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## Taxonomic study of the genus *Colotis* Hubner, (1819) (Lepidoptera: Pieridae) from India

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### Abstract

In this present work, six species of butterflies of genus *Colotis* Hubner (commonly called as Arabs) are redescribed based on morphological characters, male and female genitalia and compared. The distribution of each species from India has also been given. The diagnosis of genus *Colotis* has been updated adding genitalic attributes.

**Keywords:** *Colotis*, male genitalia, female genitalia, genus, species, distribution

### Introduction

The genus *Colotis* commonly called as orange tips or Arabs, was reported by Hubner in 1819 with *Papilio amata* Fabricius as its type species. This genus comprises 49 species and is widely distributed in the Afrotropical region and in Asia (Mal and Memon, 2013) [6]. From India, 7 species of this genus have been reported i.e. *Colotis amata* (Fabricius), *Colotis danae* (Fabricius), *Colotis etrida* (Boisduval), *Colotis eucharis* (Fabricius), *Colotis fausta* (Olivier), *Colotis vestalis* (Butler) and *C. protractus* Butler. The genus *Colotis* has been studied by various eminent workers like Butler (1897) [2], Bingham (1907) [1], Evans (1932) [4], Talbot (1939) [8], Chowdhury and Soren (2009) [3], Mal and Memon (2013) [6] and Harinath *et al.* (2016) [5]. During present studies the detailed male and female genitalic characters of six species have been studied.

### Materials and Methods

During present research work the specimens of genus *Colotis* were studied from the collections lying in the National Museum, Zoological Survey of India, Kolkata. The images of dorsal and ventral sides of the specimens were obtained with a digital camera (Nikon D7000 18-105 mm). The dissections of genitalia have been done by adopting the method proposed by Robinson (1976). The photography of the male and female external genitalia has been done by using Leica binocular microscope equipped with a photographic unit.

### Observations and Discussion

#### Genus *Colotis* Hubner, (1819)

Common name: Orange Tips

*Colotis* Hubner, (1819); *Verz. bek. Schmett.* (7): 97.

*Aphrodite* Hubner, (1819); *Verz. bek. Schmett.* (6): 95.

*Idmais* Boisduval, 1836 [5]; *Hist. nat. Ins., Spec. gen. Lepid.* 1: 584.

*Callosune* Doubleday, (1847); *Gen. diurn. Lep.* (1): 57.

*Anthopsyche* Wallengren, 1857; *K. svenska VetenskAkad. Handl.* 2(4): 10.

*Thespia* Wallengren, 1858; *Ofvers. Vet. Akad. Forh.* 15: 77.

#### Type species: *Papilio amata* Fabricius, 1775

*Papilio amata* Fabricius, 1775; *Syst. Ent.*: 476.

**Diagnosis:** Forewing veins R<sub>4</sub> and R<sub>5</sub> originates from a point. Male genitalia with uncus undivided, downcurved from lateral view, in dorsal view Y-shaped; aedeagus with highly arched proximal part of suprazone, bears thecal appendage, saccus long. Female genitalia with large appendix bursae, signum present, apophysis anterioris short, developed.

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**Key to species of the genus *Colotis* Hubner**

1. Ground color of both the wings not white.....2
  - Ground color of both the wings white.....3
2. Forewing dorsal side with small black spot at the tornus in area Cu<sub>2</sub>; valve with somewhat straight costal margin.....*amata* (Fabricius)
  - Forewing dorsal side without small black spot at the tornus in area Cu<sub>2</sub>; valve with concave costal margin.....*fausta* (Olivier)
3. Forewing dorsal side with broad orange apical patch enclosed by narrow black inner edge; saccus sinuous.....*etrida* (Boisduval)
  - Forewing dorsal side without orange apical patch. Saccus not sinuous.....4
4. Forewing dorsal surface with black apex enclosing two submarginal creamish-white spots, saccus long, inclined, not sinuous.....*vestalis* (Butler)
  - Forewing dorsal side without creamish-white spots.....5
5. Forewing dorsal side with broad crimson red apical patch; saccus small; narrow, not sinuous.....*danae* (Fabricius)
  - Forewing dorsal side with broad orange apical patch without black inner edge; saccus small, broad, sinuous.....*eucharis* (Fabricius)

***Colotis amata* (Fabricius, 1775)**

Common name: Small Salmon Arab

- Papilio amata* Fabricius, 1775; *Syst. Ent.*: 476.  
*Papilio cypraea* Fabricius, 1787; *Mantissa Insectorum* 2: 22.  
*Teracolus carnifer* Butler, 1876; *Proc. Zool. Soc. Lond.*:138.  
*Teracolus kennedii* Swinhoe, 1884; *Proc. Zool. Soc. Lond.*:440.  
*Teracolus amatus* Butler, 1897<sup>[2]</sup>; *Ann. Mag. nat. Hist.* 20: 388.

**Adult (Male) (PLATE-01):** Forewing dorsal surface with salmon orange ground color; costa thick dark black joins black spot at the end cell; apex thick black; 5-6 ground color submarginal spots upto vein Cu<sub>2</sub>; black small spot at the tornus in area Cu<sub>2</sub>. Ventral surface with yellowish-green ground color; dorsum orcheous colored; maculation as on the dorsal surface. Hindwing with dorsal surface salmon-orange; costa with androconial patch; dark black margin forming 5 spots; dorsum dusted with black scales. Ventral surface yellowish-green, dusted with black scales.

**Adult (Female) (PLATE-02):** Forewing maculation as in male. Series of marginal and submarginal spots of ground color. Hindwing dorsal surface without androconial patch at the costa; dorsum little dusted with black scales.

**Wing expanse:** 30-45mm.

**Male Genitalia:** Uncus well sclerotized, robust, Plate 1 blunt tip bent downwards, broader base, slightly shorter than tegumen, Y- shaped from dorsal view; tegumen in dorsal view anteriorly more sclerotized and broad, posteriorly narrow; vinculum longer than tegumen, slightly curved; saccus very long, narrow, distal end robust, swollen and rounded; juxta V- shaped with arms flattened; valva with apex moderately broad, proximally narrow, costa oblique, distal tip rounded, apical and marginal area ornamented with dense small sized setae; appendices angulares small, sclerotized; subscaphium transparent; aedeagus slender, curved, ventrally placed thecal appendage, the latter small and rounded, subzone much smaller than suprazone, ductus ejaculatorius enters dorsally, apical area of aedeagus bears cornuti.

**Female Genitalia:** Corpus bursae rounded, signum narrow, slightly

constricted in the middle, with spines; appendix bursae balloon-like, well separated from corpus bursae; ductus bursae much longer; papilla analis somewhat rounded, pilosed; posterior apophysis sclerotized, narrow, rod-like; anterior apophysis smaller than posterior apophysis, genital plate bilobed, each lobe sac-like, oval with median hairy patch.

**Material examined:** ZSI, Kolkata, National Museum Collections. 1♀, 31.i.1971, Karian Shola, Coimbatore, (Coll. K.S. Pradhan); 1♀ 28.viii.2013, Kolhapur, Maharashtra, (Coll. K. Chandra & B. Mitra); 1♂, 31.viii.2013, Sindhudurg, Maharashtra, (Coll. B.Mitra); 1♂, 19.ix.2016, Moti Daman, (B.Mitra); 1♂, 21.ix.2016, Dadra-Nagar Haveli, (Coll. B.Mitra), 2♂, 13-19.vii.2017, Thane, Maharashtra, (Coll. P.C.Pathania); 1♂, 23.3.2018, Sagar island, Sunderbans, West Bengal, (A. Das).

**Distribution India:** Maharashtra, Karnataka, Andhra Pradesh, Gujarat, Odisha, Delhi, Goa, Tamil Nadu, Rajasthan.

**Elsewhere:** Sri Lanka, Africa, Rhodesia, Botswana, Madagascar.

**Remarks:** *Colotis amata* (Fabricius) is a species distributed in the above mentioned localities at the altitude of 1200 m. Bingham (1907)<sup>[1]</sup> explained the external morphology of both the sexes of *C. amata* including two different forms of females and their distribution but it is clearly mentioned that this concerned species is not found in West Bengal. Evans (1932)<sup>[4]</sup> devised a key for *C. amata* and its subspecies and reported the presence of *C. amata modesta* from West Bengal. Talbot (1939)<sup>[8]</sup> described it as *Colotis calais* (Cramer) including its subspecies and distribution. Chowdhury and Soren (2009)<sup>[3]</sup> reported the reoccurrence of *Colotis amata* in the saline localities of West Bengal after 70 years. Mal and Memon (2013)<sup>[6]</sup> described *C. amata* in detail with external morphological characters and male and female genitalic characters. In this present work, *C. amata* is compared with *C. fausta* and *C. vestalis* and it has been observed that the genitalic attributes of *C. amata* and *C. vestalis* are similar with slight differences. In both the species, the valve is broad proximally with narrow distal end but in *C. amata* it is slightly broad. The saccus is long and aedeagus arched with small rounded thecal appendage in both the species but the distal end of saccus is swollen in *C. amata* and narrow in *C. vestalis*. In *C. amata*, the uncus is slightly broad and curved downwardly whereas in *C. vestalis*, the dorsal margin of the uncus is slightly humped and the distal tip bent downwardly.

