A REDESCRIPTION OF THE ADULTS AND LARVA OF *THAUMALEA SUBAFRICANA* (DIPTERA: THAUMALEIDAE), AND FIRST DESCRIPTION OF THE PUPA[1]

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ABSTRACT: The male, female and last instar larva of *Thaumalea subafricana* from the Canary Islands, Spain, are redescribed and illustrated. The pupa of this species is described and illustrated for the first time, and brief biological notes on the species are provided.

We recently had the opportunity to obtain and study a moderately large series of larvae, pupae, and adults of *Thaumalea subafricana* (Becker). As part of an effort to better elucidate the fauna of the Canary Islands and this species in particular, we redescribe and illustrate its larva and adults, present the first description and illustrations of its pupa, and provide additional biological information. Although Storå (1936) figured and briefly described the larva of this species, both the description and figures are inadequate. We redescribe the larva in greater detail and provide new illustrations to help distinguish it from the larvae of other Palearctic species, and also because the larvae of thaumaleids are generally not well known. We also provide illustrations of the male and female terminalia. Although adults of this species were described by Becker (1908), Bezzi (1913), Edwards (1929), and Lindner (1930), their descriptions and/or illustrations are not fully satisfactory, and undoubtedly were based on fewer specimens than are now available. Therefore, we present these updated descriptions and new illustrations to help make this species better known. In the descriptions we utilize the morphological terminology that was outlined in the *Manual of Nearctic Diptera* (McAlpine 1981, Teskey 1981), and the larval setal numbering system of Saunders (1923). All illustrations were prepared using a Leitz tracing device on a Leitz Ortholux II compound microscope.

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Thaumalea subafricana (Becker)

Figs. 1-17

Orphnephila subafricana Becker, 1908: 70 (male, female) (Orphnephilidae). (Holotype and paratypes not indicated).

Thaumalea subafricana (Becker). Bezzi, 1913: 249 (male, female, fig. 4, distribution); Edwards, 1929: 139 (male, fig. 24, species group, distribution); Lindner, 1930: 14 (male, female, fig. 11s, P1.2 fig. 21, distribution); Storå (in Frey), 1936: 31 (larva, P1.6 figs. 48-49, distribution, ecology); Collart, 1945: 5 (distribution); Schmid, 1958: 4 (species group, distribution); Vaillant, 1963: 26 (male, distribution), 1969: 702 (distribution, species group).

