

THE DUNG-ROLLERS OF PAKISTAN WITH OBSERVATIONS ON THE GENUS ANOMALA
INCLUDING THE ECONOMIC IMPORTANCE AND DESCRIPTIONS OF NEW
SPECIES FROM KARACHI (COLEOPTERA: SCARABAEIDAE)

MÖHAMMAD ABDULLAH and (Miss) ROSHAN ARA ROOHI

Central Laboratories, Pakistan Council of Scientific and Industrial Research, Karachi

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Distinguishing characters and keys to the identification of the families (Lucanidae, Passalidae, Trogidae, Acanthoceridae, Geotrupidae and Scarabaeidae) of the superfamily Scarabaeoidea, the subfamilies (Ochodaeinae, Chironinae, Orphninae, Hybosorinae, Scarabaeinae=Coprinae, Aphodiinae, Dynastinae, Cetoniinae, Desmomychinae, Hopliinae, Rutelinae, Euchirinae and Melolonthinae) of the family Scarabaeidae, the tribes (Adoretini, Peltonotini, Parastasiini, Anomalini and Adorrhinyptiini) of the subfamily Rutelinae, the genera (*Rhinnyptia*, *Tropiorrhynchus*, *Callistopopillia*, *Dactylopopillia*, *Popillia*, *Trichanomala*, *Spilopopillia*, *Mimela* and *Anomala*) of the tribe Anomalini, and 39 species of the section VI of the genus *Anomala*, 14 species of West Pakistan and 59 species of East Pakistan are given. Three new species (*A. ashrafii*, *A. qadrii* and *A. shafqati*) are described from Karachi. Tables summarizing the host plant records of *Anomala* species and their seasonal distribution are also included.

Introduction

This is the first report of research work completed on a project undertaken involving the scarab beetles of our country.

The beetles treated here belong to the superfamily Scarabaeoidea (Polyphaga—Haplogastra) and are also classified as Lamellicornia by some authors. The name is derived from the fan shaped (or lamellate) antenna of these beetles which is suggestive of their specialized olfactory powers. The adults are adapted for burrowing in having a compact and heavily sclerotized body and spinous front tibiae. The central nervous system is concentrated in the anterior part of the body. The larvae and some adults have vocal organs and produce sound. Some of the species are pests of economic importance (see Table 1).

1. Key and Distinguishing Characters of the Families of the Scarabaeoidea (Crowson, 1955)

1(a). ADULT. *Head*: antenna ten-segmented, segments of the club dull and pubescent. *Thorax*: elytra completely covering abdomen and spiracles in repose. *Abdomen*: number of sternites visible 5 (III–VII), they are usually flat and sharply set off at the sides from the vertical pleurites; spiracles dorsal, in the membrane at the sides of the tergites; aedeagus with the median lobe well-developed and sclerotized in its apical part beyond the basal-piece, internal sac usually small and simple.

LARVA. *Head*: Maxillary stipes without a row of spines (stridulatory file) on

its dorsal face; galea and lacinia^r completely separate. *Abdomen*: anus often a longitudinal slit.....2

(b). ADULT. *Abdomen*: number of sternites visible 6 (III–VIII), rarely with sharply set off pleurites; aedeagus with the median lobe almost entirely membranous, the eversible internal sac large and complex.

LARVA. *Head*: maxillary stipes almost always with a row of spines on its dorsal surface. *Abdomen*: anus Y-shaped or V-shaped or transverse, never longitudinal; tergites always with two or three distinct transverse convex folds.....5

2(a). ADULT. Species usually elongate and parallel-sided. *Head*: antennal club with lamellae often more than three, not closely co-adapted; mandibles large and freely projecting.

Thorax: tarsal claw with a well-developed bi-or plurisetose empodium in between.

LARVA. *Thorax*: Mesocoxa with a stridulatory file on posterior face against which hind leg works.

Abdomen: terga without transverse folds.....3

(b). ADULT. Species of more or less rounded and convex shape *Head*: antennal club with three closely co-adapted lamellae; mandibles small, not conspicuously projecting. *Thorax*: tarsal claw with empodium small or absent, not setose.

- LARVA. *Thorax*: Mesocoxa without stridulatory file.
Abdomen: terga with transverse folds.
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- 3(a). ADULT. *Head*: antenna geniculate, the segments of the club not at all co-applicable; maxilla with galea without a chitinous hook at apex; labium with the mentum entire, the ligula inserted on its inner face.
- Thorax*: hind wings with two apical detached veins between cubitus and first complete anal; M-Cu loop distinct.
- Abdomen*: aedeagus with the lateral lobes distinct and separate; median lobe not globose.
- LARVA. *Head*: mandible with a ventral crushing tubercle on its posterior edge.
- Thorax*: hind legs fully developed and normal.
- Abdomen*: anus straight, longitudinal.
 Lucanidae
- 3(b). ADULT. *Head*: antenna not geniculate, the segments of the club loosely co-applicable by 'rolling up' of antenna; maxilla with galea with a chitinous hook at apex; labium with the mentum emarginate, the ligula attached to its apical margin.
- Thorax*: hind wings with one detached apical vein between cubitus and first complete anal; M-Cu loop absent.
Abdomen: aedeagus with the lateral lobes reduced or fused together; median lobe globose.
- LARVA. *Head*: mandible without a ventral crushing tubercle.
- Thorax*: hind legs greatly reduced.
Abdomen: anus transverse.
 Passalidae
- 4(a). ADULT. Body not capable of being rolled into a ball. Dorsal surface dull, more or less scaly or setose.
Thorax: hind wing with two apical detached veins between Cu and first complete anal; M-Cu loop distinct.
- LARVA. *Head*: antenna three-segmented. *Thorax*: tarsal claws usually long and acute. *Abdomen*: ventral anal lobe longitudinally furrowed.
 Trogidae
- (b). ADULT. Body capable of being rolled into a ball (as in the Clambidae, etc.). Dorsal surface highly polished and glabrous. *Thorax*: hind wing with only one apical detached vein between Cu and first complete anal; M-Cu loop absent.
- LARVA. *Head*: antenna four-segmented. *Thorax*: tarsal claws short, normal. *Abdomen*: ventral anal lobe not longitudinally furrowed.
 Acanthoceridae
- 5(a). ADULT. *Head*: antenna 11-segmented; mandibles and labrum freely exposed. *Thorax*: elytra completely covering abdomen; mesocoxae practically contiguous; hind wing (except in apterous forms) with two apical detached veins between Cu and first complete anal; hind tibia with two apical spurs. *Abdomen*: short, spiracles situated in membrane at sides of tergites.
- LARVA. *Head*: antenna three-segmented; without a distinct sensory appendage on the penultimate segment; raster not distinctly developed; maxilla with the galea and lacinia quite separate. *Abdomen*: tergites markedly spinose..... Geotrupidae
- (b). ADULT. *Head*: antenna eight-ten segmented. *Thorax*: hind wings with only one apical detached vein between Cu and first complete anal.
- LARVA. *Head*: if maxilla with the galea and lacinia separate, antenna with a distinct sensory appendage on the penultimate segment; raster almost always distinct. *Abdomen*: tergites not markedly spinose.
 Scarabaeidae
2. *Key and Distinguishing Characters of the Subfamilies of the Scarabaeidae* (Arrow, 1910 and Crowson, 1955)

