore femur yellow interiorly.

Venation mainly yellow, to reddish yellow. Pterostigma black, the proximal cross-vein red. Basal amber continuous and extensive, on forewing to second Ax and to beyond Cuq; on hindwing to third Ax, base of triangle and two-thirds of the distance to tornus. Membranule pale brown, white at base. Forewing with 12½ Ax, 9–10 Px.

Abdomen yellowish at base (probably darkens at maturity) orange-red distally, with black markings as in the figure: the usual lateral stripe on basal segments; 4–5 with only distal, sub-lateral spots; segments 6–8 with sub-lateral band; 9 with orange basal spot, 10 black at base. Superior appendage blackish, orange at base; inferior mainly pale.

Accessory genitalia typical.

Abdomen 22 mm, hindwing 26 mm, pterostigma 2 mm.

It is possible that with its fairly distinctive thoracic and abdominal patterns and the bronze on the frons it is a distinct insular subspecies. The bronze may, however, be only a teneral condition (cf. *monardi*, teneral ♂). With only the single example at hand it is safer to consider it a form. McLachlan (1903: 400) placed it in form *distincta*. Kimmins (1960: 388) followed this lead in listing the species collected on Socotra by G. Popov and called them race *distincta*.

T. arteriosa ennediensis subspec. nov.

♂-Holotype in the National Museum, Bulawayo.

This subspecies is erected on the basis of a male kindly donated by the late Dr Karl Buchholz and on the description and figures in his 1959 paper. It is too close to *arteriosa* to regard as a separate species, yet distinct from all other forms seen of this species.

A long series was collected by Dr F. Kollmannsperger in the Ennedi Mountain range of the North East corner of the Central African Republic and it must here be regarded as a very local subspecies, probably because of some ecological conditions in these mountains.

♂-Holotype (mature): Labium ochreous, posterior lobe black; labrum and face entirely ochreous. Frons red-brown with very narrow black basal band and shallowish groove. Vesicle red-brown.

Synthorax as in the figure. Sternal pattern complete. Legs black, all femora yellowish on inner surfaces.

Venation red; pterostigma pale brown, between black long veins. Amber basal fasciae on forewing to first Ax and to Cuq; on hindwing to second Ax, base of triangle and halfway to tornus. Forewing with 11½–12½ Ax.

Abdominal black markings sparse, as in the figure; very reduced on basal segments, but rather more pronounced on other segments than in *stuhlmanni*. Superior appendage pale. Prophallus as illustrated.

Abdomen 23 mm, hindwing 25 mm, pterostigma slightly less than 2 mm.

In the original series in Museum König, Buchholz (1959: 91, figs 16, 17) found some variation in the sparse abdominal markings. This subspecies differs from typical *arteriosa* in the reduced black on the labium, the absence of it on the labrum, the pale

jacksoni

pterostigma (despite maturity); in the reduced thoracic and abdominal fasciae, especially segments 9–10; and in the unmarked anal appendages.

DISTRIBUTION OF *T. arteriosa*

Not only one of the two most widely distributed African species of *Trithemis* but also one of the commonest, often the most abundant anisopteran in Africa. It is found virtually throughout continental Africa where any Anisoptera occur and on most of the neighbouring islands: Madagascar, Comoro, Zanzibar, Socotra, Cape Verde, Canary Isl.; also Syria, Arabia, Iran and Suez. It is surprisingly absent from Mauritius and the entire Seychelles groups.

The subspecies *ennediensis* has been found only in its restricted locality in North Central Africa.

HABITS

Found over or near most freshwater sources, whether stagnant or fast flowing. Both sexes may be equally abundant over the water, unlike most other species. They settle on reeds, grasses, twigs or any other convenient perches, the wings well depressed. On the wing throughout the year in most haunts, again unlike most species.

It has been recorded as the prey of asilid Diptera of the species *Alcimus setifemoratus* Hobby and *Neolophonotus robustus* Ric. (Department of Agriculture, Salisbury).

MATERIAL EXAMINED

From Cape Province, Natal, Swaziland, Transvaal, Botswana, Mozambique, Rhodesia, Angola, Zambia, Malawi, Congo (Kinshasa and Brazzaville), Tanzania, Kenya, Socotra, Central African Republic, Gabon, Cameroons, Nigeria, Ivory Coast, Sudan, Somalia, Ethiopia, Morocco.

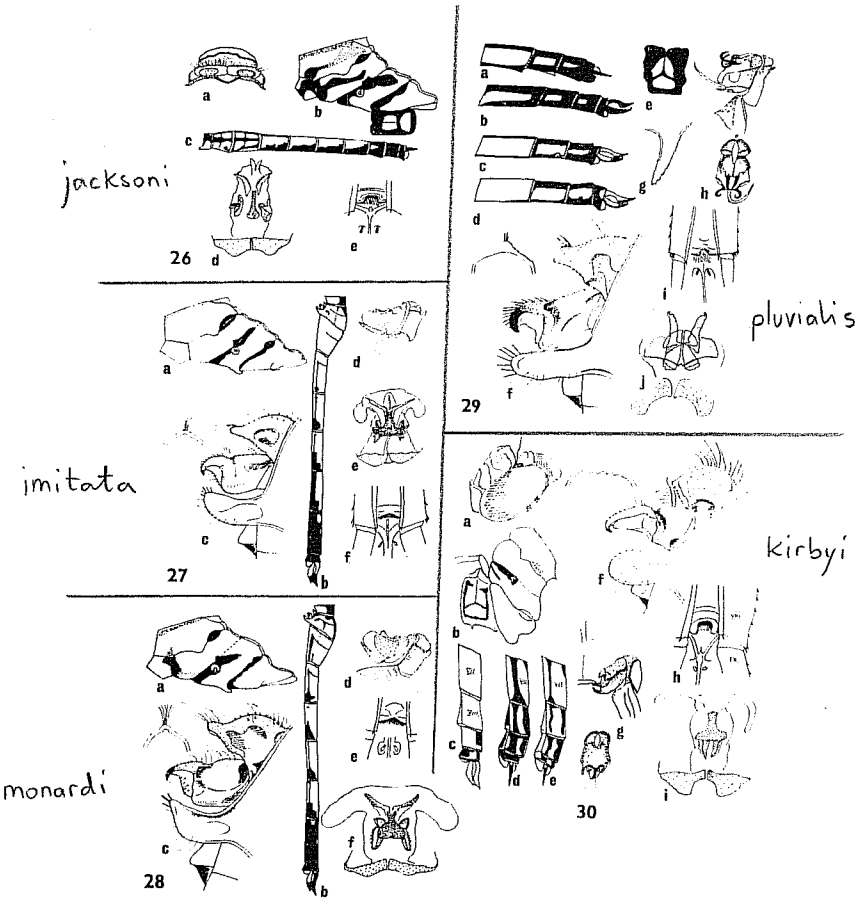
Trithemis jacksoni spec. nov., fig. 26 p68

♀-Holotype in National Museum, Bulawayo.

This is quite evidently a distinctive species, related to *imitata*, *arteriosa* and *monardi*. Unfortunately only a single female is available and normally it is inadvisable to name a species on this sex alone. Since this is, however, a revisional paper covering the African species and this female has definite features of identification it appears advisable to describe and name this female. It is named here in memory of an ever-helpful friend, the late T. H. E. Jackson, who sent this and large selections of Odonata from Ivory Coast, Nigeria, Congo (Brazzaville) and elsewhere. It is a small example, probably of a small red-bodied species.

FEMALE

♀-Holotype (mature): Labium yellow with black central band which narrows slightly on the posterior lobe so that this lobe is black with yellow lateral bands. Labrum yellow with small black hemisphere on lower margin. Face and frons yellow; frons with moderate groove and narrowish violet-black basal band, narrower than the distance between central and lateral ocellus. Vesicle ringed with black, yellow on crest. Occiput all yellowish. Back of orbit black with the usual yellow spots.



imitata

Prothorax with yellow collar, the median lobes yellow with black ellipses; posterior lobe projecting medially, brown with orange free margin. Synthorax yellow with grey and black pattern as in fig. 26. Sternal pentagon complete. Legs black, yellow at bases, the fore femur yellow on inner surface.

Venation red, apices rather rounded and with brown apical fasciae covering the pterostigmatal area. Pterostigma brown with yellow posterior line, the anterior, posterior and distal edges black. Both wings amber at base, the forewing to first Ax and to Ac and base of anal field; the hindwing to second Ax, base of triangle, basal half of loop and anal field just to tornus. Membranule brownish white. Nodal index $\frac{8.\ 11\frac{1}{2} = 10\frac{1}{2}.7}{10.\ 8\ =\ 8.10}$.

Abdomen shorter and broader than in *imitata*, the segment 5-6 ratio < 2. Yellow with black markings as in the figure. Segment 8 with yellow cone, 9 black, 10 with yellow dorsal spot, cerci black. Vulvar lip a shallow U, ova broadly elliptical.

Bursa: dorsal plate slender, slightly expanded posteriorly. Anterior ventral sterigmata slender, with ventral hair (cf. *arteriosa*); posterior ventral plates coiled. Bursal arms very short. It is closely similar to *arteriosa*.

Abdomen 19.5 mm, hindwing 25 mm, pterostigma 2.8 mm.

The ♀-holotype was collected in the Tiassale Forest, Abidjan, Ivory Coast, July 1965.

By its size and abdominal markings the unknown male is probably a red-bodied species in the *arteriosa* group. The basal and apical wing markings suggest a similarity to *monardi* or *imitata* in the male, possibly with brown wing apices and probably with deeper basal patches. By this comparison the male may favour reedy swamps and have a fluttering motion in flight. The bursal complex also shows close affinity to *arteriosa*.

Trithemis imitata Pinhey, fig. 27

Trithemis monardi imitata Pinhey, 1961, *Publn. Brit. Mus. (Nat. Hist.)*: 164.

♂-Holotype, ♀-allotype in National Museum, Bulawayo.

The present research has shown *imitata* to be nearer *arteriosa* than to *monardi* and since it is moderately distinct from *arteriosa*, yet widely distributed in equatorial Africa across the *arteriosa* range it must here be regarded as a distinct species.

MALE

Congo (Buta) ♂-holotype (mature): Lips, face, frons and vertex all ochreous except a basal black band on frons, approximately as wide as the distance between central and lateral ocelli. Frontal groove moderate.

EXPLANATION OF FIGURES

Figs 26–30. *Trithemis* species. 26. *T. jacksoni*, ♀-holotype. a—Prothorax. b—Synthorax. c—Abdomen. d—Bursa. e—Vulvar lip. 27. *T. imitata*, a–c. ♂-holotype. a—Thorax. b—Abdomen. c—Accessory genitalia and anterior lamina. d—Prophallus (♂-paratype, Tororo). e—Bursa (Bouar). f—Vulvar lip (Bouar). 28. *T. monardi*. a—Thorax (♂, forma *insuffusa*, Abercorn or Mbala). b—Abdomen (♂, Abercorn). c—Genitalia and anterior lamina (Sepopa). d—Prophallus (Nkata Bay). e—Vulvar lip (Sepopa). f—Bursa (forma *insuffusa*, Zambia). 29. *T. pluvialis*. a–d. Abdomen. a—Female (Mwinilunga). b—Male (ab. *melanistica*). c—Male (East Angola). d—Male (Shimba Hills). e—Metasternum (Shimba Hills). f—Genitalia and anterior lamina (Shimba Hills). g—Genital lobe (Ndola). h—Prophallus. i—Vulvar lip. j—Bursa (Kitwe). 30. *T. kirbyi ardens*. a–b. Head and thorax (♂). c—Abdomen (♂). d–e. Abdomen (♀). d—Limpopo R. e—Sabi R. f—Genitalia (Botswana). g—Prophallus. h—Vulvar lip. i—Bursa (Balla Balla).

monardi

Synthorax sparsely marked with black as in the figure. Sternal pattern incomplete laterally and anteriorly. Legs black, fore femur yellowish interiorly.

Venation red; pterostigma pale brown, between black veins. Amber on forewing to first Ax, almost to arculus, to beyond Cuq and in anal field; on hindwing extensive and uniform, to third Ax, distal end of triangle and far beyond tornus, almost to end of anal loop. Forewing with 11¼ Ax.

Abdomen shaped as in *arteriosa*, red, with sparse black markings as in the figure: lacking on segment 3; on segments 4–6 confined to distal end; 8 with only small dorsal red marks, 9–10 all black. Superior appendage only black on distal half. Anterior lamina short, weakly sclerotized, with produced, undivided apex having a prominent tuft of hair (unlike *arteriosa*). Hamular hook broad but more weakly developed than in *arteriosa*, the hamule not heavily chitinised; the hook with short outer setae. Genital lobe more pointed and curved at apex and having only a few apical setae.

Prophallus like *arteriosa* but the glans chitinised to the apex.

Abdomen 23 mm, hindwing 25 mm, pterostigma 3 mm.

An Ndu male (also Northern Congo-Kinshasa) has the posterior lobe of the labium black, but it is otherwise similar. Of two from Dingila-Uele River one has the labium all ochreous, the other has the posterior lobe partly black, a small apical dark spot on m dian lobe, and a black distal triangle on the labrum.

C.A.R.: One male from Kembe Falls, La Kotto (Central African Republic) has no black on the lips.

Uganda: A series taken some years ago at Tororo on the Kenya-Uganda border, one of which is in the National Museum (Bulawayo) differed only in having the posterior lobe of the labium black.

FEMALE

C.A.R. (Bouar) ♀-allotype: Face and head as in male but a slightly broader black basal band on frons.

Synthorax as in male. Sternal black slightly more complete. Legs similar but fore femur ochreous with black streak.

Wings as in male, with only slightly less amber, of a paler tint.

Abdomen as in *arteriosa* but the lateral spot on segment 8 rounded, not triangular. Vulvar scale shallow but more V-shaped.

Bursa rather like *arteriosa*. Dorsal sterigma bifid anteriorly, widely splayed posteriorly and irregularly margined (unequally on the two sides as is often the case). Posteriorly, the attached ventral sterigmata are folded. Anteriorly there are two divergent processes, slightly hirsute. Bursal arms short and broad.

Abdomen 21 mm, hindwing 25 mm.

Congo: A female from Dingila-Uele River shows no appreciable differences.

DISTRIBUTION

Apart from the above records on the Kenya-Uganda border, Central African Republic and Northern Congo (Kinshasa), the author has also recorded the species from Garamba National Park.

HABITS

These have the typical trithemine flight, not the fluttering, papilioid motion of *monardi*. At Tororo they were somewhat gregarious on reeds and grasses at one bend

in the Tororo River. In the Northern Congo they were on reedy pools on the banks of rivers and at La Kotto on a large quiet pool above the Sembe Falls.

Trithemis monardi Ris, fig. 28 p 68

Trithemis arteriosa var. Ris, 1919, *Coll. Zool. Selys* **16:** 1196 (♂ Okosongomingo, S.W. Africa).
Trithemis monardi Ris, 1931, *Revue suisse Zool.* **38:** 108 (Angola); Pinhey, 1962c: 272.

Types ♂♀ in Museum Les Chaux-de-Fonds.

In facies this is very closely similar to *arteriosa* but differs in the pale pterostigma, the sparse thoracic markings, in the abdominal pattern, particularly that of segments 5–7; and in the accessory genitalia: the anterior lamina is sclerotized to the apex; the hamular hook devoid of setae. Characteristically it always has very large amber basal fasciae and, in the males, these are filled in with brown on the hindwing. In flight it differs from all other *Trithemis* species seen by the present author in life. From *imitata* it differs by the strong black lip markings and the latter has no brown fillings on the amber wing-areas.

In a long series from the Okavango swamps of western Botswana the wing apices in both sexes are well tinged with brown. In all material from further east or north east, Rhodesia, Zambia, Malawi, East Angola and Mozambique, these brown apical markings are lacking or there is only the merest trace of them. On these grounds the species can be divided into West and East races. Ris' South Angola and South West African specimens would be in regions closely linked ecologically with the Okavango swamps and in fact these swamps are fed by the Okavango River in South Angola. Ris, who only examined males, does not mention the brown tips which are occasionally less noticeable in males than in females.

Subspecies *monardi* Ris

Botswana (Sepopa) ♂ (mature): Labium with broad black median band, completely covering the posterior lobe; labrum mainly black with ochreous basal band. Frons with moderate groove; brownish above with purplish black basal band, as wide as the distance between central and lateral ocelli; vesicle dark violaceous. Occipital triangle brown, yellow posteriorly; orbits posteriorly black with yellow spots, not yellow with black bands.

Prothorax mainly black, with traces of reddish on collar and on middle lobes. Synthorax marked very sparsely with black as in the figure from Abercorn. Metasternal pattern heavily blackened. Legs black, fore femur yellowish posteriorly.

Venation red; pterostigma pale brown, between black veins; apices tinged with brown. Basal amber deep and extensive: on forewing to second Ax, to arculus and to base of subtriangle; on hindwing to third Ax, to distal end of triangle and to beyond tornus, and the cells filled in with brown. Forewing with 11¼ Ax.

Abdomen shaped as in *arteriosa*, red, with black markings as in the Abercorn illustration. Segments 4–7 with the black concentrated at distal ends; 8 black with a small basal spot more lateral than in *arteriosa;* 9–10 all black. Superior appendage black, inferior black distally. Anterior lamina entirely black, with produced, undivided apex and a strong tuft of apical hair (like *imitata*, but unlike *arteriosa*); hamular hook well developed but with the outer setae only minutely developed. Genital lobe with curved, pointed apex and only a few long setae.

Prophallus very like that of *arteriosa*.

Abdomen 24 mm, hindwing 28 mm, pterostigma 3 mm.

In males from Maun and Makala-ma-Bedi the labral black is rather less, triangular but with a median line extending to base. In teneral males from the Okavango system the amber on the wings is not so deep and the frons above may have a bronze sheen.

FEMALE

BOTSWANA (West Ngamiland): Labium with broad black median band; labrum with small notched fascia on lower margin. Frons with moderate groove, and a broad purplish basal band like the male; vesicle ochreous above, black at sides and posteriorly.

Synthorax with two faint antehumeral grey bands; at sides like the male. Sternal black complete. Fore femur ochreous with black exterior stripe.

Wings as in male, the amber fasciae deep but not brown-spotted. Distinct brown apical patches.

Abdomen more cylindrical, marked very like the female *arteriosa*. Vulvar scale with a very shallow V-shaped notch.

Abdomen 19 mm, hindwing 25 mm.

Females from Maun are similar to the above but one has a small square central spot on the lower margin of the labrum.

W. ZAMBIA: A Barotseland female has less apical brown on the wings. It might be intermediate to the eastern subspecies.

T. monardi insuffusa subspec. nov.

MALE

ZAMBIA (Abercorn) ♂-holotype (mature): A narrower band on labium and only a small black triangle on lower margin of labrum.

Wing apices without brown.

Otherwise like the nominotypical subspecies.

Other males from Abercorn have broader fasciae on both lips, similar to *monardi monardi*. One is slightly smaller, the hindwing 24 mm. Another mature example has broad black on the labium but only a trace on the labrum; basal wing fasciae, although very dark, are slightly less extensive than usual.

The back of the orbit is not always as dark as in the male described for *monardi monardi* and they are sometimes like *arteriosa*.

Other Zambian males show the same range of variation: Broken Hill (Kabwe), Chingola, Chinsali and Mwinilunga. A teneral from Mwinilunga has the broad labial band but only a trace on the labrum. The anterior lamina is just as black in this teneral and the abdominal markings are fully developed.

Males from Nkata Bay (Malawi) and Dondo Forest (Mozambique) are not appreciably different.

FEMALE

ZAMBIA (Abercorn) ♀-allotype: Labium with broad black band constricted before distal end; labrum with small black distal triangle. Otherwise like female *monardi monardi*.

pluvialis

Bursa, like *arteriosa*, has a well chitinised dorsal sterigma with folded postventral lobes and two slender, angled, divergent anterior processes, somewhat pectinate outwardly.

Abdomen 20 mm, hindwing 27 mm.

Another from Abercorn has narrower black on labium, none on labrum. One from Katambora (Zambezi River) is similar but has a fine trace of apical brown on the wings.

RHODESIA: A teneral female from Salisbury has a broad blackish labial fascia, none on the labrum; basal amber slightly more extensive than usual.

MALAWI: A teneral from Nkata Bay has narrow black on the labium, a small labral triangle; on the wings there are faint nodal amber spots, which are absent in a maturer female from the same locality.

The only reliable distinction of subspecies *insuffusa* is the virtual lack of infuscation at wing apices.

DISTRIBUTION

South-central and South West Africa:

monardi monardi in South West Africa, Okavango Swamps and River northwards into South Angola;

monardi insuffusa in East Angola, Barotseland (intermediate?), Zambia, Malawi, Mozambique and Rhodesia.

HABITS

Quiet reedy pools or swamps, or sluggish reed-fringed rivers. It exhibits a fluttering, papilioid flight like members of the genus *Rhyothemis* Hagen. It settles on reeds, sedges or grasses with wings slightly tilted upwards, not strongly depressed as in *arteriosa*.

MATERIAL EXAMINED

Ngamiland and Okavango system; East Angola, Zambia, Malawi, Mozambique and Rhodesia.

Trithemis pluvialis Förster, fig. 29 p 68

Trithemis pluvialis Förster, 1906, *Jber. Ver. Naturk. Mannheim* **71-72:** 30 (Usambara Mts); Pinhey, 1962c: 273.

Holotype male in Ann Arbor, Michigan; allotype female (Ris, 1919: 1196) in British Museum (Nat. Hist.) (Chirinda Forest).

In the field this species can, at first glance, be easily mistaken for *arteriosa*, despite its broader abdomen and more uniformly broad wing bases. The lack of synonyms for the species is somewhat surprising and suggests that it may have been overlooked because of the resemblance. Yet it is very common in some localities and it is prone to variation in black markings.

MALE

A Shimba Hills (south west of Mombasa) male is used here for general description since this locality is biologically linked with the type locality in the Usambara Mountains.

KENYA (Shimba Hills) ♂: Labium ochreous with broadish black median band; a black ellipse on lower margin of labrum; face and frons ochreous; frontal groove moderate. Frons with metallic black basal band, narrower than the distance between central and lateral ocelli, and surrounding the lateral ocellus. Vesicle ochreous. Occiput normal.

Synthorax reddish brown with sparse black markings, discontinuous; metasternal pattern complete and very heavily blackened on anterior half. Legs blackish; fore femur yellow interiorly.

Venation red but brown posterior-distally and brown on hindwing from anal loop to apex. Pterostigma reddish brown between black long veins. Amber basal fascia on forewing to first Ax and to Cuq; on hindwing to second Ax, to base of triangle and just reaching the tornus. Forewing with 11½–12½ Ax.

Abdomen bright red, without pruinosity, broadish but less so than *annulata;* segment 1 with two black basal spots; segment 2 and base of 3 with very faint mid-dorsal line which, on segment 2, surrounds a small red ellipse; 4–7 unmarked; 8–9 with black dorsal band, 9 also with sub-lateral band; segment 10 black with red latero-distal spot. Anal appendages ochreous, the superior black at apex, inferior black at margin and apex. Anterior lamina large, black, with broad undivided apex and long postapical hair-tuft; hamule massive, the hook black, with stout outer setae; genital lobes narrowish, straight, with long apical setae.

Prophallus with cornuti and long flagella. Corpus small.

Size variable in this locality: abdomen 21–24 mm, hindwing 26–32 mm, pterostigma 3 mm.

There is some variation in the amber wing patches in different areas but a Nairobi male is not markedly different.

RHODESIA: An Umtali male has the amber on hindwing broad but not reaching tornus. Black body markings are variable. In two Burmah Valley (Umtali) examples the labium is all ochreous except the posterior lobe which is all black; no black on labrum; all thoracic black reduced; no black on basal segments of abdomen but terminal segments normally marked since these segments are primarily sexually patterned. Another Burmah Valley specimen has posterior lobe of labium black and a trace on lateral lobes and on lower edge of labrum. Another Umtali male is normal except that the labral black is a small square spot. One from Chimanimani Mountains is like the Shimba Hills example in all respects, but one from lower down on these Mountains differs slightly: labral black a small free central macula not touching lower margin; the two black stripes on segment 9 are much broadened.

ZAMBIA: In an Ndola example the hindwing fascia is of usual breadth but that on forewing is much reduced, only a trace.

Two Abercorn males have broad labial band and a continuous black central band on labrum; the red on segment 9 is restricted by an increase in black. Another has the labrum all black except at base and the red on 9 is still more narrowed. An Ndola male differs in having only a small black labral fascia on lower margin. Another has this fascia larger and a continuous but diffuse blackish dorsal band on segments 1–4. A Kitwe example has only a small lower stripe on the labrum.

A series from Mwinilunga shows much variation. In different examples the labral fascia may be very small or cover half the labrum or a broad triangle reaching to the base. Abdominal markings may resemble the Shimba Hills examples, or the red on segment 9 may be more restricted; or the central dorsal black may be almost continuous on the abdomen. A melanic male is described below from this region. A very teneral male shows that the black develops early: broad band on labium; linear black on lower edge of labrum; thoracic markings normal; abdomen with continuous dorsal line; 8–10 with well developed markings; anal appendages with dark markings developed; wing amber formed but pale.

ANGOLA: A male from East Angola has a continuous dorsal band on the abdomen and broadened black areas on segments 9–10.

MALAWI: Two from the Central Highlands of Malawi have variable black on labrum, a broad band on labium and normal abdominal markings. One from Limbe has *no* black on either lip and reduced black on the abdomen.

MOZAMBIQUE: A Vila Paiva example resembles the Shimba Hills specimens.

var. ***melanistica*** ab. nov.

This is a melanotic male from the Isombo River, Mwinilunga, 26 January 1965 (leg. Pinhey).

♂-Holotype: Labium all black except pale lateral patch on lateral lobe; labrum all black; frons and vesicle metallic brown, with black basal band on frons.

Thoracic markings normal. Legs almost entirely black.

Venation dark red-brown in costal-subcostal zones, otherwise black. Pterostigma almost black. Amber fasciae much restricted: absent on forewing; on hindwing only in cubital space to just beyond Cuq and at base of anal field.

Abdomen with black band on segment 1; continuous dorsal band on 2–10 and lateral band on segments 3–10; the black much increased on 7–10: on 8–9 covering all but a lateral red rectangle, 10 all black. Appendages black except base of superior. Accessory genitalia normal but darkened.

Abdomen 25 mm, hindwing 30 mm.

FEMALE

ZAMBIA (Mwinilunga) ♀: Labium with posterior lobe ochreous, narrowish black stripe on lateral lobes; labrum with black trace on lower edge. Face ochreous. Frontal groove moderate. Frons with black basal stripe narrower than the distance between central and lateral ocelli. Vesicle ochreous, with low peaks. Occipital triangle normal.

Synthorax with more dark marking than in male: faint median and antehumeral brown bands; dorsal humeral spot; diffuse band on mesepimeron; black spiracular band, curving distally to meet the dorsal spot on second lateral suture; this suture also brown and subtending a triangle on metepimeron. Sternal pattern well developed. Legs black, fore femur yellow with black exterior stripe.

Venation red anteriorly and at base, otherwise blackish. Pterostigma blackish with pink or ochreous posterior line, between black veins. Amber fascia on forewing to first Ax, to Cuq and a trace against membranule; on hindwing a larger patch to first Ax, trace in median space, to beyond Cuq, and in loop and anal field but not reaching tornus. Forewing with 9½–10½ Ax.

Abdomen more cylindrical, ochreous with black markings: segment 1 with two black basal spots; 2 with basal and medial lines and a discontinuous lateral stripe; segments 3–7 with black sub-lateral line; 6–8 with black dorsal band, widening on 8; 7–8 also with black subbasal band; 9 black with red lateral bar, usually tapering distally; segment 10 all black. Cerci black or with trace of basal red. Vulvar scale with small V-shaped notch. Abdomen ventrally black with yellow lines.

Kirbyi

Bursal sterigmata with two heavily thickened branches ending in apical hooks; two ventral, slightly folded plates, deeply excised; a broad, fan-shaped dorsal sterigma forming two semicircles. Lip not thick.

Size variable: abdomen 20–23 mm, hindwing 28–31 mm, pterostigma 3–3.5 mm.

Body markings vary more than the amber fasciae.

In another from Mwinilunga the labral black is slightly larger; thick dorsal band on segment 2. A Kitwe female has a very broad band on labium, a triangle on labrum; wing amber broader than normal; pterostigma black with scarcely a trace of the yellow posterior line. It is obviously an old female, probably past sexual age. A Chongwe specimen has labial marking normal, labrum with twin spots on lower margin.

RHODESIA: In a female from Vimba Forest (Melsetter) there is scarcely a trace of amber on forewing; on hindwing slightly less than normal. Labium with black spot on posterior lobe and only a fine line on lateral lobes; no black on labrum; pterostigma with broad yellow posterior stripe; abdominal black slightly reduced. A Nyamadzi River female is like the first Mwinilunga example.

DISTRIBUTION

South Africa to Angola, Congo (Kinshasa) and East Africa. Fraser (1949: 18, 36) mentions it from Madagascar but this is a very dubious record.

HABITS

A locally common species which settles on vegetation near or over running streams, rocky or reedy, or slow-flowing streams; sometimes common in tropical forest (in Kenya). The author some years ago (1951: 264) described it as a somewhat solitary species but since then it has been proved to be almost gregarious in certain restricted localities. When in company with *arteriosa* the latter will be the dominant species.

MATERIAL EXAMINED

Rhodesia, Mozambique, Zambia, Malawi and Kenya.

GROUP 2. KIRBYI. Includes only a single species.

Trithemis kirbyi Selys, fig. 30 p 68

Trithemis aurora Kirby (*nec* Burmeister), 1886, *Proc. Zool. Soc. Lond.:* 18 (pars).
Trithemis kirbyi Selys, 1891, *Annali Mus. civ. Stor. nat. Giacomo Doria* **30:** 465 (India); Pinhey, 1962c: 272.
Trithemis marnois Brauer, 1868, *Verh. zool.-bot. Ges. Wien* **18:** 735 (*nom. nud. teste* Calvert, 1899).
Trithemis ardens Gerstaecker, 1891, *Jb. Hamb. wiss. Anst.* **9:** 5, 9, 187 (Mbusini, Tanzania); Pinhey, 1962c: 272.
Trithemis lacustris Kirby (pars) 1898, *Ann. Mag. nat. Hist.* (7) **2:** 233 (South Africa, not Abercorn or Wadelai).
Trithemis kirbyi ardens f. **comorensis** Fraser, 1958, *Mém. Inst. Scient. Madagascar* **10:** 1–2 (Comoro Isl.).

Types: *kirbyi* ♂ in Selys collection, Bruxelles Museum; *ardens* ♂-lectotype in Museum Hamburg; *comorensis* ♂ in Inst. Science Madagascar.

The Abercorn and Wadelai examples of Kirby's *lacustris* are *Brachythemis lacustris* (Kirby). The nominotypical race of *kirbyi* is Oriental.

Subspecies *kirbyi kirbyi* Selys

MALE

In the National Museum there is a single male from Mysore: Head and thorax as in subspecies *ardens*. Legs more sparsely marked with black. Wings with basal amber deep but more restricted than in *ardens:* on forewing to third Ax and not reaching triangle; on hindwing to third or fourth Ax, to distal end of triangle but not quite reaching the tornus. Pterostigma very small, only 1.5 mm. Abdominal marking sparser, with only a dark smear on segment 1 and a dorsal stripe on segment 9. Anal appendages and accessory genitalia as in *ardens*.

Abdomen 20–23 mm, hindwing 24–28 mm, pterostigma 1.8–2 mm.

As Fraser says (1936, 1956) the species is easy to recognize, with its broad amber wings, and is the brightest red species known. However, the African subspecies has been confused at times with the superficially similar *Brachythemis lacustris*.