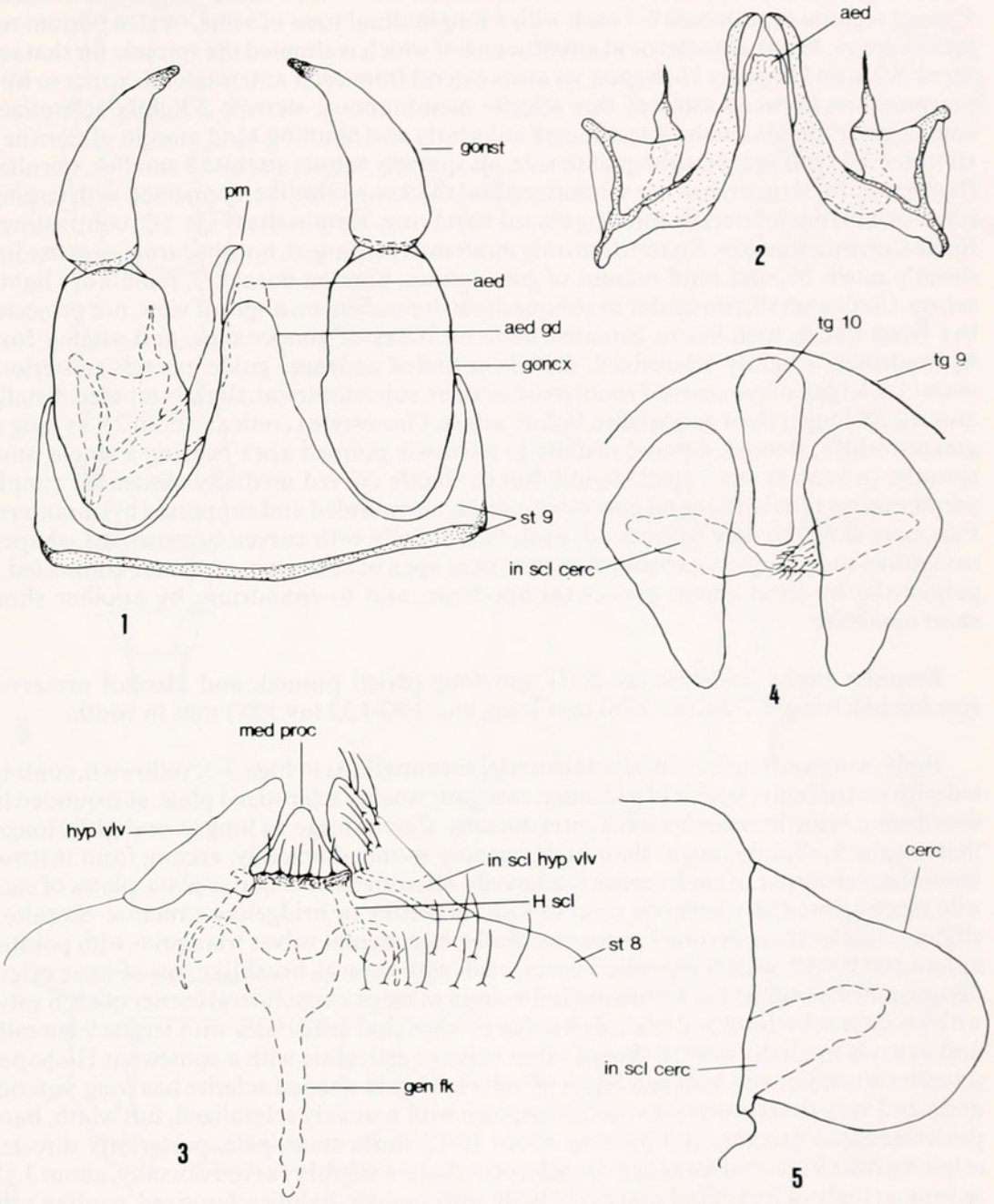
Description

Male: Body, 2.10-3.24 (av 2.51) mm long (dried pinned, and alcohol preserved specimens); wing, 2.76-3.30 (av 2.98) mm long, and 0.96-1.14 (av 1.06) mm in width.

Head: Frons, vertex, and occiput black, evenly but sparsely covered with erect, stiff, black setae; frons small, vertex and occiput prominent; clypeus small, strongly convex, with sparse, erect, black setae, slightly paler than frons and occiput but concolorous with blackish brown antenna and palpus. Scape of antenna reduced; pedicel largest, with sparse short, black setae; flagellum aristate, composed of 8 flagellomeres; first (basal) flagellomere largest, subquadrate but tapered distally, with about 7-10 round sensory pores that are difficult to discern; sometimes basal two flagellomeres weakly or imperfectly separated and appear as one continuous unit. Second flagellomere subconical, with about 4-6 round sensory pores; remaining flagellomeres more cylindrical. Flagellomeres 1, 2, 4, 6, and 8, with long, dark setae at apices, remaining flagellomeres with short setae; proportions of flagellomeres about 17:9:9:9:11:11:9:17 (basal to apical). Palpus with 5 palpomeres, each bearing dark setae; proportions of palpomeres 11:20:38:40:56 (basal to distal), 3rd palpomere without a sensory vesicle.

Thorax: Mostly brown, mottled with patches of both darker and paler color, subshining but varyingly brownish gray microtomentose, generally covered with sparse, mostly erect, short, black setae. Antepronotum visible in dorsal view, consisting of prominent lobe on each side connected by slender, straplike median portion. Postpronotal lobe small, subquadrate to subtriangular. Scutellum prominent, triangular, darker than scutum, with 8-10 black, dorsal, marginal setae; also with 2-8 shorter, finer, more ventral setae along hind rim of scutellum, these highly variable, ranging from 1 to 4 setae on each side but not necessarily in equal numbers on each half. Postnotum strongly convex, concolorous with scutum, bare. Pleuron largely yellowish brown, mottled with darker areas and rather uniformly grayish microtomentose; anepisternal membrane grayish brown, bare; anepimeron with small, but usually distinct, shining callus. Legs slender, generally pale yellowish brown; tarsi slightly darker. Wing distinctly brown, slightly darker in cells c, sc, and bm. Halter long and slender; stem grayish to brownish and only slightly longer than bright yellow knob, both covered with microtrichia, and stem with a row of setae along outer margin which stops at base of knob, and a row of setae along inner margin that continues nearly to tip of knob, knob also with about 4 other irregular, longitudinal rows of setae, at least some of these setae yellow.