- 1(a). ADULT. All abdominal spiracles situated in membrane at sides of tergites, seventh tergite not fused to sternite.
 LARVA. Maxillary galea and lacinia quite separate; antenna with apical sensory appendage on penultimate segment.....
 Laprostici (Laprosticti).....2
- (b). ADULT. At least fifth and sixth abdominal spiracles situated in upper parts of sternites; seventh tergite and sternite usually fused into a complete ring.
 LARVA. Maxillary galea and lacinia fused, or so closely applied together as to appear to be so; penultimate antennal segment without apical sensory appendage.....
Pleurostici (Pleurosticti).....7
2. Labrum and mandibles usually projecting and easily seen in a dorsal view of the head; pygidium generally concealed; antenna 9 or 10-segmented.....3
 Labrum and mandibles concealed from dorsal view; antenna 9-segmented.....6
3. Eyes entire.....Ochodaeinae
 Eyes divided in front.....4
4. Antenna 9-segmented....Chironinae
 Antenna 10-segmented.....5
5. Antennal club simple.....Orphninae
 Antennal club telescopic..Hybosorinae
- 6(a). ADULT. Hind tibia with one terminal spur; elytra leaving pygidium uncovered; meso-coxae rather widely separated.
 LARVA. Legs reduced, claw absent or minute; abdomen strongly humped dorsally in front.
 Scarabaeinae (=Coprinae)
- (b). ADULT. Hind tibia with two terminal spurs; elytra completely covering abdomen; meso-coxae only slightly separated.
 LARVA. Legs fully developed, normal; abdomen not usually humped on dorsum of anterior abdominal segments..... Aphodiinae
7. Labrum membranous, not visible externally.....8
 Labrum thick, more or less exposed....9
- 8(a). ADULT. Front coxae transverse, their front surfaces ridged; antennal sockets completely hidden under expanded sides of front; mandibles visible dorsally.
 LARVA. Lower face of labrum (epipharynx) without curved transverse row of spines; labrum usually asymmetrical..... Dynastinae
- (b). ADULT. Front coxae vertical, their front faces not ridged; antennal sockets more or less visible from above; mandibles hidden from dorsal view.
 LARVA. Epipharynx with a curved transverse row of spinules parallel to the middle part of its anterior margin; labrum always symmetrical
 Cetoniinae
9. Labrum (and maxillae) degenerate, scarcely chitinous.....
 Desmonychinae
 Labrum well-developed.....10
10. Abdomen with the sixth visible ventral segment retractile.....Hopliinae
 Abdomen with the sixth visible ventral segment not retractile.....11
11. Tarsal claws equal (or if unequal; both cleft) and not separately movable..12
 Tarsal claws unequal, separately movable, not toothed at base, the shorter one always undivided; abdomen with the spiracles IV-VII lying in strongly diverging lines. (LARVA. Anus transverse, not angulate; mandibular stridulating area sharply defined, oval, formed of transverse striae).....
 Rutelinae
12. External lamellae of the antennal club enclosing the middle one.....
 Euchirinae
 External lamellae of the antennal club not enclosing the middle one; abdomen with the spiracles IV-VII lying

in almost parallel lines. (LARVA. Anus angulate in middle, more or less V-or Y-shaped; mandibular stridulating area without definite boundaries, formed of minute granules)..... Melolonthinae

3. The Subfamily Rutelinae

According to Crowson (1955), 'of the Pleurostict subfamilies, Melolonthinae are usually regarded as including the more primitive forms (it is among them that the forms most resembling Glaphyrinae, such as *Oncerini* and *Chasmatopterus*, are found) and it is possible to suppose that Rutelinae together with the Pachypodinae-Dynastinae-Cetoniinae group have arisen from an early Melolonthine type.'

With the exception of the small group Parastasiini, the Rutelinae of the oriental region are pests of economic importance, the larvae are root-feeders and the adults are leaf-feeders (*vide* Table 1).

4. Key to the Tribes of the Rutelinae of Pakistan (Arrow, 1917)

1. Labrum produced downwards..... Adoretini
Labrum (with at least the basal half) not produced downwards (*i.e.*, horizontal).....2
2. Labrum visible from above..... Peltonotini
Labrum not visible from above.....3
3. Mandibles produced beyond the clypeus..... Parastasiini
Mandibles entirely covered by the clypeus.....4
4. Antenna 9-segmented; elytra with membranous margins.....Anomalini
Antenna 10-segmented; elytra without membranous margins..... Adorrhinyptiini

5. The Tribe Anomalini

The distinguishing characters of the adults are given in the preceding key. Most of the species of the Old World Rutelinae and almost all the brilliantly coloured ones belong to this tribe. The inconspicuous forms are nocturnal in their habits.

6. Key to the Genera of the Anomalini of Pakistan (Arrow, 1917)

- 1 Clypeus produced into a truncate rostrum.....2

Clypeus not produced into a truncate rostrum.....3

- 2 Pronotum broadly transverse, not hairy..... *Rhinyptia* Burm.
Pronotum not broadly transverse, hairy..... *Tropiorrhynchus* Blanch.
- 3 Pronotum excised before the scutellum.....4
Pronotum not excised before the scutellum.....6
- 4 Hind coxae acutely produced at the base.....*Callistopopillia* Ohaus
Hind coxae not acutely produced at the base.....5
- 5 Narrowly elongate; teeth of the front tibia separated by an acute notch.....*Dactylopopillia* Arrow
Short; teeth of the front tibia not separated by an acute notch.....*Popillia* Serv.
- 6 Mesosternal epimera interposed between the prothorax and elytra.....*Trichanomala* Arrow
Mesosternal epimera not interposed between the prothorax and elytra.....7
- 7 Pronotum and elytra very flat, the former widest at the hind angles.....*Spilopopillia* Kraatz
Pronotum and elytra not very flat.....8
- 8 Prosternum strongly elevated and bent abruptly forward....*Mimela* Kirby
Prosternum rarely elevated and never bent abruptly forward; all the tibiae armed with terminal spurs.....*Anomala* Smouelle

II. Genus *Anomala* Samouelle, 1819 (vide Arrow, 1917)

This large genus of nearly a thousand species is distributed throughout the world except Madagascar, Australia (except for one species *A. antiqua* (Gyll.), New Zealand, and South America west of the Andes. Information on the agricultural importance of the species of the oriental region is summarized in Table 1. They are pests of tea-crops, sugar-cane and cereals, etc. (Arrow, 1917).