***Colotis fausta* (Olivier, 1804)**

Common name: Large Salmon Arab

- Papilio fausta* Olivier, 1804; *Voy. L'Emp. Othoman. Atl.* 4: 29.  
*Teracolus tripuncta* Butler, 1868; *Proc. zool. Soc. Lond.* (1): 221.  
*Teracolus rosaceus* Butler, 1876; *Proc. zool. Soc. Lond.*: 134.  
*Teracolus fausta* Butler, 1897<sup>[2]</sup>; *Ann. Mag. nat. Hist.* 20: 498.  
*Colotis fausta* Korb & Bolshakov, 2011; *Eversmannia Suppl.* 2: 26.

**Adult (Male) (PLATE-03):** Forewing dorsal surface salmon-orange; costa thick black; base sprinkled with black scales; apex black with marginal and submarginal spots of ground color; submarginal spots larger than marginal spots; large black spot at the end cell. Ventral surface brownish-orange; costa blackish; macular submarginal bar; dark black discocellular spot. Hindwing dorsal surface salmon-orange; costa and inner margin pale; black marginal spots on the veins. Ventral surface brownish-orange; yellow discocellular spot ringed with brown; macular post-discal bar.

**Wing expanse:** 50-55mm.

**Male Genitalia:** Uncus undivided, in lateral view broad at the base, narrow towards blunt tip, sclerotized, bent downwards, Y-shaped from dorsal view; tegumen broader and longer than uncus, well sclerotized, somewhat triangular; vinculum slightly incurved, broad towards tegumen, sclerotized, saccus sinuous, longer than tegumen,

rounded distal tip; appendices angulares broad towards tegumen, narrow towards valva; latter oblique in orientation, proximally broad, narrow and truncate towards distal tip, apex narrow, costa slightly concave, marginal area hirsute with small setae, apex slightly protrudes beyond uncus; aedeagus broad, rounded, arched, subzone much smaller than suprazone, thecal appendage ventral, rounded, ductus ejaculatorious enters dorsally, vesica apical with cornuti.

**Material examined:** ZSI, Kolkata, National Museum Collections. 3♂, 16.iv.1909, Hamirpur; 1♂, 25.i.2004, Pulladigunta, Guntur, Andhra Pradesh, (Coll. Maulik); 1♀, 26.i.2004, Nallapadu, Guntur, Andhra Pradesh, (Coll. Maulik); 1♂, 27.i.2004, Chilkaluripet, Guntur, Andhra Pradesh, (Coll. Maulik).

**Distribution India:** Rajasthan, Karnataka, Maharashtra, Telangana, Andhra Pradesh, Tamil Nadu, Gujarat, Delhi.

**Elsewhere:** Syria, Baluchistan, Sri Lanka, Turkey, Israel, Afghanistan, South Arabia, North Somalia.

**Remarks:** *Colotis fausta* (Olivier) is a common species in the above mentioned localities. Moore (1881)<sup>[7]</sup> described the male external morphological characters of this species as *Idmais tripuncta*. Butler (1897)<sup>[2]</sup> described the distributional range seasonal forms of the concerned species under genus *Teracolus*. Bingham (1907)<sup>[1]</sup> discussed about the special and roconial scales in males of *C. fausta*. Evans (1932)<sup>[4]</sup> devised a key for *C. fausta* and its subspecies on the basis of their morphological features Talbot (1939)<sup>[8]</sup> described its morphological features and distribution including its subspecies. In this present work, the morphological characters, genitalic attributes and distribution of *C. fausta* have been studied. The wing expanse of *C. fausta* is 50-55 mm which is largest among all the discussed species of this genus. The genitalic attributes of this species have been studied, illustrated and compared with other species of the genus for the first time. In *C. fausta*, the valve is different from other species belonging to this genus. The costa of the valve is strongly concave and the apical tip is narrow and rounded as compared to other species of this genus.

#### ***Colotis etrida* (Boisduval, 1836)<sup>[5]</sup>**

Common name: Little Orange Tip

*Anthocharis etrida* Boisduval, 1836; *Hist. nat. Ins., Spec. gen. Lepid.* 1: 576.

*Teracolus pernotatus* Butler, 1876; Plate 1 *Proc. zool. Soc. Lond.* 159.

*Teracolus farrinus* Butler, 1876; *Proc. zool. Soc. Lond.* 159.

*Teracolus purus* Butler, 1876; *Proc. zool. Soc. Lond.*: 160.

*Teracolus casimirus* Butler, 1876; *Proc. zool. Soc. Lond.*: 161.

*Teracolus etrida* Butler, 1897<sup>[2]</sup>; *Ann. Mag. nat. Hist.* 20: 456.

**Adult (Male) (PLATE-04):** Forewing dorsal surface white; apex black enclosing large orange colored patch; black bar arising from vein Cu<sub>2</sub> and reaches upto costa lining the inner edge of orange patch; very small discocellular black spot. Ventral surface white with greenish-yellow base; apex sulphur-yellow; small discocellular black spot more prominent. Hindwing dorsal surface white with black marginal spots; obsolete discocellular spot. Ventral surface white; discocellular spot more prominent and dark; margin sulphur-yellow.

**Adult (Female) (PLATE-05):** Forewing dorsal surface white; black scales dusted on base; thick black apex; thick black bar arising from tornus and reaches upto costa enclosing narrow orange patch; small discocellular black spot. Ventral surface white with greenish-yellow base; apex orcheaceous yellow. Hindwing dorsal surface white; large marginal black spots. Ventral surface white, little dusted with black scales; small dark black spot at the end cell; post-discal bar of discontinuous black spots; yellowish-green margin.

**Wing expanse:** 35-45mm.

**Male Genitalia:** Uncus narrow, finger-like downcurved oriented,

sclerotized, broader at the base, blunt tip, Y- shaped from dorsal view; tegumen well sclerotized, longer than uncus, anterior slightly broad, posterior narrow, triangular from lateral view; vinculum sclerotized, straight, slightly curved towards saccus; saccus very long wavy, blunt distal end; appendices angulares narrow, stumpy, sclerotized; juxta V- shaped, arms narrow; valva broad, apex broadly rounded, costa oblique marginal area ornamented with setae; aedeagus long, curved, broad, rounded, subzone much shorter than suprazone, suprazone bifid, curved upwards, thecal appendage small, rounded; ductus ejaculatorious entering dorsally, vesica apical with long cornuti.

**Female Genitalia:** Corpus bursae almost rounded, signum small, sclerotized, margins ornamented with spines, appendix bursae transparent, ballon-shaped, ductus bursae longer, slightly sclerotized, curved, papilla analis with small to medium sized hairs, posterior apophysis sclerotized, slightly longer than anterior apophysis, latter with blunt distal tips, genital plate bilobed, densely setosed.

**Material examined:** ZSI, Kolkata, National Museum Collections. 1♂, ix.1913, Mussoorie; 1♂, 17.iv.1916, Sukha, Nainital; 1♂, 17.iv.1917, 1♂, 19.iv.1917, Sagar range, Nainital; 1♂, 2♀, 16.iv.1909, Hamirpur, (Coll. Dr. N. Sharma); 1♂, 11.i.1971, Nilgiri Hills, (Coll. K.S. Pradhan); 1♀, 27.i.1971, Coimbatore, (Coll. K.S. Pradhan); 2♂, 26.i.2004, Amaravathi, Guntur, Andhra Pradesh (Coll. Maulik); 2♀, 29.i.2004, Puturpalli, Guntur, Andhra Pradesh, (Coll. Maulik); 1♂, 2♀, 3.iii.2005, Kadapa, Andhra Pradesh, (Coll. Maulik); 1♂, 1♀, 6.iii.2005, Belapalle, Andhra Pradesh, (Coll. Maulik).

**Distribution India:** Rajasthan, Karnataka, Maharashtra, Telangana, Andhra Pradesh, Tamil Nadu, Gujarat, Kerala, Madhya Pradesh, Delhi.

**Elsewhere:** Sri Lanka.

**Remarks:** *Colotis etrida* (Boisduval) is a common species in the above mentioned localities. Butler (1897)<sup>[2]</sup> reported it as *Teracolus etrida* and compared it with its WSF, intermediate form and DSF and also described its distribution within India. Bingham (1907)<sup>[1]</sup> described its morphological characters. Evans (1932)<sup>[4]</sup> devised a key for *C. etrida* and its subspecies on the basis of their morphological features. Talbot (1939)<sup>[8]</sup> described the morphological characters of *C. etrida* including its subspecies. Mal and Memon (2013)<sup>[6]</sup> discussed the male and female genitalia of *C. etrida* with illustrations. Harinath *et al.* (2016)<sup>[5]</sup> observed that the specimens reported from humid localities of Eastern Ghats of Southern Andhra Pradesh possess large terminal black spots. In this present work, the morphological and genitalic characters of *C. etrida* have been compared with *C. eucharis* and *C. danae*. It has been observed that *C. etrida* is morphologically similar to *C. eucharis*. In both the species, the wings are white with orange apical patch and the wing expanse of both species is 35-45 mm. The apical orange patch is slightly narrow and inner edge of the patch is bordered with black in case of *C. etrida*. In *C. eucharis*, the orange apical patch is slightly broad and the black border lining the inner edge of the patch is absent. In *C. etrida*, very small discocellular spots are present on both sides of both the wings but these spots are more prominent on the ventral side and the black marginal spots are present on the dorsal side of hindwing whereas in *C. eucharis*, the small discocellular spot is present on the ventral side of the hindwing. The genitalic attributes shows remarkable differences. In *C. etrida*, the uncus is narrow, valve with distal end broadly rounded, saccus long and sinuous, juxta V-shaped with long and narrow arms and aedeagus with small and rounded thecal appendage whereas in *C. eucharis*, the uncus is slightly broad, valva somewhat squarish, saccus small, juxta V-shaped with small and broad arms and aedeagus with hook-shaped thecal appendage.

