

*Anopheles paltrinieri*, n. sp.,

(Culcidae: Diptera) from the Sultanate of Oman

by

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ABSTRACT. A new species of *Anopheles* (*Cellia*), series *Neocellia*, is described from Oman and the United Arab Emirates. Keys are given to the females and fourth stage larvae of the 20 species of *Anopheles* so far recorded from the Arabian Peninsula.

## INTRODUCTION

Over the course of the past 16-17 years a series of puzzling larvae of *Anopheles* have been collected from numerous localities in south-eastern Arabia. The first specimens to be reported were collected by Zahar from Wadi Ham, Wadi Sidi and Bithna, United Arab Emirates, close to the border with Oman (Zahar, 1969). One of us (MTG) examined adult material in 1971 and noted its resemblance to *An. apoci* Marsh and *An. azaniae* Bailly-Choumara.

In December 1975, one of us (GRS), while on official mission in Oman, collected a large number of *Anopheles* larvae from five localities, (Sumail, Fanja, Nizwa, Dank and Hajer of the Interior Region) which he could not identify by available keys and which most closely resembled larvae of *An. rufipes brusselsi* Edwards and/or *An. pulcherrimus* Theobald (Shidrawi, 1976). However, few adults were reared and none resembled either *An. rufipes brusselsi* or *An. pulcherrimus*, but were close to *An. apoci*. He subsequently brought a sample to Dr. G. B. White at the British Museum (Natural History) in 1976, who agreed that the specimens were not similar to any known species, at least from that area. Between 1976 and 1979, larvae of the same species were collected from numerous localities and reared to adults by Mr. A. A. Mamser, WHO Technical Officer (Malaria) in collaboration with GRS.

More recently, Mr. M. F. Beidas sent us reared adults collected in 1983 from Al. Ain, United Arab Emirates.

Examination of all the above material has demonstrated beyond doubt that they represent a previously unknown species and thus, form the basis of the present paper.

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*Anopheles (Cellia) paltrinieri*, new species

1. Egg. Not known.
2. Larva. Head (Fig. 3): seta 2-C (inner clypeal hair) simple, often finely frayed, seta 3-C (outer clypeal hair) with 2-6 branches ( $x=2.8$ ,  $n=26$ ), 4-C (posterior clypeal hair) simple,  $3/5$  to  $4/5$  length of 3-C; setae 5-C, 6-C, 7-C (Frontal hairs) with 8-18 branches, setae 8-C (Sutural) and 9-C (vertical) with 3-6 branches; spicules on inner surface of base of antenna not markedly longer than those on distal  $2/3$ . Thorax: setae 1-P, 2-P (shoulder hairs) mounted on separate tubercles (Fig. 4); 9-M, 10-M (long mesopleural hairs) simple and feathered respectively; both 9-T, 10-T (long metapleural hairs) feathered; seta 3-T (thoracic palmate hair) undifferentiated. Abdomen: palmate hairs, seta 1-I partially developed, 1-II fully differentiated but narrow, 1-III to 1-VII with well-marked shoulders and finely drawnout filaments (Fig. 5); tergal plates less than half the distance between insertions of seta 1; a single median accessory tergal plate present on segments II-VII; pecten plate (Fig. 6) with a reduced number of fine teeth; seta 1-X (saddle hair) long and simple.
3. Pupa. Paddle fringe extending from apex as far as halfway to base, not continued beyond seta 1-P (apical hair), consisting of fine spines changing abruptly to spicules: seta 2-P with up to 6 branches. Seta 1-V-VII simple to 3 branches, about equal length of segment; seta 5-V-VII with 5-7 branches, less than half length of segment; seta 9-VII  $1/3$  to  $2/5$  length of segment, 9-VI and 9-V  $1/5$  to  $1/3$ , 9-IV about  $1/10$ , 9-III a short stub.

4. Adult(a) Female

Vertex scales narrow, straw-colored; palps without pale bands; pharynx with 16-18 pairs of rods and cones, the latter with long roots, the pediment with a double crest.

Scutum with hairs only, lacking anterior promontory scale tuft; legs and wings entirely dark-scaled. Abdomen with sparse hairs only.

(b) Male

Palps with dark scales only. Terminalia (Figs. 1,2): apical seta of claspette slightly longer than lateral club, intermediate seta (outer accessory hair) nearly as long as club; aedeagus without leaflets.