Seasonal distribution of our species of *Anomala* is summarized in Table 2. The adults are most

common from April to June. Several species are attracted to light. The biology of *A. polita* Blanch, has been worked out by Maxwell-Lefroy and published under the name *A. varians* (Oliv.).

The material treated here is deposited in the Zoological Museum of the University of Karachi. In the monograph of Arrow (1917), the specimens key out to the section VI of this genus on account of the mesosternum which is produced between the middle coxae in each case. From the Zoological Record, we could not find any subsequently described species of *Anomala* from West Pakistan, although some of the records are not available here (those for the years 1927, 1935-37, 1943-1945, 1948, 1950-52). The distinguishing characters of the species of section VI of *Anomala* are summarized in Table 3. From the table it should be apparent that all the 39 species mentioned there are distinct from each other.

Key to the Species of Anomala Found or Likely to be Discovered in West Pakistan

- 1 Mesosternum produced between the mesocoxae..... 2
Mesosternum not produced between the mesocoxae 8
- 2 Pronotum of one colour dorsally as well as laterally (without prominent spots).... 3
Pronotum of more than one colour..... 6
- 3 Dorsal surface green..... 4
Dorsal surface yellow or brown..... 5
- 4 Elytra with the humeral or apical calli ruby-red *A. stoliczkae* Sharp
Elytra entirely green.....
..... *A. viridis* (Fabricius)
- 5 Yellow dorsally with the pronotum rosy *A. xanthonota* Arrow
Brown dorsally; Figs. 3-5.....
..... *A. qadrii* **n. sp.**
- 6 Pronotum green and red.....
..... *A. moorei* (Kraatz)
Pronotum brown and black..... 7
- 7 Pronotum with one black spot on the disc; Figs. 6-7... .. *A. shafqati* **n. sp.**
Pronotum with two black spots on the disc; Figs. 1-2... .. *A. ashrafii* **n. sp.**
- 8 Pronotum of one colour dorsally as well as laterally..... 9
Pronotum of more than one colour..... 11

- 9 Dorsal surface green; clypeus of the male with rounded or obtuse front angles; elytra of the female not angularly dilated.... 10
Dorsal surface testaceous or reddish; clypeus of the male with sharp front angles; elytra of the female angularly dilated.....
..... *A. dorsalis* (Fabricius)
- 10 Legs and ventral surface uniform deep green, not at all golden or fiery; aedeagus with the parameres narrowed apically.....
..... *A. chlorosoma* Arrow
Legs and ventral surface not uniform deep green; aedeagus with the parameres dilated apically..... *A. dimidiata* (Hope)
- 11 Base of the pronotum completely margined 12
Base of the pronotum not completely margined..... 13
- 12 Pronotum with a black triangular spot on each side..... *A. rugosa* Arrow
Pronotum with the lateral margins green in the male and with two green spots in the female..... *A. fulviventris* (Blanch.)
- 13 Elytra strongly striate-punctate.....
..... *A. lineatopennis* Blanch.
Elytra without strongly-marked grooves or lines of punctures .. *A. xanthoptera* Blanch.

Key to the Species of Anomala Found or Likely to be Discovered in East Pakistan

- 1 Mesosternum produced between the mesocoxae..... 2
Mesosternum not produced between the mesocoxae 11
- 2 Mesosternal process elongate and pointed.. 3
Mesosternal process not elongate..... 7
- 3 Body long and narrow..... 4
Body oval; deep metallic green; mesosternal process strongly curved and a little compressed..... *A. varia* (Newm.)
- 4 Dorsal surface green..... 5
Dorsal surface reddish orange; mesosternal process slender, strongly curved and acute *A. tumidicauda* Arrow
- 5 Elytra shining..... 6
Elytra not shining, with humerus red.....
..... *A. stoliczkae* Sharp
- 6 Lateral margins of the elytra narrow; fiery-red stripe interrupted.. *A. auronitens* (Hope)
Lateral margins of the elytra broad; fiery-red stripe continuous *A. pterygophora* (Ohaus)