#### ***Colotis vestalis* (Butler, 1876)**

Common name: White Arab



*Teracolus vestalis* Butler, 1876<sup>[2]</sup>; *Proc. zool. Soc. Lond.*: 135.  
*Teracolus puellaris* Butler, 1876<sup>[2]</sup>; *Proc. zool. Soc. Lond.*:136.  
*Teracolus intermissus* Butler, 1883; *Proc. zool. Soc. Lond.*:152.  
*Teracolus rorus* Swinhoe, 1884; *Proc. zool. Soc. Lond.*:437.  
*Teracolus vestalis* Butler, 1897<sup>[2]</sup>; *Ann. Mag. nat. Hist.* 20:390.

**Adult (Male) (PLATE-06):** Forewing dorsal surface creamish white; base and costa thick black; apex dark black with 2 subapical spots; large ground color submarginal spot in area M<sub>3</sub>; a streak from base to costa joins the spot at end cell. VentralPlate 1 surface yellowish-green; dark black discocellular spot; three submarginal large black spots. Hindwing dorsal surface white; thick and broad black marginal border. Ventral surface yellowish-green; green discocellular spot ringed with dark brown.

**Adult (Female) (PLATE-07):** Similar to male but the markings on the dorsal surface of both the wings are slightly brownish-black. Ventral surface of both the wings greenish-yellow.

**Wing expanse:** 45-50mm.

**Male Genitalia:** Uncus sclerotized, broader base, blunt tip, downcurved, sinuated ventrally, smaller than tegumen, in dorsal view Y-shaped; tegumen triangular from lateral view, sclerotized, broad anteriorly, gradually narrow towards posterior; vinculum narrow, longer than tegumen, saccus very long, tube-like, blunt distal end, inclined; appendices angulares narrow, sclerotized; juxta V-shaped, leaf-like; valva narrow, setosed, costa slightly incurved at the base; aedeagus rounded, broad, suprazone longer than subzone, ductus ejaculatorious entering dorso-caudally, thecal appendage small, vesica apical.

**Female Genitalia:** Corpus bursae much broad, rounded, signum long, sickle shaped, margins serrated, cornuti cone-shaped, appendix bursae broad, somewhat ballon-shaped, ductus bursae robust, papilla analis pilosed, posterior apophysis as long as anterior apophysis, latter with pointed distal tips, genital plate bilobed, leaf-like. Plate 1

**Material examined:** ZSI, Kolkata, National Museum Collections. 1♀, 8.iii.1906, Pundol, Agra, Uttar Pradesh, (Coll. B. Biswas); 1♂, 16.iv.1909, Hamirpur; 2♀, 15.iv.1960, Bikaner, Rajasthan, (Coll. Roy).

**Distribution India:** Rajasthan, Delhi, Gujarat, Maharashtra, Madhya Pradesh.

**Elsewhere:** Baluchistan, East Africa, Kenya, Somalia, South, Ethiopia, Sudan, Tanzania.

**Remarks:** *Colotis vestalis* (Butler) is a common species in the above mentioned localities. Butler (1897)<sup>[2]</sup> described it as *Teracolus vestalis* including its seasonal forms i.e. *T. vestalis* as WSF and *T. intermissus* as representative of intermediate and DSF. Bingham (1907)<sup>[1]</sup> discussed it as *C. vestalis* including its WSF and DSF. Evans (1932)<sup>[4]</sup> devised a key for *C. vestalis* on the basis of its morphological features. Talbot (1939)<sup>[8]</sup> described its morphological features including its subspecies and seasonal forms. Mal and Memon (2013)<sup>[6]</sup> studied its male and female genitalic characters. In this present work, the morphological characters, genitalic attributes and distribution of *C. vestalis* have been studied.

#### ***Colotis danae* (Fabricius, 1775)**

Common name: Scarlet Tip

*Papilio danae* Fabricius, 1775; *Syst. Ent.*: 476.  
*Papilio eborea* Stoll, (1781); *Uitl. Kapellen.* 4:121.  
*Teracolus sanguinalis* Butler, 1876<sup>[2]</sup>; *Proc. Zool. Soc. Lond.*: 158.  
*Teracolus taplini* Swinhoe, 1884; *Proc. Zool. Soc. Lond.*: 444.  
*Callosune sanguinalis* Moore, (1881)<sup>[7]</sup>; *Lepid. Ceylon* 1: 129.

*Callosune danae* Moore, (1881)<sup>[7]</sup>; *Lepid. Ceylon* 1: 129.  
*Teracolus danae* Butler, 1897<sup>[2]</sup>; *Ann. Mag. nat. Hist.* 20: 498.

**Adult (Male) (PLATE-08):** Forewing dorsal surface white with broad crimson red apical patch; costa and termen thin black; bar of black scales arising from tornus and reaches upto costa enclosing crimson-red patch; small black dot at the end cell. Ventral surface white with grayish-black base; orchaceous-orange apex, series of 5 black spots. Hindwing dorsal surface white with black margin. Ventral surface white; orange colored discocellular spot ringed with black; series of 7 black post-discal dots.

**Adult (Female) (PLATE-09):** Forewing dorsal surface creamy-white; base heavily dusted with brownish-black scales; black margin broader than in male; apical crimson red patch smaller; post-discal black dots in the area of crimson red-patch; larger discocellular dot; black dot in area Cu<sub>2</sub>. Ventral surface white with costa and base lemon-yellow; apex orchaceous yellow with black post-discal dots forming band dusted with reddish tinge; black dot at the end cell; black spot in area Cu<sub>2</sub>. Hindwing dorsal surface white; wide black margin; obsolete discocellular dot; incomplete black macular post-discal band. Ventral surface yellowish-white with orange colored discocellular spot ringed with black; post-discal macular band well marked.

**Wing expanse:** 45-50mm.

**Male Genitalia:** Uncus narrow, well sclerotized, blunt tip, downcurved, beak-shaped from lateral view, in dorsal view Y-shaped, V-shaped constriction separates uncus from tegumen; tegumen in dorsal view broader at the base, gradually narrows posteriorly, groove in the centre of posterior portion, longer than uncus; vinculum, narrow, slightly concave; saccus tube-like, blunt distal tip; appendices angulares well developed, sclerotized, triangular; juxta sclerotized, lower part V-shaped, base thicker and longer than arms; upper part circular, hollow; valva somewhat triangular, apex narrow, protrudes beyond uncus, sacculus broader and hairy, marginal area setosed; aedeagus long, arched, suprazone longer than subzone, thecal appendage rounded, ductus ejaculatorious enters dorsad.

**Female Genitalia:** Corpus bursae broad, somewhat rounded, signum well sclerotized, arc-shaped, spinuous, appendix bursae somewhat oval, ductus bursae sclerotized at base, papilla analis ornamented with long hairs, posterior apophysis and anterior apophysis well sclerotized, latter is smaller with pointed distal tips, genital plate bilobed, sac like, spinose.

**Material examined:** ZSI, Kolkata, National Museum Collections. 1♂, 7.i.1913, Mysore; 2♂, xii.1913, Ganjam, Orissa; 1♂, 24.i.1979, Coimbatore; 1♂, 15.x.1998, Machhalipattanam, Andhra Pradesh, (Coll. Chakraborty); 1♀, 4.vii.1999, Kondavedu Reserve Forest, Guntur, Andhra Pradesh, (Coll. Roy); 1♂, 30.vi.1999, Machala, Guntur, Andhra Pradesh, (Coll.P.H. Roy); 1♀, 2.vii.1999, Pezechalna, Guntur, Andhra Pradesh; 1♂, 10.vii.1999, Pulicate lake, (Coll. P.H. Roy); 1♀, 3.iii.2005, Kadapa, Andhra Pradesh, (Coll. Maulik).