Holotype female, OMAN: Dank river (N.  $23^{\circ} 36'$ ; E.  $36^{\circ} 15'$ ), and Nizwa River (N.  $22^{\circ} 52'$ ; E.  $57^{\circ} 35'$ ), IV. 77, G. R. Shidrawi, deposited in the British Museum (Natural History). No allotype designated. Paratypes; 3 males, 3 females, same provenance and 3 males, 6 females Wadi Sur (N.  $22^{\circ} 33'$ ; E.  $59^{\circ} 32'$ ) and Wadi Srou (N.  $23^{\circ} 25'$ ; E.  $58^{\circ} 10'$ ) Oman, VII.77 A. Mamsar, also

deposited in BMCNH. A series of 3 male and 7 female paratypes have also been deposited in the Smithsonian Institution, Washington, D. C. We also have 4 males, 3 females, United Arab Emirates, Al Shise (25° 15'N, 56° 15'E), 3.1.83 & 12.iv.83, M. F. Beidas. The species is named for Dr. A. B. Paltrinieri, formerly WHO Representative in Oman, in recognition of his active assistance in the initial survey of 1975.

The adults of this species are not separable from those of *An. apoci* without dissection. The females can be distinguished by the well-developed roots of the cones in the pharyngeal armature and the males by the absence of leaflets on the aedeagus. The pupa is separable by seta 5 being long and simple on all segments and by seta 9 being much shorter than in *An. apoci* (Al-Tikrity, 1963). The larva is readily separable by seta 9, 10-T being feathered.

Although the adults closely resemble the other desert species, *An. dthali* Patton, *An. azaniae* and *An. apoci*, in series Myzomyia, the structure of the pharyngeal armature and the larval chaetotaxy are both consistent with this species belonging to the series Neocellia. Thus, the morphological resemblance does not reflect phylogenetic relationship but is clearly the result of convergence, perhaps in response to factors associated with an arid environment. In this respect, *An. paltrinieri* appears to be an exceptional member of series Neocellia, which are generally conspicuously dappled species.

#### DISTRIBUTION

The species has been collected so far from the Interior Region of Oman, the United Arab Emirates and the northern tip of Oman in the Masandam Peninsula<sup>1</sup>. It is limited in distribution by the specific breeding sites which are mountain streams and rivulets. It has been collected (see map) from all localities around streams lying between 22 and 26 degrees North latitude and 56 to 60 degrees East longitude. The proportion of larvae of this species in relation to other existing species was about 10% of the total collected in the survey of 1975 (Shidrawi, 1976).

#### ADULT BEHAVIOR

Nothing known beyond the fact that rare specimens have been caught resting in houses.

#### LARVAL ECOLOGY

Larvae were collected from unshaded breeding places in the forms of small irrigation pools or reservoirs and sides of running streams attached to stones and floating leaves and/or algae. The water is relatively free from organic material and in general clear and not noticeably saline to taste, mostly from underground water sources emerging at the bases of mountains.

<sup>1</sup> Collected in 1983 by the G. R. Shidrawi.

No keys to the anopheline fauna of Arabia have been published more recently than those of Mattingly and Knight (1956). Since that date three species new to the fauna of the region have been recorded; *An. squamosus* Theobald, Kuzentsov (1971), *An. azaniae*, Bailly-Choumara (1960) and *An. paltrinierei*. Modified keys to the females and 4th stage larvae are, therefore, given here. The keys are based on those of Mattingly and Knight. Apart from the inclusion of the three new species, we have omitted *An. hyrcanus* (Pallas) and *An. subpictus* Grassi on the grounds that these species have still not been recorded from the Arabian Peninsula. The four species *An. coustani* Laveran, *culicifacies* Giles, *pharoensis* Theobald and *squamosus* Theobald are now known to be complexes of genetically distinct sibling species (Gillies and Coetzee 1987), and are referred to in the keys as such.