FEMALE

No example available. Fraser says there are two forms of female in *kirbyi kirbyi*. One is evidently similar to the normal female of *ardens* (q.v.), the other is rarer and andromorphic like the Nigerian female described under the other race.

Subspecies *kirbyi ardens* Gerstaecker

This is the race found in most parts of the Ethiopian region.

MALE

RHODESIA: Labium ochreous; labrum, face, frons and vesicle vermilion, slightly ochreous on sides of frons against the eyes. Vesicle and frons both have characteristically high, conical peaks; consequently the frontal groove is abnormally deep. Occipital triangle brown, paler posteriorly; orbits yellow with black bars.

Prothorax reddish brown, broadly black on anterior lobe, with narrow red collar and black on posterior lobe with red margin. Synthorax pale reddish brown with very reduced dark markings: the only consistently black lateral mark is the line on the suture below the mesothoracic spiracle. Sternal black pattern narrow, somewhat open anteriorly. Legs ochreous, with black lateral stripe on fore and mid femora; hind femora mainly black.

Venation vermilion red; wing apices narrowed distally. Pterostigma very short, blackish, between black long veins, the cross-veins usually red. All wings very broadly amber, to about seventh Ax in forewing, well beyond all triangles and, on hindwing, extending to the tornus or beyond this.

Wing colour: In very teneral males the venation is yellow and the amber zones, although just as extensive, are paler and tend to show an uncoloured basal area on the hindwing. This pale amber of the teneral covers costal, medial and cubital fields as in the mature insect, but from the discal area the amber extends in a broad diffuse band posteriad, across the anal loop to the tornus of the hindwing, leaving the basal cells of the loop and part of the anal field clear. This basal clear zone in the anal region is of interest in considering the origin of the isolated amber fascia near the tornus of the normal form of female.

In some of the older males, and perhaps more particularly those of hotter, drier localities there are clearer or quite clear cells at the bases of the amber region. In one mature male from Nelspruit (Transvaal), the amber is restricted on hindwing to sub-

costal and cubital spaces and with a discal-tornal band as in some teneral males; even the forewing is similarly fasciated, the amber not covering the medial space nor the posterior field of the wing-base.

Forewing with 11½–13½ Ax.

Abdomen moderately broad, almost entirely vermilion red. A brown transverse smear on segment 1; 9 with black dorsal band; segment 10 with or without a black dorsal band. Anal appendages also red but the superior sometimes darkened apically. Ventral dentition on superior less well developed than in others such as *annulata*. Anterior lamina unusually globular, distinctively notched at apex and without setae. Hamule not sclerotized, the base small, rounded, the hook almost straight except at tip, sparsely setose. Genital lobe broad, paddle-shaped (spatulate).

Prophallus with large corpus, small glans, slender flagella.

Abdomen 19–21 mm, hindwing 23–26 mm, pterostigma 1.5–1.8 mm.

A Madagascar male, possibly not quite mature, is paler, with still less black on abdomen: segment 1 unmarked; segment 9 with narrow black dorsal and lateral bands, 10 with basal traces.

FEMALE

RHODESIA: Lips and head all ochreous; frontal and vesicular crests high but more broadly rounded than in male; frontal groove deep; a narrow or very narrow blue-black basal band on frons, narrower than the distance between central and lateral ocelli. Occipital triangle as in other species.

Prothorax blacker than in male. Synthorax greenish ochreous with slightly more developed brown or black fasciae, but not contiguous: faint brown antehumeral band, brown upper humeral spot, narrow, faint stripe on mesepimeron, the black spiracular stripe as in male but extended also dorsad, a smear on second lateral suture and a more or less complete metasternal pattern. Legs as in male.

Venation brown to black. Pterostigma as in male, black. No basal amber on forewing; on hindwing with subcostal and cubital traces and an *isolated* amber macula in the posterior anal field near the tornus. Forewing with 10½–12½ Ax.

Abdomen stouter, more cylindrical; ochreous with more extensive dark brown or black markings: segment 1 black above; 2 with black basal band, 2–4 with narrow, diffuse lateral stripe; segments 4 or 5 to 9 with sub-lateral black band; 8–9 with dorsal band; 10 all black or black medially and laterally. Cerci brown. Vulvar scale deep with lateral angles (lips) very pronounced.

Bursa with central sterigma well chitinised and somewhat like an inverted T; ventral sterigmata folded. Bursal arms slender. Lips not very thick.

Abdomen 19–23 mm, hindwing 23–28 mm, pterostigma 1.6–2.2 mm.

Forma ***aurantiaca*** nov.

This form of female, andromorphic in wing pattern and known for some years in Nigeria (*vide* Ris, 1912: 780) and apparently from Ethiopia (Förster, 1906) is, according to Gambles (in correspondence), the normal form in Nigeria, but the commonly distributed heteromorphic African form also occurs there.

♀-Holotype: Head, thorax and legs typical. Wings with brown venation, red in the anterior regions. Pterostigma brown between black long veins. A broad amber basal area on all wings, paler than in mature males, on forewing to fifth Ax and distal end of

triangle; on hindwing to well beyond discal triangle and to beyond tornus, without any clear basal zone. Forewing with only 9 and 9½ Ax.

Abdomen with a more discontinuous lateral band; segments 8–10 with dorsal and lateral bands. Cerci pale at base. Vulvar scale normal.

Abdomen 18 mm, hindwing 24 mm, pterostigma 2 mm.

The holotype is a small female from Vom, Northern Nigeria, October 1961, kindly presented by R. M. Gambles to National Museum, Bulawayo.

This broadly amber-winged form seems to have a peculiarly discontinuous distribution, as far as it is known at present: Nigeria; Schoa (Ethiopia) and Madagascar. In the Royal Scottish Museum there is an andromorphic female from Mandritsana, Madagascar, and a normal heteromorphic female from N. Nigeria.

As mentioned above (*et vide* Ris, 1912: 778) the nominotypical *kirbyi* of Asia also has an andromorphic female.

Possibly the discontinuous distribution, at least in Africa, may be due to genetic considerations.

OTHER MALE FORMS

NIGERIA: A male collected by D. W. Tarry at Mailumba, N. Nigeria, April 1960, differs from *k. ardens:*

Wing-amber as deep but not quite as extensive as in normal male, on forewing scarcely reaching beyond fifth Ax and triangle; on hindwing correspondingly restricted.

Abdomen with black markings more reduced: segment 1 with diffuse dorsal band; 9 with only a dorsal trace; the rest and the appendages all red. Accessory genitalia normal.

This is the only Nigerian male in the National Museum, so that its status cannot be estimated here. It may be a recessive because Ris (1912) records several males from N. Nigeria without stating that they differ from typical *ardens*.

COMORO ISL.: f. *comorensis* Fraser. The description (Fraser, 1958) of the male indicates that it differs from *ardens* only in having the basal amber zone tinted with brown. The female has not been recorded.

If there should prove to be uniformity in the darker tint it may be accepted as an insular race.

ARABIA: Saudi Arabian examples (leg. G. Popov) seen in the Royal Scottish Museum seem to be intermediate between *kirbyi kirbyi* and *kirbyi ardens*.

MALE: forewing amber reaches halfway to nodus, but in hindwing much less extensive, reaching about the third Ax before nodus.

FEMALE: intermediate to f. *aurantiaca*. Both wings with strong amber subcostal and cubital streaks, to level of triangle in forewing and an identical level in hindwing. The hindwing also has the isolated amber sub-tornal macula of the more normal (African) female.

More Arabian material could decide its status.

DISTRIBUTION

kirbyi kirbyi occurs in India and Pakistan, with a dubious record (1893) from Ceylon (teste Fraser, 1936: 387, ref. Kirby, 1893, *J. Linn. Soc. Zool.* **24:** 551).

kirbyi, intermediate, Saudi Arabia.

kirbyi ardens extends from South Africa, S.W. Africa and Botswana northwards to equatorial Africa, Sudan, Ethiopia; Madagascar; Comoro Islands.

bredoi

HABITS

Settle usually on rocks or stones in the bed of fast or slow rivers and streams in open country, or on nearby slabs of rock. Where such conditions are not available it will settle on sandy banks of open water-stretches or sometimes on low vegetation. Females are more often found away from the water's edge, on bare twigs of shrubs or trees, or on grasses if there are no taller plants.

Despite the conspicuous colouring of the males Fraser (1936: 387) says, of *kirbyi kirbyi*, that they resemble *Salius* Fabricius, a hymenopteran genus (evidently a homonym of a Coleopteran genus of that name). He considers the bright red and amber are pseudaposematic warning colours. The African *kirbyi ardens*, equally conspicuous in its haunts, is not obviously mimetic of any African hymenopteran known to the present author. Several Pompilidae have very amber wings, without red abdomina, but in any case they are not seen commonly in *ardens* haunts, which would be a necessary factor for mimetic advantage.

The curious superficial resemblance of *Brachythemis lacustris* (Kirby), favouring a different habitat to *kirbyi* seems to have no relevant bearing on mimicry.

MATERIAL EXAMINED

kirbyi kirbyi, Mysore only.

kirbyi ardens, Cape Province, Natal, Rhodesia, Mozambique, Botswana, Malawi, Tanzania, Sudan, Northern Nigeria, Madagascar. Also Arabia.

GROUP 3. KALULA. Includes *bredoi*, *kalula*, *werneri*.

Trithemis bredoi Fraser, fig. 31 p 82

Trithemis bredoi Fraser, 1953, *Revue Zool. Bot. afr.* **48**: 252 (Congo); Pinhey, 1962c: 270.

Types ♂♀, 3 paratypes (♂♀) in Tervuren Museum, Belgium.

Described from Congo (Kinshasa), this species can now be recorded also from Sierra Leone.

MALE

CONGO (Banzyville) ♂-paratype: Labium plain ochreous; labrum with large blackish central macula on lower margin. Frons with shallowish groove; frons and vesicle metallic violet.

Synthorax all ferruginous dorsally and most of sides, with very sparse black markings: a dorsal spot on humeral suture; a black band across mesothoracic spiracle, diffuse more dorsally; diffuse band below second lateral suture, continuing on to centre of metepimeron. Sternal pattern incomplete and not very blackened. Legs black, fore femur yellow on interior surface. As will be mentioned below the thorax may develop pruinosity sometimes.

Venation red; pterostigma yellowish brown, between black veins, the proximal cross-vein red. Basal amber on forewing only a mere trace; on hindwing extending only to Cuq and three quarters of the distance to tornus. Membranule grey. Forewing with 9½–10½ Ax.

Abdomen red with sparse blackish marking on most segments, as in the figure. Segment 8 with broad black dorsal band, 9 all black except a small reddish sublateral dot; 10 with black basal band. Anal appendages reddish, the superior slightly darkened distally. Anterior lamina broad, the apex produced, undivided, with very short outer hair and setae and a long apical hair-tuft. Hamule not heavily chitinised, the hook long, straightish and slender. Genital lobe broader than in *kalula* and with only a few apical setae.

Prophallus, as figured, closely similar to *arteriosa*.

Abdomen 20 mm, hindwing 25 mm, pterostigma 2.5–2.8 mm.

Another paratype (Ubangi) has a brown median stripe on labium; labrum black with reddish basal band. Otherwise similar.

A male from Dingila-Uele River (leg. Pinhey) has the labium all pale, labrum all black. Thorax dorsally with purplish red pruinescence (like *annulata*). Anal appendages all red. Two others are similar, but in yet another the labral black is confined to a large central ellipse; in another, as well as one from Ndu, this labral macula is small and central. Other features, including the amber on wings, are fairly constant.

The largest example (Dingila) has the abdomen 22 mm, hindwing 28 mm.

SIERRA LEONE: A male from Sewa River (leg. J. Phipps) is purplish red pruinose on the thorax. It has a black median band on labium, slightly wider than the black posterior lobe; labrum all black. Amber on hindwing deeper and slightly more extensive, the cubital ray darkish. Abdominal markings are figured.

This discontinuous distribution, Congo and Sierra Leone, is probably due to inadequate collecting. Whether the Sierra Leone example represents a separate race will depend on more material.

FEMALE

CONGO (Banzyville) ♀-paratype: Labium all yellowish; labrum with black lower margin produced upwards as a small triangle. Frons ochreous, with moderate groove and violet-black basal band, nearly as wide as distance between central and lateral ocelli. Vesicle ochreous.

Synthorax greenish ochreous with faint brown bands (as figured) but darker ones at lateral sutures. Sternal pattern very incomplete. Fore and mid femora with yellowish interior stripes.

Wings faintly fumose, venation red anteriorly, brown posteriorly. Pterostigma reddish brown between black veins, the proximal cross-vein red. Forewing with only slight trace of amber, hindwing as in male. Forewing with only 9½ Ax.

Abdomen pale reddish, broadish (like *kalula*), sparsely marked as in figure. Cerci red, darker distally. Lip of vulvar scale with shallow U.

Bursa different from *kalula*. Dorsal plate conical, bifid anteriorly; two ventral plates attached to it and with poorly chitinised folded sterigmata. At anterior end two divergent ventral horns. Bursal arms short and broad.

Abdomen 21 mm, hindwing 27 mm, pterostigma 2.5–2.8 mm.

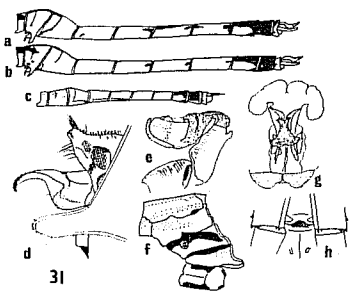
A female from Dingila-Uele River has only a minute black central triangle on lower margin of labrum; forewing without amber and only a trace in cubital and anal fields of hindwing. Forewing with 10½ Ax. The ova are extruded (as in many other dried libellulids) and are broadly elliptical.

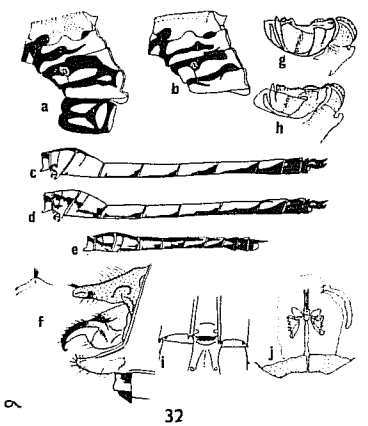
Abdomen 19.5 mm, hindwing 21.5 mm.

DISTRIBUTION

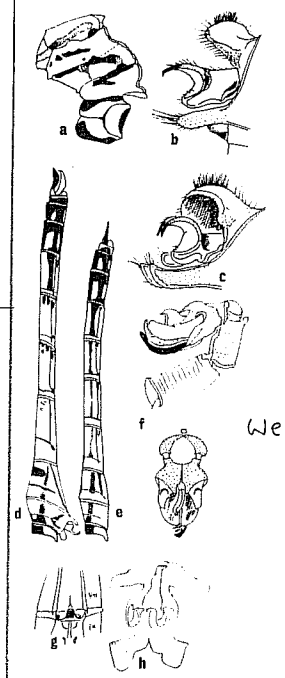
Congo (Kinshasa) and Sierra Leone.

bredoi





kalula



Werneri

Figs 31–33. *Trithemis* species. 31. *T. bredoi*. a–c. Abdomen. a—Male paratype (Banzyville). b—Male (Sierra Leone). c—Female paratype (Banzyville). d—Genitalia (Sierra Leone). e—Prophallus (Dingila—Uele R.) f—Thorax (♀-paratype, Banzyville). g—Bursa (Banzyville). h—Vulvar lip (♀-paratype). 32. *T. kalula*. a–b. Thorax. a—Male (Vom). b—Male (Farangbaia). c–d. Abdomen. c—Male (Farangbaia). d—Male (Vom). e—Abdomen (♀, Vom). f—Genitalia and anterior lamina (Freetown). g–h. Prophallus. g—Male (Upper Volta). h—Male (Vom). i—Vulvar lip (Vom). j—Bursa (Vom). 33. *T. werneri*. a—Thorax (♂, Limpopo R.). b–c. Genitalia (Limpopo R.). b—From left. c—Obliquely. d–e. Abdomen (Chirundu Bridge). d—Male. e—Female. f—Prophallus (Limpopo R.). g—Vulvar lip (Chirundu Bridge). h—Bursa (Chirundu Bridge).

Kalula

HABITS

The Dingila-Uele River specimens (the only *bredoi* seen by the author in life) were on reedy pools on the banks of the river.

Trithemis kalula Kirby, fig. 32

Trithemis kalula Kirby, 1900, *Ann. Mag. nat. Hist.* (7) **6:** 69 (Sierra Leone); Pinhey, 1962c: 272.

♂-Lectotype in British Museum (Nat. Hist.).

Described from Sierra Leone and known as far east as Nigeria, the mature male is very like *bredoi* (also now known from Sierra Leone) and similar in facies to mature *annulata*. They have a reddish, broad body, overlaid with pruinosity, giving a "port wine" effect. The hamular hooks of *kalula* are much more like *bredoi*. To distinguish *bredoi*, this latter has a paler pterostigma; very little marking on middle segments of abdomen; the black on segment 8 is in a reverse position; 9 has the pale dot more ventral than in *kalula;* 10 and the anal appendages are paler. The hamular hook of *kalula* is longer and more slender than in *bredoi* and the nodal index is higher.

There is some variation in markings in *kalula*, particularly the basal segments of the abdomen, and it is possible that Nigerian specimens represent an easterly race.

MALE

Sierra Leone (Freetown) ♂ (mature): Labium very broadly black in centre; labrum all black; postclypeus with central trace; frontal groove shallowish. Frons above and vesicle entirely dark purplish metallic.

Synthorax marked almost as in the Farangbaia specimen illustrated, overlaid with purplish red pruinosity. Sternal black complete. Legs mainly blackish grey.

Venation red. Pterostigma black, its terminal cross-veins red. Wing bases deep amber, on forewing only traces; on hindwing more or less to second Ax, sub-triangle and in anal field about two thirds of distance to tornus. Forewing with 11½–13½ Ax.

Abdomen broadish, red, marked as in the Farangbaia specimen but with the five basal segments coated with whitish pruinescence. Segments 7–8 black sub-laterally; 9 black with small pale basal dot; 10 and appendages all black.

Anterior lamina concave posteriorly, with slender undivided apex and a hair-tuft. Hamular hook long, thick, well chitinised and with outer setae. Genital lobe narrowing, with fine apical setae.

Prophallus with short corpus, long glans.

Abdomen 22.5 mm, hindwing 27.5 mm, pterostigma 2.5 mm.

The male from Farangbaia, also pruinose, has the labium even blacker, with only a small yellow lateral macula. Otherwise similar.

Upper Volta: One from Leguema, (Upper Volta), again pruinose, has narrower labial black and on labrum there is a pale basal line. Abdomen more sparsely marked, the black reduced, but the last three segments are typical.

Nigeria: Males from Vom, possibly less mature in one and certainly juvenile in two others, have no pruinosity and are smaller. Labium very broadly black with small lateral yellow spot; labrum black with two yellow basal spots. Thoracic black as in figure. Legs normal. Basal amber less deep. Forewing with 11½ Ax. Abdominal pattern as figured, the basal segments with more black than in Sierra Leone examples. Abdomen 19 mm, hindwing 24 mm. A juvenile male from Vom is similar in all respects, including

Werneri

the heavily blacked lips. A more teneral one has the labium all yellow, labrum yellow with brown median band; frons and vesicle bronze. Thoracic and abdominal markings well developed but the pterostigma paler. Abdomen 21 mm.

Evidently the lips are later than the body in developing the black pattern.

FEMALE

No females from Sierra Leone were available.

NIGERIA (Vom) ♀: Labium yellow with black median band only as wide as posterior lobe. Labrum yellow with black ventral margin and traces of brown on centre. Face and frons yellow; black basal band on frons almost as wide as distance between central and lateral ocelli; vesicle yellow.

Synthorax yellow with black pattern very like male but the antehumeral bands are black and continuous (instead of grey). Fore femur yellow posteriorly.

Venation reddish anteriorly, brown posteriorly; pterostigma paler than in male and with traces of yellow at each end. Forewing without basal amber; hindwing with pale trace in anal field. Membranule dark grey. Forewing with 11¼ Ax.

Abdomen yellowish with black pattern as figured, more extensive than in male and including a black dorsal band. Vulvar lip almost straight.

Bursa very different from *bredoi*. Dorsal sterigma very slender, bifid anteriorly. Ventral plates coiled, their outer edges jagged. Bursal arms slender.

Abdomen 19 mm, hindwing 26.5 mm, pterostigma 2.5 mm.

A second female from Vom, evidently teneral, has both lips entirely yellow; pterostigma yellower. Otherwise similar.

DISTRIBUTION

Sierra Leone, Guinea, Togo, Nigeria, Northern Congo (Garamba National Park).

HABITS

Not seen in life by the author. Probably of similar habits to *bredoi*. The Garamba example was evidently on a rocky stream (Pinhey, 1966: 104).

MATERIAL EXAMINED

Sierra Leone, Upper Volta and N. Nigeria.

Trithemis werneri Ris, fig. 33 p 82

Trithemis werneri Ris, 1912, *Coll. Zool. Selys* **14:** 765 (Gondokoro); Pinhey, 1962c: 273.

♂-Holotype in Museum Wien.

One of the larger and more slender members of the genus, the male with dull red abdomen and large, slender hamular hook. The type was collected in the Southern Sudan by Dr F. Werner.

MALE

RHODESIA (Nuanetsi R.) ♂: Labium ochreous; labrum with black fusiform macula on lower margin. Face ochreous and greenish ochreous. Frons reddish, with moderate groove, and very thin black basal line, much narrower than the distance between central and lateral ocelli. Vesicle all ochreous, rounded, the crests almost imperceptible. Occipital triangle ochreous; orbit posteriorly yellow with three dark bars.

Prothorax light brown with black depressions and black lateral macula on median lobe. Synthorax pale brown with long white mesepisternal hair; antehumeral stripe faint; lateral bands darker and tending to coalesce. Metasternal pattern discontinuous anteriorly and postlaterally. This and other sublateral areas with tendency to slight white pruinosity. Legs black, fore femur yellowish interiorly, mid femur less so; all tibiae yellow posteriorly.

Venation variegated, mostly dark brown, but with dark red long veins in costal to medial zones, antenodal cross-veins mostly dark red, paler near base and the costal margin yellow near base. Pterostigma reddish brown between black long veins. Forewing without basal amber; hindwing with pale amber to or just beyond first Ax, to base of triangle and just reaching tornus. Membranules white. Forewing with only 9¼–10¼ Ax despite the large overall size. Rspl well divided into two rows.

Abdomen very slender, orange-red, with blackish markings sparse except on first and terminal segments. Middle segments elongated. Segment 3 with distal saddle; 8–9 with two lateral pale spots but the lower one is obsolete at maturity. Superior appendage blackish, with yellow basal area; inferior yellowish, darker at lateral margin. Anterior lamina globular, not sloped at base and with a dense growth of subapical orange hair. Hamule shortish, not well sclerotized, the hook long, curved and slender. Genital lobe black and slender.

Prophallus with flagella and heavily chitinised retinaculum.

Abdomen 24–26 mm, hindwing 30 mm, pterostigma 2.5–3 mm.

In a Limpopo River series the labium occasionally has traces of black on posterior lobe or, centrally, on lateral lobes; labral fascia narrower or broader. At side of vesicle there may be a black ring around the lateral ocellus. The amber on hindwing is of constant size in this series but slightly reduced in three from Chirundu Bridge (Zambezi River) and these three have no black at all on lips. Inferior appendage sometimes darkened on apical third. A Devuli River example is like the Zambezi ones; also one from the lower Sabi River.

KENYA: A teneral male from Kacheleba (Suk) of N. Kenya may be closer to the Gondokoro type. Labium unmarked; labrum with two small spots on lower margin; orbit only faintly marked with brown bands. Thoracic and abdominal markings as in the Nuanetsi male. Basal amber on hindwing faint. Hindwing 29 mm, scarcely smaller than the Rhodesia series. The type from Gondokoro had the labrum brown along the middle. Abdomen 27 mm, hindwing 30 mm.

It appears that there are no distinct racial differences in the males.

FEMALE

Females are much more variable, especially in wing markings.

RHODESIA (Chirundu Bridge): Lips, face, frons and vesicle all pale; merely a trace of a black basal line on frons; moderate frontal groove.

Synthorax with lateral bands rather faint but more contiguous than in male and with ventral arm on metepimeron extended to post-lateral angle. Metasternal black thinner and overlaid with white pruinosity. Femora with less black, all of them yellowish posteriorly; tibiae as in male, with yellow posterior stripe.

Venation dark brown; basal antenodals yellowish. Pterostigma as in male. No apical amber and basal pale amber on hindwing reduced; trace in subcostal, in cubital to Cuq and a faint cloud in basal half of anal field.

Abdomen stouter than in male, the black markings as figured. As in male there are two yellow lateral bars on segments 8–9 but the more ventral one on 9 is more

obsolete than in the example figured. Vulvar scale very distinctive, a very deep U-shaped invagination, which is well distad, between segments 8–9. On 9 in all examples examined the median gonapophyses are obsolete, with only a depression visible.

Bursa (seen partly obliquely in the figure) rather like *atra*. Dorsal sterigma broad, tapering, not well chitinised, and having an upturned apex. Two folded ventral plates. Lip deeply invaginated but not heavily chitinised.

Abdomen 24 mm, hindwing 31 mm.

Three other Chirundu Bridge females have amber subapical maculae below the pterostigma as well as amber nodal spots on all wings, these being fainter in the more teneral female. The hindwing basal amber is much more reduced in all three, being just a vivid trace in the subcostal zone, as far as Cuq in the cubital, and on only one basal cell in anal field. In the teneral female the lower yellow bar on segment 9 is more developed; segment 10 is yellow with only a black basal line. In another the lower bar on 9 is absent, 10 has more black; in yet another the markings on 9–10 are as figured.

A Limpopo River female is smaller, hindwing 27 mm. Wing-apices with trace of sub-pterostigmal amber; hindwing with basal amber more developed than in the Chirundu Bridge series.

MALAWI: A mature female from Mpatamanga Gorge has some fuscation on margins of posterior lobe of labium and a black spot on lower edge of labrum. Thoracic markings all blacker and slightly broader. Pterostigma darker; without the subapical amber fascia; hindwing with moderate amber area as in the Limpopo example. Segment 9 has only the upper yellow bar and 10 is all black. No male, unfortunately, has been seen, but this South Malawi example may represent a separate race. A teneral from this locality has only yellow lips and typical abdominal markings. The wings have distinct brownish-amber subpterostigmatal fasciae; also amber nodal spots and the hindwing basal amber traces are bright, as in the less mature Chirundu Bridge examples.

Whether or not these Malawi specimens represent a race it does seem possible that at maturity the species may show dimorphic females even in one locality. The subapical and certainly the nodal amber may perhaps disappear at full maturity but the basal amber of the hindwing may be either a vivid trace or a more diffuse patch nearly as large as in the male.

KENYA: A female from Kacheleba (Suk) has no black on the lips; abdominal markings as in the Chirundu Bridge specimen illustrated. Wings without subapical marking and hindwing with only traces of vivid amber at base.

DISTRIBUTION

The eastern half of Africa. From the Rhodesian valleys of Limpopo, Nuanetsi and Zambezi Rivers to South Malawi (on Shiré River); at rivers in the lowlands near the northern borders of Kenya and Uganda; to Gondokoro in the Southern Sudan.

HABITS

Haunts river valleys or low-lying plains. Generally settles on bare twigs of low bushes or other low plants near the river or up to about 200 metres from the river; much less often on reeds in the water.

MATERIAL EXAMINED

Rhodesia, Malawi and Northern Kenya. Examples from Northern Uganda also seen previously.

persephone

GROUP 4. PERSEPHONE. Includes only a single species.

Trithemis persephone Ris, fig. 34 p 88

Trithemis persephone Ris, 1912, *Coll. Zool. Selys* **14:** 768; Pinhey 1962c: 272.

Known only from Madagascar and described from Nossi Bé, the type male is in the Selys collection, Bruxelles Museum, type female in Paris Museum.

Amongst red-bodied Madagascar males this is easily recognized by the dark brown basal fascia on the hindwing and the large, slender hamular hook. From all other *Trithemis* species known, at least in this review, this species and *brydeni* are distinguished by the paired apical tumours on the anterior lamina.

This paired development, as well as the bifid apices of a few other species or the internal septum, suggest that, like the hamules and posterior lobes, the anterior lamina may have originally been paired and have now become fused to act as a protective hood for the prophallus and perhaps to prevent further anterior movement towards the thorax.

All the specimens (and of *selika*) were collected by René Vieu.

MALE

MADAGASCAR (Forêt de l'Est) ♂ (mature): Lips and face plain ochreous; frons dorsally and vesicle metallic violet, this not spreading over the frontal crest.

Synthorax purplish red pruinose (as in *annulata*). Dark markings obscure, greyish, with blacker spiracular band. Sternal pattern not well developed, incomplete posteriorly. Legs black, fore femur brown interiorly.

Venation red; pterostigma dark brown between black long veins. Forewing without coloured base; hindwing with amber to second Ax, to base of triangle and three quarters of distance to tornus; the cells filled in with brown (as in *annulata* f. *violacea*), and with dark brown subcostal and cubital rays. Membranule grey. Forewing with 13½–14½ Ax.

Abdomen red with very sparse marking except on segments 9–10. Segment 1 with grey dorsal saddle; 2 with dorso-lateral dark stripe; 8 with fine black median line; 9 black with red sub-lateral dot; segment 10 all black. Superior appendage black, inferior brown with black apex. Anterior lamina broadly rounded and with two distinctive apical tumours; sparse hair. Hamule not heavily chitinised but with very long, curved, slender hook. Genital lobe black, pitted, very narrow.

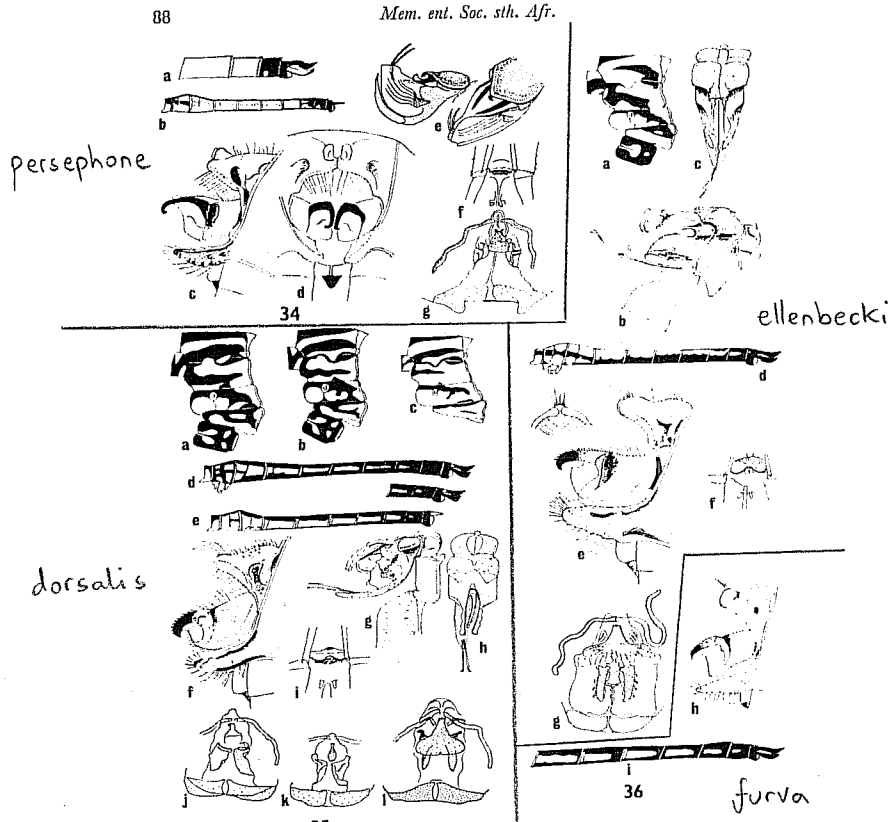
Prophallus distinctive. The corpus forms a hood ending in a hook and below it are two gently curved cornuti. Glans very large. Long flagella. The glans exhibits radiating channels.