- 7 Pronotum densely punctate laterally.....8
Pronotum scarcely punctate; blue-green,
elytra brick-red... *A. erythroptera* (Kraatz)
- 8 Ventral surface dark; pygidium dull.....9
Ventral surface pale; pygidium shining;
mesosternal process a broad, compressed
slightly prominent lamina.....
..... *A. pusilla* Arrow
- 9 Mesosternal process slightly produced....10
Mesosternal process not at all produced;
elytra orange with green or red lustre
..... *A. parva* Arrow
- 10 Pygidium densely hairy; tibiae dark.....
..... *A. lateralis* Hope
Pygidium not densely hairy; tibiae coppery
red..... *A. dohertyi* Arrow
- 11 Clypeus of the male with sharp front angles;
elytra of the female angularly dilated;
testaceous or reddish *A. dorsalis*
(Fabricius)
Clypeus of the male with rounded or obtuse
front angles; elytra of the female not an-
gularly dilated.....12
- 12 Hind legs extremely massive; pronotum
strongly attenuated in front.....13
Hind legs not extremely massive; pronotum
not strongly attenuated in front.....14
- 13 Elytra coarsely (macroscopically) punctate
deep pitchy red.... *A. validipes* Arrow;
Elytra finely (microscopically) punctate;
black..... *A. trochanterica* Arrow
- 14 Base of the pronotum completely margined 15
Base of the pronotum not completely mar-
gined.....43
15. Metallic..... 26
Non-metallic.....16
16. Pale—coloured (sometimes partly dark
above); front tibia usually tridentate..17
Ventrally black; front tibia bidentate.....
..... *A. transversa*
(Burmeister)
17. Longer claws cleft on the middle legs....18
Longer claws cleft on the fore legs only....24
- 18 Clypeus weakly emarginate in front; pale
testaceous yellow..... *A. bengalensis* Blanch.
Clypeus not emarginate in front.....19
- 19 Large and elongate; elytra sparsely punctate;
testaceous..... *A. polita* Blanch.
- Small and usually oval; elytra densely pun-
ctate..... 20
- 20 Narrow and elongate.....21
Short and compact.....22
- 21 Fore tibia tridentate; elytra with opaque
lateral areas..... *A. bilunata* Fairmaire
Foretibia bidentate; elytra without opaque
lateral areas..... *A. clerica* Arrow
- 22 Fore tibia tridentate.....23
Fore tibia bidentate; pale to black.....
..... *A. varivestis* Arrow
- 23 Elytra very closely sculptured.....
..... *A. rugosa* Arrow
Elytra not very closely sculptured.....
..... *A. varicolor* (Gyll.)
- 24 Clypeus bilobed in front.....
..... *A. bilobata* Arrow
Clypeus nearly straight in front.....25
- 25 Elytra black..... *A. tristis* Arrow
Elytra brown..... *A. biharensis* Arrow
- 26 Fore tibia tridentate; dark metallic green or
coppery..... *A. antiqua* (Gyll.)
Fore tibia bidentate.....27
- 27 Eyes very large and prominent (interocular
distance in the male less than their com-
bined width) as well as clypeus very small
..... 28
Eyes small; if clypeus small then also strongly
transverse.....31
- 28 Red brown; the dorsal surface suffused with a
brilliant golden-green metallic lustre....
..... *A. vivida* Arrow
Essentially yellow; the dorsal surface if
metallic, lightly so and confined to front
only.....29
- 29 Pronotum dark (yellow).....
..... *A. aegrota* Arrow
Pronotum reddish-orange with yellow on
sides.....30
- 30 Elytra shining, sutural margins of the elytra
reddish..... *A. euops* Arrow
Elytra dull, sutural margins of the elytra
yellow *A. macrophylla*
(Wiedemann)
- 31 Metasternum entirely clothed with thick
hair..... 32

- Metasternum not entirely clothed with thick hair33
- 32 Brown; intervals of the elytra dissimilar*A. propinqua* Arrow
Black; intervals of the elytra similar.....*A. anthracina* Arrow
- 33 Hind tibiae stout and not long.....34
Hind tibiae long.....36
- 34 Small, oval and convex in shape; pygidium with large and distinct punctures; 9-10 mm.*A. siliguria* Arrow
Large, rather depressed and oblong; 12-16 mm.....35
- 35 Frontal region of the head black; tarsi red*A. marginipennis* Arrow
Frontal region of the head and tarsi dark coppery green.....*A. viridilatera* Arrow
- 36 Hind tibiae swollen in the middle.....37
Hind tibiae not swollen in the middle....40
- 37 Elytra weakly and incompletely striated; pronotum blue green with lateral margins orange.....*A. chinensis* (Redt.)
Elytra deeply striated.....38
- 38 Elytra with the intervals equal.....39
Elytra with the intervals alternately convex and flat; pronotum partly or entirely orange-yellow.....*A. galerucina* Arrow
- 39 Pronotum yellow with green spot on the disc; aedeagus with the parameres narrow, each with an apical and a similar subapical tooth on the outside.....*A. signaticollis* Nonfried
Pronotum metallic green in the male, in the female yellow with two metallic green spots; aedeagus with the parameres stout, each with an apical slender tooth and a subapical triangular broader tooth on the outside.....*A. fulviventris* (Blanch.)
- 40 Pronotum moderately closely clothed with yellowish setae and dark brown.....*A. cinderella* Arrow
Pronotum not hairy.....41
- 41 Pronotum with a median and four dark green spots.....*A. variegata* Hope
Pronotum with two dark spots.....42
- 42 Pronotum with the spots' inverted comma-shaped'; pygidium not entirely hairy....*A. comma* Arrow
- Pronotum with the spots different; pygidium entirely clothed with grey hair.....*A. angusta* Arrow
- 43 Elytra strongly striate-punctate.....44
Elytra without strongly-marked grooves or lines of punctures.....53
- 44 Pronotum with the front angles blunt and the hind angles acute, and yellow with three longitudinal black stripes.....*A. trivirgata* Fairmaire
Pronotum with the front angles more acute than the hind angles.....45
- 45 Short and convex; hind tibiae stout; pronotum metallic greenish black with the lateral borders reddish-testaceous.....*A. protea* Arrow
Elongate; hind tibiae slender.....46
- 46 Pronotum of one colour dorsally as well as laterally.....47
Pronotum of more than one colour.....49
- 47 Elytra striped or spotted.....48
Elytra neither striped nor spotted.....*A. agilis* Arrow
- 48 Pronotum iridescent; clypeus broad.....*A. flavofasciata* Arrow
Pronotum not shining; clypeus narrow....*A. flavonotata* Arrow
- 49 Pronotum with the sides yellow.....50
Pronotum with the sides not yellow....52
- 50 Elytra with transverse bands.....51
Elytra without transverse bands; greenish black.....*A. lineatopennis* Blanch.
- 51 Black or purplish black with yellow band on the elytron.....*A. flaviventris* Arrow
Pale yellow with black or dark brown bands on the elytron.....*A. flavopicta* Arrow
- 52 Pronotum with the disc entirely green; body not boat-shaped (convex and broad behind).....*A. semiaurea* Arrow
Pronotum with the disc with a narrow median line and one or two patches green; body boat-shaped.....*A. bella* Arrow
- 53 Pronotum of one colour dorsally as well as laterally.....54
Pronotum of more than one colour.....57
- 54 Abdomen ventrally red; dorsal surface dark bronzy green.....*A. rufiventris* Redt.
Abdomen ventrally green, blue or black..55

TABLE I.—THE HOST PLANT RECORDS OF ANOMALA SPECIES OF THE ORIENTAL REGION.