#### Key to Adult Female *Anopheles* of the Arabian Peninsula

1. Abdominal segments with numerous scales forming laterally projecting tufts of scales . . . . . 2  
    Abdominal segments not so . . . . . 4
2. Distal part of hindtarsomere 2 and whole of tarsomeres 3-5 white . . . . . *pulcherrimus*  
    Hindtarsomeres 3-4 broadly dark at base . . . . . 3
3. Hindtarsomere 5 and about apical half of 4 pale . . . . . *pharoensis* complex  
    Hindtarsomere 5 all dark and 4 with much less than apical half pale . . . . . *squamosus* complex
4. Hindtarsus with at least last two segments entirely pale . . . . . 5  
    Hindtarsus not so . . . . . 7
5. Legs conspicuously speckled . . . . . *pretoriensis*  
    Legs not speckled . . . . . 6
6. Hindtarsomere 1 broadly pale at base, apex of tibia with long pale stripe . . . . . *coustani* complex  
    Hindtarsomere 1 dark at base, apex of tibia with narrow pale ring . . . . . *tenebrosus*
7. Legs speckled . . . . . 8  
    Legs not speckled . . . . . 9

- 8. Scales present on all abdominal terga except I; no pale interruption in preapical dark area of 1st vein (R<sub>1</sub>) . . . . . *stephensi*  
 Scales present on terga VII and VIII only; preapical dark are of 1st vein with pale interruption, sometimes fused with preceding pale area . . . . .  
 . . . . . *arabiensis*
- 9. Wing unicolorous, without any pale spots . . . . . 10  
 Wing with pale and dark spots at least on costa and 1st vein (R+R<sub>1</sub>), sometimes poorly contrasted . . . . . 11
- 10. Head scales broad, white on vertex, dark laterally . . . . .  
 . . . . . *rhodesiensis rupicolus* (in part)  
 Head scales narrow, straw-colored throughout . . . . . *paltrinierii*
- 11. Pale and dark spots on wing confined to costa and 1st vein (R + R<sub>1</sub>), or at most with two to three indistinct pale patches on other veins . . . . . 12  
 Wing with well-defined pale patches on all or most veins . . . . . 14
- 12. Head scales broad, white on vertex, dark laterally . . . . .  
 . . . . . *rhodesiensis rupicolus* (in part)  
 Head scales narrow, straw-colored throughout . . . . . 13
- 13. Palps with two to three pale bands . . . . . *dthali*  
 Palps without pale bands . . . . . *azaniae*
- 14. All or most of scutum covered with narrow scales, those on the fossae somewhat broader than the rest; base of costa pale-scaled . . . *multicolor*  
 Scutal fossae bare of scales; base of costa dark . . . . . 15
- 15. Palps dark at tip or apical pale band interrupted giving a 4-banded appearance . . . . . 16  
 Palps 3-banded, pale at tip . . . . . 19
- 16. Palps dark at tip . . . . . 17  
 Palps pale at tip . . . . . 18

- 17. Wing generally pale, contrast between pale and dark areas, apart from costa and 1st vein (R+R<sub>1</sub>), poorly defined; scutal anterior promontory scales scanty, not forming conspicuous tuft . . . . . *turkhudi*  
 Wing with well contrasting light and dark areas; scutum with conspicuous anterior promontory scale tuft . . . . . *cinereus* (in part)
- 18. Four or more propleural (proepisternal) bristles present; a well marked pre-accessory sector spot present on 1st vein (R+R<sub>1</sub>); first three hind tarsomeres with distinct apical pale spots . . . . . *cinereus* (in part)  
 Propleural bristles absent; sector pale area uninterrupted; hind tarsomeres at most very faintly pale at tip . . . . . *superpictus* (in part)
- 19. Propleural bristles absent; subapical segment of palp about two-thirds the length of the preceding segment or more; 3rd vein (R<sub>4+5</sub>) largely pale; sector pale area uninterrupted; scutal scales usually exceptionally broad and numerous . . . . . *superpictus* (in part)  
 At least one propleural bristle present; subapical segment of palp usually not more than about three-fifths the length of the preceding segment, often less . . . . . 20
- 20. A broad dark spot present in the pale basal area of 1st vein (R) proximal to 1st main dark area . . . . . *culicifacies* complex  
 Basal area of vein R entirely pale . . . . . 21
- 21. Third vein (R<sub>4+5</sub>) largely or wholly dark . . . . . *sergentii*  
 Third vein largely pale . . . . . 22
- 22. First vein (R+R<sub>1</sub>) with well marked pre-accessory dark spot . . . *demeilloni*  
 First vein without or at most with a rudimentary pre-accessory dark spot . . . . . *fluviatilis*

Key to 4th Stage Larvae of *Anopheles* of the Arabian Peninsula

- 1. Setae 2-C (inner clypeal hairs) with bases nearly touching . . . . . *coustani* complex  
 . . . . . *tenebrosus*  
 Setae 2-C with bases widely separated . . . . . 2