Abdomen 23 mm, hindwing 31 mm, pterostigma 3 mm.

A second adult male (Tananarive) has a brown median stripe on labrum. This may be a variable character since Ris (1912) states that the labrum is "schwarz mit gelben Ecken". It is doubtful if the example he described was more mature but it is possible that his example (Nossi Bé) may be a race with darker lips. The labium was also diffused with some brown. A male has also been examined in the Royal Scottish Museum.

FEMALE

MADAGASCAR (Forêt de l'Est): Lips, face, frons and vesicle ochreous; frons with moderate groove and a black basal band less wide than the distance between central and lateral ocelli.



Figs 34–36. *Trithemis* species. 34. *T. persephone* (Tananarive). a–b. Abdomen. a—Male. b—Female. c–d. Accessory genitalia. c—From left. d—Ventral. e—Prophallus, left ventrolateral. f—Vulvar lip. g—Bursa. 35. *T. dorsalis*. a–c. Thorax. a—Male (Seven Weeks Poort). b—Male (Inyanga). c—Male (Ladysmith). d—Abdomen (♂, Seven Weeks Poort) and end of abdomen (♂, Inyanga). e—Abdomen (♀, Inyanga). f—Genitalia (Seven Weeks Poort). g–h. Prophallus (Zululand). i—Vulvar lip (Constantia). j–l. Bursa. j—Teneral (Kirstenbosch). k—Teneral (Bulawayo). l—Mature (Mwinilunga). 36. *T. ellenbecki*. a—Thorax (juvenile ♂). b–c. Prophallus. d—Abdomen (juvenile ♂). e—Genitalia and anterior lamina. f—Vulvar lip. g—Bursa. h–i. *T. furva*, ♂-holotype. h—Accessory genitalia. i—Abdomen.

dorsalis

Thorax greenish ochreous with markings as obscure as in the male, only the stripe on second suture black. Legs black; fore and mid femora yellow on interior surfaces.

Venation all dark brown; pterostigma dark brown between black veins. Wing apices slightly brown. Forewing without amber; hindwing with only minute basal traces in subcostal and cubital spaces. Forewing with 12½ Ax.

Abdomen broadish. Faint grey lateral band on segments 2–5 or 2–6; segments 2–7 with fine black dorsal and sub-lateral lines; 8 black on distal half; 9 black with pale sub-lateral spot; segment 10 and cerci black. Vulvar lip almost straight.

Bursa distinctive. Dorsal sterigma very bulbous, with bifid apex. The folded ventral plates have long slender, asymmetrical spines. Bursal arms very long and slender and evidently banded. The bands suggest "stretch-bars", permitting further lengthening of the arms.

Abdomen 22 mm, hindwing 32 mm, pterostigma 3.5 mm.

DISTRIBUTION

Madagascar.

SECTION B. Black-bodied species

GROUP 5. DORSALIS. Includes only a single species.

Trithemis dorsalis (Rambur), fig. 35

Libellula dorsalis Rambur, 1842, *Ins. Névroptères:* 89 (♀, Cape).
Helothemis dorsalis Karsch, 1890, *Berl. ent. Z.* **33:** 378.
Stoechia distanti Kirby, 1898, *Ann. Mag. nat. Hist.* (7) **2:** 236 (♂, ♀, Transvaal).
Misthotus marshalli Kirby, 1905, *Ann. Mag. nat. Hist.* (7) **15:** 192 (♂, ♀, Rhodesia).
Misthotus ambiguus Kirby, 1905, *Ann. Mag. nat. Hist.* (7) **15:** 193 (♂, Cape Colony).
Trithemis dorsalis Pinhey, 1962c, *Publ̨cões cult. Co. Diam. Angola* **59:** 271.

Types: *dorsalis* ♀ in Bruxelles Museum; *distanti* ♂-lectotype (formerly W. L. Distant collection) in British Museum (Nat. Hist.) and cotypes in Berlin Museum; *marshalli* and *ambiguus* ♂♂ also in British Museum.

The generic and specific confusion (originating in Kirby) in this relatively easily recognized species was eventually and adequately dissembled by Longfield (1936: 490): the type of *distanti* is the same as *dorsalis*, whilst later references to *distanti* (such as Ris 1912: 791) were generally the species called *risi* by Longfield (1936) (now *furva*). The differences between *furva* (*risi*) and *dorsalis* are clear in the venation, thoracic markings and accessory genitalia.

The cotypes of *marshalli* were found by Longfield to be *dorsalis* but those of *ambiguus* were of the two species, a Cape Colony male being *dorsalis*, a Transvaal cotype *risi*.

Wing colours: Some female *dorsalis*, particularly from the Western Cape Province, exhibit amber nodal and subcostal markings. This is also the case in Cape *arterivosa* females and in *furva* from the Cape and sometimes elsewhere (see also *werneri*). Cape *dorsalis* may have apical fasciation. It might be considered strong enough grounds to separate a Western Cape subspecies on the female wing fascia. But this would have to be the nominotypical subspecies. The more widespread subspecies might then be called *dorsalis distanti* (Kirby). On the other hand some Natal females are also marked similarly

on the wings. It is advisable to avoid subspeciation, leaving these chromatic females in the subordinate status of physiological or ecological female variants. As a supposition, an alternative is to treat the typical Cape form (or race) as montane in Natal, Transvaal and other higher localities, such as Inyanga. The remaining localities, at lower altitudes, might then be regarded as *dorsalis distanti*. Long series would be necessary from montane areas before a definite decision can be made. It is safer to consider the amber-nodal-apex females as produced climatically, perhaps by the lower temperature gradient on mountain streams The survey of material here indicates that subspecific separation is not really valid.

Occasional specimens show the distal antenodal incomplete on the forewing.

MALE

CAPE (Seven Weeks Poort) ♂ (slightly juvenile): Labium very broadly black with large yellow lateral maculae on lateral lobes; labrum all black. Face greenish yellow with black central bar on postclypeus. Frons with shallowish groove; above all metallic black with violet sheen to below crest. Vesicle metallic violet-black. Occipital triangle ferruginous, yellow posteriorly; orbits black with several yellow spots.

Prothorax black, with yellow collar, middle lobe with yellow central spots as well as lateral spots. Synthorax dark yellow with black bands; laterally the bands are slenderish, characteristic in appearance and only narrowly contiguous; sternal black very thick and complete, posteriorly enclosing two separate yellow spots. Legs black; fore femur with fine yellow external streak on dorsal half. At a later stage the thorax and abdomen will be pruinose blue.

Wings hyaline, venation blackish brown, subcostal cross-veins of forewing, antenodals and most postnodals of hindwing yellow. Pterostigma thickish, all dark brown, between black long veins and yellow cross-veins. Forewing with small basal trace of cubital amber; hindwing with darker amber across base, not reaching Cuq. Membranule pale grey, whiter at base. Forewing with 12–13 Ax, the last antenodel cross-veins complete.

Abdomen broad, black with yellow markings. Segments 4–7 with single broad yellow row of streaks, 8 with short streak; segments 9–10 and anal appendages black. Accessory genitalia well chitinised. Anterior lamina with produced apex and long tuft of pale brown apical hair and some short outer setae. Hamular hook short but very broad, armed outwardly with very short setae. Genital lobe narrow, with poiated apex and with apical setae.

Prophallus with long flagella; with cornuti which are directed straight with slight curve; not well chitinised, and somewhat crenulate on outer edges.

Abdomen 23.5 mm, hindwing 27.5 mm, pterostigma 3 mm.

NATAL: A juvenile from Haladu (Natal) has base of labrum yellow laterally; frons and vesicle more brightly metallic violet; black bands on thorax narrower, not contiguous. Fore femur also with yellow exterior stripe. Forewing with 11–13 Ax. Abdomen with larger yellow fasciae on basal segments; 9 with an extra yellow spot which is normally present in specimens elsewhere (except the Cape?). A mature male from Nqutu has thorax and abdomen almost all covered with grey-blue or grey-violet pruinosity, except lower sides of thorax and end segments of abdomen. Labium with still wider black, labrum all black. Fore femur (even at maturity) with yellow exterior line; subcostal cross-veins also yellow. Forewing with 12 Ax. Abdominal yellow streaks more or less obscured but it is possible to see that segment 9 has a yellow trace unlike the Cape

specimens. A mature male from Ladysmith has 13½ and 14½ Ax in forewing, the distal antenodals incomplete. Cross-veins mostly darkened.

Incompleteness of distal antenodal cross-veins is quite frequent in Southern Africa (but they are more stable in East Africa) and probably indicates not only instability in this feature but that the subgenus *Helothemis* (with complete distal antenodals) is of recent origin, derived from *Trithemis* (last Ax incomplete).

MOZAMBIQUE: Individuals have been examined from Vila Pery, Ingamanhé Forest and Mavita.

RHODESIA: A short series from Rhodesia shows size variation, the hindwing 26–31 mm. The larger size is, however, abnormal for this species. A mature, pruinosed male from Salisbury has larger yellow labial spots than in Natal examples; all venation dark; hindwing with small amber basal fascia. A small specimen, hindwing 26 mm, forewing with 9–10 Ax. In a small Bulawayo example the subcostal veins are red, not yet blackened. Forewing with 10–11 Ax. A large juvenile from Inyanga Mountains shows the thoracic bands slender and mostly separate; subcostals yellow; forewing with 12–13 Ax. Segment 9 with yellow streak. Another juvenile is similar but base of labrum is yellow. Others have been seen from Rusape and Umvumvumvu River.

ZAMBIA: A mature Ndola male has face in front nearly all blackened, postclypeus nearly all dark brown. Venation all black. The yellow exterior streak on fore femur is faint but discernible. In another from Ndola the femoral streak has vanished. A juvenile has face and postclypeus all yellow, the lips normally marked, frons without violet sheen. Thoracic stripes slender, discontinuous. Antenodal cross-veins yellow. Segment 9 with only a minute yellow dot. A mature Abercorn example has the face less black than in mature Ndola male. Femoral streak absent. Subcostals red. Segment 9 with faint streak. Mature Mwinilunga specimens are similar. A teneral male has a yellow face but a narrow central bar on postclypeus. Segment 9 with yellow streak. A mature male from Kapiri M'poshi is like Ndola specimens; venation all black. A juvenile from Chingola is like the teneral from Mwinilunga.

KATANGA: A mature male from Lubumbashi has the very black face like Ndola ones and dark venation; but it has the yellow exterior streak on fore femur. One from Mokambo is like Mwinilunga examples but has the femoral yellow streak; segment 9 shows a faint streak.

Thus, the lip markings develop early in this species, but postclypeal and frontal fasciae develop later. Thoracic and abdominal markings are obscured at maturity by both blackening and pruinescence; and a characteristic *external* streak on fore femur may often disappear in the pruinosed male. Venation in subcostal spaces only darkens late in life. One character of the species is the pattern of *two* yellow posterior spots in the very black sternal marking. These spots may be widely or narrowly apart.

FEMALE

W. CAPE (Constantia) ♀ (teneral): Labium with broad blackish median band, less wide than in average male; labrum with black T (central band and stripe along margin); postclypeus with narrow brown central bar. Frontal furrow deep; a blue-black basal band, nearly as wide laterally as the distance between central and lateral ocelli, and still wider centrally in the groove. Vesicle yellowish, blue-black posteriorly and laterally. Occipital triangle brown, yellow posteriorly.

ellenbecki

Prothorax mainly black, with yellow collar and yellow transverse band on median lobe. Synthorax as in mature male but without pruinosity, the stripes slender, not contiguous. Sternal black complete, with the two posterior yellow spots narrowly separated. Fore femur broadly yellow interiorly; mid and hind femora with yellow exterior streak (cf. fore femur of male).

Venation and amber basal patches as in male; pterostigma as in male but with yellow posterior line. A costal-subcostal amber streak, strongest at nodus where it spreads posteriorly over the bases of the radial veins. A smoky amber sub-pterostigmatal fascia before apex. Membranule whiter than male. Subcostal cross-veins yellow. Forewing with 13 Ax.

Abdomen with broader yellow basal fasciae. Segment 9 with yellow streak: probably this streak should always be present, the lack of it in the Seven Weeks Poort male being abnormal. Cerci dark brown. Vulvar lip with broad invagination.

ZAMBIA ETC.: Bursa (Mwinilunga-Zambia example)—dorsal sterigma much broadened posteriorly and below it two folded plates which continue anteriad to thick uncinate apices. Near apex of dorsal plate there are two delicate, angled lateral processes. Bursal arms very slender. Lip very thick. In a teneral (Kirstenbosch, Cape) the dorsal plate is much reduced in size. In another teneral (Bulawayo) the plate is small and narrow. Ventral plates in tenerals are less thickened than dorsal plate.

Abdomen 22.5 mm, hindwing 26.5 mm, pterostigma 2.5–3 mm.

CAPE: A teneral from Kirstenbosch differs from the Constantia female only in having the costal amber heavier and continuous from base to pterostigma; and the central area of the wings, subnodally and, in forewing, most of the discoidal field is fumose.

NATAL: Mature Ladysmith females have less black on face and thorax. Labium with posterior lobe black and only a very narrow black median stripe on lateral lobes. Labrum with only a minute black central spot on lower margin. Postclypeus unmarked; frons with narrower basal band. Thorax with reduced and well isolated bands, as figured. Anterior amber on wings almost confined to nodal zone. Pterostigma blackened, with scarcely a trace of pale posterior line. Sub-pterostigmatal brown fascia present. Forewing with 11 Ax. Abdominal markings similar but broader on most segments. A Kambula specimen has a more normal broadish labial band, a narrow black T on labrum. Thoracic, wing and abdominal patterns as in the Ladysmith examples. One from Natal National Park has facial markings like the Ladysmith specimens but the labial black is in between these and the Kambula one.

RHODESIA: Females are very variable in size, the smallest from Marandellas, the largest from Inyanga Mountains: abdomen 20.5–23 mm, hindwing 25–30 mm. A Marandellas specimen has labium black on posterior lobe and narrow median stripe; labrum with basal dot and a line on lower margin. Thorax like Natal specimens. Wings with yellow subcostal cross-veins but no nodal or apical amber. Segment 9 with yellow streak. Inyanga specimens have broader labial black and one has some nodal amber. A bred teneral from Bulawayo has narrowish labial black, a narrow T on labrum; wings with strong amber nodal-subcostal suffusion.

ZAMBIA: Specimens show almost as much size variation as Rhodesian ones. A smal Mwinilunga example has the labial black, conical, narrowed in front; labrum with black T. Mid and hind femora with yellow exterior line. Wings with well developed basal amber but no other markings. Pterostigma black without pale posterior line. Otherwise typical. Another one, more juvenile, has only a narrow line on posterior

lobe of labium and a bulbous spot on lateral lobes; labral black reduced to a central dot. Pterostigma with yellow posterior line. An older female has broad bands on labium and labrum. Not even the teneral female has any amber on wings except at base of hindwing. Ndola specimens are more uniform on the lips, with broadish black bands. An Abercorn one has conical black on labium and a very slender T on labrum. Wings in all these with only basal amber.

KATANGA: A Bunkeya female resembles most Zambian specimens.

Lip markings are evidently very variable in the female. Wing markings vary more in specimens south of the Zambezi River, particularly in the Cape and Natal.

These comparisons indicate that no true subspecific distinctions can be recorded.

DISTRIBUTION

Cape, Natal, Mozambique, northwards to Kenya; Rhodesia, Angola, Zambia, Congo (Kinshasa). None have been seen in Botswana.

HABITS

On streams and pools in open country. From Rhodesia northwards to Kenya it is much less common than the superficially similar *furva;* in South Africa it is more abundant.

GROUP 6. STICTICA. Includes *aenea, anomala, atra, dichroa, ellenbecki, falconis, festiva, furva, hecate, nuptialis, pruinata, stictica.*

Those in which the male abdomen is thicker will be described before the others.

Trithemis ellenbecki Förster, fig. 36 p 88

Trithemis ellenbecki Förster, 1906, *Jb. nassau. Ver. Naturk.* **59:** 314 (♂, Südschoa, Ethiopia); Pinhey, 1962c: 271.

♂-Lectotype in Ann Arbor, Michigan.

Superficially the mature pruinose male closely resembles *furva* and until I received specimens collected by B. G. Hill in Ethiopia it was not realized how much these two differ in head and body markings, as well as in genitalia. It was R. M. Gambles, in 1961, who discovered the differences when he examined series in the British Museum (Nat. Hist.).

Both species occur in Ethiopia. The series sent by Hill were collected at a Coffee Experimental Station at Jats, near Jimma, August 1963.

The mature male is a dark bluish species with very short pterostigma (lacking a pale line) and deep amber basal rays on the hindwing. The hook of the hamule has a wide gape like *furva* but it is straighter and blacker. The anterior lamina is slightly indented at the broadened apex, whereas in *furva* it is only incompletely seamed, not divided. The posterior lobe is less attenuated and broader at apex and base. The labium is totally black in the male. The thoracic black is very complete and contiguous but peculiarly reduced on the mesepisternum. The sternal black is very thick, even in juveniles, enclosing only a small yellow posterior spot, and at maturity the entire pattern is black.

The abdominal pattern is quite distinct and affords a *link* between the pale-bodied species of Section A and the black-bodied ones of Section B: segments 4–6 or 7

furva

have the orange streaks quite dorsal and very broad, so that in dorsal aspect they are more or less continuous; or, in other words, these segments lack a black dorsal band, unlike all others in Section B. It should therefore be easy to separate the species in Ethiopia from *furva* because even in pruinose adults the abdominal pattern is at least partially discernible.

MALE

ETHIOPIA (Jimma) ♂ (mature): Lips entirely black. Postclypeus broadly black on lower margin. Frons with shallow groove, metallic violet to below crest; vesicle metallic violet. Occipital triangle blackish, yellow posteriorly. Orbit yellowish with only one complete black band.

Prothorax ferruginous with sparse black marking. Synthorax ferruginous with thin bluish pruinosity; with black marking as figured; mesepisternum with reduced black; sides with bands contiguous; sternal plate all black. Legs black.

Wings hyaline with black venation and short, plain blackish pterostigma. Forewing with just a trace of basal amber in cubital space; hindwing with strong amber rays in subcosta to first Ax, in cubitus to just beyond Cuq and traces at base of costa, median and anal fields. Membranule pale grey. Forewing with 11½ Ax.

Abdomen broad, black with wide yellow bands, as in the figure, which reach up to dorsal carina on segments 2–5, but on 6–7 the carina itself is finely black; 8–9 with fine yellow streaks, segment 10 and appendages all black. Accessory genitalia all black. Anterior lamina thickened apically, very slightly bifid and with pronounced apical hair-tuft. Hamular hook large, straightish, apically inturned towards segment 2 (not posteriad as in *furva*), surmounted by numerous very short setae; base of hamulus without the usual ridge. Genital lobe broad at base, irregularly tapering to a broad apex, with long setae.

Prophallus rather like *pruinata* and *furva* but with more extended outer ("upper") portions, glans and corpus. Long, free flagella and retinaculum; no cornuti. The glans appears to have channels along it.

Abdomen 24 mm, hindwing 30 mm, pterostigma 1.8–2 mm.

A teneral male (same locality) has similar facial markings except that the dorsum of the frons is bronze. Thoracic markings similar except the sternal plate is not all black. Wings similar but subcostal cross-veins pale. Pterostigma all brown, between black long veins. Forewing with 10¼ Ax. Segment 10 with two minute yellow dorsal dots. A mature male, from R. Hawash, R. Akabi (C. Ethiopia, 14 May 1915), was kindly lent from the British Museum by Kimmins, (as well as a female from Maraquo, *vide infra*). This male had a small yellow lateral fascia on the labium. Pterostigma 2–2.3 mm.

As in *furva* and *dorsalis* the last antenodal vein of the forewing is variably complete or incomplete. Quoting from Gambles (letter, 15 September 1961): "The last Ax in forewing is often complete in *ellenbecki:* 3 out of 5 specimens examined by Ris; and of the B.M. series 3 out of 8 ♂♂ have last Ax complete in one wing, 2 out of 7 ♀♀ have it in both wings, 1 ♀ has it in one wing and a Y in the other, 1 ♀ has it in one wing. Of *risi* (*furva*) 3 out of 44 have Ax complete in one wing, ♂; in ♀ 3 out of 16 in both wings, 1 (♀) in 1 wing complete." This instability has been observed by the present author in *furva* and *dorsalis* (as well as other species) but mainly from Southern Africa. Yet *ellenbecki*, solely from Ethiopia, shows this variable feature. This suggests that speciation in the group is from two areas, one in N.E. Africa, the other in the South. Long series would be essential to confirm this hypothesis.

FEMALE

ETHIOPIA (Jimma) ♀ (mature): Labium yellow with black band slightly wider than posterior lobe, narrowed in front but expanded again at anterior margins of lateral lobes. Labrum with narrow T. Face all yellow. Frons with uniformly narrow blue-black basal band, half as wide as the distance between central and lateral ocelli. Vesicle ochreous, narrowly black in front and laterally. Occipital triangle brown, yellow posteriorly. Orbit yellow, with only one transverse black stripe.

Prothorax yellow on anterior collar, black in the groove, orange on median lobe; posterior lobe black with minute central and lateral orange dots. Synthoracic pattern as in the male but the black more reduced; laterally the bands are narrowly contiguous. Sternal pattern black only on periphery. Fore femur yellow interiorly. Legs with slight white pruinosity.

Wings all fumose, with amber subcostal streaks at nodes; hindwing with trace of basal amber right across. Pterostigma black with pale posterior line. Subcostal cross-veins pale. Forewing with 10¼, 11¼ Ax.

Abdomen broad, patterned as in male but segments 4–6 with short extra sublateral streaks. The single streak on segment 9 is long; 10 with two orange dorsal spots. Cerci black. Vulvar lip not as thick as *furva*, with broad U invagination.

Bursa with dorsal sterigma narrow anteriorly, broad, fanlike but bifid posteriorly and thinly chitinised post-laterally. Ventral plates well chitinised. Bursal arms slender.

Abdomen 22 mm, hindwing 29 mm, pterostigma 2.5 mm.

A teneral female from same locality has the posterior lobe of the labium black with yellow lateral spots, and only a fine black median line on lateral lobes. Labrum with small black mid-basal dot and a central spot on lower margin. Thoracic markings not fully developed, particularly on metepimeron and mesinfraepisternum. Wings not fumose but with nearly complete amber subcostal stripe as far as pterostigma. Pterostigma with broader pale posterior band. Forewing with 9¼ and 10 Ax (complete on left forewing). Basal markings on abdomen as in previous female (distal half missing). Hindwing 27.5 mm.

The British Museum juvenile female from Maraquo (C. Ethiopia, 20 August 1914) had fumose wings, tinted with amber subcostally.

Other females examined in British Museum have fumose wings with amber at nodus or continuous subcostal streaks on all wings.

DISTRIBUTION

Ethiopia.

Trithemis furva Karsch, fig. 36, 37 p88 & 100

Trithemis pruinata Karsch (pars), 1899, *Ent. Nachr.* **25:** 369 (Zanzibar; not Togo).
Trithemis furva Karsch, 1899 *ibid*, **25:** 370 (♂ Malchrito Bay, Issango Forest).
Misthotus ambiguus Kirby (pars), 1905, *Ann. Mag. nat. Hist.* (7) **15:** 193 (Transvaal, not Cape Colony).
Trithemis risi Longfield, 1936, *Trans. R. ent. Soc. Lond.* **85:** 490, 494 (Uganda, Congo, W. Dafur, S. Africa); Pinhey, 1962c: 271 (et nota) **syn. nov.**

Types: *furva* type ♂ in Berlin Museum; *risi* ♂-holotype (Kenya), ♀-allotype in British Museum (Nat. Hist.).

The holotype of *furva* Karsch, mislaid for a time, was rediscovered in Berlin Museum by Dr K. Günther who kindly sent the specimen for examination.

Karsch (1899) described it as a blackish brown species near *pruinata*, with shorter wings and body, the abdomen more parallel-sided; without any blue pruinosity.

Re-examination of this type shows that without any doubt it is conspecific with *risi* Longfield. It is in good condition except the left wings which have lost the apical portions.

♂-Holotype. Labium all black except a small yellow anterior lateral fascia on lateral lobes. Labrum all black. Face yellow. Postclypeus dark brown in the centre, fading more laterally to pale brown, yellow at sides. Frons with shallow groove. Frons above and vesicle dark metallic violet. Occipital triangle deep brown, yellow posteriorly; orbits yellow with two black bands.

Synthorax stained, brownish yellow with black fasciae less continuous than in the Chimanimani Mt female (fig. 37b): the antehumeral black band is completely severed into a ventral spot and dorsal stripe; the lateral black bands, however, are continuous from mesepimeron to dorsal end of metepimeron, as in fig. 37a, but not so broad. Sternal pattern as in that figure. Legs black.

Venation black. Pterostigmata black with yellow proximal vein and yellow posterior line. Membranule dark grey. Forewings with 11½ Ax, the right forewing with 9 Px. Hindwing with only the merest trace of basal amber in cubital space.

Abdomen broadly triquetral as in *dorsalis* and related species. Basal segments marked as in the Maseru male, fig. 37c; Segments 4–9 with yellow lateral stripes as in the figure of the type. Anal appendages black.

Accessory genitalia as figured and similar to examples previously named *risi*.

Abdomen 22 mm, hindwing 28 mm, pterostigma 2.7 mm.

The labels on this specimen are "Malichrito Bay, W. Issango Wald, 19.12.91 Stuhlmann; Trithemis furva Karsch; Trithemis n.sp. nächste stictica Burm.; Typus (red label)"; and a label applied by Günther (1969), "Trithemis furva Karsch Holotype".

The only point in which it differs from *risi* is the lack of pruinosity. This, however, may be due to two reasons, either it has lost the blue during the drying process or it is insufficiently mature, as indicated by the mesepisternal black markings. It differs, of course, considerably from *stictica*.

The locality has been recorded as "Malchrito Bay", but the label on the type seems to read "Malwrito Bay" or "Malichrito Bay".

To Longfield (1936) the credit is due for sorting this species (as *risi*) from "distanti", "ambiguus", *dorsalis* (q.v.) and *pruinata*. The mature male *furva* (*risi*) is very like *dorsalis*, *pruinata* and *ellenbecki* but it is easily separated from the first two by the large hamular hook and *ellenbecki*, only found in Ethiopia, can be separated as mentioned under that species (*supra*).

Female *furva* is nearer to *pruinata* in most characters than to *dorsalis*. It can usually be distinguished from *dorsalis* by the incomplete distal antenodal cross-vein (although this is occasionally unstable in both species); both generally show a pale posterior line on the pterostigma, unlike *pruinata*; but the vulvar lip is thick, with a deep U in *furva* and *pruinata*, unlike *dorsalis*. Apart from the generally small size of *dorsalis* this vulvar lip is an important distinguishing feature for use with the antenodal character in females of *furva* and *dorsalis*. From *pruinata* female the most useful guide to distinction from *furva* is the pale line on the pterostigma in the latter species.

In *dorsalis* the lateral thoracic black bands are more or less well separated, whilst they are well fused in the other two. Yet in *furva* the bands are sometimes separate (see fig. 37b).

Females of *furva* from Cape Province and Natal often show nodal amber fasciae as in *dorsalis* (q.v.).

MALE

Cape (Citrusdal) ♂ (mature, leg. C. G. C. Dickson): Labium yellow with broad black median band; labrum black. Postclypeus mainly brown with black central bar on lower margin. Frons with shallow groove, metallic violet to below crest; vesicle metallic violet. Occipital triangle dark ferruginous. Orbit yellow and orange-brown with two black bars.

Prothorax mainly blackish, with yellow lateral spots. Synthorax almost entirely coated with grey-blue pruinosity, masking the bands. Legs black.

Wings hyaline, venation black, costa blue at base. Pterostigma brown, with pale posterior band, between black long veins. Hindwing with trace of basal amber in subcostal, medial and cubital spaces. Membranule pale brownish grey. Forewing with 10½–11½ Ax.

Abdomen broad, black, with blue pruinosity on basal segments; yellow pattern obscured. Anal appendages black. Anterior lamina narrowed before a broad apex, with long tuft of reddish hair as in *dorsalis* but without the short outer setae. Hamular hook large, narrow, strongly setose, with wide gape, the tip pointed *posteriad*. Genital lobes narrow, acuminate, with apical hair. All well chitinised. In the figure drawn from the type by Kimmins the anterior lamina and genital lobe are broader.

Prophallus very like *pruinata*, with a thin, setose vesica at the base of the free flagella and retinaculum; the glans above it scarcely curved (the figure is from a Natal specimen, not the Cape male; one from Errer Valley, Ethiopia, is similar).

Abdomen 24 mm, hindwing 27.5 mm, pterostigma 2.5 mm.

Like most South African examples this Cape specimen is small. Another mature male from Tulbagh's Kloof has a narrower labial band, elliptical yellow basal spots on labrum; postclypeus yellow with black central bar. The thoracic pruinosity is thinner and shows the black bands are not contiguous (see fig. 37b); sternal black moderately complete except in centre. Fore femur with pale inner stripe. Amber on hindwing reaches beyond Cuq and to first Ax. Forewing with 11½ Ax. Abdomen with single yellow streaks on distal segments 4–9 and a fine mid-dorsal yellow line on segment 10.

Lesotho: A teneral from Maseru has the same facial markings as the Tulbagh example; frons bronze above, not violet; thoracic lateral bands contiguous; sternal black complete. Basal amber reduced to a trace only in cubital of hindwing. Subcostal cross-veins yellow (cf. *dorsalis*). Forewing with 10½ Ax. Fore femur all black. Abdomen with single row of yellow stripes on 4–9 and a dorsal stripe on 10.

Natal: A Natal series of pruinose males shows the amber on hindwing to vary from a cubital trace to strong streaks in *both* wings: on forewing in subcostal space, in cubital nearly to Cuq; on hindwing to first Ax and beyond Cuq. Labial black from a moderate band to a very broad one leaving only a small round yellow patch; labrum all black; postclypeus black extensive in some. Distal antenodal occasionally complete on one forewing or even on both. A teneral has the labial black broadish; labrum with two small yellow basal dots; thoracic bands contiguous. Venation brown.

Rhodesia: Rhodesian examples show a size range of hindwing 29 (Bulawayo) to 33.5 mm (Chimanimani Mountains). In a Bulawayo specimen the labial black is narrowed anteriorly; abdomen completely pruinose blue. Salisbury and Glenlivet ones are similar.

Examples from Chimanimani Mountains, Nyamadzi and Penhalonga have broader labial black and the largest from Chimanimani has the yellow sides reduced to small maculae. A teneral from Bazeley Bridge (Umtali) has only a narrow central band on labium, but labral black is complete. Thoracic bands contiguous. Last Ax in forewing complete on one side. Otherwise like the Lesotho example. Others have been examined from Mazoe, Sinoia and Umvumvumvu River.

MOZAMBIQUE: Males are also variable in size and labial black but this is usually narrowed anteriorly. These have been from Dondo, Vila Paiva, Ingamanhé Forest and Inyagui River.

ZAMBIA: A male from Makonde (leg. R. C. Dening) has broad labial black. It is a very black specimen, the blue pruinosity obviously lost by heat (on removal of pruinescence in Section B the thorax is found to be mainly black). A pruinose Choma male has rather narrower labial black.