**Distribution India:** Karnataka, Maharashtra, Tamil Nadu, Telangana, Andhra Pradesh, Kerala, Gujarat, Pondicherry.

**Elsewhere:** Sri Lanka, Ethiopia, Baluchistan, Botswana, Rhodesia, Africa.

**Remarks:** *Colotis danae* (Fabricius) is a common species in the above mentioned localities. Butler (1897)<sup>[2]</sup> described it under genus *Teracolus* including its WSF as *T. danae*, intermediate form as *T. sanguinalis* and DSF as *T. taplini*. Bingham (1907)<sup>[1]</sup> discussed the external morphological features and distribution of *C. danae*. Evans (1910)<sup>[4]</sup> reported it as a common species in the Palni hills in the months of April to June and August to October. Plate 1 Talbot (1939)<sup>[8]</sup> compared the external morphological characters of this species

with *C. etrida* and observed that *C. danae* possess crimson-red apical patch on the forewing whereas in *C. etrida* it is orange colored. Talbot (loc. cit) explained *taplini* as extreme dry-season form and *sanguinalis* as intermediate form. In this present work, the morphological and genitalic attributes of *C. danae* have been compared with *C. etrida* and *C. eucharis*. It has been observed that the morphological characters of *C. danae* are similar to *C. etrida* with slight differences. In both the species, the wings are white and discocellular spots are present on the ventral side of both the wings but in *C. danae* these spots are large. In *C. danae*, the apical patch on the dorsal side of the forewing is crimson-red, black marginal border on the dorsal side of hindwing is broad, ventral side of forewing with series of 5 black post-discal spots upto area M<sub>2</sub> and ventral side of hindwing with series of 7 black post-discal dots upto area Cu<sub>2</sub> whereas in *C. etrida* the apical patch on the dorsal side of the forewing is orange and black marginal spots on the dorsal side of hindwing. The genitalic attributes shows remarkable differences. In *C. danae*, the uncus is dove-beak shaped from lateral view, in dorsal perspective it is Y-shaped, valve with narrow distal end, saccus moderately long and aedeagus with narrow and rounded thecal appendage whereas in *C. etrida*, the uncus is narrow and inclined downwardly, valve with broad distal end, saccus long and sinuous and aedeagus with slightly broad and rounded thecal appendage.

#### ***Colotis eucharis* (Fabricius, 1775)**

Common name: Plain Orange Tip

*Papilio eucharis* Fabricius, 1775; *Syst. Ent.*: 472.

*Euchloe coeneos* Hubner, (1819); *Verz. bek. Schmett.* (6): 94.

*Pieris titea* Godart, 1819; *Encyclopedie Methodique* 9: 124.

*Teracolus pseudevanthe* Butler, 1876; *Proc.zool. Soc. Lond.*: 164.

*Teracolus pallens* Moore, 1877<sup>[7]</sup>; *Ann. Mag. nat. Hist.* 20: 49.

*Callosune eucharis* Moore, (1881)<sup>[7]</sup>; *Lepid. Ceylon.* 1: 128.

*Teracolus eucharis* Butler, 1897<sup>[2]</sup>; *Ann. Mag. nat. Hist.* 20: 455.

#### **Adult (Male) (PLATE-10)**

Forewing dorsal surface white; costa thin black; apex thin black with orange patch; termen thin black. Ventral surface white with greenish-yellow base; apex light orange with black bar reaching upto vein Cu<sub>1</sub>. Hindwing dorsal surface white with black spot at the costa. Plate 1 Ventral surface white with yellowish base; black spot at the costa.

**Wing expanse:** 30-45mm.

#### **Male Genitalia**

Uncus well sclerotized, curved, apex shorter, blunt, Y-shaped from dorsal view, shorter than tegumen; tegumen sclerotized, somewhat rectangular from lateral view, in dorsal view broader at the base and gradually narrows posteriorly; vinculum narrow, slightly concave, longer than tegumen; saccus Plate 1 shorter, robust, downwardly, rounded distal tip, slightly smaller than tegumen; juxta small, leaf-like; valve somewhat squarish, costa straight, marginal area pilose; aedeagus long, curved, suprazone much longer than subzone,

suprazone slightly curved upwards, thecal appendage ventral, hook-like, narrow, curved, ductus ejaculatorious enters dorsad.

#### **Material examined**

ZSI, Kolkata, National Museum Collections.

2♂, 23.i.1913, Trichy, Tamil Nadu; 3♂, xii.1913, Ganjam.

**Distribution India:** Tamil Nadu, Odisha.

**Elsewhere:** Sri Lanka.

#### **Remarks**

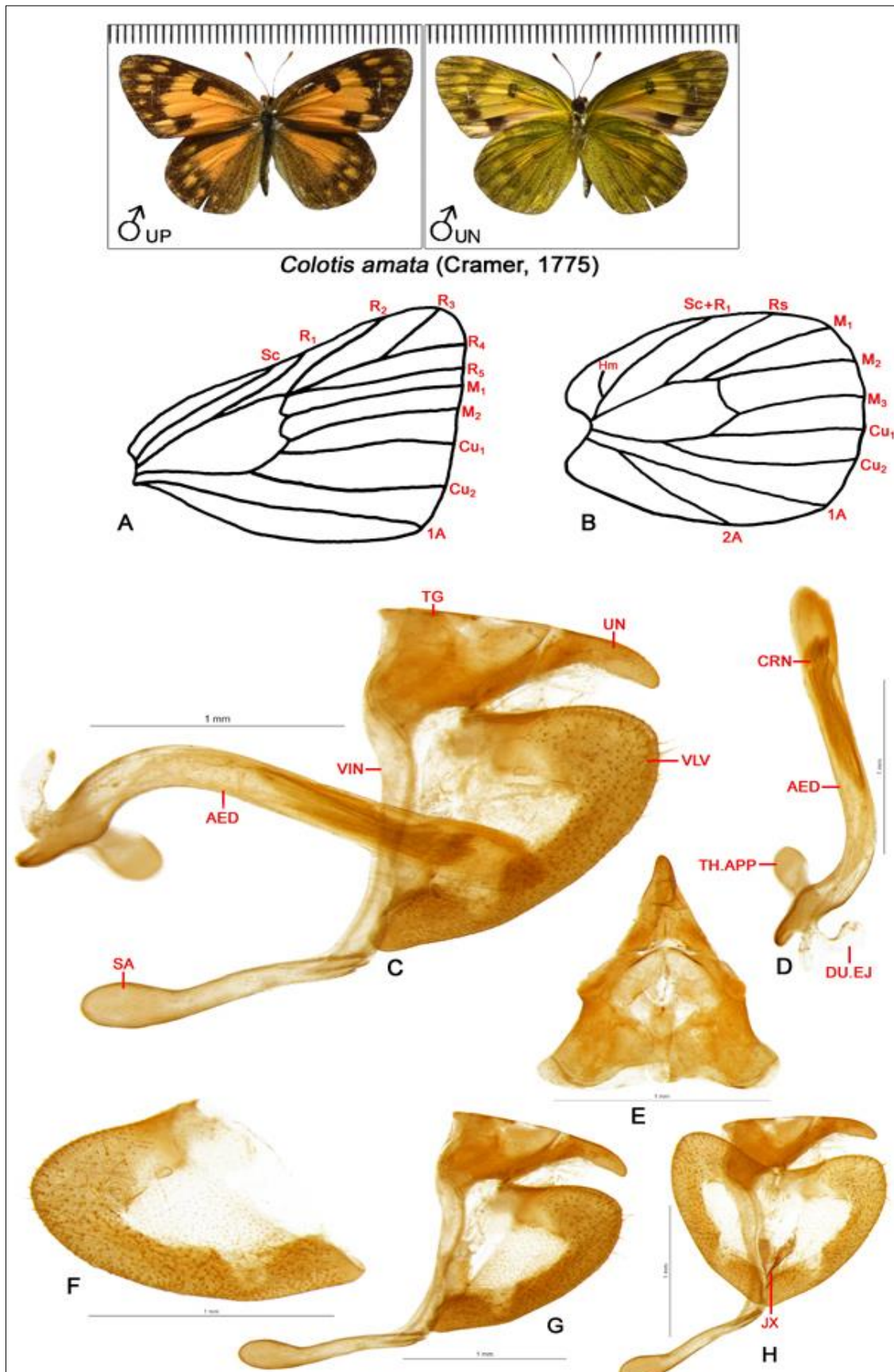
*Colotis eucharis* (Fabricius) is a common species in the above mentioned localities. Butler (1897)<sup>[2]</sup> reported it as *Teracolus eucharis* and described the morphological characters of its seasonal forms. Evans (1932)<sup>[4]</sup> devised a key for *C. eucharis* on the basis of its morphological characters. Talbot (1939)<sup>[8]</sup> described the morphological characters of *C. eucharis* including its DSF. In this present work, the morphological and genitalic characters of *C. eucharis* have been compared with *C. etrida* and *C. danae*. It has been observed that *C. eucharis* is morphologically similar to *C. etrida*. In both the species, the wings are white with orange apical patch and the wing expanse of both species is 35-45 mm. In *C. eucharis*, the orange apical patch is slightly broad and the black border lining the inner edge of the patch is absent whereas in *C. etrida* the apical orange patch is slightly narrow and inner edge of the patch is bordered with black. In *C. eucharis*, the small discocellular spot is present on the ventral side of the hindwing whereas in *C. etrida*, very small discocellular spots are present on both sides of both the wings but these spots are more prominent on the ventral side and the black marginal spots are present on the dorsal side of hindwing. The genitalic attributes shows remarkable differences. In *C. eucharis*, the uncus is slightly broad, valva somewhat squarish, saccus small, juxta V-shaped with small and broad arms and aedeagus with hook-shaped thecal appendage whereas in *C. etrida*, the uncus is narrow, valve with distal end broadly rounded, saccus long and sinuous, juxta V-shaped with long and narrow arms and aedeagus with small and rounded thecal appendage.