Abdomen: Black, shining, hind margins of segments narrowly yellowish or grayish; segments gradually expanded posteriorly to third, fourth and fifth which are widest, then



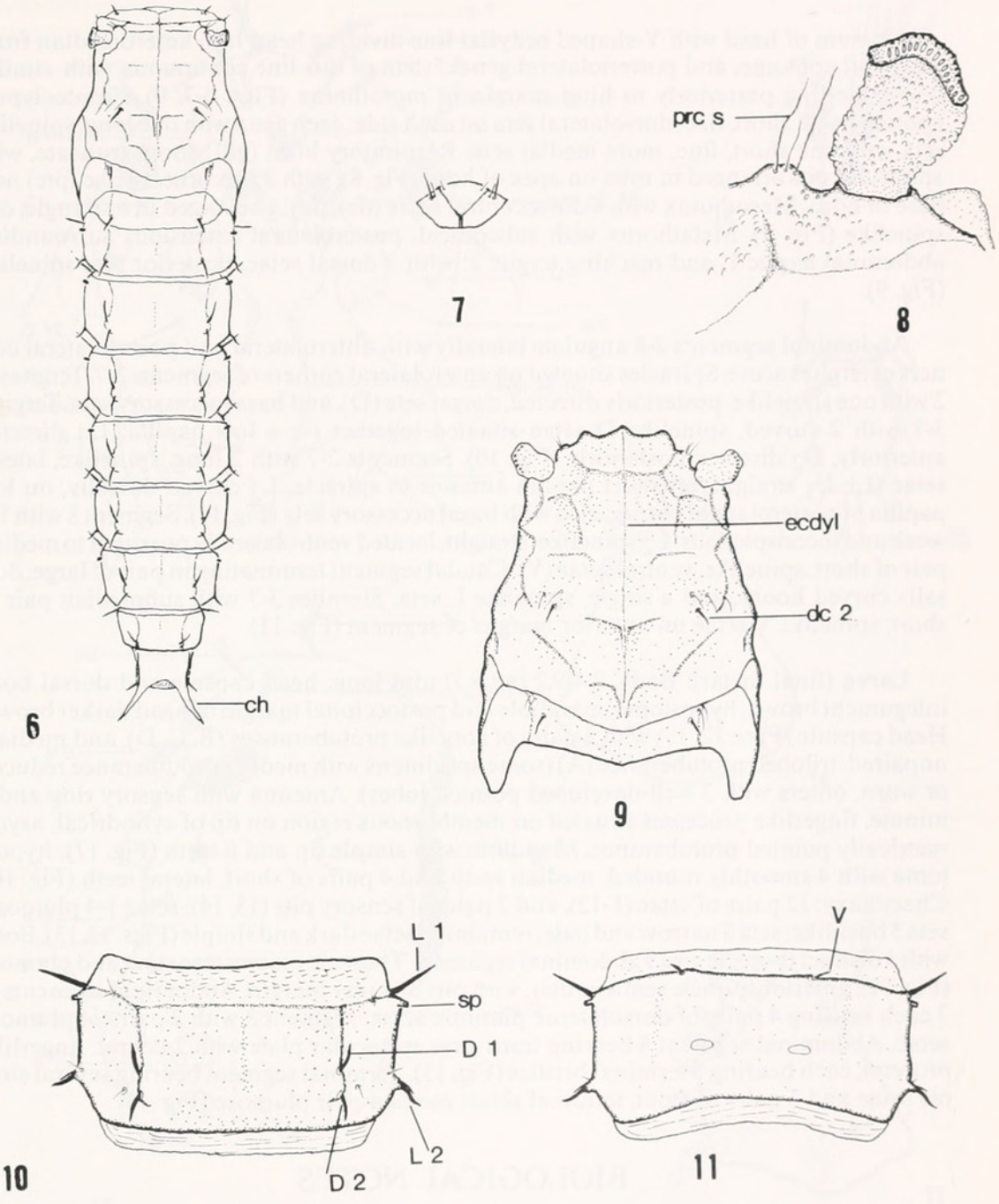
Figs. 1-5. *Thaumalea subafricana.* Adults. Figs. 1-2, Male. 1, Terminalia, ventral view, showing outline of paramere of left side only, setae omitted. 2, Paramere and aedeagus, ventral view. Figs. 3-5, Female. 3, Terminalia, ventral view. 4, Cerci and tergite 10, terminal (end) view, showing sclerites on inner surfaces. 5, Cercus, left lateral view, showing sclerite on inner surface. Abbreviations: aed gd, aedeagal guide; aed, aedeagus; cerc, cercus; gen fk, genital fork (sternite 9); goncx, gonocoxite; gonst, gonostylus; H scl, "H-shaped" sclerite; hyp vlv, hypogynial valve; in scl cerc, sclerite on inner surface of cercus; in scl hyp vlv, sclerite on inner surface of hypogynial valve; med proc, median process; pm, paramere; st, sternite; tg, tergite.