2. Seta 3-C (outer clypeal hair) with 8 or more branches . . . . . 3  
 Seta 3-C simple or with less than 7 branches . . . . . 4
3. Filaments of setae 1-III-VII (palmate hairs) short and blunt . . . . .  
 . . . . . *pharoensis* complex (in part)  
 Filaments of setae 1-III-VII long and drawn out . . . . .  
 . . . . . *squamosus* complex (in part)
4. Plates on terga III-VII very large, their posterior borders enclosing the  
 median (anterior) accessory tergal plate; width of tergal plate on V at  
 least three-quarters of distance between setae 1-V . . . . . *fluviatilis*  
 Median accessory tergal plates always entirely exposed; width of tergal  
 plate on segment V not more than two-thirds of distance between setae 1-V  
 (except sometimes in *sergentii* and *culicifacies* . . . . . 5
5. Setae 9, 10-M (long mesopleural hairs) both simple . . . . . 6  
 Seta 9-M simple or feathered, 10-M feathered . . . . . 8
6. Seta 1-P (inner shoulder hair) poorly developed, without basal tubercle  
 . . . . . *arabiensis*  
 Seta 1-P well developed, arising from well-formed tubercle . . . . . 7
7. Setae 2,3-X (inner, outer caudal hairs) both with strongly hooked branches;  
 seta 4-C (posterior clypeal hair) about as long as seta 3-C (outer clypeal  
 hair) . . . . . *dthali*  
 Branches of seta 2-X straight, their ends not recurved; seta 4-C distinctly  
 shorter than seta 3-C . . . . . *culicifacies* complex (in part)
8. Seta 9,10-T (long metapleural hairs) both feathered . . . . . 9  
 Seta 9-T simple, 10-T feathered . . . . . 15
9. Setae 9,10-M (long mesopleural hairs) both feathered . . . . . 10  
 Seta 9-M simple, 10-M feathered . . . . . 11
10. Leaflets of setae 1-III-VII (palmate hairs) fully developed, filaments of  
 leaflets sharply pointed and about half length of blade . . . . . *cinereus*  
 Seta 1-III rudimentary, 1-IV-VII fully developed, filaments short and blunt  
 . . . . . *turkhudi*

11. Seta 3-C (outer clypeal hair) with 2-6 branches . . . . . *paltrinierii*  
 Seta 3-C simple or finely frayed . . . . . 12
12. Seta 1-T (thoracic palmate) differentiated into a palmate hair; seta 2-C (inner clypeal hair) with delicate fraying . . . . . *superpictus*  
 Seta 1-T undifferentiated; seta 2-C without fraying (except sometimes in *stephensi*) . . . . . 13
13. Seta 1-P (inner shoulder hair) with basal tubercle absent or poorly developed . . . . . *multicolor*  
 Seta 1-P with well developed sclerotized tubercle . . . . . 14  
 2, 3-X with strongly hooked branches; paired accessory tergal plates usually entirely absent . . . . . 18
14. Seta 1-II (palmate hair on segment II) small but with shoulders of leaflets well developed; basal tubercles of setae 1-P, 2-P (inner and median shoulder hairs) often fused; metathorax sometimes with a pair of small submedian tergal plates; seta 2-C (inner clypeal hair) simple or at most with a single small barbule . . . . . *pretoriensis*  
 Seta 1-II poorly developed; basal tubercles of 1-P, 2-P separate; metathorax without tergal plates; seta 2-C often frayed . . . . . *stephensi*
15. Antenna with a group of spicules on the basal one-third of the inner border markedly longer than the rest . . . . . *rhodesiensis rupicolus*  
 Antenna without such a group of spicules . . . . . 16
16. Seta 1-P (inner shoulder hair) with about 5-12 branches, mounted on a very small scarcely developed tubercle . . . . . *azaniae*  
 Seta 1-P with about 15-20 branches, mounted on well-developed tubercle . . . . . 17
17. Branches of seta 2-X (inner caudal hair) straight, their ends not recurved; paired submedian (posterior) accessory tergal plates always present on posterior abdominal segments . . . . . *culicifacies* (in part)  
 Setae 2, 3-X with strongly hooked branches; paired accessory tergal plates usually entirely absent . . . . . 18
18. Tubercle at base of seta 1-P (inner shoulder hair) variable in size, usually small, sometimes absent; width of main tergal plate at least two-thirds the distance between setae 1-V, often more . . . . . *sergentii*  
 Tubercle at base of seta 1-P large and strongly sclerotized; width of main tergal plate not more than five-eighths the distance between setae 1-V . . . . . *demeilloni*