MALAWI: A Cholo male (leg. R. C. Wood) has the labial black so broad that the yellow is reduced to small round spots; another has this black slightly less; amber fasciae reduced to traces. A teneral male has the frons bronze. A Zomba plateau male has broad labial black but less so than the Cholo ones. A Mzimba male (leg. W. G. Gray) is like the Zomba specimen.

TANZANIA: One from Kimboza Forest (Uluguru Mountains) has the labial black narrowed anteriorly; no basal amber. Otherwise normal. In this and other fully adult examples the pale line on the pterostigma has disappeared

KATANGA: In mature specimens from Lubudi (leg. Pinhey) the labial yellow is reduced to a small round spot. Basal amber obsolescent; segment 10 has the fine yellow dorsal line (which disappears in adults from some localities). A teneral example has a larger yellow labial patch; no pale line on pterostigma nor on segment 10.

C.A.R.: A specimen from André (Central African Republic) has the labial black very conical, narrowed anteriorly. Otherwise normal.

ETHIOPIA: One from Doreu (Eritrea) has the labial black only as wide as the posterior lobe. Otherwise normal. One from Errer Valley has wider labial black, slightly expanded anteriorly.

Thus, lip markings develop early in males although the labrum may not be fully black until maturity. Thoracic bands are usually contiguous, occasionally free. Basal amber is very variable, especially in Natal. The distal antenodal on forewing is quite often complete. Segment 10 may or may not have a yellow dorsal line. Pterostigma often loses pale posterior line at maturity.

FEMALE

Females from Cape Province and Natal tend to have amber wing patches not only basally but also nodally, costally and occasionally apically, as in *dorsalis* (q.v.). CAPE (Klein Tafelberg, S.W. Cape) ♀ (juvenile, leg. C. G. C. Dickson): Labium yellow, posterior lobe mainly brown, a narrow brown stripe on lateral lobes. Face all yellow. Frons with deepish groove and a blue-black basal band, laterally narrower than the distance between central and lateral ocelli but centrally extending further along the groove. Vesicle yellow, blackish anteriorly and laterally. Occipital triangle brown, yellow posteriorly. Orbit yellow with two black bars.

Prothorax yellow, with black groove behind collar, brown ellipses on median lobe, posterior lobe black. Synthorax yellow with brown and dark brown pattern as in the male figured from Maseru. Sternal pattern slenderly brown, incomplete anteriorly. Legs black, fore and mid femora yellow interiorly.

Wings hyaline, venation brown, but subcostal cross-veins yellow. Pterostigma brown, yellow posteriorly, between black long veins. Costal-subcostal zone continuously amber from base to pterostigma; a faint brown subpterostigmatal infuscation. Basal amber on forewing covering cubital space; on hindwing deeply amber to Cuq. Membranule pale grey, white at base. Forewing with 8½–10½ Ax, but several cross-veins incomplete.

Abdomen broad, with yellow pattern as in male, but with traces of narrow yellow additional streaks on segments 4–5; 10 broadly yellow dorsally. Cerci black. Vulvar lip very thick with U-shaped invagination (wider than the gap figured for the Chimanimani female).

Bursa of mature female (Chimanimani Mountains, Rhodesia) very unlike *dorsalis* but near *pruinata*. Dorsal sterigma consisting of two thinly chitinised, fan-like hemispheres. Two pairs of long ventral plates, irregularly edged, well chitinised. The ostium is clearly visible in the figure. Bursal arms slender. A Natal female is similar.

Abdomen 22.5 mm, hindwing 29 mm, pterostigma 3.2 mm.

A smaller, maturer female from Clanwilliam (Cape, leg. Dickson) has hindwing 26 mm, pterostigma 2.5 mm. Labial marking similar but blacker. Labrum with basal dot and black lower margin. Thoracic marks blacker. Sternal pattern complete anteriorly. Wings with basal and nodal amber, but not apical.

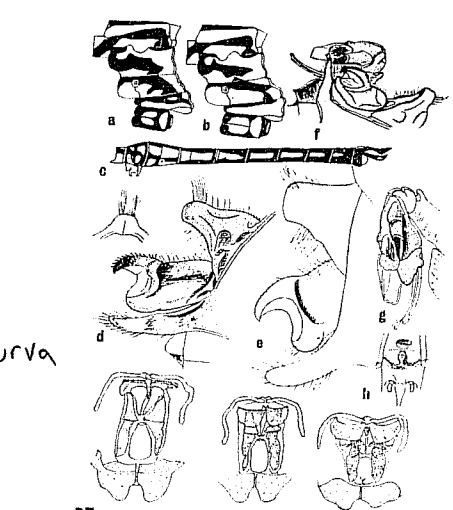
NATAL ♀: One from Ladysmith (leg. A. H. Newton) resembles the Clanwilliam specimen. Another lacks the basal black dot on labrum; thoracic bands brown, not black. Forewing in these with 9½, 10½ and 10½, 10½ Ax. Another from Kambula (leg. Newton) differs in having the labrum entirely yellow; abdomen with the double yellow row of stripes fused on segment 4, and it is double also on 5–7.

RHODESIA: A small juvenile from Matopos (Bulawayo) has hindwing 27 mm; labium all yellow, labrum with central brown dot, frons normal. Thoracic bands more or less disconnected. Wings slightly fuscous apically; basal amber reduced to cubital trace on hindwing. Antenodals normal. Segment 10 with yellow mid-dorsal line and two dots. Two mature females from Chimanimani Mountains are much larger and quite different: hindwing 32 mm; labium with broad black median band, in one of them strongly constricted anteriorly. Labrum with black T. Thoracic bands disconnected, as in figure. Wings hyaline, without basal or apical amber; forewing in one with 11, 12 Ax (distal antenodals complete) and 11½, 11½ Ax in the other. Pterostigma with pale posterior edge. Vulvar lip very thick.

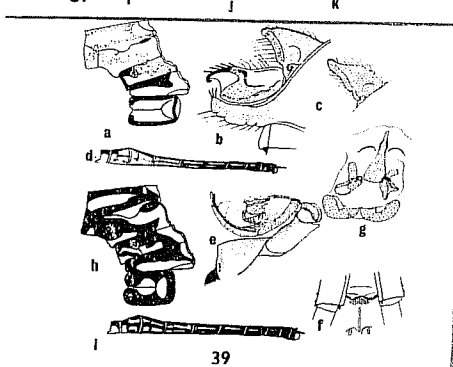
MOZAMBIQUE: A mature example from Vila Paiva (leg. Pinhey) has the posterior lobe of labium nearly all black and narrow line on lateral lobes; labrum with central dot and black lower margin. Thoracic bands disconnected. Hindwing 31 mm. Hindwing with only a cubital trace of amber; pterostigma pale posteriorly. Another has broad conical band on labium, a black margin but no dot on labrum. The pale line on pterostigma has almost vanished with darkening. A third specimen only differs in having the basal dot on the labrum.

ZAMBIA: An Ndola female (leg. Pinhey) has a uniformly broad black labial band, a broad T on labrum. Pale line on pterostigmata distinct. Amber basal traces stronger.

furva

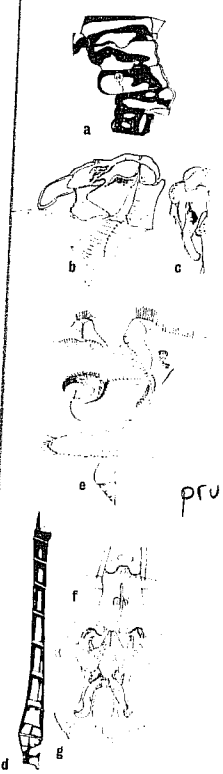


37



39

grouti



38

pruinata

pruinata

Hindwing 30.5 mm. Thoracic bands disconnected. An old mature Mwinilunga specimen (leg. Pinhey) has the thoracic bands thickly contiguous as in the Maseru male. Pale line of pterostigma obsolescent. Hindwing 32.5 mm. Segment 10 all black. A teneral has hindwing 28.5 mm; labial black broad, labrum with T.

KENYA: A Nairobi female (leg. Pinhey) has the labial black narrower, the labrum all yellow.

ETHIOPIA: A female from Errer Valley (leg. Hill) has narrowish labial black, constricted anteriorly; labrum with dot and marginal bar. Thoracic bands almost contiguous. Last Ax complete on one side.

KATANGA: A mature one from Lubudi (leg. Pinhey) has the labial black broad, narrowed anteriorly; labrum with T. Thoracic bands almost contiguous. Pterostigma with pale posterior line. Segment 10 all black.

In facial and body markings, therefore, as well as in male and female genitalia this species is very like *pruinata*. The larger hamular hook and the pale posterior line on the pterostigma distinguish *furva*, as stated earlier; but in older *furva* this pale line is evanescent in both sexes. They are not conspecific since their distribution overlaps and both may be on one stream.

DISTRIBUTION

Probably throughout continental Ethiopian Africa; also recorded from Madagascar but specimens from there not examined.

HABITS

On streams, rivers or reed-fringed pools, in the open or even in forest. Often very abundant; usually found nearly throughout the year.

Trithemis pruinata Karsch, fig. 38

Trithemis pruinata Karsch, 1898, *Ent. Nachr.* **24:** 342 (*nom. nud.*); 1899, *Ent. Nachr.* **25:** 369 (♂ Togo, not Zanzibar); Pinhey, 1962c: 273.

♂-Holotype in Berlin Museum.

Ris (1912: 794) considers that the name *pruinata* is valid, despite the confused series of 1899, because the 1898 paper gave the Togo locality only.

Very like both *furva* and *dorsalis* in facies but generally larger than the latter. Easily confused with *furva* (*risi*, *vide* Pinhey, 1961: 166) in the field unless examined with a lens. The differences are given under *furva*. In *pruinata* the accessory genitalia are all much more densely armed with apical setae and the anterior lamina has a very broad apical hood, seamed but not bifid. The hindwing of the male lacks basal amber but has

EXPLANATION OF FIGURES

Figs 37–39. *Trithemis* species. 37. *T. furva*. a–b. Thorax. a—Juvenile male (Maseru). b—Female (Chimanimani Mts). c—Abdomen (juvenile ♂, Maseru). d—Genitalia and anterior lamina (Kimboza Forest). e—Genitalia (♂-type, del. Kimmins). f–g. Prophallus (Natal). f—*In situ*. g—From left. h—Vulvar lip (Chimanimani Mts). i–j. Bursa (Chimanimani Mts). i—Ventral. j—Dorsal. k—Bursa (Ladysmith). 38. *T. pruinata*. a—Thorax (♀, Vom). b–c. Prophallus (Mwinilunga). d—Abdomen (♀, Vom). e—Genitalia and anterior lamina (Vom). f—Vulvar lip (Vom). g—Bursa (Vom). 39. *T. a. atra*. a—Thorax (♀, Sierra Leone). b—Genitalia (Jinja). c—Anterior lamina (Ndola). d—Abdomen (♀, Sierra Leone). e—Prophallus (Dingila-Uele R.). f—Vulvar lip (Sierra Leone). g–i. *T. a. grouti*. g—Bursa (Abong-Mbang). h—Thorax (♀-allotype). i—Abdomen (♂-holotype).

heavy black contiguous thoracic bands. The last Ax in forewing is incomplete. The prophallus lacks cornuti.

MALE

NIGERIA (Vom) ♂ (mature, leg. Gambles): Labium all black except a small antero-lateral yellow spot on lateral lobes; labrum all black; postclypeus brown, yellow laterally. Frons with shallow groove; very broadly metallic purple to below crest; vesicle metallic purple. Occipital triangle dark ferruginous, orange posteriorly. Orbits with broad black bands.

Prothorax mainly black, the collar with fine yellow anterior edge; a palish central spot on median lobe. Synthorax thinly coated with grey-blue pruinosity, partially obscuring the markings; laterally the black bands are very broadly contiguous, more so than in the female illustrated. Sternal black complete, thick except at posterior transverse band. Legs black.

Wings hyaline, venation dark brown, no amber or brown markings; pterostigma plain dark brown between black long veins. Membranule grey-brown. Forewing with 11½–12½ Ax.

Abdomen broad, thinly pruinosed, the markings somewhat obscured. Basal segments mainly pale, the rest black with single row of yellowish stripes on segments 4–8 and a faint spot on 9. Anal appendages blackish. Accessory genitalia well sclerotized. Anterior lamina with broad, undivided apex bearing a thick tuft of setae (not a long hair-tuft like *dorsalis*). Hamule with strong short hook, more densely *setose* than *dorsalis* or *furva*. Genital lobe long, somewhat narrowed, and with numerous apical setae.

Prophallus with flagella and retinaculum free and unenveloped; glans long and curved; vesica exposed and setose. No cornuti.

Abdomen 23.5 mm, hindwing 30 mm, pterostigma 2.5 mm.

GABON: A pruinose male from Lastoursville (leg. P. C. Rougeot) has the labium entirely black, postclypeus mainly black, not brown. Entire thorax more or less blackened and pruinose, the markings completely obscured; the abdomen similarly. Forewing with 11½ Ax; hindwing 32 mm.

KENYA: An Nzoia male (leg. P. S. Corbet) only differs in having a smallish yellow lateral patch on lateral lobes of labium.

ZAMBIA: A pruinosed Mwinilunga series (leg. Pinhey) has hindwing 31–33 mm, pterostigma 2.5–3 mm. The labium may be all black or it has a small or very small yellow lateral spot. All lack any amber fasciae on wings.

FEMALE

NIGERIA (Vom) ♀ (mature, leg. Gambles): Labium yellow with very broad black median band, slightly expanded at anterior end; labrum yellow with very broad black T. Face yellow. Frons orange, with deepish groove, a broad blue-black basal band, wider than the distance between central and lateral ocelli. Vesicle orange, blue-black laterally and anteriorly. Occipital triangle pale ferruginous, orange posteriorly.

Prothorax yellow, with black post-collar groove, a dark brown ellipse on both inflations of median lobe, posterior lobe black. Synthoracic black as in the figure, with the lateral bands broadly contiguous. Sternal black even thicker than in the Vom male. Legs black, fore femur with whitish interior stripe, incomplete distally.

Wings hyaline with just a trace of cubital amber on hindwing; otherwise as in male. Forewing with 11½–12½ Ax.

grouti

Abdomen as figured, broad, with wide yellow stripes which are partly doubled on segments 4–5, single on 6–9. Cerci black. Vulvar lip thick, almost as large as in *furva*, with U-shaped invagination.

Bursa very like *furva*. Dorsal plate small, fan-shaped, not strongly chitinised posteriorly. Ventral sterigmata very long, hooked at anterior ends, beyond which are bands of chitin on the bursa. Bursal arms slender.

Abdomen 24 mm, hindwing 32 mm, pterostigma 2.8 mm.

CONGO: A female from Kabambare (Congo) has a narrower labial band, only as wide as the posterior lobe, but expanded at distal end. Both forewing and hindwing have basal amber, in forewing traces in subcostal and cubital spaces, in hindwing also in these spaces, reaching Cuq.

DISTRIBUTION

Guinea, Togo, N. Nigeria, N. Uganda, W. Kenya, Congo (Kinshasa), N.W. Zambia. Apparently a very local species of Central and Equatorial West Africa. The author always examines at least one or two of the dark blue *Trithemis* in each locality in case *pruinata* may be amongst the *furva*, but this is rarely the case.

HABITS

Tends to fly in thickish bush or forest near small streams.

MATERIAL EXAMINED

Nigeria, Kenya, Congo, Zambia.

Trithemis atra Pinhey, fig. 39 pl00

Trithemis atra Pinhey, 1961, *Publn. British Mus. (Nat. Hist.)*: 166.
Trithemis grouti Pinhey, 1961, *Entomologist's mon. Mag.* **96:** 269 (♂♀ Cameroons), **syn. nov.**
Trithemis leptosoma Pinhey, 1966, *Explor. Parc Natn. Garamba Miss. H. de Saeger* **45:** 64, **syn. nov.**

Types: *atra* ♂-holotype, ♀-allotype in British Museum (Nat. Hist.); *grouti* ♂-holotype, ♀-allotype in National Museum, Bulawayo; *leptosoma* ♂-holotype, ♀-allotype in Instit. Parcs Nat. Bruxelles.

Described from the Ripon Falls at Jinja, Uganda, this species has since been found as far south as Zambia. The nominotypical subspecies is similar in appearance and size to *dichroa*, but with a more slender abdomen and a violet frons. In the field the black frons of *dichroa* is an easy guide to separation. The adult male, like *Diplacodes lefebvrei* (Rambur) is densely coated with *black* pigment, *presumably* melanin, instead of the usual white or blue, fatty pruinose exudation. In *atra* segment 9 is all black but in *dichroa* it has a yellow streak.

It is now evident that *grouti* is a larger, slightly brown-tipped subspecies; and that *leptosoma* is no more than an unusually slender form or very localized subspecies.

Subspecies *atra atra* Pinhey, **stat. nov.**

MALE.

UGANDA (Jinja) ♂ (mature, leg. Pinhey): Labium yellow at sides, very broadly black medially, and posterior lobe all black; labrum all black. Anteclypeus with narrow brown transverse stripe, postclypeus with broad black stripe. Frons with shallow groove, frons above and vesicle metallic purple. Occipital triangle black. Back of orbit black with two yellow spots.

Prothorax and synthorax black, without visible pattern. Sternal pattern thickly black-edged but incomplete centrally. Legs all black.

Venation black; no basal amber at all. Pterostigma brown between black veins. Membranule grey. Left forewing with 10¼ Ax, right forewing with tortological deformity: instead of 11¼ Ax it has 9¼ and two distal subcostal cross-veins.

Abdomen slender, black; segments 4–8 with slender yellow streaks; anal appendages black. Anterior lamina rounded, slightly produced at apex; hamular hook smallish much more slender than in *dichroa*, with outer setae. Genital lobe narrowish, with apical setae.

Prophallus rather like *arteriosa* but with flagella.

Abdomen 22 mm, hindwing 27 mm, pterostigma 3 mm.

Two others from Jinja (leg. P. S. Corbet) are larger, abdomen 23.5 mm, hindwing 28.5 mm. Labial black slightly less broad.

CONGO: Specimens from Dingila-Uele River (leg. Pinhey) are similar. Forewing of one with 11½–12¼ Ax. In one there is again a deformity, with last Ax complete and other cross-veins abnormal.

GABON: Examples from Lastoursville (leg. P. C. Rougeot) are also typical but with slightly fuscated wing apices.

ZAMBIA: Two males from Ndola (leg. Pinhey) are similar but the anteclypeus is entirely yellow. The anterior lamina is slightly more produced. Possibly the Zambian examples could be a southern subspecies.

Unfortunately all the above males are black, so that the basic body markings cannot be illustrated.

SIERRA LEONE: Darker violet on the frons but otherwise quite typical *atra*; collected, incidentally, on the same day with a *dichroa*.

Forma *leptosoma* Pinhey

CONGO: A ♂-paratype in the National Museum when re-examined is evidently, like the holotype and second paratype, an *atra* with abnormally slender abdomen. Abdomen 23 mm, hindwing 29 mm. It was collected in the Garamba National Park, Congo (Kinshasa).

Possibly it is a very local race but here it will be placed as a male form.

FEMALE

UGANDA: The female mentioned in the original description of *atra*, from Jinja (leg. Corbet) is undoubtedly this species. The most important features in the description were the black labrum, broad blue band on frons and the partially doubled row of yellow abdominal streaks. The size given was abdomen 20.5 mm, hindwing 26 mm.

No Jinja female is available for the present synopsis but the general description will be based on one from Sierra Leone, although this is probably atypical, perhaps even another (westerly) subspecies.

SIERRA LEONE: Old ♀ (Taima R., leg. A. Todd): Labium yellow with only a fine continuous black median line, not covering the posterior lobe; labrum yellow with large black inverted central triangle. Epistome yellowish with brown band on postclypeus. Frons above with shallow groove and broad metallic blue basal band, as wide as the distance between central and lateral ocelli. Vesicle metallic blue with ochreous anterior and posterior spots. Occiput black; back of orbit mainly black.

Synthorax ochreous with thickish brown markings and black spiracular band just contiguous. Sternal pattern with narrower black periphery than in male and no central marking. Traces of white ventral pruinosity.

Wings slightly fumose (with age); venation black. Pterostigma dark brown, between black veins. Hindwing with slight trace of basal amber in cubital space. Forewing with 11½–12½ Ax.

Abdomen thicker than in male, black with double row of yellow streaks on segments 4–6, single on 7–8. Cerci black. Ova broadly elliptical. Vulvar scale with shallow incision. (For bursa see subspecies *grouti*).

Abdomen 23 mm, hindwing 27 mm, pterostigma 3 mm.

ZAMBIA: Females from Ndola (leg. Pinhey) have a broadish median band on labium; labrum black with large yellow spots; postclypeus black in centre. Frontal band very broad, blue-black. Thoracic black thickly contiguous laterally (as in subspecies *grouti*); segments 4–7 with two rows of yellow streaks, 8 with one streak (a second in tenerals), 9 all black (or with minute trace in tenerals). A teneral from Mwinilunga has these markings fairly well developed: labium yellow; labrum with black T; frons and vesicle broadly blue-black. Wings somewhat fumose and marked with amber as in teneral *anomala*. Pterostigma pale brown. Tenerals may not always show the dorsal black on segments 4–5, which may not have developed at that stage.

SUBSPECIATION

All the above females (tentatively placed under the subspecies *atra* but perhaps including other races) are rather difficult to separate from female *nuptialis* except that they are smaller than *nuptialis* and their labrum is not entirely black. The vulvar scale has a shallow incision in both species. In the subspecies *grouti* (*infra*) the labrum is all black but, unlike *nuptialis*, the wing apices are distinctly brown. The males of both species are more easily separable on body colour and genitalia.

The variation in width of abdomen in male *atra atra* and the apparent tendency to tortology of cross-veins suggest that it is an unstable species, either in process of stabilization or of fission into other taxa, specific or subspecific.

Subspecies *atra grouti* Pinhey, **stat. nov.**

MALE

CAMEROONS (near Douala) ♂-holotype (mature): Labium black with obscure postlateral pale macula on lateral lobes; labrum black; anteclypeus with brown band; postclypeus more broadly black than in *atra atra*. Frons and vesicle typical. Back of orbit all black.

Pro- and synthorax all black; with some white ventral pruinosity. Legs all black.

Venation black; wing apices narrowly brown; pterostigma dark brown between black veins; no basal amber. Membranule dark grey. Forewing with 11½–12¼ Ax.

Abdomen and anal appendages almost all black, with faint traces of the yellow lateral streaks on the slender abdomen. Accessory genitalia typical but with slightly stronger development of the lip of the anterior lamina. Prophallus identical.

Size larger: abdomen 25.5 mm, hindwing 30 mm, pterostigma 3 mm.

A paratype male (same locality) has large yellow lateral spots on labium each nearly half the size of each lateral lobe. In another these maculae are only slightly smaller. Yet another is similar but smaller in size, hindwing 29 mm. A male from

dichroa

Kumba, Mount Cameroon, resembles the holotype; labium completely black. A male from Lomié (leg. P. Lascelles) has a small post-lateral yellow spot on labium; faint traces of narrow yellow streaks on abdomen. Two others from Lomié are similar.

S. NIGERIA: One from Benin has larger yellow labial patches like one of the paratypes; another is similar.

FEMALE

CAMEROONS (Douala) ♀-allotype: Labium yellow with broad black median band, as wide as the black posterior lobe. Labrum and epistome as in male but less black on postclypeus; frons and vesicle as in male but with very broad metallic blue (not violet) band, this band wider than in *atra* from Jinja or Sierra Leone.

Synthorax yellow, with very heavy black pattern as in the male figure; much more heavily marked than in the Sierra Leone female; sternal pattern also very black. Legs all black.

Wings with the apical brown fascia; trace of basal amber on hindwing in cubital and anal fields; and the postnodal zone of all wings is tinged with amber. Forewing with 11½–12½ Ax.

Abdomen heavily blackened and with yellow stripes as figured. Vulvar scale typical of *atra*.

Bursa with long, tapering, sclerotized dorsal sterigma and two partly folded ventral plates. Vulvar lip partly thickened. Rather like *werneri*.

Abdomen 24.5 mm, hindwing 30.2 mm, pterostigma 3 mm.

A female from Kumba (leg. Lascelles) has broader labial black; less basal amber. Segments 1–5 are like the allotype (but last five segments are lost). A very teneral female is from Bertoua. One from Abong-Mbang (leg. Lascelles) has a complete black postclypeal band. Wings with brown apices but amber base reduced to a cubital trace on hindwing.

CONGO: One from Mekoum Forest, Souanke, (Congo Brazzaville; T. H. E. Jackson) is similar.

From *atra atra*, *grouti* differs in its larger size, thicker abdomen; heavier black body markings and apical brown on wings.

DISTRIBUTION

atra atra (and other subspecies ?): Uganda, Congo (Kinshasa), Gabon, Angola, N.W. Zambia, Sierra Leone; and f. *leptosoma* from Garamba (N. Congo).

atra grouti: Southern Nigeria, Cameroons, Congo (Brazzaville).

HABITS

A forest species, near forest streams.

Trithemis dichroa Karsch, fig. 40 pl 8

Trithemis dichroa Karsch, 1893, *Berl. ent. Z.* **38:** 24 (Togo); Pinhey, 1962c: 270.
Trithemis serva Kirby, 1900, *Ann. Nag. nat. Hist.* **6:** 69, 70 (♂ Sierra Leone); Pinhey, 1962c: 270.

Type: ♂, ♀ *dichroa* in Berlin Museum, cotype ♂ in Hamburg Museum; ♂-lectotype *serva* (segments 7–10 lost) in British Museum (Nat. Hist.).

In the author's catalogue (Pinhey, 1962c) *serva* was placed in synonymy with *dichroa*, and Kimmins, who kindly sent a line-drawing of the accessory genitalia of the

lectotype, said it was placed under *dichroa* in the British Museum (Nat. Hist.) and he was convinced it is a synonym.

In accessory genitalia it is similar to typical *dichroa* but the genital lobe is a little more curved. Kirby's description was somewhat vaguely based on the characters of six males, collected by Austen in Sierra Leone. Kirby compared it with *festiva*. His description deviated from typical *dichroa* in three important features. The frons and vesicle were said to be metallic violet; the thorax pruinose blue; and the pterostigma was dark brown with a pale yellow line (unlike *dichroa*, but like *furva* in this respect). The forewing was said to have 11–13 Ax (the last Ax complete ?); 7–10 Px. The pterostigma was given as 2.5 mm long, but other dimensions were for total body length and total expanse.

Kimmins (in litt., Jan.-Feb. 1969) says the lectotype is larger than average *dichroa*; the frons is black with only the faintest violet sheen and the thorax is all black. He describes Kirby's description as "a little misleading". He also sent a camera lucida sketch of the prophallus of a *serva* paratype. This, again, is closely similar to *dichroa*.

It will therefore be accepted that *serva* is a synonym of *dichroa*. The larger size is not significant since the National Museum has a typical *dichroa* from the type region (Sierra Leone) which is of normal dimensions.

♂ *serva* body 34 mm, expanse 57 mm; Sierra Leone ♂ *dichroa* body 28 mm, expanse 52 mm; Sudan ♂ *dichroa* body 34 mm, expanse 58 mm.

The types of *dichroa* were from Bismarckburg (Togo) but the species is widely distributed in tropical West Africa and is one of the blackest species, easily distinguished from *atra* in the male by the black frons. Karsch described it as all shiny black on body and legs, with black pterostigma, brownish yellow abdominal markings. And despite its broadish abdomen he compared it not with any dark species but with the slender-bodied red *arteriosa*. He gave the dimensions as: abdomen 23 mm, hindwing 28 mm, pterostigma 3 mm.

MALE

NIGERIA (Vom) ♂ (mature, leg. Gambles): Labium and labrum all black; face in front dark greenish ochreous, postclypeus with lower margin blackish. Frons with moderate groove and entirely glossy black above; vesicle black with greenish ochre crest. Occipital triangle and back of orbit dark brownish, the latter with the usual black bands.

Prothorax black, with anterior lobe mainly ochreous; ochreous central spots on middle lobe. Synthorax heavily blackened even ventrally, without any pruinose blue or white areas but with traces, especially on mesepisternum, of a brown ground colour. Legs all black.

Venation blackish; pterostigma blackish brown without any pale line. Basal amber absent on forewing, on hindwing in cubital space only halfway to Cuq and on a few basal cells in anal field. Membranule pale grey. Forewing with 10½–11½ Ax. (11½–12½, in Karsch).

Abdomen broad; almost entirely black, with faint traces of a pale dorsolateral band. Anal appendages black. Accessory genitalia black, but somewhat of *arteriosa* form. Anterior lamina undivided, produced apically and with long apical hair-tuft. Hamular hook massive, with outer setae and sharp basal ridge. Genital lobe slender, tapering (rather like *furva*).

Prophallus deep. Two curved cornuti. Retinaculum with semicircular flap at base.

Figs 40-42. *Trithemis* species. 40. *T. dichroa*. a—Thorax (immature ♂, Mwinilunga). b–c. Prophallus. (Kotto R.). b—Left aspect. c—Ventrolateral. d—Abdomen (immature ♂, Mwinilunga). e—Genitalia (Vom). f—Vulvar lip (Mwinilunga). g—Bursa (Mwinilunga). h—Accessory genitalia (*serva* ♂-lectotype del. Kimmins). i—Prophallus (*serva* paratype, del. Kimmins). 41. *T. anomala*. a–e. Male (Mwinilunga). a—Prothorax. b—Synthorax. c—Abdomen. d—Accessory genitalia. e—Prophallus. f–g. Female (Mwinilunga). f—Vulvar lip. g—Bursa. 42. *T. aenea*. a–b. Synthorax. a—Male (paratype, Buta). b—Teneral (♂, Eala). c–d. Abdomen. c—Male (paratype, Buta). d—Teneral (♂, Eala). e—Genitalia (paratype, Buta). f—Prophallus (Buta). g—Bursa (Eala). h—Vulvar lip (Eala).

Abdomen 21 mm, hindwing 27.5 mm, pterostigma 3 mm.

A mature male from Ikom has the distolateral portion of the labium yellowish.

SUDAN: One from Jebel Marra (leg. Happold) has a smaller yellow trace on labium.

C.A.R.: A male from Kembe Falls (leg. Pinhey) has the labium yellow with broad black median band; but another has the labium all black.

SIERRA LEONE: In two from Farangbaia (leg. Todd), one has the labium all black, the other with a pale lateral spot.

E. ANGOLA: A specimen from Caianda (leg. Pinhey) has the labium all black.

ZAMBIA: A series of mature examples from Mwinilunga (leg. Pinhey) have the labium all black except one which has a yellowish lateral patch; in one the amber on hindwing is only a mere trace.

In a juvenile from Mwinilunga the labium is black with ochreous lateral patch, labrum all black; face and frons as at maturity but the frontal black not quite reaching the crest. Thorax ochreous, with thick black markings as in the figure; sternal pattern very black. Legs all black. Pterostigma blackish brown *with* fine yellow posterior line (cf. *furva*). Abdomen black with yellow lateral band as illustrated. Anal appendages black.

FEMALE

All females in the National Museum, Bulawayo, have brown wing-apices, sometimes prominently.

Karsch described the female from a large specimen, abdomen 25 mm, hindwing 31 mm, pterostigma 3 mm.

ZAMBIA (Mwinilunga, leg. Pinhey): Labium black with large round yellow fascia on lateral lobes; labrum black with two large yellow basal maculae. Face, frons and vesicle yellow; frons with broad black basal band, as wide as the distance between central and lateral ocelli. Vesicle with black periphery.