#### **Abbreviations**

Sc = Subcosta vein; R<sub>1</sub> = Radius vein 1; R<sub>2</sub> = Radius vein 2; R<sub>3</sub> = Radius vein 3; R<sub>4+5</sub> = Radius vein 4+5; Rs = Radial sector; M<sub>1</sub> = Median vein 1; M<sub>2</sub> = Median vein 2; M<sub>3</sub> = Median vein 3; Cu<sub>1</sub> = Cubitus vein 1; Cu<sub>2</sub> = Cubitus vein 2; 1A+2A = Anal vein 1+2; 3A = Anal vein 3; AED = Aedeagus; TG = Tegumen; UN = Uncus; VLV = Valva; VIN = Vinculum; SA = Saccus; DU.EJ = Ductus ejaculatorious; HRP = Harpe; VES = Vesica.

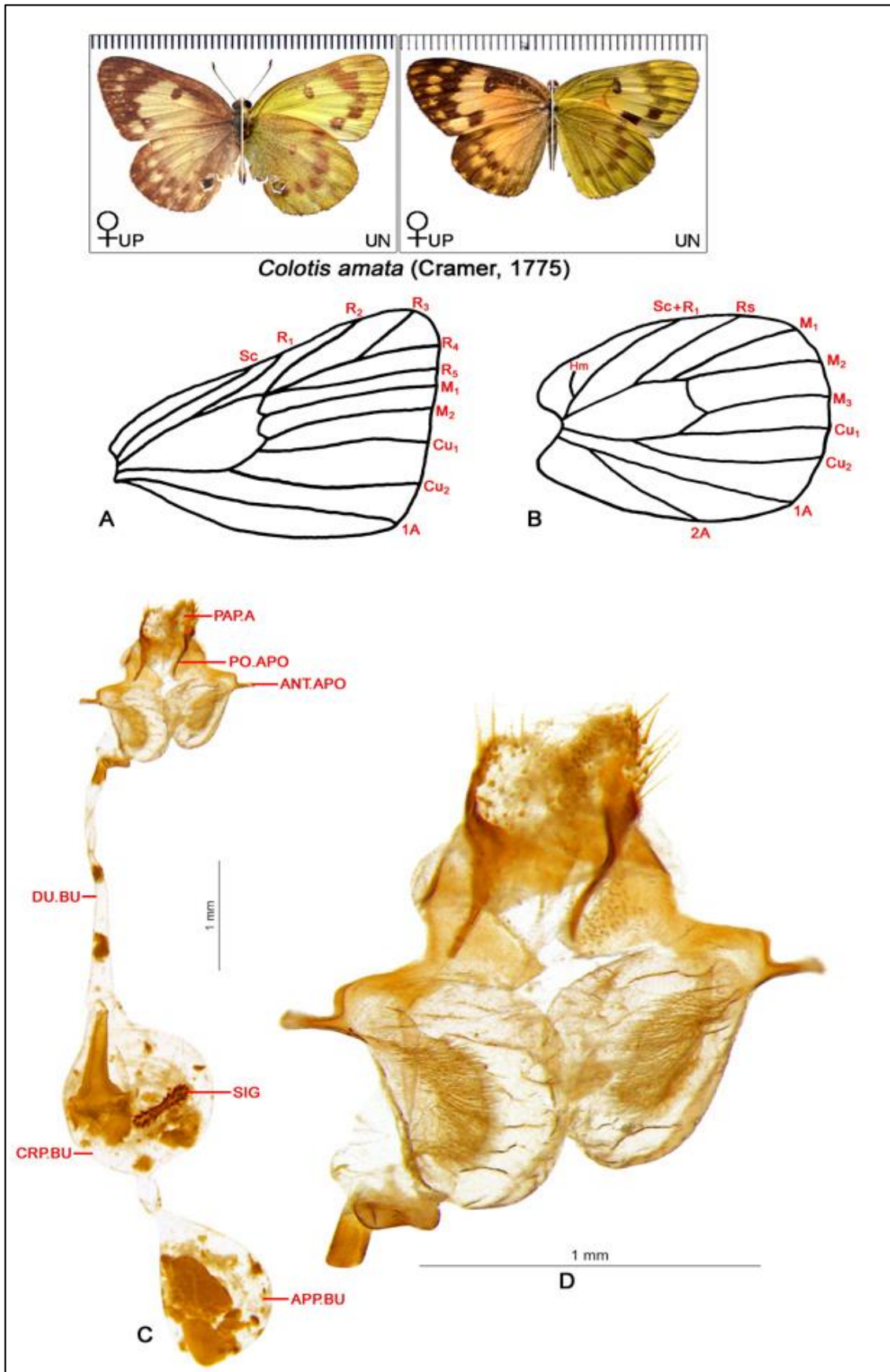
#### **Acknowledgements**

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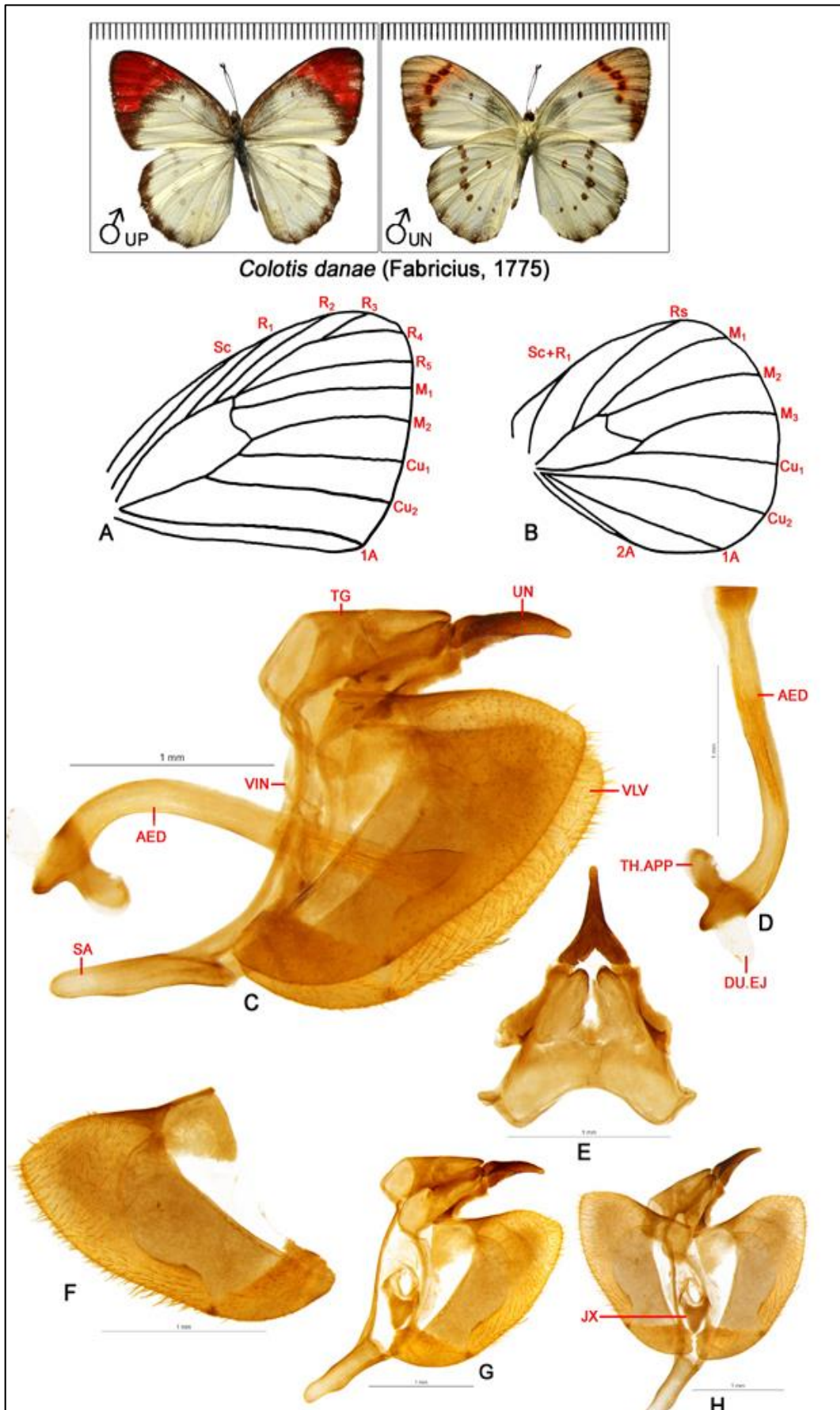


**Plate 1:** A. Forewing, B. Hindwing, C. Male genitalia, D. Aedeagus, E. Uncus (Dorsal view), F. Valva, G. Male genitalia (Lateral view), H. Male genitalia (Dorsal view).