tapered posteriorly; sparsely covered with short, stiff, black setae; tergites sclerotized. Pleural regions of segments 3-7 each with 4 longitudinal rows of setae, next to bottom row set in narrow, brownish sclerite at anterior end of which is situated the spiracle for that segment. Sternite 1 broadly U-shaped, its arms extend from each anterolateral corner to hind margin, area between arms of this sclerite membranous; sternite 2 lightly sclerotized, somewhat triangular with apex directed anteriorly and abutting hind margin of sternite 1; sternites 3-7 rectangular, subequal in size, all sparsely setose; sternite 8 smaller; sternite 9 (hypandrium) slender, heavily sclerotized and thickened rimlike, connected with tergite 9 (epandrium) dorsolaterally forming closed basal ring. Terminalia (Figs. 1-2) contrastingly lighter brownish yellow. Epandrium only moderately enlarged, not obscuring or extending distally much beyond hind margin of gonocoxites, bare on basal 1/3, remainder lightly setose. Cercus small, triangular to subquadrate depending on angle of view, not projected but lying flat in membrane. Situated between bases of gonocoxites, and arising from hypandrium, a lightly sclerotized, distally rounded aedeagal guide extends posteriorly about 1/2 length of paramere. Gonocoxite slender, subcylindrical, slightly tapered distally, about 2.5X longer than gonostylus, lightly setose. Gonostylus conical, about 2X as long as greatest width, slender, tapered distally to narrowly pointed apex bearing a single, stout spinule; in ventral view, apex slightly but distinctly curved medially. Aedeagus simple, membranous tube with round gonopore; closely surrounded and supported by parameres. Paramere stout, heavily sclerotized; each half distally with curved, somewhat L-shaped, troughlike rod obliquely expanded distally near apex of aedeagus; paramere connected to gonocoxite by short, stout, gonocoxal apodeme, and to epandrium by another short, stout apodeme.

Female: Body, 2.40-3.60 (av 2.97) mm long (dried pinned, and alcohol preserved specimens); wing, 2.7-3.6 (av 3.26) mm long, and 1.02-1.32 (av 1.17) mm in width.

Body, wing and legs essentially as in male. Terminalia as in Figs. 3-5; yellowish, contrasted with rest of body; tergite 10 a slender, elongate, weakly sclerotized plate, surrounded by membrane, lying between bases of cerci dorsally. Cercus large, as long as or slightly longer than tergite 9, slightly longer than high, broadly rounded apically; arising from internal anterolateral corner of each cercus is a heavily sclerotized, triangular plate, plates of each side meeting medially between cerci to form bracelike or bridgelike structure. Sternite 8 slightly smaller than sternite 7, setose medially; hypogynial valves triangular with pointed apices and broad, widely separated bases, each with ventral, brushlike row of setae extended posteriorly and set back from medial margin of valve; dorsolateral corner of each valve with an internal sclerotized plate or barlike process that articulates with tergite 9 laterally and extends medially toward that of other valve to articulate with a somewhat H-shaped sclerite situated at and between bases of valves. This H-shaped sclerite has long anterior arms and very short posterior arms; crosspiece with a weakly sclerotized, full width, bare, posteromedian process, and bearing about 10-12 short, stout, pale, posteriorly directed setae. Sternite 9 (genital fork) heavily sclerotized, stem slightly curved dorsally, about 3.5X as long as body of fork; hind margin of body with slender, lightly sclerotized, median process that is almost 1/2 as long as body of fork, and each posteriolateral corner with long, slender, recurved arm.