Synthorax yellow with black markings as in juvenile male. Legs black, fore femur yellow on inner surface (as in Karsch's description).

Venation variegated. Main veins black, cross-veins mostly brown, but subcostals, arculus and Cuq yellow. Pterostigma blackish with yellow posterior line, proximal cross-vein yellow. Amber marks as in male. Membranule grey. Wing tips slightly brown. Forewing with 9½–10½ Ax.

Abdomen broad, mainly yellow with black pattern as in immature male. Cerci black. Vulvar lip with deep U which is flat at the bottom.

Bursa with dorsal sterigma bifid, the arms broad and fanshaped as in *pluvialis*, *pruinata* and *furva*. Two small, folded ventral plates and two well chitinised anterior processes, partly twisted, ribbed outwardly. Lip well sclerotized.

Abdomen 20 mm, hindwing 28.5 mm, pterostigma 3.2 mm.

The size in Mwinilunga specimens varies: abdomen 19–21 mm, hindwing 25.5–30 mm. The labial black may be much narrower but it always covers the posterior lobe. Labral black may also be much less, just a trace on distal margin and a short disconnected central line; or T-shaped; or the distal margin may be yellow, with a short thick central bar; or all yellow except for a tiny central dot.

anomala

NIGERIA: A female from Vom (leg. Gambles) has large yellow lateral patches on labium; labral black T-shaped; antehumeral black disconnected, forming a free ellipse above the dorsal black spot on the humeral suture.

SUDAN: One from Jebel Marra (leg. Happold) has the labium yellow except a fine median line down posterior and lateral lobes; labrum with black T.

DISTRIBUTION

Sierra Leone eastwards to Nigeria, West Dafur and Golal (Jebel Marra), then southwards through Cameroons to Uganda, Congo and Zambia.

HABITS

A small dark species of forest or thick bush, quiet streams and pools.

MATERIAL EXAMINED

Sierra Leone, Nigeria, Sudan, Central African Republic, Zambia and East Angola.

Trithemis anomala Pinhey, fig. 41 p 108

Trithemis anomala Pinhey, 1956, *Occ. Pap. Corymbon Meml. Mus.* **4:** 38 (♂♀, Zambia); Pinhey 1962c: 269.

♂-Holotype, ♀-allotype in British Museum (Nat. Hist.).

Described from Lake Chila at Abercorn it has been found only in other parts of Zambia, although it must occur in Katanga and East Angola.

Like some of the red-bodied species, such as *arteriosa*, the male does not have the dorsum of the frons metallic but it has a black basal band.

MALE

ZAMBIA (Lake Chila, Abercorn) ♂ (nearly mature, leg. L. D. E. F. Vesey-Fitzgerald): Labium yellow, with narrow black median band on lateral lobes and the black does not completely cover the posterior lobe; labrum yellow with an inverted T, the stem thick. Face yellowish, frons orange with shallow groove and a black basal band as wide as the long diameter of the anterior ocellus. Vesicle and occipital triangle ochreous; back of orbit yellow with the usual black bars.

Thorax unusually hirsute. Prothorax blackish brown with dark groove behind the yellow anterior collar; middle lobe with ochreous central and lateral spots; posterior lobe normal. Synthorax greenish ochreous with faint dorsal marking, brown to black lateral and ventral fasciae as figured. Sternal pattern not well developed posteriorly. Legs black; fore femur with yellow inner stripe.

Wings faintly fumose (more strongly in other specimens), with black venation. Pterostigma pale brown between black veins. Basal amber absent on forewing, on hindwing pale amber in subcostal and cubital spaces as far as the first cross-veins. Membranule whitish. Forewing with 10½–11½ Ax.

Abdomen not very broad; black with two rows of yellow streaks, segment 9 with one small streak. Superior appendage yellowish with distal two-thirds black; inferior yellow with blackish margin. Anterior lamina a broad undivided hood with slight yellow projection at apex; hamule with small hook and outer setae; genital lobe with apical setae.

aenea

Prophallus with curved cornuti, with flagella and a very long, curved retinaculum.

Abdomen 23.5 mm, hindwing 29.5 mm, pterostigma 4 mm.

A male, more mature, from Mwinilunga (leg. Pinhey) has a broader labial band covering posterior lobe; blacker lateral marking on thorax; wings markedly fumose, with amber edgings to cells in anal field. Anal appendages slightly darker. Hindwing 31 mm. Other males show the fumosity developing on the wings with maturity; size variable, hindwing 29–31 mm. Segment 9 with the yellow macula always small, narrow or broad. In one of the immature examples, with almost clear hyaline wings, the forewing has faint traces of basal amber, on hindwing to beyond the first Ax and beyond Cuq. In juveniles the subcostal cross-veins are yellowish. Only in one immature specimen does the posterior lobe of the labium have a trace of yellow at the sides; labial, labral and corporal black markings are developed early. Mature males from Luwingu and Mporokoso (leg. R. C. Dening) are quite normal.

FEMALE

ZAMBIA (Mwinilunga, leg. Pinhey) ♀: Very like the male but with broader abdomen. Median black on labium narrower and with yellow lateral maculae on posterior lobe; labrum with narrower T; frons with narrower basal band, not as wide as the distance between central and lateral ocelli.

Thoracic pattern as in male; sternal pattern less blackened centrally and posteriorly.

Wings as in male; fumose. Forewing with 10½–12½ Ax.

Abdomen similarly marked but basal segments with narrower black and therefore larger yellow fasciae. Cerci black. Vulvar lip straight. Ova round-elliptical.

Bursa with dorsal sterigma fusiform, slightly curved posteriorly, expanded at base. Two angled ventral plates. Bursal arms slender. Lip nearly straight, well chitinised.

Abdomen 20.5 mm, hindwing 27.5 mm, pterostigma 3.8–4 mm.

As in the male the wings become more strongly fumose at maturity. Labium with posterior lobe sometimes all black. Older females have white ventral pruinosity. Hindwing 27–31 mm. In some mature females the cells in anal field and loop are amber-edged as in the males. A teneral female from Lake Chila (leg. Pinhey) has no black on labium *or* labrum, so that the black may not develop as early as in the male. Basal black on frons developed; also the thoracic and abdominal markings. Wings with amber tint in costal, subcostal and cubital zones; more strongly, however, in the usual positions on hindwing. Pterostigma paler.

Evidently in females the body markings develop early, the lip markings late.

DISTRIBUTION

So far known only from the northern areas of Zambia.

HABITS

Open swamps, reedy pools.

Trithemis aenea Pinhey, fig. 42 p 108

Trithemis aenea Pinhey, 1961, *Entomologist's mon. Mag.* **96:** 270 (Congo).

♂-Holotype in National Museum, Bulawayo.

Described from the Congo (Kinshasa) this has since been collected by Peter Lascelles in the Cameroons during the Oxford University Expedition. It is a large

species, somewhat like *atra grouti* but not so heavily black and the male has the frons *bronze* at maturity instead of metallic purplish. The probable female is described in this revision. It has a different vulvar lip to *atra*.

MALE

Congo (Kinshasa) (Buta) ♂-holotype (mature, leg. Pinhey): Labium with broad black median band, as wide as the posterior lobe (which it covers), spreading at anterior end along margins of lateral lobes. Labrum black. Face ochreous; brown central band on postclypeus. Frontal groove moderate, the frons above and the vesicle bronze. Occipital triangle blackish; back of orbit black with small yellow spots.

Prothorax blackish brown, with yellow collar. Synthorax ferruginous brown with sparsely discernible deeper markings: mesepisternal marking obliterated; upper spot on humeral suture; brown band from mesinfraepisternum crossing the lateral plates somewhat like the much blacker markings of *atra grouti*, the only blackish band being on the lower half of the first lateral suture as far as the spiracle. Sternal pattern not thick posteriorly, nor in the middle; with slight white pruinosity. Legs black, fore femur ochreous interiorly.

Venation black; wing apices brown (more strongly so in paratypes and others); pterostigma brown, between black veins. Only the faintest trace of basal amber on hindwing. Membranule dark grey. Forewing with 13¼ Ax.

Abdomen moderately broad, black with yellow fasciae in two rows of fine streaks on segments 4–7; 8 with minute dash; 9–10 and anal appendages black. Accessory genitalia rather like *atra*. Apex of anterior lamina produced; hamule robust, the hook directed posteriad; with outer setae. Genital lobe with long yellow apical setae.

Prophallus with flagella; retinaculum as long as these and with broad basal flap.

Abdomen 27 mm, hindwing 33 mm, pterostigma 4 mm.

In a paratype from Buta, abdomen 26.5 mm, hindwing 32 mm, there is a trace of basal amber in hindwing on one or two cells in anal field; yellow dash on segment 8 thicker in another paratype. The apical brown on the wings is slightly variable in extent. A male from Uele River (leg. Pinhey) is possibly slightly less mature since the anal appendages are brown; no basal amber. A very teneral male from Eala (labelled *nuptialis* by Fraser) has the labial and labral black fully developed as well as the bronze on the frons. Synthorax with brown mid-dorsal band and broken yellow antehumeral stripe. Abdominal yellow fasciae more distinct than in type series.

Cameroons: A series from Abong-Mbang (leg. Lascelles) resembles the Buta series but in one the labial black is very slightly narrower and does not extend along anterior borders of lateral lobes.

FEMALE

The following are probably the unknown females.

Congo (Eala): Lips and face as in Buta male. Frons above with steely blue-black basal band, narrower than the distance between central and lateral ocelli. Vesicle ferruginous, blackish around the base.

Synthorax more greenish ochreous with ferruginous bands, patterned more or less like the teneral male figure; these bands blackened in positions as in the illustrated Buta male. Sternal pattern similar. Legs black, fore femur yellow on interior surface.

falconis

Wings brown at apices, without basal amber but fumose in the postnodal cross-vein zone. Pterostigma blackish brown. Forewing with 13¼ Px.

Abdomen scarcely thicker than in males from Buta and patterned very similarly. Cerci black. Vulvar lip straight (unlike *atra*).

Bursa with dorsal sterigma very solid, thick, curved anteriorly, somewhat uncinate. Two angled rods subtended from rounded lobes form the ventral plates. Lip nearly straight thick, well chitinised.

Abdomen 26 mm, hindwing 31 mm.

Another female from Etoumbi Forest (Congo, Brazzaville; Jackson) may also be this species. Face and lips as in Buta males; frons above with steely blue basal band; vesicle ferruginous, black at base. Thorax and abdomen very like the Eala female and the vulvar scale similar. Size approximately the same.

DISTRIBUTION

Congo (Kinshasa and Brazzaville); Cameroons; and Liberia (teste Lieftinck 22 November 1968).

HABITS

Streams in equatorial forests.

Trithemis falconis spec. nov., fig. 43 p 114

♂-Holotype, ♀-allotype in National Museum, Bulawayo.

This species, discovered by the author on and near the ramifying, reedy diverticula of the Khwaai River, about 80 miles north of Maun, Botswana, in December 1968, was at first mistaken for larger juveniles of the blue-bodied *hecate* which is plentiful from Maun northwards. The expedition was sponsored by Falcon College, under the organization and leadership of John Stakesby Lewis, the author being invited as entomological leader. The new species is dedicated to Falcon College, Matabeleland.

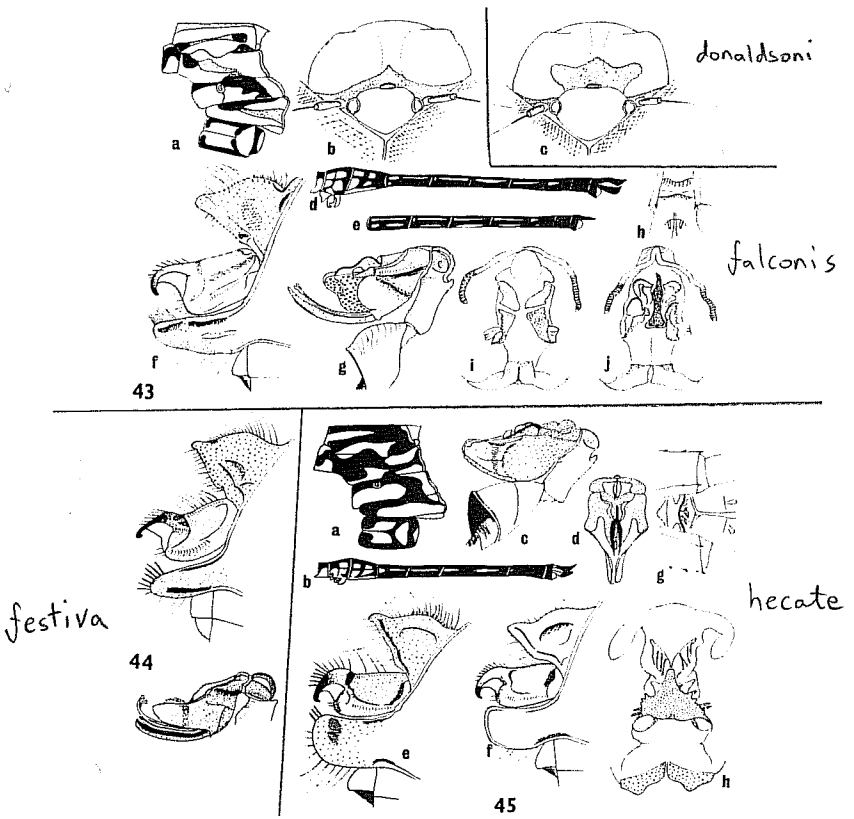
The area is part of the Okavango swamp system. Examples of the species when examined by a lens exhibited a higher antenodal index than *hecate* and it was not until the last day in camp that it was realized that it was quite distinct from other species. A few hurriedly collected at the last moment were destroyed by ants but two specimens of each sex were saved.

MALE

Botswana (Khwaai R. camp, 11 December 1968, leg. Pinhey) ♂-holotype (mature): Labium ochreous yellow with only a fine brown line down posterior lobe and inner margins of lateral lobes. Labrum mainly black, ochreous at lateral corners. Face yellowish, a short black central streak on lower margin of postclypeus. Frons with shallow groove; frons above and vesicle purple with some reddish reflections. Occipital triangle reddish brown, posteriorly with two black-framed yellow spots. Orbits yellow with thick black bands.

Prothorax reddish brown with diffuse black markings, the anterior collar yellow, with black groove posteriorly. Synthorax brownish with some thin reddish violet pruinosity dorsally; laterally greenish ochreous; the dark bands, as in the figure, obscure, partly black near sutures, not strongly developed and almost disconnected. Sternal black very narrow and incomplete. Legs black, fore femur yellowish interiorly.

Wings hyaline, venation black, basal antenodals pale reddish. Pterostigma pale brown, between thick black longitudinal veins and black cross-veins. Hindwing



Figs 43–45. *Trithemis* species. 43. *T. falconis* (N. Okavango). a—Synthorax (♂-holotype). b–c. Head, dorsal, to show basal band on frons of b—♀-allotype, and c—*T. donaldsoni* (♀). d—Abdomen (♂-holotype). e—Abdomen (♀-allotype). f—Genitalia (♂-holotype). g—Prophallus (♂-holotype). h—Vulvar lip (paratype). i–j. Bursa. i—Ventral. j—Dorsal. 44. *T. festiva*, accessory genitalia and prophallus (♂, Orient). 45. *T. hecate*. a—Synthorax (♂, Samfya). b—Abdomen (teneral ♂, Salisbury). c–d. Prophallus (Tananarive). e—Accessory genitalia (Tananarive). f—The same (Ugalla R.). g—Vulvar lip (Lake Dow). h—Bursa (Ndola).

with amber basal traces subcostally and medially; in cubital space halfway to Cuq; halfway along membranule in anal field. Membranule pale brownish grey. Forewing with 10½ Ax, 7 and 9 Px.

Abdomen very slender, black with yellow markings as figured. Segments 4–7 with single yellow streaks, 8 with basal triangle; segments 9–10 and anal appendages all black. Anterior lamina black, rounded, scarcely produced apically, rising to a peak and shaped as in *hecate*; with few short outer spines. Hamule with larger hook than in *hecate* but poorly sclerotized; with short outer setae. Genital lobe broadish but irregularly narrowed apically, very black, with dense inner apical setae.

Prophallus without distinct cornuti, but with flagella: opposite in characters to *hecate* which has cornuti but no flagella. Retinaculum as long as flagella.

Abdomen 28 mm, hindwing 32 mm, pterostigma 3 mm.

A paratype male differs only in facial markings, the labium with the thin central line blacker, labrum ochreous with rectangular black central fascia; frons above bronze-black with violet sheen. Hindwing 33 mm. Forewing with 11½ Ax. In another the labium is similar, the labrum as in the holotype but with black lateral dots as well as the central band. Frons with violet sheen. Forewing with 10½ Ax.

FEMALE

Botswana (Khwaai R., 10 December 1968) ♀-allotype: Labium also with linear brown central line; labrum yellow with squarish black central spot on lower margin; postclypeus and face all yellow; frons with shallow groove and dark violet-black basal band, continuous down sides, slightly narrower than the distance between central and lateral ocelli. Vesicle yellow with black anterior and lateral markings around the ocelli. Occipital triangle ferruginous, yellow posteriorly. Orbit with narrower black than in male.

Synthorax pale yellow with the lateral black stripes contiguous. Sternal pattern as in male. A slight dusting of white pruinosity. Fore and mid femora yellowish interiorly with white pruinosity.

Wings as in male but forewing also with faint amber basal traces. Forewing with 10½ Ax.

Abdomen slender, black, with double row of yellow streaks on segments 4–8; 9 with minute basal dot; segment 10 and cerci all black. Vulvar scale with shallow lip.

Bursa quite different from *hecate*. Dorsal sterigma slender, slightly expanded in middle, acute and down-turned apically. Two pairs of ventral sterigmata, both very irregular, curled, and seen better in ventral view. Bursal arms long and slender with spiral coils in distal portions, suggestive of further lengthening of the arms.

Abdomen 27.5 mm, hindwing 32 mm, pterostigma 3.3 mm.

♀-Paratype (Khwaai R., 13 December) (damaged by ants): Very similar. Labrum with narrow brown central bar (labium lost); forewing with 10½ Ax, hindwing 31.5 mm.

This species is rather close to *hecate* but has much thinner pruinosity in the mature male, less black on labium, thinner and much less complete dark bands on thorax; abdomen with larger yellow triangle on segment 8 (like *nuptialis*); larger hamular hook, less chitinised; genital lobe more like *nuptialis*.

From *nuptialis* it differs in the much thinner male pruinosity; the much thinner black thoracic and other markings and in the weaker hamules.

The female *falconis* is in nearly all characters so similar to female *donaldsoni* that the only way to separate them without examining the bursa is on the frontal black band as in the figure. This is continuous and narrow in *falconis*, discontinuous at sides and

festiva

broad in *donaldsoni*. The male is, of course, easily separated from *donaldsoni* on accessory genitalia and other features.

DISTRIBUTION

So far only known from the Khwaai River in Northern Botswana.

HABITS

Settles on reeds or sedges in streams or on low vegetation away from the banks Both sexes were seen on such perches.

Trithemis festiva (Rambur), fig. 44 p114

Libellula festiva Rambur, 1842, *Ins. Névroptères:* 92.
Trithemis festiva Brauer, 1868, *Verh. zool.-bot. Ges., Wien* **18:** 736; Ris, 1912: 761, 796; Fraser, 1936: 387; Pinhey, 1962c: 274.
Libellula infernalis Brauer, 1865, *Verh. zool.-bot. Ges. Wien.* **15:** 507.
Trithemis proserpina Selys, 1878, *Mitt. Mus. Dresden:* 294, 314.

Type ♀ *festiva* in Selys collection, Bruxelles Museum.

Although not recognised as an Ethiopian species it was recorded by Martin (1908: 661) from French Guinea. This may have been either an error of locality or of identification but to make this revision as complete as possible it is briefly included here under the African fauna. Martin, moreover, also named a male from Harrar (Ethiopia) as this species (teste Ris, 1912: 798). It seems possible that Martin confused this Oriental species with the "*distanti*" complex which was not unravelled until 1936 (Longfield).

MALE

India (Coimbatore) ♂: Labium black with small yellow spot on lateral lobe; labrum black; face greenish ochreous; postclypeus with brown band on lower margin; frons and vesicle violet; occipital triangle black.

Synthorax greenish with black bands heavily marked; mesepisterna coated with thin dark blue pruinosity. Sternal pattern well developed, thickly black anteriorly, narrowly marked centrally. Legs black.

Venation black; pterostigma brown between black veins; hindwing with dark amber at base of subcostal field, in cubital space to Cuq and on basal cells of anal field. Membranule pale grey. Forewing with 11½–12½ Ax.

Abdomen moderately slender, the basal segments broadly banded with black; the rest black with single row of short yellow streaks on segments 4–7; 8–10 and anal appendages all black. Anterior lamina rounded, slightly produced at apex; hamular hook slender, with few outer setae; genital lobe narrowish with long apical setae.

Prophallus with flagella but no cornuti.

Abdomen 22.5 mm, hindwing 29.5 mm, pterostigma 2.5–3 mm.

Fraser (1936) described the labrum as olivaceous brown or black and brown; the anteclypeus black, the postclypeus dark olivaceous brown. It seems to the present author unusual to find the anteclypeus darker than the postclypeus. The forewing can have only 10½ Ax; size ranges from abdomen 22–28 mm, hindwing 26–32 mm.

In juvenile males and in females the abdomen is black with yellow streaks, segments 9–10 all black.

No female was available for study.

hecate

DISTRIBUTION

India, Pakistan, Ceylon, Burmah and South East Asia.

HABITS

Not known to the author.

MATERIAL EXAMINED

Only one male from Coimbatore, India.

Trithemis hecate Ris, fig. 45 p114

Libellula hova Selys, 1869, in Pollen et van Dam, *Rech. Faune Madag. Ins.* **25:** 17 (Madagascar).
Trithemis hecate Ris, 1912, *Coll. Zool. Selys* **14:** 787 (Madagascar); Pinhey, 1962c: 271.
Trithemis aureola Ris, 1912, *Coll. Zool. Selys* **14:** 788 (Madagascar; Dakar, Delagoa Bay) (nom. nov. pro *hova* Selys, nec Rambur, 1842).

Types: *hova* (Selys) at Oxford University; *hecate* ♂ in Paris Museum.

The above synonymy has previously been recorded (Pinhey, 1962c: 271) but some explanation is necessary. Rambur's *hova* is now in the genus *Zygonyx* Hagen-Selys. Although Ris described *hecate* and then renamed *hova* (Selys) on the following page as *aureola* he was certainly dubious whether the latter was specifically distinct: "Die spezifische Verschiedenheit von *hecate* und *aureola* ist problematisch und bedarf der Bestätigung durch reichlicheres Material". In the National Museum, Bulawayo, there are long series from continental Africa as well as some examples from Madagascar and there are indications of transitional characters between *hecate* and *aureola*.

One important feature of this species, differing from all other known African *Trithemis* species, is the low nodal index, with only 8½–9½ Ax in the forewing. In fact, in the field this is a simple diagnostic feature in the dark, slender-bodied species. Being few in number the antenodals are spaced out and easy to count with a low power lens.

The differential characters of *hecate* and *aureola* can be discussed before descriptions of examples.

1. Labium in *hecate* "schwarz mit ziemlich schmal gelben Seiten", and in *aureola* "gelb in der mitte breit schwarz". The black is in fact very variable in extent.
2. Thorax in *hecate* dark violet blue, in *aureola* blackish brown with yellow markings. This appears to be only a question of age, the male *hecate* being mature (and called an adult by Ris), the male *aureola* obviously being described from a specimen with fasciae not obscured by pruinosity and not fully adult. Several stages in such development are apparent in the National Museum collection.
3. Abdomen of *hecate* was described as very slender, like *basilineta*, but somewhat fusiform in *aureola*. It is, in fact, normally slender, but in some continental males there is a slight expansion on the distal segments due, however, to less contraction on the sternites.
4. Hamular hook rather weaker in *hecate*, not reaching beyond posterior lobe as in *aureola*. This could also be partly due to age, the hook and its setae less developed in some than in others; partly to size, the larger individuals tending to have more robust hamules; and partly the extensibility of the hamule from its base is at least to some extent adjustable in *Libellulidae*. The posterior lobes are fixtures being ventral extensions of the tergites of segment 2, whereas the hamules are rooted ventrally to the sternal margins. They have to move sideways, up or down during the coitional stages.

5. Pterostigma brown with black veins in *hecate*, but yellow with black veins in *aureola*. In most available examples the pterostigma changes with age from yellow to yellowish brown and later the black or brown of the anterior edge encroaches on the yellowish colour. In none of these specimens is the pterostigma uniformly dark.
6. Base of forewing hyaline in *hecate*, but with a gold trace in *aureola*. An example from Botswana and one from Madagascar have traces on the forewing. Most, however, only have amber on the hindwing.
7. Hindwing in *hecate* with "tief schwarzbraunen Fleck", in *aureola* with golden patch. The basal amber is very variable in extent on the hindwing, sometimes a trace, sometimes reaching the end of the membranule; dark or pale in tone.

In general these main features are either variable or merely age criteria. There seems to be no difference in accessory genitalia.

MALE

Extracts from original descriptions:

hecate Ris (Madagascar) labium black with small yellow lateral macula; labrum black. Epistome with blackish median band. Frons and vesicle dark metallic violet.

Thorax dark violet-blue. Legs black.

Wings suffused with pale yellow; base of forewing hyaline, of hindwing with blackish brown fascia in Sc one third to first Ax, trace in median space, in cubital to Cuq and in anal field to end of membranule. Pterostigma brown, between black veins; membranule black. Forewing with 8½–9½ Ax.

Abdomen very slender, black. Dorsum of segments 1–3 bluish pruinose; with small yellow dorsal and lateral spots; 6–7 with evanescent streaks. Accessory genitalia like *aureola* but the hamular hook weaker and not reaching beyond the genital lobe.

Abdomen 31 mm, hindwing 33 mm, pterostigma more than 3 mm.

aureola Ris differs from this description in the following respects: labium yellow, broadly black in middle.

Thorax blackish brown with yellow, rather parallel-sided antehumeral stripes, very narrow dorsally. Sides yellow with three black stripes.

Forewing with amber basal trace; hindwing with similar fascia but strongly amber. Pterostigma yellow, between black veins.

Forewing with 8½ Ax.

Abdomen slender, somewhat spindle-shaped. Segment 4 with a yellow spot and a line; 5–7 with finer lines, 8 with a dot. Hamular hook reaching beyond posterior lobe.

Madagascar:

Abdomen 31 mm, hindwing 32 mm, pterostigma less than 3 mm.

Dakar and Delagoa Bay:

Abdomen 27 mm, hindwing 28 mm, pterostigma less than 3 mm.

Details from National Museum collection:

MADAGASCAR (Tananarive) ♂ (mature): Labium yellow with black median band as wide as the posterior lobe and expanded along anterior margins of lateral lobes. Labrum black. Face ochreous, postclypeus mainly brown with black central bar. Frontal groove shallow. Frons above and vesicle dark metallic violet. Occipital triangle blackish, yellow posteriorly. Orbits black with yellow spots.

Prothorax dark, with blue pruinosity. Synthorax ferruginous, suffused dorsally with dark blue pruinescence; less so at sides, where the black bands are discernible on the lateral sutures. Sternal black thin but complete. Legs black.

Wings somewhat fumose; venation black. Pterostigma yellowish brown edged broadly with black anteriorly; between black veins. Forewing with traces of basal amber in cubital and anal fields; in hindwing with dark amber in subcostal and medial spaces, in cubital to Cuq and in anal field to end of membranule. Membranule dark grey. Forewing with 8½–9½ Ax.

Abdomen uniformly slender, except the basal segments; black with yellow spots on basal segments; segments 4–7 with single row of narrow yellow streaks; 8–10 and anal appendages all black. Anterior lamina thin-walled, rounded, produced apically, with outer hair and short, thick setae. Hamular hook short but robust, with longish outer setae; genital lobe very broad, reaching (in this example) to end of hamule and having a few apical setae.

Prophallus with cornuti but no flagella.

Abdomen 32 mm, hindwing 33 mm, pterostigma 3 mm.

Another Tananarive male is similar but smaller, the hindwing 30.5 mm.

TANZANIA: One from Ugalla River (leg. P. Bally) has the fore femur yellowish on inner surface and pruinose; venation dark reddish brown; wings hyaline, not fumose, the pterostigma yellowish brown; no amber on forewing; on hindwing with amber fascia reaching nearly to end of membranule. Nodal index similar. Streaks on segments 4–7 rather thicker. Anal appendages dark brown. Accessory genitalia less robust and not so heavily chitinised. Hindwing 31 mm. Despite thoracic pruinosity it is probably not quite mature. Another male is similar but the basal fascia on hindwing is dark brownish amber.

ZAMBIA: An older male from Abercorn has fumose wings, stronger pruinosity on thorax, the foreleg all dark. Pterostigma dark yellowish brown; slight amber traces on forewing as well as the fascia on hindwing; but the venation is reddish brown in anterior zones (as in the Ugalla R. examples). Another from Abercorn is smaller, with broader black on the labium; thoracic lateral bands broader and anastomosing more strongly. Forewing with 8½ Ax. No basal amber on forewing, but normally developed on hindwing. Abdomen slender, normal. Accessory genitalia all well chitinised. Hindwing only 27.5 mm. A Samfya example resembles the first Abercorn one. Another is less mature, without thoracic pruinosity and so the fasciae are clear, as in the figure. Yet the abdomen, after the basal segments, is very black, with only a small yellow streak on segment 7, none on 5–6. One from Shasheki (Zambezi River) is heavily pruinosed on thorax, the wings hyaline (not fumose); venation partly reddish. Hamular hook not reaching beyond the posterior lobe.

In all the Zambia and other continental examples the anterior lamina is devoid of the minute outer setae seen in the Madagascar males.

BOTSWANA: One from Chobe River is like Zambian males, well pruinosed, but the bases of the anal appendages are yellowish red, not black. Foreleg all black. Venation anteriorly brownish yellow. Examples from the Maun region and northwards to the Khwaai River are essentially similar, but the anal appendages are almost all black, except in tenerals. Prophallus as in the Madagascar example mentioned. In a long series from this region only three out of fifteen males had 9 Ax in forewing, the rest all had 8 Ax.

RHODESIA: A mature pruinosed male from Salisbury also has the reddish venation; black foreleg; abdomen with well developed streaks; hamule not heavily sclerotized; anal appendages all black. Very teneral Salisbury males have the labial pattern developed but dark brown; labrum brown with yellow base. Frons metallic brown. Thoracic fasciae well developed. Foreleg all brown. Pterostigma very pale yellow; hindwing amber developed at base; venation reddish. Segments 4–10 very black with narrow streaks. Superior appendage all brown, inferior mainly yellow.

SUBSPECIATION

From a study of males in this and other descriptions it seems probable that the Madagascar examples of *aureola* (= *hova* Selys) were immature *hecate*.

It is possible that continental African specimens, including some of Ris' examples (under *aureola*) may represent a different subspecies distinguishable on three features:

Venation in anterior zones of wings reddish or reddish yellow, not black; anterior lamina lacking the short, thick outer spines; genital lobe has only a few sparse apical hairs, whilst in Madagascar specimens there are these hairs and anterior-apical setae.

FEMALE

MADAGASCAR (Tananarive): Labium yellow with black median band as in male. Labrum yellow with broad black anterior margin and minute brown centrobasal dot. Face and frons yellow, the frontal groove shallow, a blue-black basal band narrower than the distance between central and lateral ocelli.

Synthorax ochreous with fasciae as in male but the dorsal ones faint. Fore femur yellow on interior surface.

Wings hyaline, venation reddish; pterostigma as in male. Forewing without basal amber, hindwing as in male. Forewing with 8½ Ax.