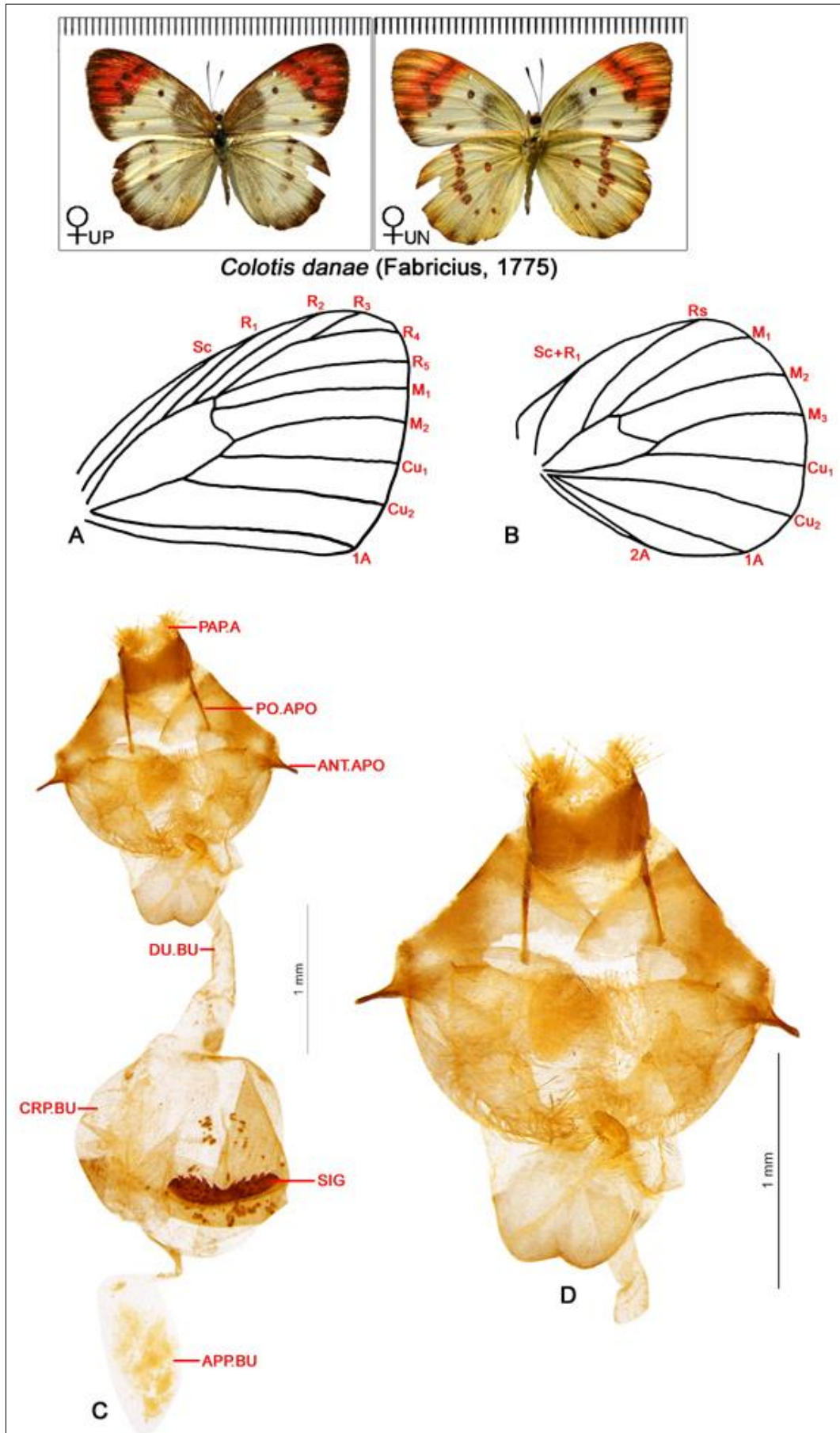


**Plate 2:** A. Forewing, B. Hindwing, C. Female genitalia, D. Papilla Analis

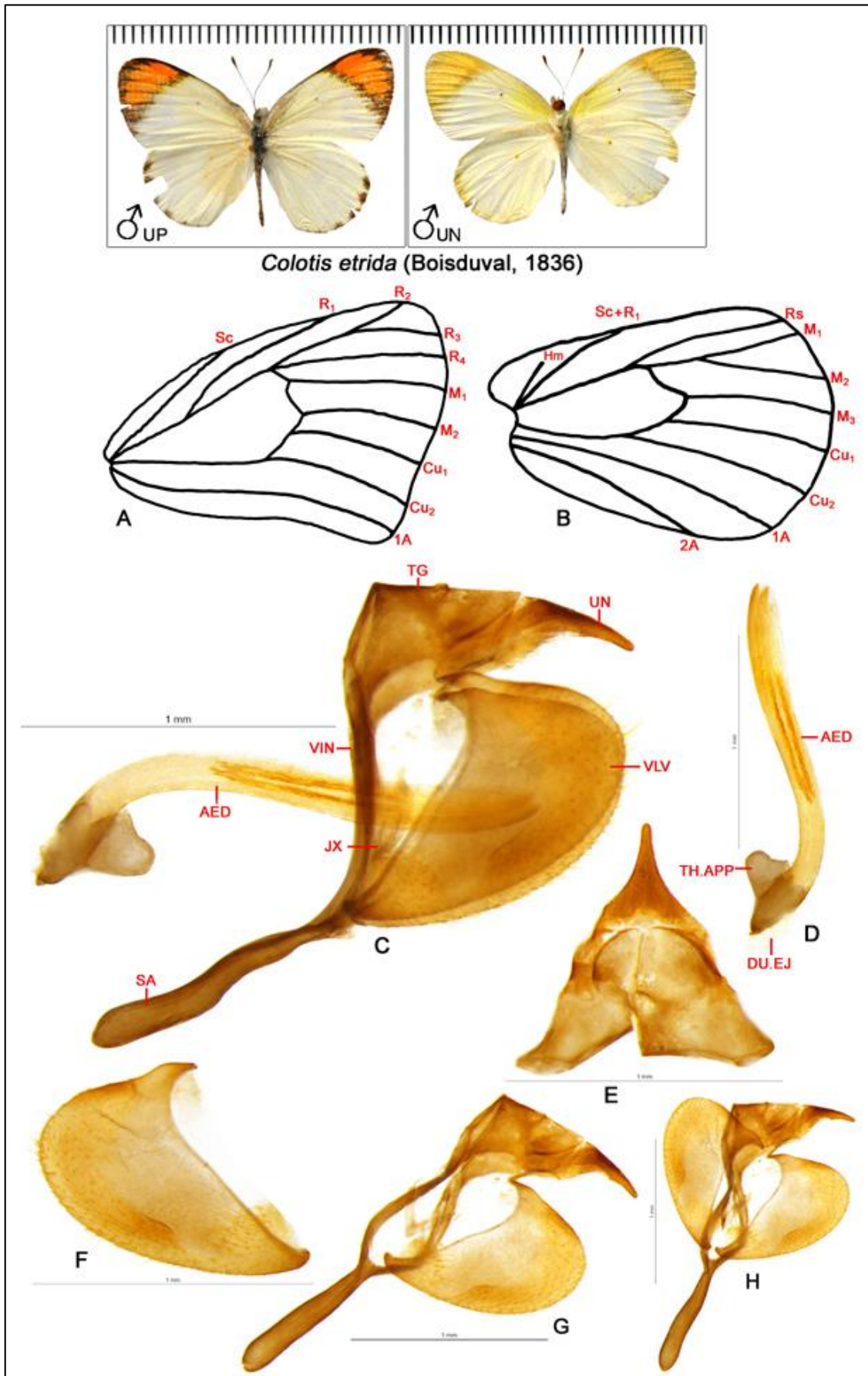


**Plate 3:** A. Forewing, B. Hindwing, C. Male genitalia, D. Aedeagus, E. Uncus (Dorsal view), F. Valva, G. Male genitalia (Lateral view), H. Male genitalia (Dorsal view).