Pupa: Length 3.2-4.2 (av 3.7) mm. Subcylindrical, broadest across posterior part of mesothorax; only slightly attenuated toward broadly rounded anterior end and evenly tapered toward posterior end; no constriction between head and thorax, or between thorax and abdomen. Wing sheaths extend to posterior margin of abdominal sternite 2, leg sheaths extend slightly beyond wing sheaths.



Figs. 6-11. *Thaumalea subafricana.* Pupa. 6, Habitus, dorsal view. 7, head capsule, posterodorsal view. 8, Thoracic respiratory horn (gill). 9, Thorax, dorsal view. 10, Abdominal tergite 4. 11, Abdominal sternite 4. Abbreviations: ch, caudal hook; D, dorsal seta; dc, dorsocentral seta; ecdyl, ecdysial line; L, lateral seta; prc s, precorneal seta; sp, spiracle; V, ventral seta.

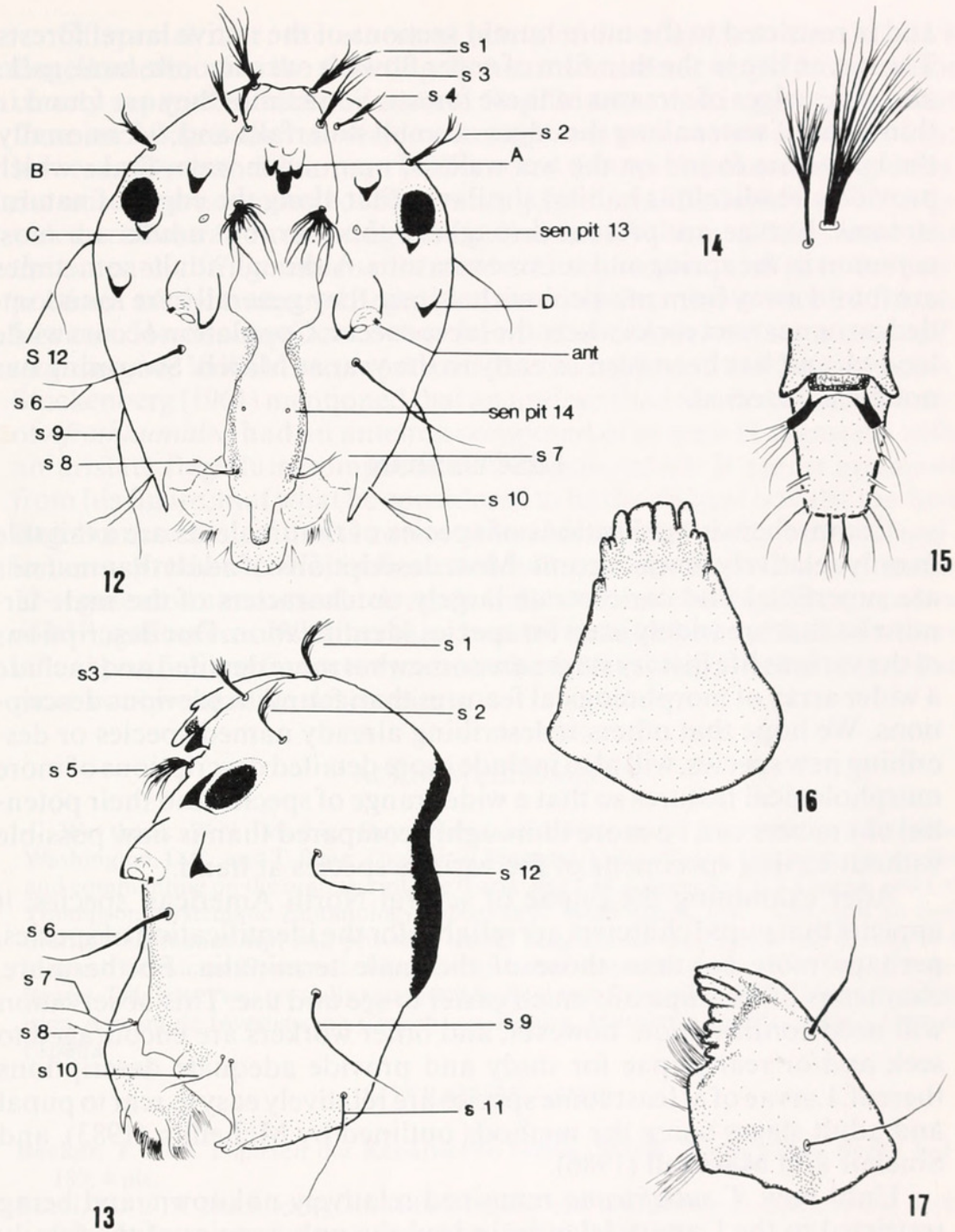
Dorsum of head with Y-shaped ecdysial line dividing head into anteromedian frontoclypeal apotome, and posteriolateral genae; stem of this line continuous with similar one extending posteriorly to hind margin of mesothorax (Figs. 6-7, 9). Frontoclypeal apotome with short, fine, dorsolateral seta on each side; each gena with one long, spinelike seta, and one short, fine, more medial seta. Respiratory horn (gill) short, truncate, with spiracular pits arranged in rows on apex of horn (Fig. 8); with 3 precorneal setae (prc) near base of horn. Mesothorax with 4 dorsocentral setae (dc), dc_{1-3} arranged in a triangle, dc_2 spinelike (Fig. 9). Metathorax with subconical, posterolateral extensions surrounding abdominal tergite 1, and reaching tergite 2; with 3 dorsal setae, posterior seta spinelike (Fig. 9).