Abdomen more cylindrical than in male but very similar in markings. Hindwing 31 mm.

TANZANIA: A female from Ugalla River has lips and entire face plain whitish yellow. It is somewhat juvenile but not really teneral. The lack of black on the lips suggests not so much immaturity as a possibly pale variant. Frons with blue-black basal band, vesicle mainly yellowish.

Thorax with faint dorsal markings overlaid with thin pruinosity. Legs as in the Madagascar female.

Anterior veins pale reddish brown; pterostigma yellow, between black veins. Forewing with trace of basal amber on one cell in anal field; hindwing with normal amber. Forewing with 8½ Ax.

Basal segments of abdomen with narrow black lines; 4–7 with single row of streaks; 8 with small yellow basal triangle; segments 9–10 black; cerci dark brown with yellow basal spot. Vulvar lip U-shaped.

Abdomen 26 mm, hindwing 29 mm, pterostigma 2.8 mm.

ZAMBIA: An Ndola female has the typical broad black labial band; labral black with two yellow basal spots; face yellow, postclypeus with two black triangles on lower margin. Frons with broader basal band, as wide as distance between central and lateral ocelli. Venation reddish brown. Cerci all black. Vulvar lip also U-shaped. Ova broadly elliptical. Another from Ndola has the labrum yellow with broad black distal band;

nuptialis

forewing has basal amber in cubital and anal areas. A teneral Samfya female has the labial fascia developed but brown; labrum black with two yellow basal dots. Thorax and base of abdomen strongly yellow without pruinosity. the black markings well developed. Abdomen with the usual markings. Bursa (Ndola female): dorsal sterigma solid, very broad posteriorly; laterally with irregular dentate margin below which are a few digitate processes. Anteriorly there are two divergent ribbed branches; ventral plates small, folded. Bursal arms slender. Lip more invaginated than in a Botswana example (Lake Dow).

BOTSWANA: A mature pruinosed female from Maun has the labial black constricted at anterior end and the posterior lobe is all yellow except at posterior end where it is brown; labrum yellow with broad-stemmed T. As in the males the forewing normally has only 8½ Ax, rarely 9. One from Lake Dow has the same lip markings. Perhaps these represent a local Botswana palustrine form of female.

RHODESIA: A slightly juvenile example from Salisbury has narrowed labial fascia which, on posterior lobe, forms a narrow central band; labrum yellow with narrow black distal marginal band. A teneral example has the labial fascia brown and narrowed, and reduced on posterior lobe to a brown posterior spot; labrum, face in front and occiput all yellow. Pterostigma whitish yellow. Another may be even younger, the labium being all yellow. In both these tenerals the black on thorax and abdomen is well developed, the abdomen black with single row of streaks on 4–8. Cercus brown with yellow basal dot. A female from Banket is juvenile but not teneral. Labium with very narrow black band on lateral lobes and two narrow brown stripes on posterior lobe. Labrum yellow with black T. Postclypeus with two dark triangles.

SUBSPECIATION

It is evident that both males and females are variable, and like the continental males the females have reddish anterior veins. This again suggests that the continental series represents a subspecies separate from Madagascar ones but without examining longer Malagassian series it does not seem advisable to name these as races. If sufficient material is seen from Madagascar it may even prove possible that *hecate* and *aureola* are two Madagascar races, and the continental one is a third.

DISTRIBUTION

South Africa, Botswana, Rhodesia, Mozambique, Zambia, Tanzania, Congo (Kinshasa), Uganda, Cameroons, Tchad, Guinea, Senegal (Mali) and Madagascar.

HABITS

The continental form (or race) prefers reedy pools and swamps or quietly flowing reedy streams. It settles on reeds, sedges and grasses growing in the water.

MATERIAL EXAMINED

From Madagascar, Tanzania, Zambia, Botswana and Rhodesia.

Trithemis nuptialis Karsch, fig. 46 p124

Trithemis nuptialis Karsch, 1894, *Berl. ent. Z.* **39:** 12 (♂, Cameroons); Pinhey, 1962c: 272.

A male in Berlin Museum, examined by the present author, is evidently the type but it has not been labelled so. It is mature, blue on thorax and base of abdomen. Labrum all black; frons and vesicle dark violet; abdomen with one row of yellow streaks.

It is a widespread tropical species, the mature male palish blue with slender abdomen and small hamular hook. Ris considered it was probably the western race of *stictica*, but this is evidently not the case. Apart from distinguishing features their distribution overlaps in Zambia and Katanga.

MALE

Cameroons (Yaoundé, leg. Lascelles) ♂ (mature): Labium black with small yellow lateral spots on lateral lobe; labrum black; anteclypeus pale ochreous; postclypeus black with very small yellow lateral spots. Frons black except for an anterior-lateral yellow spot; dorsally metallic violet, with shallow groove; vesicle metallic violet. Occipital triangle black; orbits very black, with minute yellow dots.

Prothorax all dull black except a fine yellow anterior margin on the collar. Synthorax entirely palish blue pruinose. Legs all black.

Wings hyaline, venation black. Pterostigma dark brown to black, between black veins. No basal amber. Very slight infuscation at wing apices. Membranule dark grey. Forewing with 11½ Ax.

Abdomen pruinose blue on segments 1–3; the remainder very slender, black; with single row of very fine yellow streaks on segments 4–8; 9–10 and anal appendages all black. Accessory genitalia all black, well chitinised. Anterior lamina rounded, produced apically. Hamular hook moderate, with outer setae. Genital lobe with broad base, narrowing distally and with long apical setae.

Prophallus with elongate glans, curved cornuti, long flagella and retinaculum.

Abdomen 27 mm, hindwing 30.5 mm, pterostigma 3 mm.

Other Yaoundé or Abong-Mbang males are similar or the yellow labial patch may be somewhat larger. A male from between N'Kongsamba and Douala (leg. Pinhey) has the labial black narrower, the lateral lobes mainly yellow.

Gabon: One from Lastoursville (leg. Rougeot) has rather fumose wings and the labial yellow very large (like the Douala specimen).

C.A.R.: A male from Boukoko (Central African Republic) also has broad yellow on labium; a small specimen, hindwing 29 mm.

Congo (Brazzaville): Another from Ketta Forest has only a very small yellow anterior lateral spot on labium. Apical infuscation may be present or absent in these or from the other localities.

Uganda: An example from Kampala (leg. Pinhey) has somewhat fumose wings and a large yellow macula on the labium. Another is similar, with a little more lateral yellow on front of frons; yellow spots on orbits larger.

Congo (Kinshasa): Some from Paulis (leg. Pinhey) have broad yellow on labium and wider anterior yellow on frons; size variable, hindwing 26–31 mm. One from Teturi and another from Buta (leg. Pinhey) are similar; also one from Uele River. One from Lubumbashi (Elisabethville) has broad labial yellow and both postclypeus and front of frons are broadly yellow at sides.

Zambia: Examples from Chingola, Mwinilunga and Ndola (leg. Pinhey) are essentially like the Lubumbashi specimen, the pterostigma sometimes paler, sometimes dark brown; size, again, variable. Some Ndola and Chingola males are juvenile. Thorax not pruinose but yellow with heavy black, broadly contiguous bands; basal segments of abdomen with yellow spots. Sternal black thick except in middle.

FEMALE

Very similar to *stictica* and *atra*.

Uganda (Kampala, leg. Pinhey): Labium yellow, with black median band covering the posterior lobe, then narrowed slightly, widened again at anterior end along edge of lateral lobe; labrum black. Face and frons yellow. Postclypeus with irregular brown central smear on lower margin. Frontal groove shallow, with blue-black basal band as wide as distance between central and lateral ocelli. Vesicle ochreous, blue-black in front and laterally.

Synthorax yellow with thick dark brown bands as in the juvenile male, the ventral ends of the sutural bands black. Sternal black incomplete posteriorly and centrally. Legs black, fore femur yellow interiorly.

Wings rather broadly rounded at apices; venation nearly black; pterostigma brown between black veins. Very faint apical infuscation. Pale basal amber on all wings in subcostal and cubital spaces to first cross-veins. Forewing with 9½–10½ Ax.

Abdomen with basal segments as in male; segments 4–7, however, with two rows of yellow streaks instead of one; 8 with one streak; 9–10 and cerci black. Vulvar lip with a very shallow U, not much thickened.

Bursa with dorsal sterigma simple, very like *atra*, tapering anteriorly; two ventral folds. Lip moderately thick.

Abdomen 26.5 mm, hindwing 29 mm, pterostigma 3.8 mm.

An immature female from Katera, Western Uganda, has only linear black on posterior and lateral lobes of labium. Labrum, however, all black; postclypeus with central brown complete. Wings narrow at apices. Basal amber absent on forewing, on hindwing with traces in subcostal and cubital spaces and in anal field.

Cameroons: A female with pale apical browning on wings; segment 8 with two fine streaks; abdomen 27 mm, hindwing 35 mm.

Zambia: Ndola specimens have the labial band and the all-black labrum as in the Kampala specimen; but with a broad black central bar on postclypeus. Vesicle only reddish on crest. Wing apices not broad; wing bases pale amber. One from Ndola has a narrower labial band, the posterior lobe with yellow lateral spots. Occiput blackish above, yellow posteriorly. It is evidently an aged female because the thorax has pale blue dorsal pruinosity, more thinly laterally and ventrally; also on inter-alar sinuses. Forewing without basal amber; hindwing only with subcostal and cubital traces.

It is possible that the broad apices of the Kampala female exhibit a racial difference, but it might be individual abnormality.

DISTRIBUTION

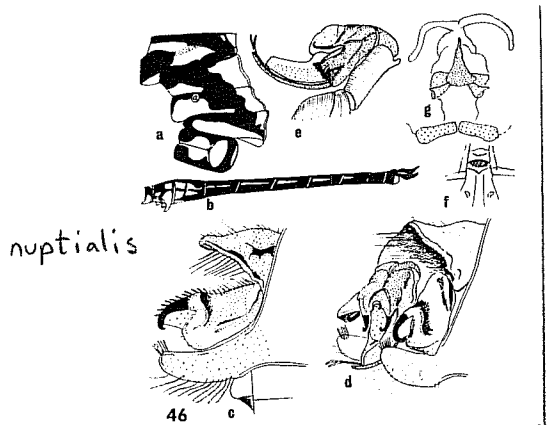
Zambia and Angola northwards through the Congos, eastwards only as far as the western half of Uganda, to Cameroons, Gabon, Nigeria and westwards to Liberia and Sierra Leone.

HABITS

Normally a species of heavy forests, probably breeding in slow forest streams. In some equatorial forests it is a dominant *Trithemis*. In Zambia it occurs in thick bush or on forest streams.

MATERIAL

Zambia, Congo (Kinshasa and Brazzaville), Gabon, Uganda, Central African Republic and Cameroons.



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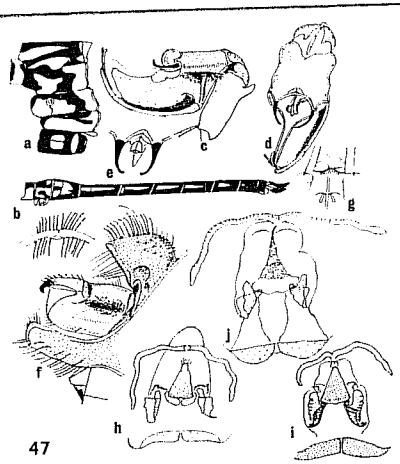
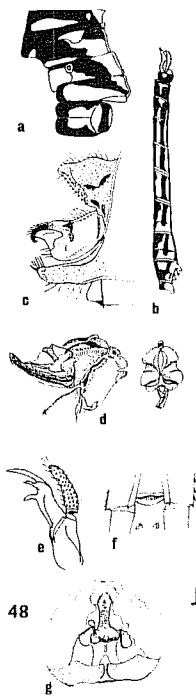


stictica



fumosa

stictica

Trithemis stictica (Burmeister), fig. 47

Libellula stictica Burmeister, 1839, *Handb. Ent.* **2:** 850 (Port Natal).
Trithemis parasticta Pinhey, 1955, *Occ. Pap. Coryndon Meml. Mus.* **4:** 35 (♂♀, Abercorn) **syn. nov.**
Trithemis stictica: Pinhey, 1962c, *Publicações cult. Co. Diam. Angola* **59:** 273.

Types: *stictica* ♂ in Berlin Museum; *parasticta* ♂♀ in British Mus. (Nat. Hist.).

♂-Holotype *stictica* (Port Natal, i.e. Durban) in Berlin Museum and described from the Dregé collection, labelled no. 2491, "Afr.Austr.". It was examined by the present author in 1964. It is a small male, abdomen 23 mm, hindwing 25 mm. Labrum black, with two yellow spots; frons and vesicle steely blue; face yellow. Synthorax partially pale blue pruinose, with yellow lateral spots. Wings hyaline, pterostigma blackish brown; hindwing without the amber distal fascia. Forewing with only 8½ Ax. Segments 4–8 with single row of yellow streaks. Accessory genitalia as described below.

This elegant species is characterized by its metallic steely blue frons and, in the male, by its pale blue and yellow thorax; slender black abdomen with yellow streaks. A common species in Southern and Eastern Africa it is, in the author's experience, more abundant around Nairobi than in other parts of its range. It is a variable species.

After comparing long series it appears that *parasticta* is no more than a large dark form. It lacks the isolated amber patch on the hindwing but so does the type.

Also tentatively placed here are two Congo females, heavily marked with black and with saffronated wings. They may be a local race or even a distinct but closely allied species but no corresponding male has been seen.

MALE

NATAL (Nqutu) ♂ (mature, leg. A. H. Newton): Labium yellow with broad black band covering posterior lobe and extending forwards to slight expansion on anterior margins of lateral lobes; labrum black with two elliptical orange lateral spots. Face yellow; postclypeus with two central, well separated black streaks on lower margin. Frons with rather shallow groove; metallic steely blue to below crest and this steely blue coating the vesicle. Occipital triangle black with two yellow posterior spots; orbits posteriorly black with four yellow spots.

Prothorax black, the anterior collar yellow, median lobe with two central yellow twin dots. Synthorax pale chalky blue pruinose except some of the more ventral areas which are bright yellow and black. Sternal pattern well developed. Legs black.

Venation dark red-brown. No apical infuscation. Pterostigma red-brown between blackish veins. No basal amber but hindwing has an amber nebulus over anal loop, triangle and a few cells distad. Forewing with 9½–10½ Ax.

Abdomen slender, black with sharp yellow spots, on segments 4–8 with single row of yellow streaks. Basal segments with pale blue dorsal pruinosity. Segments 9–10

EXPLANATION OF FIGURES

Figs 46–48. *Trithemis* species. 46. *T. nuptialis*. a—Synthorax (juvenile ♂, Chingola). b—Abdomen (the same). c—Genitalia (Yaoundé). d—Genitalia and prophallus *in situ* (Kampala). e—Prophallus (Kampala). f—Vulvar lip (Kampala). g—Bursa (Ndola). 47. *T. stictica*. a—Synthorax (teneral ♂, Victoria Falls). b—Abdomen (the same). c-d. Prophallus (Orange Free State). e—Cornuti. f—Genitalia and anterior lamina (Zululand). g—Vulvar lip. h–i. Bursa (Orange Free State). j—Bursa of Central African subspecies (Boukoko). 48—*T. fumosa*. a–c. Male holotype. a—Synthorax. b—Abdomen. c—Genitalia. d—Prophallus. e—Right maxilla (♀). f—Vulvar lip (♀-allotype). g—Bursa (Etoumbi Forest).

black, 10 with yellow mid-dorsal line. Anal appendages dark brown. The anterior lamina and hamule are rather like the Oriental *T. lilacina* Förster. Anterior lamina very solid, well chitinised, and hemispherical, outwardly coated with long hair and short thick setae. Hamule robust, with short hook having outer setae. Genital lobe long, strap-like, well chitinised, with thick tuft of apical hair.

Prophallus long and deep, with large glans, long flagella and retinaculum, and two short curved cornuti. Behind the cornuti there are bulbous tumours.

Abdomen 22 mm, hindwing 27.5 mm, pterostigma 3.2 mm.

CAPE: A male from Plettenberg Bay is similar except for extra yellow lateral spots on the thorax (less pruinosity) and a larger pterostigma (3.7 mm).

ORANGE FREE STATE: One from Clocolan has the labrum yellow with black mid-basal dot and a stripe on lower margin; postclypeus unmarked. In another the labrum has a black T, the postclypeus two black commas.

RHODESIA: A series from Rhodesia shows much size variation, the hindwing 26–30 mm; with dwarfs (*vide infra*) still smaller. Lip variation is as much as in South African examples. One from Matopo Hills (Bulawayo) has a narrow labial band; large yellow lateral spots on labrum (the black being almost a T); commas on postclypeus. Another has the labral black in the form of two separate medial spots. In both these, although well pruinosed, the hamules are much less chitinised. A Salisbury specimen has narrow labial black, its posterior lobe yellow laterally; labrum with T; no postclypeal commas. This example is tortological having segments 5, 6 and 7 fore-shortened, the abdomen 19 mm, hindwing 29 mm. Marandellas specimens are fairly normal, the labial band narrowish; labrum with T; postclypeus with commas. One from Melsetter has a broad labial band. Although obviously mature the blue pruinosity has almost vanished (probably through over-heating). The synthorax is heavily glossy black except for yellow ventral spots. The melanic pigment spreads under blue pruinescence, obscuring the original thoracic pattern, as stated in the introductory pages.

A Pungwe Gorge example has the broad labial band, the labral T and the epistomal commas. Synthorax entirely blue pruinose, even ventrally. The abdomen is again tortologically fore-shortened: abdomen 20 mm, hindwing 26 mm. Umtali specimens show the usual variation. A Victoria Falls specimen of normal size has a reduction in labral black but is otherwise typical. A teneral example has the black all fully developed on the face, the labrum with a T; no pruinosity, the thoracic fasciae very distinct; segment 9 with a minute yellow dot. But most others lack this dot on 9. Fore femur yellow on inner side in tenerals. Examples were also examined from Rusape and the Umvumvumvu River.

Dwarf Rhodesian males. A dwarf series from grassy pools on the bank of the Zambezi River just above the Victoria Falls in the rain-months of December to April show reduction in venation, the forewing having only two rows of cells in the discoidal field and 9½ Ax. Most of them are females (*infra*). Male dimensions are: abdomen 19 mm, hindwing 23 mm. They are normal in head and body markings as well as in accessory genitalia. A teneral has the usual facial black except that the T is divided.

BOTSWANA: Males from the Okavango River system show the usual black facial variation but they are particularly characterized by the entire ground colour of the face being creamy white instead of bright yellow; and the hindwing has some basal amber. The status of this form is discussed below.

MOZAMBIQUE: Variation as usual in specimens from Dondo Forest, Mt Gorongoza, Vanduzi and Ingamanhé Forest.

ZAMBIA: One from Abercorn has thicker commas on the postclypeus; synthorax only blue dorsally, the sides yellow and black as usual; segment 9 with the unusual extra dot (as in a Victoria Falls teneral). Series from Mufulira, Mwinilunga and Ndola are more or less typical; but there are dwarfs from Mwinilunga and Luanshya which are as small as the Victoria Falls dwarfs; with partly two rows in discoidal field, but typical in markings. One which has lost the pruinosity (? by heat) has the mesepisternum and metepimeron clouded with black but the lateral markings are distinct; indicating that the pruinescence had been purely dorsal. A teneral from Kapiri M'poshi has the black facial markings developed and segment 9 has the extra yellow basal dot.

ANGOLA: Examples from Caianda (East Angola) are normal but the accessory genitalia are totally black.

MALAWI: Specimens from Nkata Bay show usual variation.

KATANGA: One from La Manda River is normal.

Forma *parasticta* Pinhey

ZAMBIA: These are large males, hindwing circa 30 mm, with thorax dorsally well blackened and pruinose. The hindwing lacks the distal amber zone which is commonly present; but as remarked above the type male also has no amber fascia. Some have the extra spot on segment 9. It was described from Abercorn (together with females) and was recorded from Ndola and Mwinilunga. It is not, however, a form of any importance.

DEVELOPMENT OF BLACK PIGMENT IN MALE: It is evident in this species, with such clear-cut markings, that the black fasciae on head and body are developed in the teneral condition. The labial black is always a complete band, narrowish or broad; labral black more variable; postclypeal commas usually but not always present. The thorax develops black clouding from the dorsum as soon as maturity is reached and this is more or less overlaid with blue pruinosity. The abdomen is always black with clear yellow spots and a single row of streaks as far as segment 8; but sometimes segment 9 has a small basal spot.

AMBER ON HINDWING: Normally there is no basal amber, except in the Okavango examples. In these it is usually only a trace but occasionally slightly more: in cubital space halfway to Cuq and on the basal cell of the anal field. The subdistal cloud is typically absent but most frequently present. It is absent in *parasticta* (Zambia), in an old Angola male, in only one of the Okavango series and in one teneral male from Victoria Falls.

FRONTAL COLOUR: Unlike many species with metallic frons the full colour (steely blue) is developed in the teneral state in *stictica*.

FEMALE

Females add another variant, the presence or absence of apical wing-infuscation. In characteristics the females, except in frontal markings, are quite close to *atra* and *nuptialis*.

MOZAMBIQUE (Vanduzi, in copula, leg. Pinhey): Labium with posterior lobe partly yellow and a very narrow band on lateral lobes. Face yellow, labrum with minute mid-dorsal spot at base and a short bar on lower margin. Postclypeus without commas.

Frons with moderate groove and very broad metallic green basal band, wider than the distance between central and lateral ocelli. Vesicle yellow, brown posteriorly, metallic green laterally. Occipital triangle ferruginous, yellow posteriorly.

Thorax and legs as in male.

Wing apices very slightly enfumed. Hindwing with faint distal amber nebulus. Forewing with 9½–10½ Ax.

Abdomen broader than in male but with similar pattern. Vulvar lip slightly invaginated.

Bursa with thickly conical dorsal sterigma, subtending on small bulbous bases, posteriorly, two large and irregularly ribbed branches which fold round to become dorsal elongated lobes. These lobes are outwardly crenulate. Ventral sclerites are also present. Bursa itself conical with slender arms. Lip well thickened. In a Central African Republic (Boukoko) female (? subspecies) the dorsal conical sterigma is finely produced anteriorly, gently down-turned. The paired ventral folded plates are smaller. Bursal arms slender.

Abdomen 22 mm, hindwing 27 mm.

ORANGE FREE STATE: Examples from Clocolan have a black T on labrum and commas on postclypeus. Thoracic lateral bands thicker, continuous and contiguous. Wing apices hyaline. Hindwing with stronger distal hyaline fascia.

RHODESIA: One from Matopo Hills (Bulawayo) is similar on the face, but the labial band is broader; thoracic bands not so thick. Wing apices hyaline. One from Honde Gorge (Inyanga) has only a basal dot and distal line on labrum; wing apices infuscated. Hindwing 28 mm. A large Matopo female, hindwing 30 mm, has labial black broad, labrum with T, frontal metallic band almost reaching crest; vesicle also metallic but yellow on its crest; wing apices well infuscated almost to base of pterostigma.

The dwarf series from Victoria Falls shows lip variation; labium very narrowly or broadly black, the posterior lobe partly or all black; labrum from a minute basal dot through stages to a T. Postclypeus with or without commas. Vesicle in all of them entirely metallic green. Thoracic black reduced to disconnected lateral fasciae, varying to contiguous stripes. Forewing with discoidal field partly of two rows. No apical infuscation and the amber of hindwing absent. Hindwing 24 mm. In all this series segment 9 has the additional small basal spot.

MOZAMBIQUE: Two from Dondo Forest have very heavily infuscated brown wing apices extending to proximal end of pterostigma. Lips normal but postclypeus without commas. Segment 9 without extra spot. No amber on hindwing.

BOTSWANA: Mature Okavango females have the ivory face as in the males, except a teneral which has slightly yellower face. Wings (in December and February examples) not infuscated, except in one (February) which has very broad brown apices and one (December) which has these and strong nodal fasciae. The February example also has the distal amber zone on hindwing. All have basal amber as in males.

ZAMBIA: Zambian females, including the large, dark f. *parasticta*, usually lack the distal amber on hindwing except in some tenerals; but a fully pruinosed mature female from Mwinilunga has a sharp distal amber fascia. Many Zambian females, like the Botswana females, have basal amber traces. None have apical infuscation. In *parasticta* the thorax is heavily blackened dorsally and the labial black is very broad. Segment 9 may have a yellow spot. In old specimens the thorax becomes as black as in males and even pruinose blue. Two Ndola specimens lack the dot on segment 9. In another, despite broad labial

black, the lateral fasciae of the thorax are reduced. Examples from Abercorn and Kitwe are not abnormal, except one from Abercorn has reduced thoracic black. A Mwinilunga series shows much variation in size, hindwing 23–28.5 mm. Facial marking also very variable. No spot on segment 9.

MALAWI: A juvenile from Nkata Bay has very narrow labial black, reduced also on posterior lobe; labrum and postclypeus all yellow. No apical infuscation, but hindwing with faint amber distal zone. Segment 9 with spot. A teneral one has lip fasciae normal; 9 without spot.

E. ANGOLA: Caianda females are normal but the labial black is broad.

ETHIOPIA: A teneral from Addis Ababa has the lips normal; postclypeus unmarked; frons and vesicle normal. No apical wing infuscation; hindwing with the amber distal cloud and also all wings are faintly amber in subcostal field. No spot on segment 9.

SUBSPECIATION AND VARIETIES

1. forma *parasticta* Pinhey

   Only a minor largish, dark variety from Central Africa.

2. Dwarfs

   Dwarfs of both sexes found near the Victoria Falls and in Mwinilunga District. Normal or even large individuals occur in such regions and the dwarfs, with their narrowed discoidal field, are probably due to ecological conditions: inadequate food supply or overcrowding in small quiet pools instead of in the Zambezi River or Isombo River where the larger specimens presumably breed.

3. Female form with broad brown apical fasciae. Specimens with slight infuscation may occur but those with broad fascia are individualistic, and are represented from Bulawayo, Dondo Forest and the Okavango Swamps. They are not seasonal but have been taken in November, February and April amongst clear-tipped females.

4. Okavango ? subspecies

   Males and females are characterized by their ivory white faces, instead of the normal yellow. The hindwing has traces of basal amber but this may occur also in Zambian females.

5. Equatorial ? subspecies

   Two females, one from Congo Kinshasa, the other from Central African Republic are closely allied to *stictica* but are darker, with saffronated wings and an entirely black labrum. Without a corresponding male it seems advisable to designate them as an unnamed subspecies of *stictica* rather than as a distinct species.

C.A.R. (Boukoko) ♀ (mature): Labium yellow, the posterior lobe all black and a narrow black stripe on lateral lobes, slightly expanded at anterior ends; labrum all black. Postclypeus with two central black spots almost united and a brown lateral suffusion. Frons as in *stictica* with very broad greenish black basal band. Occipital triangle nearly black, orange posteriorly. Orbits mainly black.

Synthorax yellow with very heavy contiguous black pattern as in *nuptialis*. Sternal black complete. Legs black, anterior femur yellow interiorly.

Wings saffronated with amber (like *fumosa*), pale in subcostal and cubital spaces of both wings and the anal loop of the hindwing; becoming stronger from nodus to apex where it is almost brownish amber. Pterostigma dark brown between black veins. Membranule pale grey. Forewing with 10½–11½ Ax.

fumosa

Abdomen black with yellow pattern more restricted than in typical *stictica*. Segment 4 with complete upper stripe and a short lower streak; 5–8 with single row of narrow stripes. 9–10 and cerci all black. Vulvar scale with shallow invagination. Dorsal sterigma of bursa (*vide supra*) more elongated than in normal *stictica*. Abdomen 24 mm, hindwing 28.5 mm, pterostigma 3 mm.

CONGO: A female from Irangi is similar but has a slightly wider labial band; postclypeal black united in centre. Segments 4–5 of abdomen lost.

DISTRIBUTION

Natal, Orange Free State, Transvaal and Botswana northwards to Ethiopia and Somalia in the East; Angola and Zambia via Congo to Nigeria and westwards to Ivory Coast (except in heavy forest). It is recorded from Madagascar (Ris, 1912: 785, from Nossi Bé, in Selys Collection).

The Botswana-Okavango examples may constitute a separate race.

There are two equatorial females which may be a subspecies or specifically distinct.

HABITS

Locally common at swamps, pools or streams in bush or open country or open forest areas. The amber-winged equatorial females may be the heavy forest subspecies?

MATERIAL EXAMINED

As recorded above. Also, further examples previously examined from South Africa: Baakens, Crags, Moordrift and Uitenhage.

GROUP 7. FUMOSA. Includes a single species.

Trithemis fumosa Pinhey, fig. 48 p124

Trithemis fumosa Pinhey, 1962, *J. ent. Soc. sth. Afr.* **25:** 48 (♂, Congo Brazzaville).

♂-Holotype and ♀-metallotype in National Museum, Bulawayo.

The species is characterized by the strongly amber wings, darkening apically, the apices broadly rounded; and the unusually short, broad segments of the abdomen.

All examples were collected in the Etoumbi Forest, Makoua District, of the Congo Brazzaville, by Mr Watuliki, on behalf of the late T. H. E. Jackson who presented so many important equatorial Odonata to the National Museum.

MALE

♂-Holotype (mature): Robust. Labium yellow with black median band as wide as the posterior lobe, which it covers; labrum all black. Face ochreous. Postclypeus with thick black bar on lower margin. Frons with broad black basal band, wider than the distance between central and lateral ocelli. Vesicle all black. Back of orbit black with yellow spots.

Prothorax blackish with yellow anterior collar and broad yellowish central commas on middle lobe. Synthorax yellow with broad black fasciae as in the figure; with broken yellow antehumeral stripe. Sternal pattern thickly black anteriorly but incomplete centrally and posteriorly. Legs black, fore femur yellow on inner surface.

Wings somewhat fumose and enfused with amber, not basally but distally and darker apically; also the anal field amber. Pterostigma brown between black veins. Wing apices unusually broad. Membranule grey. Forewing with 12½ Ax.

donaldsoni

Abdomen short and thick, with short, broad segments; patterned with black and yellow as in the figure. Segments 3–8 with two rows of yellow stripes; 9 with a yellow T, 10 with distal spot. Superior and most of inferior appendage somewhat darkened. Anterior lamina rather rounded, undivided. Hamular hook smallish, with outer setae. Genital lobe narrowing, with long apical setae. Prophallus with short flagella, no cornuti; a long, robust retinaculum.

Abdomen 22 mm, hindwing 30 mm, pterostigma 4 mm.

A slightly juvenile male is similar and has all black markings developed; superior appendage darker.

FEMALE

♀-Metallotype: Head as in holotype but vesicle brown and the basal band on frons is not so broad, only as wide as the long diameter of the anterior ocellus.

Thoracic pattern similar, but sternal black complete posteriorly. Legs as in male.

Wings as in male, with more uniform amber tint on hindwing. Forewing with 13½ Ax.

Abdomen similar in shape, size and markings. Cerci black. Vulvar lip very shallowly excised. Bursa: dorsal plate with robust neck ending anteriorly in a slightly inflated, less chitinised area; widened posteriorly where it is slightly divided medially. The folded ventral sterigmata are narrowly connected to one another. Bursal arms slender.

Abdomen 22 mm, hindwing 31 mm, pterostigma 4 mm.

A paratype female, probably less mature, has a minute yellow lateral dot on posterior lobe of labium; postclypeal band replaced by a pair of lateral bars; vesicle yellowish brown above and posteriorly. Otherwise similar.

DISTRIBUTION

Only known so far from one forest in the Congo Brazzaville.

HABITS

Not known to author. Presumably lives in primordial forest.

GROUP 8. BASITINCTA. Includes *basitincta*, *bifida*, *caruncula*, *congolica*, *donaldsoni*, *nigra*.