Pest species	Host plants	Miscellaneous observations
<i>A. anchoralis</i> Lansb.	Leaves of Cassava plants, <i>Manihot utilissima</i> Pohl (Euphorbiaceae)	Attack at night during October & November in Java
<i>A. aurora</i> Arrow	Peach trees <i>Prunus persica</i> Stokes (Rosaceae)	Burma
<i>A. biharensis</i> Arrow	Banyan tree, <i>Ficus bengalensis</i> Linnaeus (Urticaceae) and Gular tree, <i>F. glomerata</i> Roxb.	Larva under ground at the former and adult at the base of the latter
<i>A. dalbergiae</i> Arrow	<i>Dalbergia latifolia</i> Roxb. (Papilionaceae)	Madras, India
<i>A. dalmani</i>	Tea plantations, <i>Camellia sinensis</i> (Linnaeus) (Theaceae)	China
<i>A. decorata</i> Kirsch	Peach trees	Burma
<i>A. dimidiata</i> (Hope)	Roots of motha, <i>Cyperus rotundus</i> Linnaeus (Cyperaceae)	Pusa, India in June
<i>A. dorsalis</i> (Fabricius)	<i>Datura</i> sp. (Solanaceae) and Bhindi, <i>Hibiscus esculentus</i> Linnaeus (malvaceae)	Attracted to light and generally distributed in India
<i>A. dussumieri</i> Blanch	Leaves of <i>Cinchona succubra</i> (Rubiaceae)	Ceylon
<i>A. flavipes</i> Arrow	Alder, <i>Alnus nepalensis</i> D. Don (Betulaceae)	U.P., India
<i>A. hindu</i> (Heller)	<i>Hibiscus</i> sp.	Ceylon
<i>A. pallidospila</i> Arrow	Leaves of peach trees	Burma
<i>A. polita</i> Blanch.	Larvae on roots of grasses, millets, rice or <i>Oryza sativa</i> Linnaeus (Gramineae) Sugar-cane or <i>Saccharum officinarum</i> Linnaeus (Gramineae) and ground-nuts or <i>Arachis hypogaea</i> Linnaeus (Papilionaceae)	Pakistan; India
<i>A. rugosa</i> Arrow	Apricot trees, <i>Prunus armeniaca</i> Linnaeus (Rosaceae)	Jalikota, India
<i>A. tenella</i> (Blanch.)	Young shoots of tea plantation	Ceylon
<i>A. transversa</i> (Burm.)	Cherry <i>Betula</i> sp. (Betulaceae), roses (Rosaceae), spiraeas etc.	Shillong, Khasi Hills of Assam, India during day time
<i>A. varicolor</i> (Gyll.)	Root of Oats or <i>Avena sativa</i> Linnaeus (Gramineae) Pipal tree or <i>Ficus religiosa</i> Linnaeus (Urticaceae) and leaves of plum trees or <i>Prunus domestica</i> Linnaeus (Rosaceae)	Larvae attack oats in Pusa, rest are adults

- 55 Elytra densely sculptured; ventral surface more shining than dorsal surface..... (length 27-30 mm, breadth 15.5-18 mm.).....*A. grandis* (Hope)
-*A. cantori* (Hope)
- Elytra smooth, shining and finely punctate; dorsal surface more shining than ventral surface.....56
- 56 Pronotum with the front angles not at all produced and the hind angles rounded; small (length 19-26 mm, breadth 11.5-15 mm) *A. dimidiata* (Hope)
- Pronotum with the front angles right-angled and the hind angles very blunt; large
- 57 Dorsal surface of the pronotum bluish green and of the elytra reddish testaceous or golden..... *A. angulicollis* Arrow
- Dorsal surface of the pronotum and elytra green..... 58
- 58 Aedeagus with the parameres narrow and smooth or simply rounded at apex..... *A. perplexa* (Hope)
- Aedeagus with the parameres dilated and toothed at apex.....*A. indistincta* Arrow

Descriptions

(1) *Anomala ashrafi*, **new species**
(Figs. 1-2)

Holotype: Female (our number 723), West Pakistan, Karachi, in the Zoological Museum, University of Karachi.

Colour.—Dark brown except as follows: head fuscous, eyes with small black patches dorsally and a large patch ventrally; pronotum reddish brown with two prominent triangular black spots on disc; elytra with sutural margins fuscous, each elytron with a faint, narrow median, fuscous stripe running from near apex down to two-third length; legs with tarsi and apices of tibiae and femora fuscous to black.

Vestiture.—Uniformly, very sparsely pubescent dorsally except along clypeo-labral suture; ventral surface with longer hairs near sides of prothorax, legs and abdomen; light brown but with two rows of fuscous ctinidia on each meso and meta-tibia.

Punctures.—Head with frons (portion between eyes) with large and dense punctures, vertex also coarsely punctate; pronotum and elytra finely, sparsely punctate, punctures on elytra arranged in somewhat regular striae and intervals also irregularly punctate.

Head.—Clypeus and frons rugose with a narrow, shallow, transverse depression between eyes; clypeus very broadly, weakly emarginate in front eyes incompletely divided apically by a narrow ridge; apex of labrum slightly produced, latter projecting ventrally (slightly approaching the vertical labrum of the Adoretini but is definitely horizontal before apex).

Thorax.—Pronotum with apical and basal angle obtuse, sides rounded and slightly narrowed at both ends, more towards apex than at base, apex emarginate in front, base rounded but slightly produced near scutellum. Scutellum roughly triangular or dome-shaped with apex obtuse. Hind wing (Fig. 2) without radial and anal cells. Metendosternite with stalk long, anterior tendons borne on a prominent median projection (as in Fig. 4). Mesosternal process posterior to mesocoxae Y-shaped, arms of Y-being slightly rounded. Legs with front tibiae bidentate; hind tibiae widest in middle emarginate beyond middle on outer side.

Abdomen.—Last visible (seventh) sternite entire, narrow Last visible tergite (pygidium) entire, large.

Total length 11 mm; maximum width 7 mm.

It is a pleasure to name this species in honour of Dr. Shahid Husain Ashrafi.

(2) *Anomala qadrii*, **new species** (Figs. 3-5).

Holotype.—Male (our number 722), West Pakistan, Karachi, in the Zoological Museum, University of Karachi.

Colour.—Light brown except as follows: fuscous, eyes yellowish brown; pronotum, scutellum and elytra with black margins; legs with tarsi and apices of tibiae dark brown to fuscous.

TABLE 2.—SEASONAL DISTRIBUTION OF THE SPECIES OF ANOMALA FOUND OR LIKELY TO BE DISCOVERED IN PAKISTAN.