Abdominal segments 2-8 angulate laterally with anterolateral and posterolateral corners of tergites acute. Spiracles situated on anterolateral corners of segments 2-7. Tergites 1-2 with one spinelike, posteriorly directed, dorsal seta (D), and basal accessory seta. Tergites 3-7 with 2 curved, spinelike D setae situated together on a low papilla; D_1 directed anteriorly, D_2 directed posteriorly (Fig. 10). Segments 2-7 with 2 long, spinelike, lateral setae (L); L_1 straight, on short papilla anterior to spiracle, L_2 curved dorsally, on low papilla at posterolateral corner, also with basal accessory seta (Fig. 11). Segment 8 with D_2 weak and inconspicuous; L_2 spinelike, straight, located ventrolaterally proximal to median pair of short, spinelike, ventral setae (V). Caudal segment terminating in pair of large, dorsally curved hooks, and a single, spinelike L seta. Sternites 3-7 with submedian pair of short, spinelike V setae on anterior margin of segment (Fig. 11).

Larva (final instar): Body, 7.4-9.2 (av 8.3) mm long; head capsule and dorsal body integument brown, hypostoma, mandible and postoccipital margin of head darker brown. Head capsule (Figs. 12, 13) with 3 pairs of conelike protuberances (B, C, D), and median, unpaired, trilobed protuberance (A) (some specimens with median protuberance reduced or worn, others with 3 well-developed pointed lobes). Antenna with sensory ring and 3 minute, fingerlike processes situated on membranous region on tip of cylindrical, asymmetrically pointed protuberance. Mandible with simple tip and 6 teeth (Fig. 17); hypostoma with 4 smoothly rounded, median teeth and 4 pairs of short, lateral teeth (Fig. 16). Chaetotaxy: 12 pairs of setae (1-12), and 2 pairs of sensory pits (13, 14); setae 1-4 plumose; seta 5 bushlike; seta 8 narrow and pale, remaining setae dark and simple (Figs. 12, 13). Body with 3 distinct thoracic and 9 abdominal segments. Thoracic macrosetae stout and plumose (Fig. 14); anterior spiracle semicircular, with pits on outer margin. Abdominal segments 1-7 each bearing 4 pairs of dorsolateral, plumose setae; segment 8 with 2 pairs of plumose setae. Abdominal segment 8 bearing transverse spiracular plate with 2 lateral, fingerlike procerci, each bearing 5 terminal bristles (Fig. 15). Terminal segment bearing several simple setae and 3 pairs of stout, terminal setae; median pair plumose (Fig. 15).