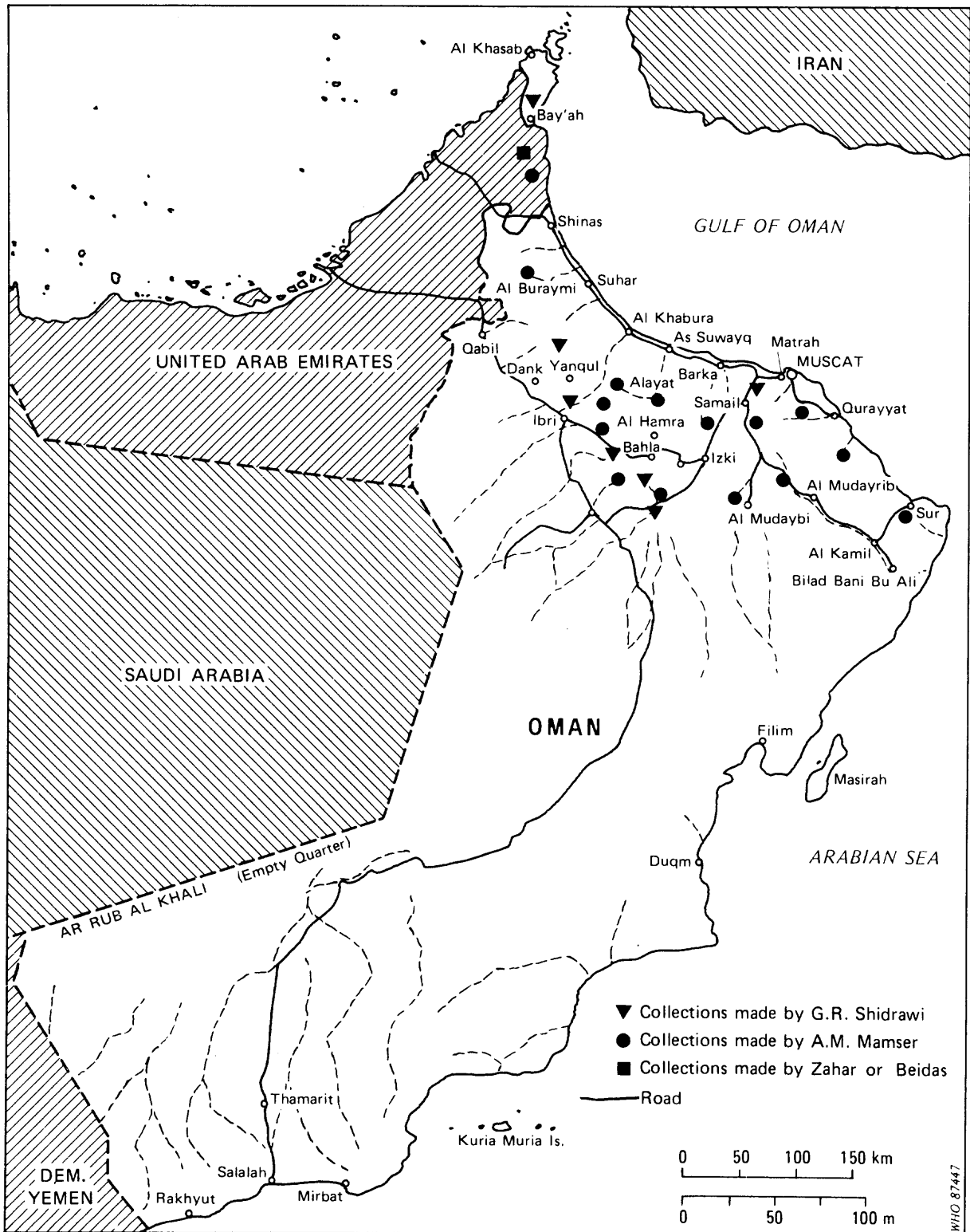
## ACKNOWLEDGEMENTS

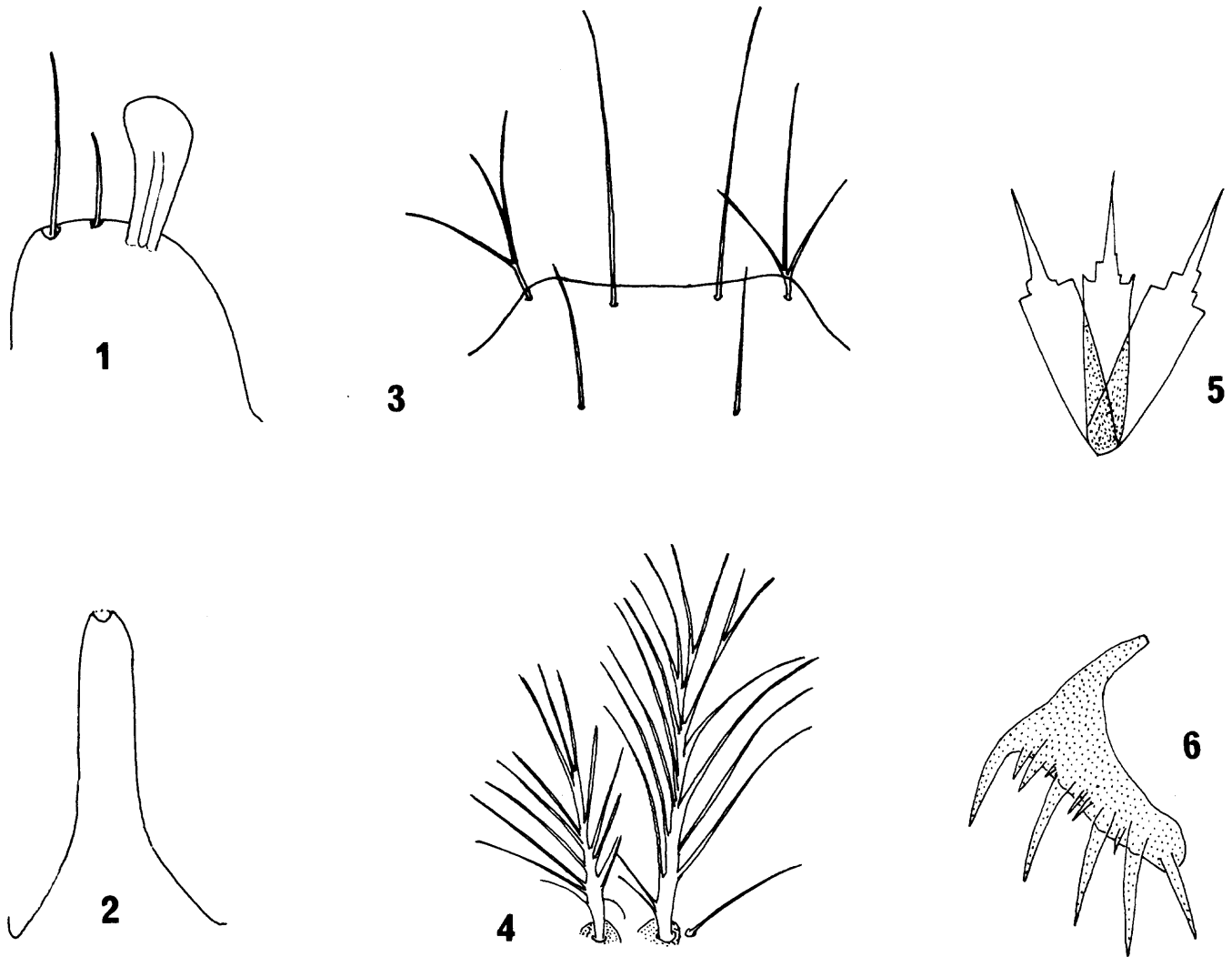
Our knowledge of the geographical distribution of *An. paltrinierii* is largely the result of the work of Mr. A. A. Mamsar, formerly WHO Technical Officer in Oman, to whom we are greatly indebted. We would also wish to thank Mr. M. F. Beidas, of the Preventive Medicine Division, Ministry of Health, Al Ain, United Arab Emirates, for specimens and for information on the occurrence of this species in Abu Dhabi.

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DISTRIBUTION OF *An. paltrinierii* IN THE SULTANATE OF OMAN  
AND THE UNITED ARAB EMIRATES (in part)





- Fig. 1 Male claspette.  
 Fig. 2 Aedeagus.  
 Fig. 3 Larval clypeal hairs (setae 2-C to 4-C).  
 Fig. 4 Shoulder hairs (setae 1-P to 3-P).  
 Fig. 5 5th abdominal palmate hair (seta 1-V).  
 Fig. 6 Pecten plate.