Species	Collection dates	Miscellaneous observations
<i>A. aegrota</i> Arrow	April	Assam, India
<i>A. agilis</i> Arrow	May-June	Darjiling, Sikkim
<i>A. anchoralis</i> Lansb.	April	Burma
" " "	October-November	Java
<i>A. angulicollis</i> Arrow	June	Bengal
<i>A. angusta</i> Arrow	June	Darjiling, Sikkim
<i>A. bella</i> Arrow	May	East Pakistan; Assam, India; Burma
<i>A. bengalensis</i> Blanch	April-June	Pakistan; India; Burma
<i>A. biharensis</i> Arrow	April-June	Pusa, India
<i>A. bilobata</i> Arrow	March-May	Bengal
" " "	May-June	Burma
<i>A. cantori</i> (Hope)	April-September	Burma
<i>A. dimidiata</i> (Hope)	May-August	Pakistan; India
<i>A. dorsalis</i> (Fabricius)	May-October	Pakistan; India
<i>A. erythroptera</i> (Kraatz)	May	Sikkim
<i>A. euops</i> Arrow	July-October	Pusa, India
<i>A. flaviventris</i> Arrow	July	Bengal
<i>A. fulviventris</i> (Blanch.)	May	Sikkim
<i>A. galerucina</i> Arrow	May-June	Gopaldhara, Sikkim
<i>A. indistincta</i> Arrow	May-December	East Pakistan; Assam, India; Burma
<i>A. lineatopennis</i> Blanch.	May-June	Pakistan; India
<i>A. macrophylla</i> (Wiedemann)	June-December	East Pakistan
<i>A. parva</i> Arrow	October	Assam, India
<i>A. polita</i> Blanch.	May-July	Pakistan; India
<i>A. propinqua</i> Arrow	June	Jolikote, India
<i>A. protea</i> Arrow	April-May	Sikkim
<i>A. rugosa</i> Arrow	May	Darjiling, Sikkim; Kulu, Panjab and U.P., India
<i>A. transversa</i> (Burm.)	May	India
<i>A. tristis</i> Arrow	September	Dehradun, India
<i>A. tumidicauda</i> Arrow	May-June	Sikkim
<i>A. varicolor</i> (Gyll.)	April-August	Bengal; Madras, India; Ceylon
<i>A. variegata</i> Hope	April-May	Darjiling, Sikkim
<i>A. xanthonota</i> Arrow	January-June	Panjab
<i>A. xanthoptera</i> Blanch.	March-April	West Pakistan; India

TABLE 3.—SUMMARY OF THE DISTINGUISHING CHARACTERS OF SPECIES OF SECTION VI OF *Anomala*.

Species	Distribution	Length in mm	Colour	Mesosternal process
<i>A. agnella</i> Arrow	Madras, India	10-13	Pale yellow; head and pronotum coppery green or bronze.	Short, straight and very sharp.
<i>A. amphillissa</i> Arrow	Nepal	13	Deep metallic green; head and pronotum fiery red, elytra orange yellow.	Acute and nearly straight.
<i>A. armata</i> Arrow	Madras	16-17	Pale yellow, with metallic green lustre and markings.	Long, strongly curved and compressed.
<i>A. ashrafii</i> sp. n. +	Karachi, Pakistan	11	Dark brown; head fuscous, pronotum with two black spots, elytron with a fuscous stripe.	Posterior to mesocoxae Y-shaped.
<i>A. auronitens</i> (Hope)*	Assam, Sikkim and Burma	12-18	Deep metallic green dorsally and nearly black ventrally.	Slender and strongly curved
<i>A. chloromela</i> Arrow	Ceylon	17-18	Bright green; ventral surface and legs golden red.	Short and sharp.
<i>A. chrysochroma</i> Arrow	Burma	15	Orange yellow with green suffusion; ventral surface and legs deep metallic green.	Long, slender and scarcely curved.
<i>A. degenerata</i> Arrow	Madras, India	18	Pale testaceous, suffused with metallic green lustre and markings; tarsi dark.	Slender, acute, not compressed, not strongly curved.
<i>A. dohertyi</i> Arrow*	Assam, India and East Pakistan	8.5-10	Deep golden or coppery green; tibiae and tarsi coppery red.	Strong, very slightly produced and very blunt.
<i>A. ebena</i> (Burm.)	Madras and Burma	17	Coal-black, shining.	Broad and compressed.
<i>A. erythroptera</i> (Kraatz)*	Assam and Sikkim	8-9.5	Blue-green; elytra bright brick-red.	A rectangular lamina which is vertical in front.
<i>A. festiva</i> Arrow	Sikkim and Tibet	8.5-9.5	Bright metallic green, golden or red; elytra testaceous.	Very slightly prominent.
<i>A. flavipes</i> Arrow	U.P., India	9-10	Testaceous with a greenish golden lustre; ventral surface deep metallic green.	A broad lamina which is not produced.
<i>A. gemmula</i> Arrow	Madras, India	11.5-13	Bright grass-green dorsally; ventral surface coppery.	Narrow, compressed, not acute, not curved but bent downwards.
<i>A. isolata</i> Arrow	Andaman Island	16-17	Deep golden green; ventral surface and legs paler.	Short, blunt and compressed.
<i>A. lateralis</i> Hope*	Sikkim and Nepal	9-10	Deep metallic green; elytra and legs brownish.	Short, right-angled lamina.
<i>A. madurae</i> Arrow	Madras, India	10.5-11.5	Pale testaceous with green markings and slight metallic lustre.	Slender, strongly curved and not compressed.
<i>A. moorei</i> (Kraatz) +	Punjab, India and Pakistan	11	Deep metallic green; elytra and legs reddish testaceous.	Slight.
<i>A. nigroscripta</i> Arrow	Madras, India	13.5	Chestnut-red with black markings.	Slender & strongly curved.
<i>A. oculicollis</i> Arrow	Madras, India	10-13	Deep metallic greenish purple with dark brown markings; ventral surface and legs variegated with yellow.	Short and conical.