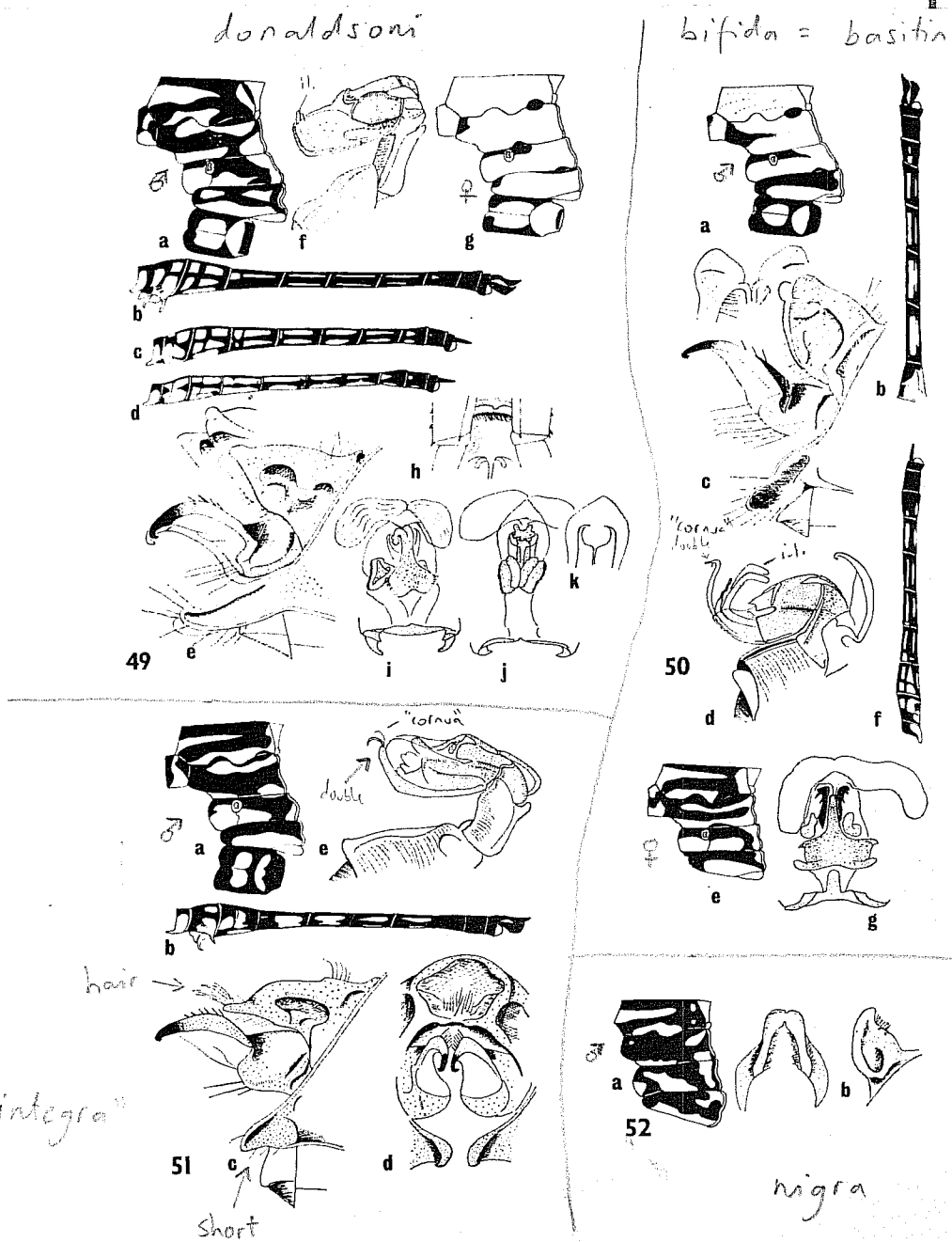
Trithemis donaldsoni (Calvert), fig. 49 p132

Pseudomacromia donaldsoni Calvert, 1899, *Proc. Acad. nat. Sci. Philad.*: 235 (Somalia).
Trithemis erlangeri Förster, 1906, *Jb. Nassau. Ver. Naturk.* **59:** 312 (Somalia).
Trithemis donaldsoni: Ris, 1912, *Cat. Coll. Zool. Selys-Longchamps* **14:** 782; Pinhey, 1962c, 270.

Type ♂ of *donaldsoni* was formerly in the Philadelphia Academy of Sciences but is now apparently mislaid (letter dated 15 Nov. 1968)*; ♂-lectotype of *erlangeri* is in Ann Arbor, Michigan.

Ris (1912: 782) placed this species in *Trithemis* and two pages later described *basitincta* as a subspecies of this. Pinhey (1951: 266) showed that their distribution overlaps and they cannot be conspecific; apart from genitalial and other differences. Long-

*See Addendum.



field (1936) described *nigra* from Principe Island as another subspecies of *donaldsoni*. It is in fact nearer to *basitincta* in characters and although the present author has not re-examined the type it seems distinct enough to be regarded as a separate species.

MALE

The mature male, with its slender abdomen, is easily recognized in the field by the pale blue colour coating the thorax and abdomen. The long sickle-shaped hamular hook confirms the identification.

RHODESIA (Umvumvumvu R., leg. Pinhey) ♂ (mature): Labium mainly yellow; posterior lobe deep brown with small yellow lateral dots, a narrow black central stripe on lateral lobes which expands slightly at anterior end. Labrum black; anteclypeus ochreous, postclypeus blackish except on ochreous lateral zone. Frons with shallow groove; dark metallic violet to below crest. Vesicle dark violet except a minute latero-basal ochreous dot. Occipital triangle black, brown posteriorly. Orbits posteriorly yellow with normal black bands.

Prothorax mainly black, with thin powder-blue pruinosity. Synthorax all pale powdery blue except sternal yellow markings. Metasternal pattern thickly margined and pruinosed but the centre all yellow. Legs all black, with some traces of basal pruinosity.

Wings entirely hyaline without any amber, fumosity or infuscation. Venation dark brown, the axillary sclerites and bases of all long veins blue-pruinosed. Pterostigma ferruginous between black long veins. Membranule cream with a fine grey line. Forewing with 11½ Ax.

Abdomen slender, pale blue pruinose except segments 9–10 which are all black; all yellow markings obscured on abdomen. Anal appendages blackish brown. Anterior lamina long, conical, apically bifid, with two distinctive, bulbous yellow apices. Hamule with small base and long sickle-shaped hook, its apex minute and in-turned; with few outer setae. Genital lobes *distant*, narrow, asetose.

Prophallus with very large glans, no cornuti, short flagella.

Abdomen 26.5 mm, hindwing 33.5 mm, pterostigma 3 mm.

Size is very constant but an occasional smaller male may have a hindwing of 30 mm.

A less mature specimen from Umvumvumvu River has labial mark even narrower, on posterior lobe only a centre line, continued on lateral lobes. Postclypeus all yellow except a short central brown bar. Synthorax only thinly pruinosed, just on mesepisterna, the black fasciae all well developed as in the figure.

EXPLANATION OF FIGURES

Figs 49–52. *Trithemis* species. 49. *T. donaldsoni*. a—Synthorax (♂, Umvumvumvu R.). b—Abdomen (the same). c—Abdomen (♀, Nuanetsi). d—The same (♀, Jinja). e—Genitalia, obliquely, and anterior lamina (Umvumvumvu R.). f—Prophallus (Khami, Bulawayo). g—Synthorax (♀, Jinja). h—Vulvar lip (Nuanetsi). i–j. Bursa. i—Dorsal. j—Ventral. k—Bursa without sterigmata (Nuanetsi). 50. *T. bifida*. a–d. Male holotype. a—Synthorax. b—Abdomen. c—Genitalia and anterior lamina. d—Prophallus *in situ*. e—Synthorax (♀, Chimanimani Mts). f—Abdomen (the same). g—Bursa (the same). 51. *T. basitincta*, male. a—Synthorax (Ituri Forest). b—Abdomen (Bwamba Forest). c–d. Genitalia (Bwamba Forest). c—Left aspect. d—Ventral. e—Prophallus (Ituri Forest). 52. *T. nigra*. a—Synthorax (modified after Longfield). b—Anterior lamina, posterior and lateral (del. Kimmins).

Legs all black. Abdominal pattern showing a single thin yellow streak on segment 4 and double streaks on 5–7; segment 8 with minute yellow basal spot; 9–10 all black. A mature example from Kariba Dam has the labium all yellow; postmedial black a central bar. Thorax pale pruinosed, abdomen less so. It is a small individual but the forewing has 11½ Ax. Abdominal pattern just visible. In a larger Kariba specimen the labial black is a narrow stripe, but covering most of posterior lobe.

In a mature Bulawayo male the labium has only a trace of black on posterior lobe and a ferruginous black band on lateral lobes which contracts anteriorly instead of expanding; postclypeus nearly all dark brown. Another mature one has labium all yellow and only a central bar on postclypeus. Still another is similar but with only the merest trace on postclypeus. Examples from Sawmills, Deka River and Nuanetsi River resemble the Umvumvumvu specimens. Ones from Umsweswe and Limpopo Rivers have the labium yellow with just a black smear at the inner anterior angles; postclypeus broadly blackish.

A teneral male from Kamativi (Sebungwe District) has the labium yellow with just a trace of a brown median line on lateral lobes; labrum yellow with black band on lower margin; postclypeus with short brown central bar; frons above and vesicle metallic bronze. Body markings clear, without pruinosity, sternal pattern well developed. Abdominal markings as for the less mature Umvumvumvu example; superior appendages dark brown, inferior ochreous edged with dark brown. Pterostigma paler brown.

KENYA: A mature male from Shimba Hills (Mombasa) has only an anterior black smear on labium; postclypeus mainly dark. Otherwise like Rhodesian examples.

DEVELOPMENT OF BLACK IN MALE: All body markings evidently develop early and are probably present at eclosion. Facial markings, especially on the lips, appear more gradually but there is variation in labial and postclypeal black at maturity. As in many species the frons is metallic above in immature stages but does not develop the violet sheen until later.

SUBSPECIATION

The Rhodesian and Kenya males may possibly represent a paler South and East African race, different from the slightly darker nominotypical taxon.

ETHIOPIA: The type male (from Stonybrook, now in Ethiopia) was described by Ris (1912: 782). The labium was broadly black in the middle. Calvert described his type as "dull bluish black" but this may have been either a thin pruinosity or partially removed by heat. Ris, however, said it was pale grey blue (p. 783). It had 12½–13½ Ax in forewing.

RHODESIA: Under female descriptions (*infra*) a Rhodesian female has the broad labial band. Perhaps the labial variation is a climatic factor.

UGANDA: Also under the females there is a strikingly different Uganda specimen.

FEMALE

?N. NIGERIA: Ris (1912: 783) described a female (evidently based on specimens from Zungeru, N. Nigeria) which is not merely anomalous but probably not *donaldsoni*. The wings were suffused with greyish yellow between triangle and proximal end of pterostigma; with amber basal fasciae on all wings; membranule black. It was an adult, not immature. It is described in more detail under *bifida* and may, in fact, be that species.

Females may sometimes (as in *stictica*) have brown at the wing apices but the present author has not found any *donaldsoni* of either sex with definite amber basal spots; and the membranule is pale grey.

RHODESIA (Nuanetsi, leg. Pinhey) ♀ (mature): Labium entirely yellow; labrum yellow with black band on lower margin sending a short black bar dorsad. Face, frons and vesicle yellow. Frons with moderate groove and a characteristic, broad blue-black basal band projecting centrally and at lateral angles but discontinuous laterally, as in the figure (see *falconis*); it is wider centrally than the distance between central and lateral ocelli. Occipital triangle ferruginous, yellow posteriorly.

Prothorax black with yellow anterior collar. Synthorax marked as in male but the fasciae are slightly narrower. Traces of white pruinosity on sternites and femora. Fore and mid femora with yellow inner stripe.

Wings as in male but bases of veins not pruinosed. A pale brown apical fascia from pterostigma to apex. No amber traces. Membranule whitish grey. Forewing 10½–12½ Ax.

Abdomen slightly thicker than in male, with broader yellow fasciae; segments 4–8 with double row of streaks; 9 with minute yellow dot. Cerci dark brown. Vulvar lip straight and strengthened anteriorly by a ridge which is pointed in the centre.

Bursa with dorsal sterigma very solid, bifurcate and down-turned at apex, which is notched. A double ventral sterigma with V-shaped anterior invagination, the two portions (left and right) united medially. Bursa somewhat mitral in shape apically and with broad arms.

Abdomen 23.5 mm, hindwing 31 mm, pterostigma 3 mm.

Another from Nuanetsi has a trace of anterior black on labium; labrum with thicker T; basal band on frons thicker. Apices of wings also brown. Forewing with 10½–11½ Ax (the smaller ones with 10½). Segment 8 with only the upper yellow triangle. A Bulawayo female is similar in all respects except that segment 9 has a basal dot and the wing apices are not brown. A Limpopo River female resembles the first Nuanetsi one on lips and abdomen; also with brown wing tips. Forewing with 12½ Ax.

SUBSPECIES

UGANDA (Jinja): Trace of anterior black on labium; labrum with T. Frons with the discontinuous basal band of *donaldsoni*.

Prothorax ochreous with black band behind yellow collar. Synthorax distinctive; ochreous with only isolated black spots at upper end of humeral suture, ventral end of mesepimeron and short bands on lateral sutures as illustrated.

Wings normal but without apical brown. Forewing with 11½ Ax.

Abdominal pattern as in the Nuanetsi females but with less black, especially on basal segments; middle segments with thicker yellow stripes, the dorsal and ventral ones almost coalescing. Vulvar scale as usual. Size average.

Differing as it does in reduced thoracic and abdominal black areas it is probably a distinct race. It may even be nearer the condition of any female found in the type locality. Subspecific designations cannot be applied for this solitary female.

DISTRIBUTION

Natal, Rhodesia and Mozambique northwards to Kenya, Somalia, Ethiopia; and Congo, Uganda, Northern Nigeria. Probably at least two subspecies.

bifida

HABITS

Local, not usually abundant, not found in forested areas, but generally in bush country, on rivers or streams; sometimes in rather arid country. Males settle on stones, rocks or vegetation in or close to the water. Both sexes are sometimes found on dead twigs of trees or shrubs a short distance from the streams but the female has not been seen in any abundance by the author.

MATERIAL EXAMINED

Rhodesia, Kenya and Uganda.

Trithemis bifida spec. nov., fig. 50 p132

♂-Holotype in the National Museum, Bulawayo.

This is an anomalous species closest to *donaldsoni* but with darker pruinosity in the males, blacker labium and different genitalia. Since the only known male is from Mwinilunga, N.W. Zambia, where *donaldsoni* has not been seen it might be inferred that *bifida* is the westerly race of *donaldsoni*. On the other hand a single female from Eastern Rhodesia is thought to be *bifida* and it certainly differs from other species in the same group of *Trithemis*. If this assumption is correct its distribution overlaps with Rhodesian examples of *donaldsoni*.

The allied *basitincta* and *nigra*, as well as two new species (vide infra) formerly attributed to *basitincta* were at one time considered infra-specific to *donaldsoni*. But the distribution of certain of these overlaps with *donaldsoni* and apart from other differences both *donaldsoni* and *bifida* can easily be separated from the other four by the bifid anterior lamina in the male: hence the specific name *bifida*.

MALE

ZAMBIA (Mwinilunga, leg. Pinhey) ♂-holotype (mature): Labium black on posterior lobe, narrowly black medially on lateral lobes but expanded at anterior end. Labrum black. Face greenish ochreous; postclypeus with black central crescent on lower margin. Frons with shallow groove; dorsally metallic violet but this does not extend below the crest as it does slightly in *donaldsoni*. Vesicle metallic violet. Occipital triangle brown, yellowish posteriorly. Back of orbits with black bars.

Synthorax ochreous at sides, ferruginous dorsally, with very slight dark blue pruinosity. Mesepisterna with markings diffuse and not clear. The only black thoracic markings are the basic ones: dorsal spot on humeral suture, upper distal spot on mesinfra-episternum, a fascia at ventral end of mesepimeron and a stripe on each lateral suture. Sternal pattern complete. Legs black; fore femur with short yellow streak on inner surface.

Venation dark brown to black. No apical marking. Pterostigma pale brown between dark brown veins. Forewing without basal marking; hindwing with dark brown basal fascia in cubital space halfway to Cuq and traces of amber in subcostal and anal fields. Membranule grey, white at base. Forewing 13½–14½ Ax.

Abdomen much more slender than in *donaldsoni;* black with sparse yellow marking but the upper stripes of the doubled row are broad on segments 4–5, fusing with the fine lower streaks; 6–7 with two rows; 8 with one row; segments 9–10 all black. Anal appendages blackish brown. Anterior lamina bifid at apex, as in *donaldsoni*, but broader, more heavily chitinised except on inner (posterior) surface: hamular hook sickle-shaped like *donaldsoni* but the apex slightly out-turned. Genital lobe short and broader; also distant from hamule. The few setae are only on the hamular hook. Prophallus very different from *donaldsoni*. Glans small; very large, curved cornuti, long flagella; distal part of stem somewhat rugose.

Abdomen 29.5 mm, hindwing 33 mm, pterostigma 3 mm.

From *donaldsoni* this species differs in its darker pruinosity; generally sparser thoracic fasciae; broader, partly fused yellow abdominal streaks; thicker anterior lamina; broader genital lobe and the dark brown and amber basal marks on hindwing.

FEMALE

Three slightly different females may be discussed here. Firstly, a large Rhodesian example; secondly Ris' female from Nigeria (placed by him in *donaldsoni*); thirdly, a dark female from Uganda.

?RHODESIA (Chimanimani Mts) ♀ (mature): Labium broadly black in centre, covering posterior lobe and on lateral lobes expanding anteriorly and along anterior margins. Labrum black. Postclypeus with short black central bar; frons with very broad blue-black basal band, wider than the distance between central and lateral ocelli and not discontinuous.

Thoracic pattern as figured, with extensive black bands, unlike the male. Fore femur with partial yellow inner streak.

Venation blackish. No basal or apical markings. Pterostigma as in male. Forewing with 13½–14½ Ax.

Abdomen, as in *donaldsoni*, with double row of yellow streaks on segments 4–8 (very small on 8); 9–10 all black. Vulvar lip slightly more concave than in *donaldsoni*. Bursa with dorsal plate slender anteriorly, broad posteriorly, with post-lateral processes. Ventral plates in two irregular pairs (the anterior ones blackened in the illustration). Bursal arms broad.

Abdomen 29 mm, hindwing 34 mm, pterostigma 3 mm.

The more strongly banded thorax and the lack of basal amber suggest this may not be *bifida* but perhaps a species as yet unknown. It cannot be *donaldsoni* because of the complete, continuous band on the frons.

N. NIGERIA: Ris' female from Zungeru (described by Ris 1912: 783, under *donaldsoni*) may belong here. This had amber basal fasciae on the wings. Labium narrowly black in centre; labrum black with two large yellow basal spots. Face, frons and vesicle pale yellow; frontal band broad, metallic blue-black (without stating whether this is discontinuous at sides). Thorax with thin whitish pruinosity and moderately developed fasciae. Legs black. Abdomen slender, black, with double row of narrow yellow streaks, becoming smaller distally, on segments 3–6; very short single spots on 7–8; segments 9–10 all black. Vulvar lip almost straight.

This is possibly a true female of *bifida*.

UGANDA: The Uganda female mentioned under *donaldsoni* lacks amber basal patches and so it is less likely to be the female of *bifida*. Moreover, the basal band of the frons is discontinuous as in all female *donaldsoni* (q.v.) and consequently this female must, at least at present, remain under *donaldsoni*.

DISTRIBUTION

Definitely known only from North West Zambia. Possible females from North Nigeria, Uganda and Rhodesia are discussed above.

integra

HABITS

The type male was collected by the author (1960) in thick gallery forest, North Mwinilunga, amongst another new species (*vide caruncula*).

Trithemis basitincta Ris, fig. 51 p 132

Trithemis donaldsoni basitincta Ris, 1912, *Coll. Zool. Selys* **14:** 784 (Cameroons).
Trithemis basitincta Pinhey, 1951, *Transv. Mus. Mem.* **5:** 265; 1962c: 270.

Type male not traced but originally in René Martin's collection, but Ris' description and genitalial figure is from the Cameroons type.

Formerly linked specifically with *donaldsoni* but separated from that species on distributional grounds by Pinhey (1951), *basitincta* is easily distinguished in the male by the undivided anterior lamina (bifid in *donaldsoni* and *bifida*). It must now be subdivided into Longfield's *nigra* and two new additional species, besides true *basitincta*. Pinhey (1961a: 167) divided *basitincta* into two groups, the first with the anterior lamina solid, dark and uniform, the true *basitincta;* the second, with the apex of the lamina pale, curved and bulbous. It has been decided now that all these are distinctive and that the second group even has to be further split up.

The National Museum has males of *basitincta* from Uganda and Congo (Kinshasa) but, unfortunately, no females.

MALE

Congo (Ituri Forest, leg. Pinhey) ♂ (mature): Labium black on posterior lobe, expanding anteriorly on lateral lobes; labrum black. Postclypeus with dark brown central bar on lower margin. Frons and vesicle dark metallic violet, the frons with very shallow groove. Occipital triangle black, brown posteriorly; orbits posteriorly black with yellow spots.

Prothorax black. Synthorax with thick black bands, all well developed, contiguous; thin dark blue pruinescence on dorsum.

Sternal black well developed. Legs black. In this specimen, evidently tortological, the claw hooks on the tarsi are obsolete or absent on most legs.

Venation black; a trace of brown at wing apices; pterostigma black. Hindwing with prominent blackish brown basal rays: trace below costa, nearly to first Ax in subcostal zone, to beyond Cuq in cubital space and a trace at base of anal field. Membranule pale grey-brown. Forewing with 14½–16½ Ax.

Abdomen slender; black, with single row of thickish yellow streaks on segments 4–7, and traces of a more ventral row; 8–10 and anal appendages black. Anterior lamina well chitinised, with slenderly produced apex, concave behind (anterior surface) but not bifid; with apical hair-tuft. Hamular hook very slender, the apex slightly out-turned and with some outer setae. Genital lobe short, conical, distant from hamule.

Prophallus without cornuti; flagella small, glans large.

Abdomen 28 mm, hindwing 35 mm, pterostigma 3 mm.

Another Ituri Forest male has stronger dorsal blue pruinosity on thorax. Forewing 16½–17½ Ax. Claw hooks well developed on tarsi. Hindwing 32–35 mm.

Uganda: One from Bwamba Forest is similar but the yellow abdominal stripes are broader. Forewing with 17½ Ax. Another from Kampala has the narrower stripes on the abdomen. Forewing with 17½–18½ Ax.

nigra

Cameroons: Ris states that in Cameroons males the labium may be all or nearly all black. Forewing with only 13½–14½ Ax. This is a low nodal value, nearer that of *congolica* (infra). The anterior lamina in the illustration (Ris, 1912: 784) is, however, quite different from the condition in *congolica* and *caruncula* and is illustrated from the type.

Congo: Ris also mentions a Katanga male with 13½–15½ Ax in the forewing. The present author has found not *basitincta* but *caruncula* in Katanga.

FEMALE

No female was available for description. The thoracic and abdominal pattern are almost certainly similar to the male but possibly the black markings are less thick.

DISTRIBUTION

Cameroons, Congo (Kinshasa), Uganda; also Turiani Forest, East Tanzania (Pinhey, 1961a: 168).

HABITS

Inhabits dense forest in tropical Africa, probably breeding in slow forest streams. A shy species.

MATERIAL

Northern Congo (Kinshasa), Uganda.

Trithemis nigra Longfield, **stat. nov.**, fig. 52 p 132

Trithemis donaldsoni nigra Longfield, 1936, *Trans. R. ent. Soc. Lond.* **85:** 491, 496 (♂ Principe Island); Pinhey, 1962c: 270.

♂-Holotype, incomplete ♂-paratype in British Museum (Nat. Hist.).

This is a small dark species still only known from the types collected on Principe in the Gulf of Guinea. As Longfield says it is nearer to *basitincta* in appearance than to *donaldsoni*. In its anterior lamina it is closer to *caruncula* (infra). By its blue metallic frons, very black thorax and abdomen, blackish membranule, and its anterior lamina, it seems advisable to regard this as a distinct species. In size and the lamina it is nearer *caruncula*. The present author examined the type briefly in 1964 and concluded at that time that it was either a very small dark race of *basitincta* or a distinct species.

It has probably evolved in insular isolation from ancestral *basitincta/caruncula* stock.

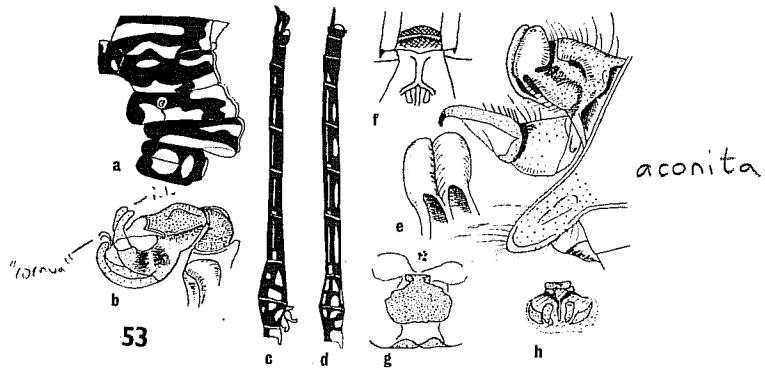
MALE

The following remarks are extracted from Longfield's description. No illustration of the accessory genitalia was given. The description is modified to follow the method employed in this revision.

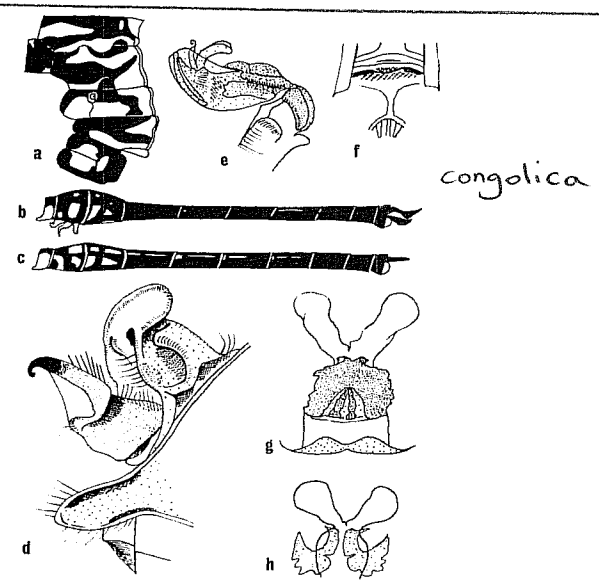
♂-Holotype: Labium and labrum black medially. Clypeus black in centre. Frons above and vesicle metallic *blue* (not violet as in related species). Occipital triangle black. Orbits black with yellow spots.

Prothorax black. Synthorax mainly glossy black with yellow markings as figured; much blacker than related species. Legs black.

Wings hyaline, apices more rounded than in *basitincta*. (Venation colour not stated but probably black). Pterostigma blackish brown, only about half as long as in *basitincta*. Forewing at base with trace of golden yellow; hindwing with larger fascia, to first Ax, to Cuq and at base of anal field.



aconita



congolica

aconita

Membranule nearly black, darker than in *basitincta*. Three rows in anal field. (Number of Ax not stated).

Abdomen glossy black with sparse yellow markings: a lateral spot on segment 1; segments 2–3 with dorsal, lateral and latero-ventral spots; segment 4 with narrow yellow dorsal streak. (Presumably segments 5–10 are all black).

The accessory genitalia are said to be "almost identical" to *basitincta*. Kimmins supplied a camera lucida drawing of the anterior lamina. The lamina has a pale apex, slightly notched and bent slightly anteriad, more like *caruncula* and *congolica*. Hamular hook not examined but presumably sickle-shaped; and the genital lobe is probably distant from it.

Abdomen 24.5 mm, hindwing 25 mm.
(probably the abdominal length is total, including the anal appendages).

The female is unknown.

DISTRIBUTION

Principe Island.

Trithemis caruncula spec. nov., fig. 53

♂-Holotype, ♀-allotype, paratypes (mostly Victoria Falls) in the National Museum, Bulawayo. A paratype of each sex will be in the British Museum (Nat. Hist.) and the Transvaal Museum.

Except for *nigra* this species is smaller than other members of the *basitincta* group; and the male has a stronger tendency to pruinosity and a lesser development of basal markings on the wings than in *basitincta* or *congolica*. The anterior lamina has a bulbous yellow retracted apex which provides the specific name for *caruncula*. The larger, more heavily marked *congolica* appears to be a separate species since the more widespread *caruncula* must overlap its distribution: unless *congolica* can be shown to occupy only certain isolated pockets of distribution. Both these have formerly been confused with *basitincta*.

MALE

VICTORIA FALLS (leg. Pinhey) ♂-holotype (mature): Labium with posterior lobe black and a broad median band extending forwards, expanded at anterior margins; labrum black. Postclypeus with black central crescent on lower margin. Frons with moderate groove; dark metallic violet, extending over the crest; vesicle metallic violet, except posteriorly. Occipital triangle ferruginous, yellow posteriorly. Orbit black with large yellow spots.

Prothorax mainly black, with bluish pruinosity. Synthorax with well developed black fasciae, but obscured by a complete coat of thin bluish pruinosity. Sternal black well developed. Legs black; femora coated with some white pruinosity.

EXPLANATION OF FIGURES

Figs 53–54. *Trithemis* species. 53. *T. caruncula*. a—Synthorax (♂-holotype). b—Prophallus (paratype). c—Abdomen (♂-paratype). d—Abdomen (♀-allotype). e—Accessory genitalia and anterior lamina (♂-holotype). f—Vulvar lip (♀-allotype). g—Bursa, dorsal (Victoria Falls). h—Sterigmata, ventral (the same). 54. *T. congolica*. a–b. Male holotype. a—Synthorax. b—Abdomen. c—Abdomen (♀-allotype). d—Accessory genitalia (♂-holotype). e—Prophallus (the same). f—Vulvar lip (paratype). g–h. Bursa (Eala). g—Dorsal. h—Ventral.

Wings hyaline, without apical infuscation. Pterostigma small, ferruginous, between black long veins. Venation blackish. Forewing unmarked at base; hindwing with brownish amber in cubital space nearly to Cuq and at base of anal field. Membranule pale grey-brown. Forewing with 12¼ Ax; 9–10 Px.

Abdomen slender on segment 4, very slightly inflated on segments 5–6. Abdomen black with small basal yellow spots and very fine upper streaks on segments 4–7; segment 8 with sub-basal dot; 9–10 black. Anal appendages dark brown.

Anterior lamina robust, with prominent yellow apical hood retracted anteriad but not as gross as in *congolica*. Hamule less chitinised than in *congolica*, with long, straight hook slightly curved posteriad (not outwards) at apex; with outer setae. Genital lobe distant from hamule, blackened, short, not so thick as in *congolica*.

Prophallus less elongate than in *congolica*, more rounded, with flagella and well curved retinaculum; two thinly chitinised cornuti as in *congolica*.

Abdomen 25 mm, hindwing 29 mm, pterostigma 2.2 mm.

In paratype males (Victoria Falls) the hindwing may be 29–32 mm. Labial posterior lobe yellow at sides in one example but in another the black is much broader than usual, covering more than half of each lateral lobe. Abdominal streaks more developed in some.

NATAL: A pruinosed male from Zululand (leg. Pinhey) has the labium abnormally pale, the posterior lobe yellow with dark brown centro-basal dot, the lateral lobes with broad blackish central suffusion on anterior three quarters. In Zululand ones recorded previously (Pinhey, 1951) the labial black is continuous.