BIOLOGICAL NOTES

The latitude and the prevailing trade-wind circulation gives the lower elevations of the Canary Islands, especially the low eastern islands, a mainly semi-arid character, while in the mountainous western islands a greater variety of habitats and a forest belt occurs at the middle elevations (Höllermann 1981). The average air temperatures of these forests vary between 11° and 20°C, depending on the season. *Thaumalea subafricana* has been found on the islands of Tenerife, Gran Canaria, and LaPalma,



Figs. 12-16. *Thaumalea subafricana*. Larva. 12, Head Capsule, front view. 13, Head capsule, lateral view. 14, Plumose macrosetae of thorax. 15, Terminal abdominal segments. 16, Hypostoma. 17, Mandible, outside surface. Abbreviations: A, Unpaired, trilobed protuberance; ant, antenna; B,C,D, paired, conelike protuberances; s, seta (1-12); sen pit, sensory pit (13, 14).

and is restricted to the more humid sections of the native laurel forests. The larvae live in the thin film of water flowing over smooth, bare, rocks along the edges of streams in these forests. Sometimes they are found in thin films of water along the edges of small waterfalls and, occasionally, the larvae are found on the wet walls of man-made water tanks which provide a madicolous habitat similar to that along the edges of natural streams. Larvae are present throughout the year, but adults are most common in the spring and summer seasons. Although adults sometimes are found away from madicolous habitats, they generally are found settled on or near wet rocks where the larvae occur. Copulation occurs while landed, and has been seen as early in the year as March. Swarming has not been observed.

DISCUSSION

Comprehensive collections of species of thaumaleids are available in only relatively few museums. Most descriptions of adult thaumaleids are superficial and concentrate largely on characters of the male terminalia that are widely used for species identification. Our descriptions of the various life history stages are somewhat more detailed and include a wider array of morphological features than found in previous descriptions. We hope that others redescribing already named species or describing new species, will also include more detailed descriptions of more morphological features so that a wider range of species and their potential characters can be more thoroughly compared than is now possible without having specimens of the various species at hand.

After examining the pupae of several North American species, it appears that pupal charcters are reliable for the identification of species, perhaps more so, than those of the male terminalia. Furthermore, characters of the pupa are much easier to see and use. This observation will need confirmation, however, and other workers are encouraged to seek and/or rear pupae for study and provide adequate descriptions thereof. Larvae of at least some species are relatively easy to rear to pupal and adult stages using the methods outlined by McLellan (1983), and Sinclair and Marshall (1986).

Until now, *T. subafricana* remained relatively unknown, and being restricted to the Canary Islands, indeed the only species of the family presently known there, has made it relatively unavailable for investigation. Bezzi (1913), Edwards (1929), and Lindner (1930) provided descriptions of *T. subafricana,* and some other authors have mentioned this species, in one way or another, in print. The references cited in the synonymy are not intended to represent a complete bibliographic listing for this species, but do constitute the most important references to this species.

Of special note, the antennal arista of *T. subafricana* consists of 8 flagellomeres with the first flagellomere sometimes imperfectly or not clearly separated from the second flagellomere making it appear that there are 7 flagellomeres. Very few descriptions even mention the antenna; however, Dyar and Shannon (1924) noted that for the American species, the arista was composed of 10 distinct 'joints', and Enderlein (1936) provided an illustration showing 10 flagellomeres. Vaillant (1959) stated that the antenna of *T. americana* Bezzi was 12 segmented, and gave the proportions of the antennal segments showing that there were 10 flagellomeres. He also mentioned that the number of antennal segments in *T. thornburghae* Vaillant was most variable, having from 5 to 8 flagellomeres. Stuckenberg (1961) mentioned that an undescribed South African species of *Afrothaumalea* had an antenna composed of at least 11 segments with an aristate flagellum composed of 9 flagellomeres. It seems apparent from his figure, that what he considered to be the pedicel is really the first flagellomere and, if this is correct, then his species really has 10 flagellomeres. Brothers (1972) indicated that *T. santaclaraensis* Brothers had a 12-segmented antenna which again indicates that the flagellum consists of 10 flagellomeres. Whether this character is highly variable, or whether it has specific significance remains to be determined, another reason for more comprehensive descriptions.

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