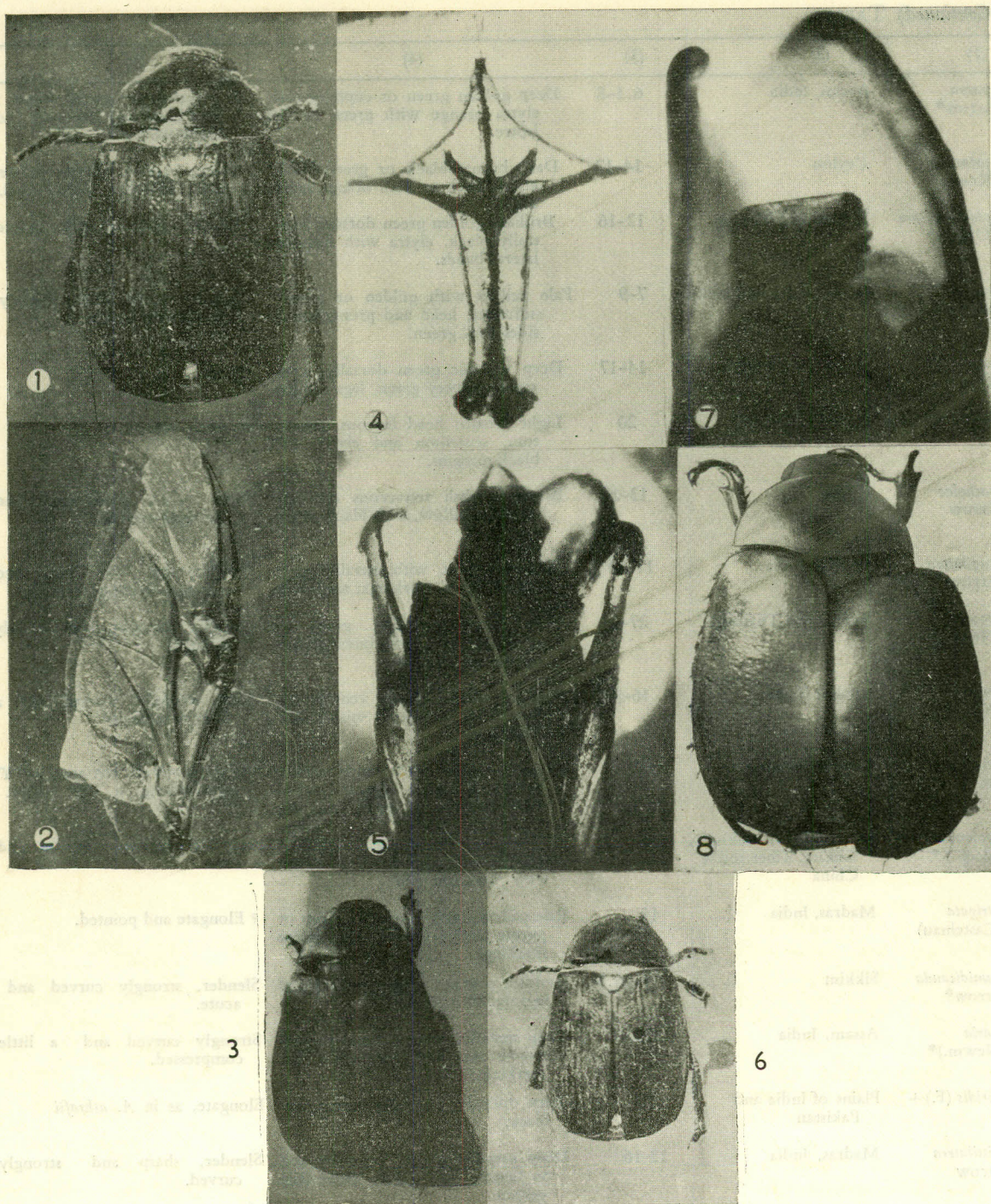
(Continued)

(Continued) TABLE 3

(1)	(2)	(3)	(4)	(5)
<i>A. parva</i> Arrow*	Assam, India	6.5-8	Deep golden green or coppery red; elytra orange with green or red lustre.	A compressed lamina which is very blunt and not at all produced forward.
<i>A. princeps</i> (Kraatz)	Ceylon	14-17	Dark bronzy-black or green-black; elytra black or with orange markings.	Large, curved, bluntly pointed and strongly compressed.
<i>A. pterygophora</i> (Ohaus)*	Sikkim and Bhutan	12-16	Brilliant golden green dorsally; ventrally black, elytra with fiery-red lateral bands.	Slender and strongly curved.
<i>A. pusilla</i> Arrow*	Assam, Nepal and Sikkim	7-9	Pale yellow with golden or green suffusion; head and pronotum on sides dark green.	Broad, compressed, slightly prominent lamina.
<i>A. pyrosclis</i> (Hope)	Assam and Bhutan	14-17	Deep metallic green dorsally; ventrally coppery green, legs reddish.	Short.
<i>A. qadrii</i> sp. n. +	Karachi, Pakistan	20	Light brown; head fuscous, pronotum, scutellum and elytra with black margins.	As in <i>A. ashrafii</i> .
<i>A. rachelae</i> Arrow	Burma	13-14	Bright reddish testaceous dorsally; ventrally yellow, with black markings.	Very acute, compressed and strongly curved.
<i>A. rugilatera</i> Arrow	Madras, India	11-13	Pale testaceous, with metallic green suffusion and markings; tarsi dark.	Slender, sharp not compressed and not strongly curved.
<i>A. rosetti</i> (Nonfr.)	Burma and Thailand	27-33	Deep shining metallic green or golden-green; sometimes slightly opalescent on elytra.	Strong, straight and sharply pointed.
<i>A. regina</i> (Newm.)	Madras, India	16-18	Brilliant golden-green; ventral surface fiery, pronotum with a large dark spot.	Very strongly curved and a little compressed.
<i>A. shafqati</i> sp. n. +	Karachi, Pakistan	11	Dorsal surface black with reddish brown patches; ventral surface dark brown to partly fuscous.	As in <i>A. ashrafii</i> but arms of 'Y' approaching a 'T' shape.
<i>A. stoliczkae</i> Sharp +*	N. India, W. Pakistan, Sikkim, Tibet and W. China	14	Brilliant metallic green or golden-green dorsally and ventrally; elytra with humerus red.	Strongly curved, slender and acute.
<i>A. strigata</i> (Castelnau)	Madras, India	15	Pale yellow, with a metallic green or purple suffusion and dark green markings.	? Elongate and pointed.
<i>A. tumidicauda</i> Arrow*	Sikkim	14-16.5	Reddish orange; ventral surface and legs metallic green.	Slender, strongly curved and acute.
<i>A. varia</i> (Newm.)*	Assam, India	12-14	Deep metallic green; elytra purple-bronze and with pale testaceous markings.	Strongly curved and a little compressed.
<i>A. viridis</i> (F.) +	Plains of India and Pakistan	20	Green dorsally; ventrally fuscous to black.	Elongate, as in <i>A. ashrafii</i>
<i>A. vittilatera</i> Arrow	Madras, India	13-16	Deep metallic green; ventrally and on femora and middle tibiae pale yellow.	Slender, sharp and strongly curved.
<i>A. xanthochroma</i> Arrow	Assam, India	14	Orange yellow; ventral surface and legs dark coppery-green.	Straight, long and sharp.
<i>A. xanthonota</i> Arrow +	Punjab, India and West Pakistan	13-17	Bright yellow dorsally; ventral surface and legs deep metallic green.	Slender, sharp and moderate.