MOZAMBIQUE: Mozambique specimens (leg. Pinhey) may have much reduction in labial black. One well pruinosed male from Vila Paiva has the labium all yellow except a small black anterior spot on lateral lobes; others may have a more or less complete band on lateral lobes, and a median line on posterior lobe. A pruinosed Vanduzi example has only the small anterior spot on labium; vesicle nearly all ochreous without metallic violet.

MALAWI: One from Nkata Bay (leg. Pinhey) has a fully developed broad black labial band; vesicle all metallic violet.

ZAMBIA: Examples from Kafue River and Ndola (leg. Pinhey) resemble the Nkata Bay male. A series from Mwinilunga (Pinhey) is similar or the labial black may be even broader. One male may be a melanotic extreme. The labium is all black except a very narrow and short yellow lateral streak.

KATANGA: A Kasongo male has the labial black as a broad median band but only a posterior spot on posterior lobe.

TANZANIA: A pruinosed Kimboza Forest specimen (Uluguru Mts; leg. Pinhey) resembles the Victoria Falls series but the anal appendages are ferruginous, not blackish.

KENYA: Examples from Shimba Hills (Mombasa, leg. Pinhey) are typical.

UGANDA: A specimen from S.W. Uganda is typical except that the labial black is broader than average.

NIGERIA: One pruinosed from Mamfe (leg. Pinhey) has the labial posterior lobe yellow except a black posterior band. Another from Kumba Gorge (leg. Lascelles) has a broadly continuous labial band; abdominal yellow streaks somewhat reduced; no fascia on segment 8.

GHANA: A male from Prah-Annam Forest (leg. F. L. Johnson) is typical, as in Victoria Falls examples.

In some of the above males, particularly from Shimba Hills, E. Nigeria and Ghana the wings are somewhat fumose.

FERNANDO PO: One male (submitted in a collection from Museum König) is abnormally large for this species, abdomen 29 mm, hindwing 31 mm. Labium broadly black in centre; labrum, as usual, all black. It may be an insular form or race.

VARIATION

It might be suggested that the pale labium series from Zululand and Mozambique represents a Southern race. It seems more likely that there is a cline starting with these pale-lipped ones from South-East Africa; darker lipped in the Zambezi Valley and East African forests; still darker in North Malawi; Mwinilunga and the rain forests of Congo, Nigeria and Fernando Po island; slightly paler again in Ghana and perhaps Northern Nigeria.

FEMALE

In the male, although there is slight variation in other respects the variable factor is the labium. In the female the apical wing infuscation (as in *donaldsoni*) brings in another factor of variability, as well as lips and postclypeus.

VICTORIA FALLS (in copula, leg. Pinhey) ♀-allotype: It is thinly pruinose, just mature. Labium all yellow with black macula at inner anterior angles of lateral lobes. Labrum yellow with black central band, slightly expanded at distal margin. Postclypeus unmarked. Frons with moderate groove and broad blue-black basal band as wide as the distance between central and lateral ocelli. Vesicle orange-ochreous. Occipital triangle ferruginous, yellow posteriorly. Orbits yellow with black bands.

Prothorax mainly black and pruinosed with yellow bands on collar and median lobe; posterior lobe yellowish with black basal band. Synthorax as in male, with thinner black bands. Fore tibia yellow interiorly.

Wings hyaline, with black venation and slightly infuscated at apices. Pterostigma pale ferruginous, between black long veins. Hindwing with trace of basal amber in subcosta, halfway to Cuq and a trace in anal field. Membranule paler than in male. Forewing with 11¼–12¼ Ax; 9 Px.

Abdomen wider than in male, black, segments 4–7 with double row of slender yellow streaks. Cerci black. Vulvar lip nearly straight.

Bursa very like *congolica* in dorsal view but the dorsal sterigma is apparently more evenly solid. On the ventral surface two smaller pairs of sclerites may be seen below the massive dorsal one, these being all posterior to the ostium which shows, in the figure, at the neck of the large dorsal sterigma. The small inner plates are more or less elliptical the other two are claw-like. The ostial ring is irregularly thickened.

Abdomen 25 mm, hindwing 30 mm.

The allotype has a paler face than normal for the series. Paratype females (Victoria Falls) may have the wings sometimes enfumed; apical brown occasionally stronger, extending to proximal end of pterostigma, sometimes absent altogether. Labium with narrowish but continuous black or brown median band; or just the anterior trace like the allotype; or the band incomplete posteriorly and only a posterior bar on posterior lobe; or, again, a bar on median lobes but the posterior lobe all yellow. The labrum is usually all black; postclypeus usually with a black central bar; basal band on

Congolica

frons varies slightly in width. One of those with infuscate wing apices has darker, slightly broader basal amber on hindwing.

ZULULAND: One female (leg. Pinhey) has a black median band on lateral lobes of labium but the posterior lobe is all yellow. No brown at wing apices.

ZAMBIA: Mwinilunga females (leg. Pinhey) have broader labial black (as in Mwinilunga males); labrum all black; postclypeus with central bar. No apical brown on wings. One is larger, the hindwing 31.5 mm. An Ndola example is juvenile and has only a trace of labial black.

TANZANIA: A Pugu Hills specimen (Dar-es-Salaam; leg. Pinhey) has only the anterior-angle trace on labium; labrum broadly orange laterally. Postclypeus with two black central dots. Wings fumose, the apices infuscated.

UGANDA: A Bwamba forest specimen (leg. Pinhey) has a broadish labial band; labrum all black; postclypeus with central black trace. Wings hyaline, apices not brown.

NIGERIA: A Mamfe female is exceptionally small, hindwing 26 mm (the male taken at the same time was normal in size). Labium all yellow; labrum with black T; postclypeus unmarked. Wings hyaline, not infuscated at apices. Despite its pale face it may not represent a separate subspecies because of the male facial markings (supra).

Although no tenerals of either sex were examined it is probable that facial black may develop rather slowly, but body markings early.

DISTRIBUTION

As recorded above the known distribution is from Natal north eastwards to the Kenya coast; along the Zambezi Valley and up to Mwinilunga; from there and North Malawi to the Congo, Nigeria and westwards to Ghana; also a larger form or race in Fernando Po.

HABITS

In Southern Africa it is found in thickish bush fringing rivers and streams (fast or slow but not stagnant). In tropical Africa it is sometimes found in the larger forests. It is somewhat shy and alert, settling on twigs over the water, almost in shade (to which it can retreat); or in shafts of sunlight.

Trithemis congolica spec. nov., fig. 54 ♀140

♂-Holotype, ♀-allotype, ♀-paratype in the National Museum, Bulawayo.

Except for an extremely slender abdomen and stronger basal coloration on hindwing this is superficially like *basitincta;* it differs in thoracic pattern and is much blacker on abdomen. By anterior lamina it is closer to the generally smaller, less heavily marked *caruncula.*

It is so far known only from the two Congo Republics, hence the specific name.

MALE

CONGO (Kinshasa) (Eala) ♂-holotype: Labium black on posterior lobe and posterior margin, with broad median band on lateral lobes, expanded at anterior ends. Labrum black. Postclypeus broadly dark brown on lower margin. Frons with shallow groove;

dark metallic violet to below crest; vesicle metallic violet. Occipital triangle ferruginous brown, paler posteriorly. Orbits mainly black.

Prothorax mainly black. Synthorax with thick black contiguous fasciae as in the figure; with very slight dorsal white pruinosity. Sternal black well developed. Legs black.

Wings hyaline with blackish venation and trace of apical brown. Pterostigma dark brown between black veins. Forewing with basal amber in subcostal zone halfway to first Ax, in cubital space almost to Cuq and dark amber on the two basal cells in anal field; hindwing dark brown in subcostal space to first Ax and a trace below costa, a trace of amber edged with dark brown in medial space, cubital space dark brown to beyond Cuq, anal field with dark brown and amber fascia as far as end of membranule. Forewing with 14½ Ax.

Abdomen very slender, very slightly widened on segments 6–8; mainly black, with only small yellow spots on basal segments; segment 5 with minute basal dot (only on left, absent on right-hand side); 7 with fine yellow line; 8–9 black, a fine pale dorsal line on 10. Anal appendages black. Anterior lamina robust, with prominent yellow, apical hood, retracted anteriad; few hairs, mostly on inner surface. Hamule very black, with long straight hook, slightly out-turned at the small apex and armed with outer setae. Genital lobe well blackened, distant from hamule, short, with long hair.

Prophallus only well chitinised on base and stem.

Very small flagella; two broad, thinly chitinised cornuti as in *caruncula.*

Abdomen 30 mm, hindwing 33 mm, pterostigma 3 mm.

FEMALE

CONGO (Kinshasa) (Eala) ♀-allotype: Labium with broad band on lateral lobes, expanded anteriorly, but posterior lobe yellow, black in centre; labrum black. Postclypeus with black central band. Frontal groove shallow, the frons dorsally all metallic blue-black, just to the crest. Vesicle ferruginous, metallic violet dorsally. Occipital triangle ferruginous; orbit mainly black.

Prothorax black, the anterior collar yellow-edged, the median lobe with yellow transverse band, posterior lobe yellow-edged. Synthorax more greenish yellow than in male, the black fasciae thinner. Fore femur yellow on inner surface.

Wings entirely as in male but with slightly more apical brown. Forewing with 11½ and 13½ Ax, lower than in male.

Abdomen slightly thicker and with larger yellow fasciae on basal segments; segments 4–7 with single row of slender yellow subdorsal streaks; 8 with minute subbasal dot; segments 9–10 and cerci black. Vulvar lip very nearly straight.

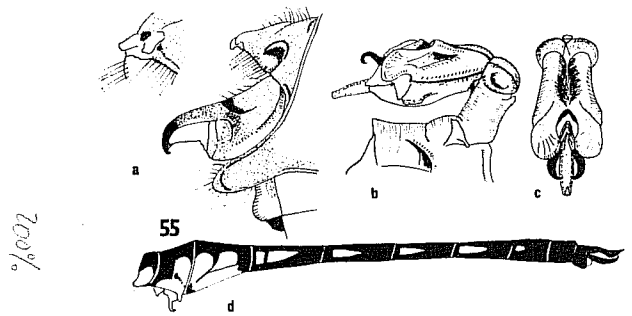
Bursa with dorsal plate very large, irregularly margined, the anterior end short and bifid; posteriorly divided. Two ventral plates completely obscured in dorsal view; curved, widened outwards, constricted on inner edges. Bursal arms broad apically.

Abdomen 30 mm, hindwing 33 mm.

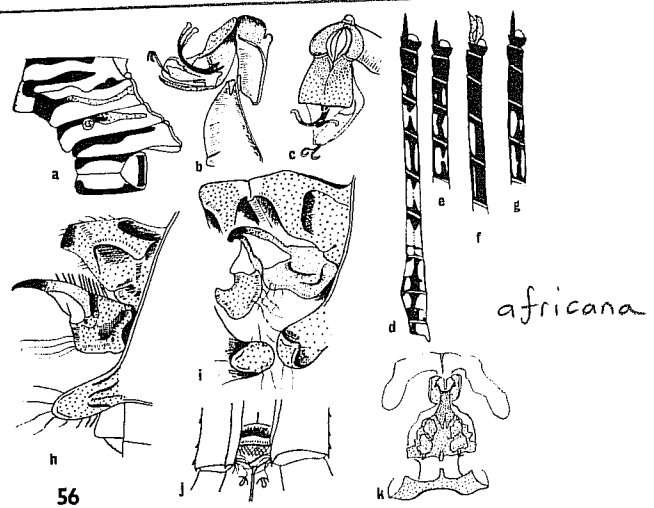
CONGO (Brazzaville): ♀-Paratype from Etoumbi Forest is similar on head, thorax, legs and wings. Forewing with 12½–13½ Ax. Hindwing faintly tinted with amber in postnodal region as well as with the basal fasciae. Abdominal markings slightly different: segment 4 with only a minute basal dash; 5–7 with smaller streaks. It is probably a more aged specimen.

DISTRIBUTION

Congo (Kinshasa) and Congo (Brazzaville).



brydeni



africana

Figs 55–56. *Trithemis* species. 55. *T. brydeni*, male. a—Accessory genitalia (holotype). b–c. Prophallus. d—Abdomen (holotype). 56. *T. africana*. a–c. *T. a. africana*. a—Synthorax (teneral ♀). b–c. Prophallus. d—Abdomen (teneral ♂). e—Abdomen (♀-allotype). f–g. *T. a. tropicana*. f—Immature male (Eala). g—Immature female (Etoumbi Forest). h–j. *T. a. africana*. h–i. Accessory genitalia (Issia). h—Lateral. i—Ventrolateral. j—Vulvar lip. k—*T. a. tropicana*, bursa (Sembe Forest).

brydeni

HABITS

Not seen in life by the author but probably an inhabitant of equatorial forest and shy, like *basitincta*.

GROUP 9. BRYDENI. Includes only a single species.

Trithemis brydeni spec. nov., fig. 55

This is a very black species closely resembling a large *dichroa* in superficial appearance but with a large, almost sickle-shaped hamular hook and a bifid apex to the anterior lamina. By these secondary genitalia it does not belong to Group 6 and since the genital lobe is short and closely approximated to the hamule it cannot be in Group 8 which has long hamular hooks like the new species. It is, in fact, intermediate in these characters between these groups.

A long series of males was collected by the author on reeds on the edge of the dam at Msamfu, Kasama. The species is named in honour of John Bryden of the Agricultural Research Station at Chilanga who not only planned and arranged the entire expedition to North Zambia but also took a very keen interest in the field work and assisted in collecting this black species. No females were seen but in all probability they were lurking either in a nearby swampy, wooded m'shitu or in swamp (dambo) at the further end of the dam.

MALE

ZAMBIA ♂-holotype (mature): Labium broadly black, bright yellow on outer two fifths of each lateral lobe. Labrum black; anteclypeus ochreous with brown transverse stripe, postclypeus brown in centre, yellow at sides. Frons with rather deep groove; broadly black to below crest and with slight violet reflection; vesicle black with steely blue tint. Occipital triangle dark brown, yellowish posteriorly. Orbits black with traces of yellow spots.

Prothorax all black except a narrow yellow edge to the collar. Synthorax dark ferruginous with connected black bands, giving a very dark appearance. Mesepisternum shows traces of a pale ventral stripe and a dorsal yellowish spot. Metasternal pattern broadly blackened. Legs all black.

Wings hyaline, venation and pterostigma black; anterior cross-veins dark red-brown; a trace of dark basal amber in cubital space of forewing; on hindwing a trace below costa, a triangular dark amber zone in cubital to just beyond Cuq and more or less covering three cells in the anal field. Membranule grey brown, white at base. Forewing with 9½–10½ Ax, 8–9 Px.

Abdomen slender, segments 4–5 three times as long as the width of each side; black with yellow pattern as in the figure, segments 4–8 with single row of yellow streaks (bright yellow in life). Anal appendages black. Anterior lamina conical, black, with yellow apex which has two rather uncinate yellow projections; on outer surface the lamina has a few hairs but no setae. Hamule mainly black with a long hook the tip of which is curved in towards the body; no setae. Genital lobe short, black, hirsute, but without setae.

Prophallus with short, incurved cornuti and an extended retinaculum. Vesica rounded, asetose.

Abdomen 27.5 mm, hindwing 32 mm, pterostigma 3.75 mm.

♂-Paratypes (mature) are very similar. Old males have the thorax and abdomen almost

africana

entirely black, the yellowish areas obliterated, and the wings somewhat fumose. The vesicle may have a violet sheen instead of steely blue.

This species differs from *dichroa*, which is also black with a dark amber basal patch on the hindwing, by its larger size and the distinctive features of the accessory genitalia.

DISTRIBUTION AND MATERIAL EXAMINED

All specimens were collected on the dam at Msamfu, 2 miles east of Kasama, Northern Province, Zambia, March 1969. Holotype in National Museum, Bulawayo. Paratypes will be presented to the British Museum (Natural History) and the Transvaal Museum, Pretoria.

GROUP 10. AFRICANA. Includes only a single species.

Trithemis africana (Brauer), fig. 56 p146

Tramea africana Brauer, 1867, *Verh. zool.-bot. Ges. Wien* **17:** 814 (Sierra Leone).
Trithemis tropicana Fraser, 1953, *Revue Zool. Bot. afr.* **48:** 252 (Congo) **syn. nov.**
Trithemis africana: Ris, 1912, *Cat. Coll. Zool. Selys-Longchamps* **14:** 780; Pinhey, 1962c: 268.

Types: *africana* ♂ in Museum Wien; *tropicana* holotype, allotype in Tervuren Museum.

It is not altogether surprising that Brauer placed this species in *Tramea* Hagen. The general facies, with long wings, slender body and large dark fascia on base of hindwing are superficially reminiscent of *Tramea* Hagen (*Trapezostigma* Hagen). In its narrower hindwing and by venation it is nearer to *Zygonyx* Hagen. It is, in fact, by venation and genitalia a true *Trithemis*, although it would be possible, if undesirable, to erect a subgeneric title for it.

FLIGHT: The present author has not seen this species in life but in all probability it must exhibit a well sustained flight, keeping airborne for longer periods than most *Trithemis* which tend to settle frequently. The high nodal index is also significant, giving added strengthening for the longer wings and stronger flight. Longer wings would not necessitate increased nodal cross-veins unless flight is proportionately equal or stronger. For instance, *Urothemis* Brauer have long wings but a low nodal index and they take only very short flights.

SUBSPECIATION: For some time it has appeared to the author that Fraser's *tropicana*, so closely similar, is the more easterly race of *africana*. The type *africana* was from Sierra Leone. It is almost certain that the record of this species for Liberia is *africana* and it has been recorded from Congo (Kinshasa), where *tropicana* was described. Yet all Congo specimens seen by the author are *tropicana*. Fraser's ♀-allotype of *africana* (Congo) was examined at Tervuren Museum in 1964 (Pinhey, 1966: 307) and it is certainly *tropicana*, not *africana*. Specimens of true *africana* have been received from Ivory Coast. Structurally the two are extremely similar.

It therefore seems reasonable to conclude that *tropicana* is the more southerly race of *africana*. The West Dafur record of *africana* has not been seen but if this is *tropicana* then this race is the southerly and easterly one.

Subspecies *africana africana* Brauer

MALE

IVORY COAST (Issia) ♂ (mature, ex T. H. E. Jackson): Labium yellow with black median band as broad posteriorly as the posterior lobe and widened anteriorly along front margins of lateral lobes; labrum black. Face brownish ochreous; postclypeus with black central bar. Frons with shallow groove; dorsally, and the vesicle, all dark metallic violet. Occipital triangle blackish above, ferruginous posteriorly; orbits black with yellow spots.

Prothorax blackish, anterior collar only narrowly yellow. Synthorax ferruginous, but heavily blackened dorsally nearly to first lateral suture and overlaid with thin dark blue pruinosity. Lateral sutures with diffuse black bands. Sternal pattern thinly black anteriorly and laterally, incomplete posteriorly and centrally, but with scarcely any ventral pruinosity. Legs black; fore femur yellow on inner surface.

Wings long, hindwing abnormally narrow across tornal region. Venation black. Pterostigma all dark brown. Forewing with faint amber at base of subcosta and all along cubital space. Hindwing with large dark brown fascia reaching to distal end of triangle, to about fourth or fifth subcostal cross-vein (but less in costal zone), covering most of the anal field and half the anal loop but not reaching the tornus. The brown is darkened in subcostal, median and cubital regions. Wing apices slightly tinged with brown. Membranule pale greyish brown. Forewing with high index, 16½–18½ Ax.

Abdomen long and very slender, all black dorsally, with some pale spots at sides of basal segments; other segments with single row of pale spots but these are obscure. Anal appendages black; superior appendages quite normal. Anterior lamina shaped rather like *anomala*, with broad apex and grooved internally; the mid-central portion paler than the rest. Hamule small, with long, slender straightish hook fringed outwardly with long setae. Genital lobe narrowish, distant from hamule.

Prophallus reminiscent of *pluvialis;* with curved cornuti and with flagella; a broad protective hood.

Abdomen 29 mm, hindwing 34 mm, pterostigma 3.5 mm. Width of sides of abdominal segments 4–6 about a quarter of the segmental length.

Another in the British Museum (Nat. Hist.) from Dalao (Ivory Coast, May 1953) has abdomen 30 mm, hindwing 36 mm.

The single row of abdominal streaks is more prominent in immature examples of subspecies *tropicana* (infra).

FEMALE

As mentioned above the ♀-allotype (Tervuren Museum) designated as "africana" is actually *tropicana*.

IVORY COAST (Issia) ♀-allotype (mature): Labium mainly yellow, the posterior lobe black with yellow centre and a black triangle covering the inner apices of the lateral lobes. Face as in male. Frons above orange, with purplish black basal band narrower than the distance between central and lateral ocelli. Vesicle orange. Occiput black, orange posteriorly. Orbits with the spots more orange.

Prothorax as in male. Synthorax paler than in male and with very little pruinosity; with black bands at sutures and on mesepisternum (as in teneral female, infra). Sternal pattern as in male. Legs with brownish yellow stripes on inner and posterior surfaces of all femora, but shorter on the hind femur.

Wings as in male but with slightly more distinct apical infuscation and increased basal fasciae: on forewing the amber additionally covers the basal part of the anal field;

on hindwing the dark brown fascia is larger and extends to the tornus but does not reach distad as far as the outer edge of the main fascia (as it does in *tropicana*). Forewing with 17½–18½ Ax.

Abdomen broader than in male and not so heavily blackened; showing traces of a double lateral row of reddish yellow streaks, the pattern as in the teneral example (infra), but obscured by melanic suffusion. Segment 8 with red sub-ventral streak and sub-dorsal spot; 9–10 and cerci all black. Vulvar lip rather straight, thick and deep-seated, with a ridge anteriorly to it and long posterior hairs (for bursa see *tropicana*).

Abdomen 29.5 mm, hindwing 34 mm, pterostigma 3.5 mm.

A second female, nearly mature, from Issia has the posterior lobe of the labium almost all yellow and the anterior black triangle much smaller. Basal violet band on frons slightly wider, the vesicle orange tinged with metallic violet. Size similar. Another specimen is teneral. Labium all yellow except for a minute anterior triangle; labrum yellow at lateral angles. Postclypeus brown in centre. Frontal band reduced, vesicle yellow. Prothorax paler. Synthorax with distinct black fasciae as in the figure. Femora yellow with black anterior surface. Wings with dark brown pterostigma, brown wing apices, black venation. Amber and brown basal fasciae all developed as in allotype, but the amber on forewing rather more extensive. The brown on hindwing paler in anal field, darkening distally, with the dark brown of subcosta, medial and cubital fields all strongly developed, contrasting sharply with the remainder of the fascia. Abdomen, as illustrated, with the black much reduced, segments 9–10 all black except a minute orange ventral dash on 9. The double row of lateral orange spots tends to anastomose, even when nearing maturity.

It is noticeable that the black on the lips develops slowly.

Subspecies *africana tropicana* Fraser

This subspecies only essentially differs in the shape of the brown basal fascia on the hindwing, being slightly more extensive in *tropicana*.

MALE

Cameroons (near Yaoundé) ♂ (mature, leg. Lascelles): Lips, face, head, thorax, and legs as in the nominotypical race.

Thorax also suffused with black and dorsal pruinosity. Sternal pattern just as complete.

Wings with venation and pterostigma as in *africana*, the apical brown slightly more distinct but also small. Forewing with pale basal amber in subcostal-costal zone and faintly amber postnodally; cubital space dark amber, some amber in anal field. Hindwing with the deep brown fascia extending to fourth Ax, distal end of triangle, thence down to posterior margin in an almost straight line along the mid-rib of the distal half of the anal loop: thus completely covering the tornal area; this brown deepest in subcostal and cubital spaces. Like the forewing the postnodal zone is faintly amber. Membranule pale grey. Forewing with 17½–18½ Ax.

Abdomen similarly slender, black, with some white dorsal pruinosity on basal segments; segments 5–8 showing one row of fine yellow streaks. Anal appendages black. Accessory genitalia and prophallus as in the typical race.

Abdomen 28 mm, hindwing 34 mm, pterostigma 3.5 mm.

Gabon: A very mature male (Lastoursville, leg. P. C. Rougeot) in the hindwing basal fascia has some of the cells paler centrally; abdominal segments black with the pale streaks almost obliterated; wings all fumose.

Congo (Kinshasa): An immature male from Eala has markings on lips and face fully developed. Thorax yellowish with black bands as in teneral *africana*. Sternal black absent except the posterior transverse bar. Legs as in mature male (not like the female). Wing fasciae all fully developed, the basal brown on hindwing also having cells with paler centres. Abdomen blacker than in teneral female *africana*, with dorsal row of pale stripes on segments 4–7 as in the figure. Anal appendages dark brown. A more teneral male has slightly narrower labial black; labrum with two reddish basal spots; abdomen with the single row of streaks broader. A teneral from Bambesa is similar but the labrum is all black; abdominal streaks finer.

FEMALE

As stated previously a female labelled "allotype" of *africana* in Tervuren Museum is a *tropicana*. There is also, apparently, a true allotype *tropicana* in that Museum.

Congo (Brazzaville) (Etoumbi Forest) ♀ (mature, ex Jackson): Posterior lobe of labium all black, lateral lobes with a long inner triangle, its apex touching the posterior lobe. Labrum black; postclypeus with dark central bar. Frons above with blue-black basal band as broad as the distance between central and lateral ocelli. Vesicle orange.

Thoracic markings typical. Sternal pattern reduced to a short, fine anterior stripe on either side and the posterior band. Legs black; fore and mid femora yellow on inner surfaces.

Wings as in male but more fumose, with thicker brown apices; the brown basal hindwing fascia with scarcely any pale-centred cells and its outer edge slightly distal to the mid-rib of the anal loop. Forewing with 16½ Ax.

Abdomen black with traces of double yellow lateral rows on segments 3–6; segment 7 with one thick streak; 8–10 and cerci black. Vulvar lip as in *africana*. Bursa with dorsal plate irregularly bulbous posteriorly and having areas of thicker chitinisation. Anteriorly the narrower portion of this plate terminates in a U-shaped aperture which has a narrow slit on the dorsal surface where there are two dorsal hood-like or cucullate extensions from the slit. Lip moderately chitinised.

Abdomen 27.5 mm, hindwing 34 mm.

In mature females from Etoumbi Forest the labial black is as broad as in the mature male. Sternal black reduced to the posterior stripe only. In another, possibly less mature, the labial black is reduced to a triangle; sternal black practically absent; yet the vesicle has a metallic violet area on the crest, a case of irregular maturation. Abdomen with the double row of spots on segments 3–7; 8–10 all black. A moderately mature female from Sembe Forest has the violet crest on the vesicle, as in the immature Etoumbi female. Others from Mambili and Mekoum forests have this same feature.

Congo (Kinshasa): One from Eala and also tenerals have the violet on the vesicular crest; the tenerals have narrower labial black; segments 3–7 with double row of streaks; 8–10 all black. In one the labial black is reduced to a black anterior triangle, the posterior lobe all yellow.

Gabon: A Lastoursville specimen is more mature and resembles the first Etoumbi example.

DISTRIBUTION

Subspecies *africana:* Sierra Leone, Liberia, Ivory Coast.
Subspecies *tropicana:* Cameroons, Congo (Brazzaville), Gabon, Congo (Kinshasa).
A West Dafur record has not been examined but perhaps it is *tropicana*.

HABITS

Not seen in life by the author. By slender body and long narrow wings they may be hoverers, with well-sustained flight, probably preferring wide expanses of water; or, perhaps, swamps. The shape of the basal wing fascia suggests also that their flight might be of the fluttering *Rhyothemis* action at times.

MATERIAL

Ivory Coast, Cameroons, Gabon and the two Congos.

BRIEF NOTES ON ORIENTAL SPECIES

Five Oriental species were mentioned in the Historical Review:
T. aurora (Burmeister), the red-bodied type-species, briefly described above (p. 44).
T. festiva (Rambur), one of the black species described above (p. 116) because of dubious African records.
T. kirbyi Selys, also described above (p. 76) because of its Ethiopian affinities; a bright red species.

T. lilacina Förster, 1899, *Ann. Soc. ent. Belg.* **43:** 63 (♂, Sumbawa); Ris, 1912: 766

Type ♂ probably in Ann Arbor, Michigan.
This is a long-winged species, hindwing c. 35 mm, of the red-bodied group with reddish blue pruinosity.

Male: Labrum black; frons above metallic violet. Thorax sparsely marked. Abdomen slender, mainly red; segment 8 black with red spot, 9–10 black. Venation black; wings fumose. Pterostigma and membranule black. A dark brown basal fascia on hindwing. Anterior lamina very rounded, like *stictica;* hamular hook small.
It is found in South East Asia.

T. pallidinervis (Kirby)

Sympetrum pallidinervis, Kirby, 1889, *Trans. Zool. Soc. Lond.* **12:** 327 (India).
?Trithemis dryas Selys, 1891, *Annali Mus. civ. Stor. nat. Giacomo Doria* **30:** 465.
Trithemis pallidinervis Morton, 1907, *Trans. Ent. Soc. Lond.:* 304; Ris, 1912: 789; Fraser, 1936: 389.

♂-Lectotype *pallidinervis* in British Museum (Nat. Hist.).
This is one of the slender-bodied black species, of variable size (hindwing, teste Fraser, 30–36 mm).
Frons and vesicle metallic purple. Thorax with moderate fasciae. Venation reddish; pterostigma black but white at each end. All wings with moderately wide basal amber. Forewing with only 8½ Ax. Abdomen slender, black, with yellow streaks on segments 4–7, sometimes on 8; or 8–10 all black. Anterior lamina rounded but with a well-defined lip; hamular hook small; genital lobe slender.
It is widespread in Asia from Ceylon to the Philippine Islands.
Kimmins (1968) says that Kirby labelled the type series as *Pseudothemis* Kirby.

ACKNOWLEDGEMENTS

I particularly wish to thank D. E. Kimmins for assistance in connection with certain details of types and for permitting the examination of types during the author's visit in 1964. That same year facilities were also readily granted to examine relevant types in the Museums of Berlin, Bruxelles and Tervuren, Edinburgh and Paris. Information as well as specimens have been received from Dr K. Günther (Berlin Museum) and R. M. Gambles and photostats from Dr Oliver S. Flint. All this has helped in producing this revision.

The specialists, amateur or professional, who have provided specimens of this and other genera are also gratefully acknowledged here. Some of these are mentioned in the descriptions of the species. The typing of the manuscript was excellently performed by Mrs. J. Legg. Grateful acknowledgement is made of assistance received from the South African Council for Scientific and Industrial Research.

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Manuscript received September 11, 1969

ADDENDUM

Since this monograph went to press the following paper on Katanga—Zambia Anisoptera has been published: Lieftinck, M. A. 1969. Ononata Anisoptera, in Symoens' *Explor. Hydrobiol. bassin lac Bangweolo et Luapula* **14** (4): 1–64. The two papers were under preparation concurrently. Some correspondence was exchanged on the material involved.

Two new species are described by Lieftinck: *T. aconita* Lieftinck = *caruncula* Pinhey, **syn. nov.;** *T. aequalis* Lieftinck, from Lake Bangweulu, evidently closest to *falconis* Pinhey, but from available information probably distinct.

A *Trithemis* species from Mobeka, Congo, on p. 43 is evidently *T. congolica* spec. nov.

Under *T. atra* Pinhey, Lieftinck indicates the presence of stiff hairs in the mid-femora. Most species exhibit such hairs, varying in length and quantity, whether orange or black. The types of *T. donaldsoni* (Calvert) and *T. ellenbeckii* Förster are described although they are not from this faunistic region.

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