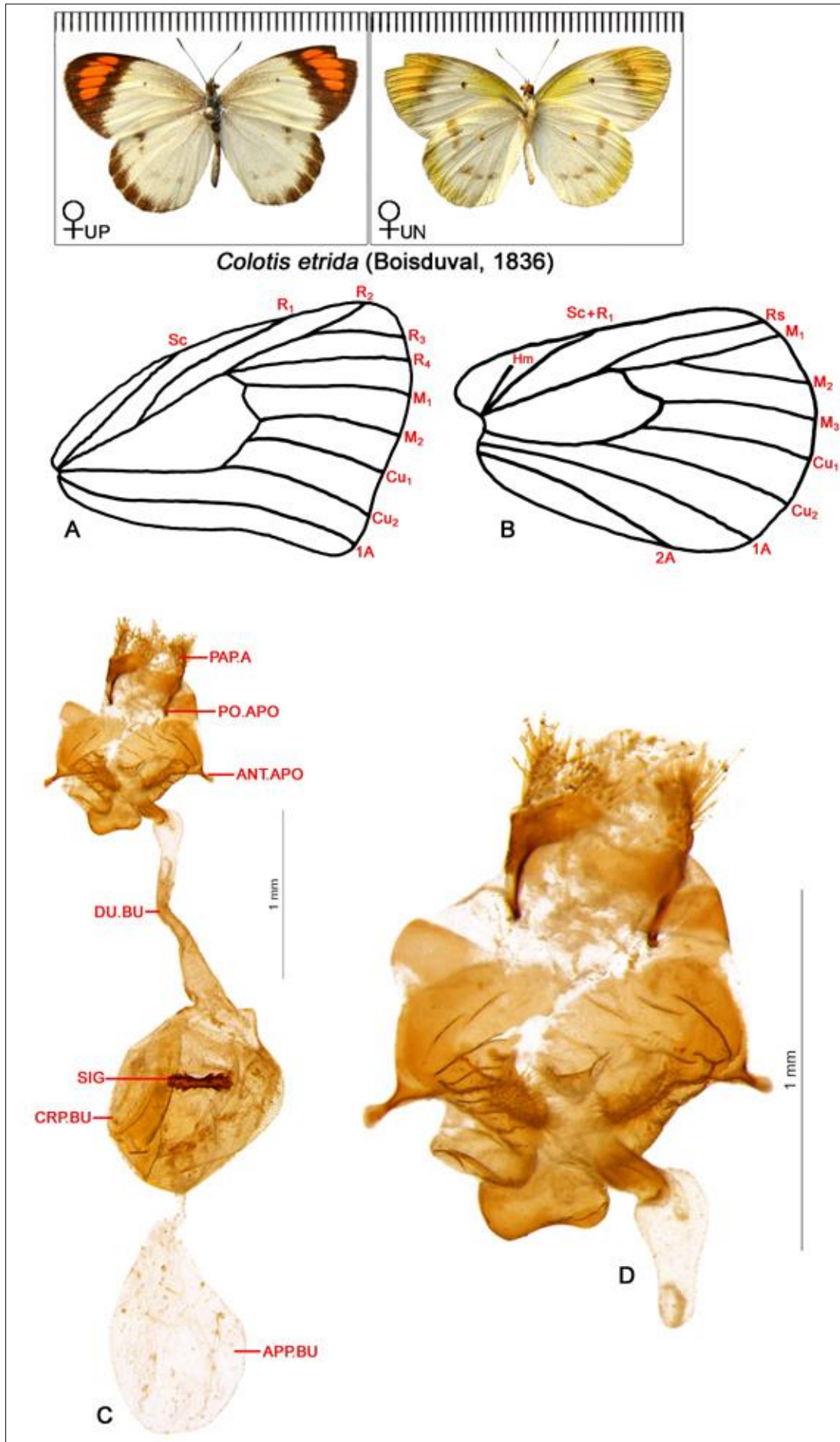




**Plate 4:** A. Forewing, B. Hindwing, C. Female genitalia, D. Papilla Analis

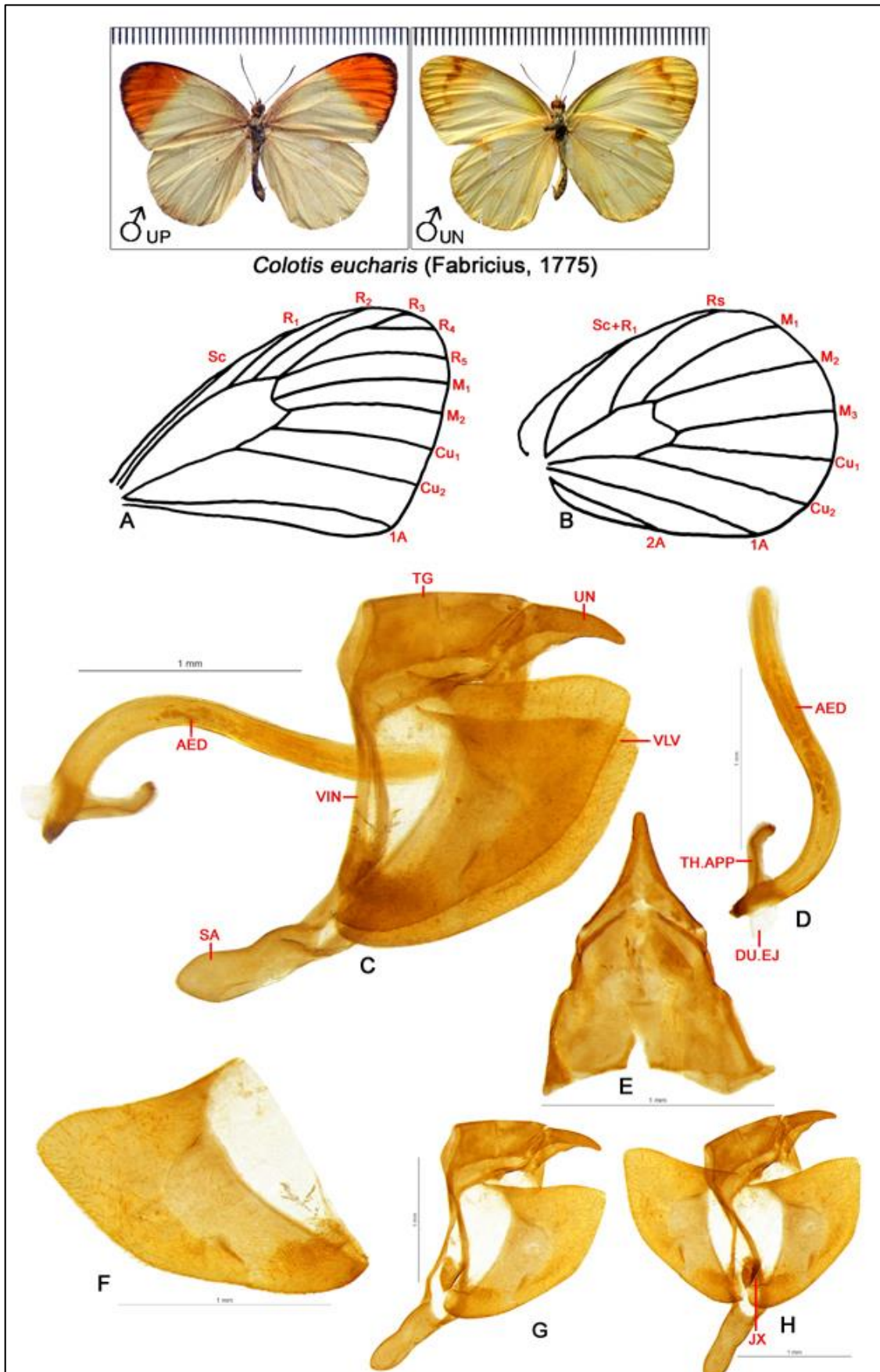


**Plate 5:** A. Forewing, B. Hindwing, C. Male genitalia, D. Aedeagus, E. Uncus (Dorsal view), F. Valva, G. Male genitalia (Lateral view), H. Male genitalia (Dorsal view).

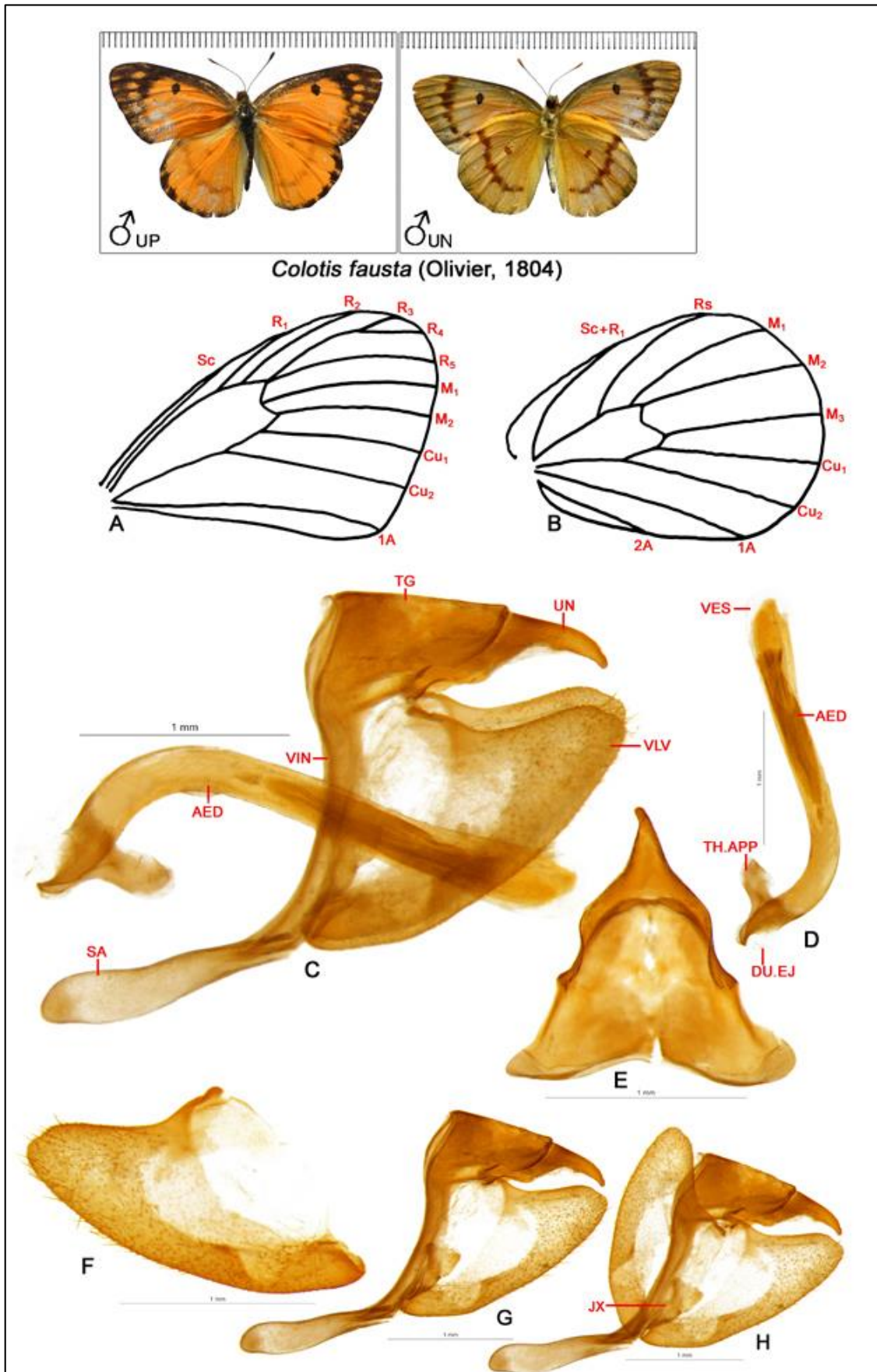


**Plate 6:** A. Forewing, B. Hindwing, C. Female genitalia, D. Papilla Analis

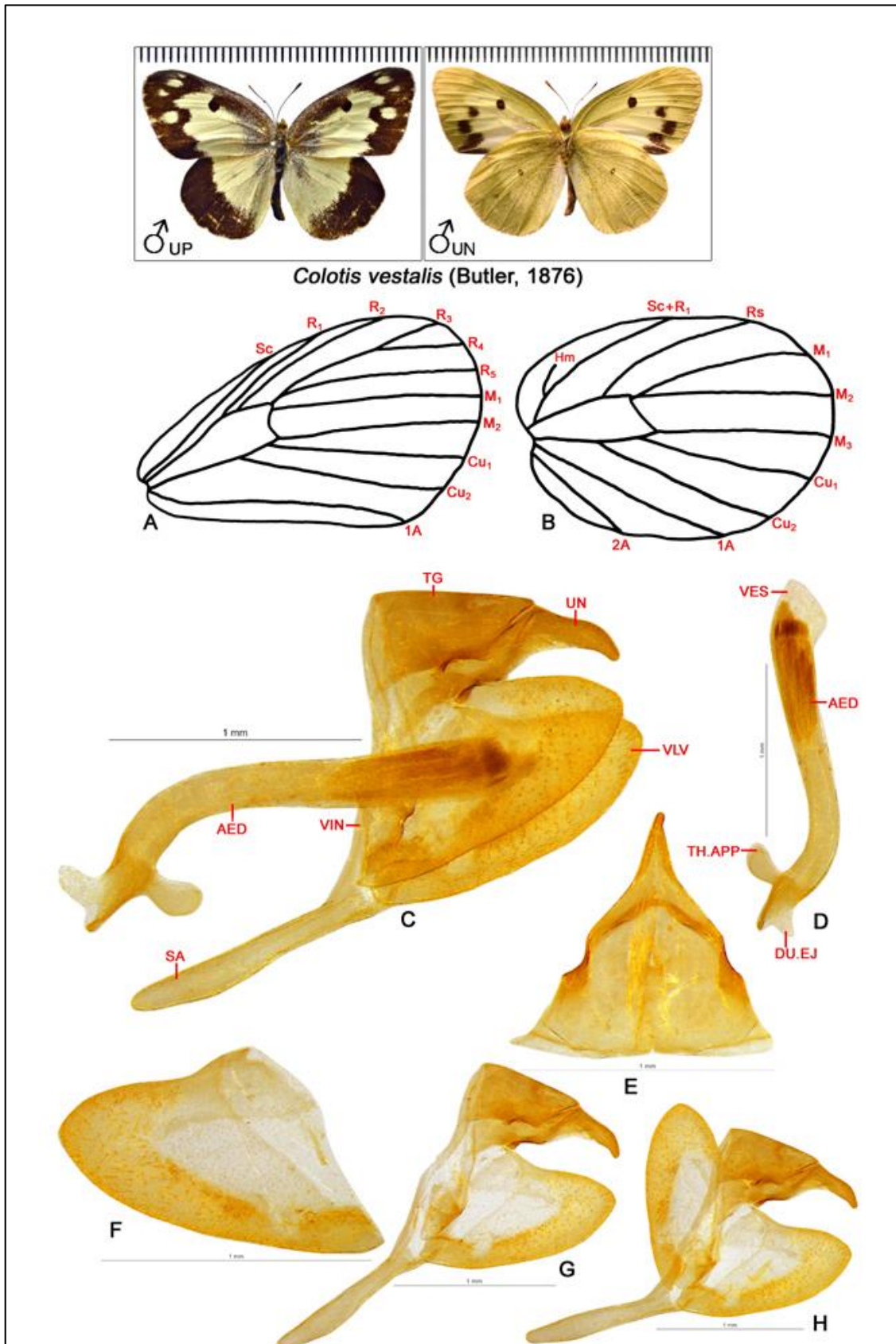




**Plate 7:** A. Forewing, B. Hindwing, C. Male genitalia, D. Aedeagus, E. Uncus (Dorsal view), F. Valva, G. Male genitalia (Lateral view), H. Male genitalia (Dorsal view).

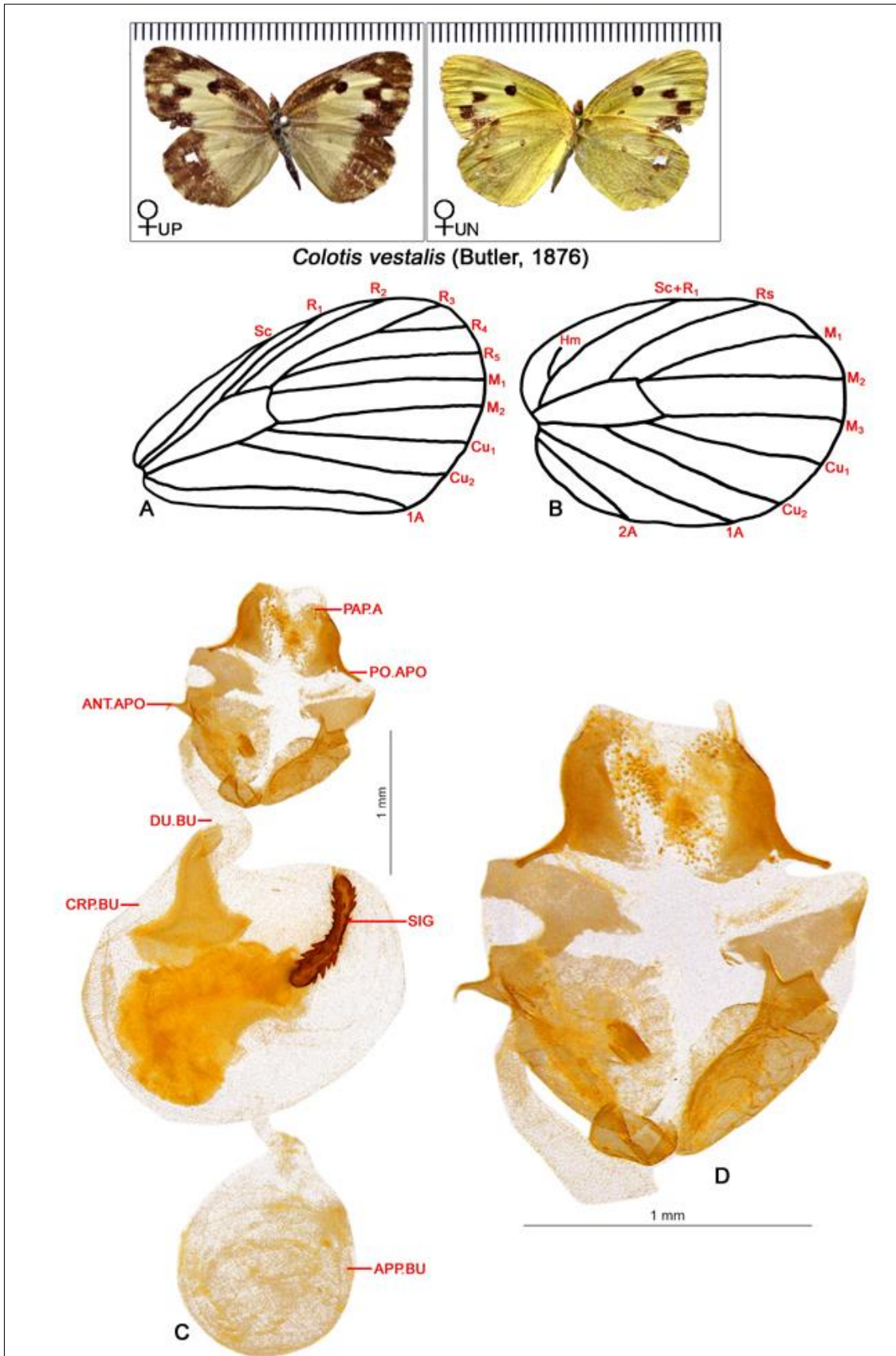


**Plate 8:** A. Forewing, B. Hindwing, C. Male genitalia, D. Aedeagus, E. Uncus (Dorsal view), F. Valva, G. Male genitalia (Lateral view), H. Male genitalia (Dorsal view).



**Plate 9:** A. Forewing, B. Hindwing, C. Male genitalia, D. Aedeagus, E. Uncus (Dorsal view), F. Valva, G. Male genitalia (Lateral view), H. Male genitalia (Dorsal view).





**Plate 10:** A. Forewing, B. Hindwing, C. Female genitalia, D. Papilla Analis.

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