* Species likely to be found in East Pakistan.

+ Species likely to be found in West Pakistan.



Figs. 1-8.—(1) *Anomala ashrafii* n.sp., holotype, female, Figs. 1-2: 1, dorsal view; 2, hind wing. (2) *Anomala qadrii* n.sp., holotype, male, Figs. 3-5: 3, dorsal view; 4, metendosternite; 5, apex of aedeagus, ventral view. (3) *Anomala shafqati* n.sp., holotype, male, Figs. 6-7: 6, dorsal view; 7, apex of aedeagus, ventro-lateral view. (4)? *Anomala viridis* (Fabricius), female, Fig. 8, dorsal view. (Photographs by Mr. M. Rafiuzzaman of the Biochemistry Research Division)

Vestiture.—Smooth, without hairs on head, pronotum and elytra dorsally, a few long, yellow or brown hairs present on antennae, mouth parts, legs, mesosternum and first two visible abdominal sternites, three rows of fuscous ctinidia present on each meso—and meta-tibia.

Punctures.—Dorsal surface of head with coarse and dense punctures near and between eyes, being sparse and less coarse elsewhere; pronotum and elytra very finely, sparsely punctate, arrangement of punctures on elytra similar to *A. ashrafi* but with striae and intervals even less marked.

Head.—Clypeus not depressed; rest as in *A. ashrafi*.

Thorax.—Pronotum with a weak median sulcus not touching base. Hind tibiae equally wide in middle and at apex, not appreciably emarginate beyond middle on outer side. Rest as in *A. ashrafi*.

Abdomen.—Last visible sternite weakly emarginate but appearing entire due to a thin cuticular extension, narrow. Last visible tergite entire, large. Aedeagus as in Fig. 5; apices of lateral lobes diverging, each with one large hook and several small spines; apex of median lobe rounded.

Total length 20 mm; maximum width 12 mm.

Maxwell-Lefroy (1909:255) mentions that *A. pallida* (Oliv.) 1789, and *A. dorsalis* (Fabricius) 1775, are common species. According to Arrow (1917:136) the former is a junior synonym of the latter and the aedeagus of the male is different from *A. qadrii* in having a truncate median lobe, and rounded and smooth lateral lobes. Furthermore, *A. dorsalis* lacks the mesosternal process between the mesocoxae so characteristic of the species of the section VI of *Anomala*.

One could confuse this species with *A. varians* (Olivier), 1789 in the work of Maxwell-Lefroy (1909:255). Arrow (1917:145) doubtfully treated *Melolontha varians* Olivier, 1789 as a junior synonym of *Anomala elata* (Fabricius), 1792 but this was a mistake. The species, *A. varians* (Olivier) mis-treated as *A. elata* by Arrow (1917) differs from our *A. qadrii* in the shape of the aedeagus and in the absence of a mesosternal process.

It is a pleasure to name this species in honour of Professor Mohammad Afzal Hussain Qadri.

(3) *Anomala shafqati*, **new species** (Figs. 6–7).

Holotype.—Male (our number 724) West Pakistan, Karachi, in the Zoological Museum, University of Karachi.

Colour.—Dorsal surface black except as follows: eyes brown; pronotum with a narrow median strip continuous with transverse strip along apex, and a basal spot near each lateral margin reddish brown; scutellum with a reddish brown spot in middle; each elytron with an elongated reddish brown patch. Ventral surface dark brown except as follows: abdominal sternites fuscous along their apices, tibiae partly to completely fuscous.

Vestiture. Smooth, without hairs on head, pronotum and elytra dorsally; sparse, long brown hairs present on antennae, mouth parts, legs, thoracic and abdominal sternites; two rows of dark brown ctinidia present on each meso- and meta-tibia.

Punctures.—As in *A. ashrafi* but striae and intervals on elytra better developed.

Head.—Similar to *A. ashrafi* except as follows: frons not depressed; clypeus truncate in front.

Thorax.—Arms of 'Y-shaped' mesosternal process rather straightened out approaching a 'T'. Rest as in *A. ashrafi*.

Abdomen.—Similar to *A. qadrii* except as follows: aedeagus (Fig. 7) with apices of lateral lobe converging, each with one prominent blunt hook only; apex of median lobe obliquely truncate.

Total length 11 mm.; maximum width 6 mm.

The shape of the aedeagus is somewhat similar to *A. dawnensis* Arrow but not entirely so unlike *A. shafqati*, the median lobe is rounded at apex and the mesosternum is not produced between the mesocoxae.

In the key of Arrow (1917) this species comes to *A. princeps* (Walker) of Ceylon but our *A. shafqati* differs in the following characters: meso-metasternal suture not obliterated; elytra with two longitudinal (not transverse) bands; pronotum with median portion of disc reddish brown etc.

It is a pleasure to name this species in honour of Dr. Shafqat Husain Siddiqi.

(4) ? *Anomala viridis* (Fabricius) (Fig. 8)

Female (our number 721), West Pakistan, Karachi, in the Zoological Museum, University of Karachi.

Colour.—Dorsal surface metallic green but eyes brown. Ventral surface fuscous to black with metallic green suffusion.

Vestiture.—As in *A. qadrii* but hairs more developed on ventral surface and meso- and metathorax each with two rows of ctenidia.

Punctures.—Clypeus coarsely, densely punctate, remaining portion of head less coarsely punctate. Rest as in *A. qadrii* but striae or intervals even less marked.

Head.—Frons not rugose. Rest as in *A. qadrii*.

Thorax.—As in *A. qadrii* but sulcus on pronotal disc not appreciable.

Abdomen.—As in *A. ashrafi*

Total length 20 mm; maximum width 13 mm.

It is by no means certain that the specimen described above belongs to *A. viridis* but we cannot prove otherwise. Maxwell-Lefroy (1909:255) mentions a green species of *Anomala* by this name but Arrow (1917) has not described this species

at all. This action is rather surprising, especially when *Melolontha viridis* F. is recognized to be a species of *Anomala* (Arrow, 1917:126). Since we cannot prove that the specimen (721) is specifically different from *A. viridis*, we are tentatively describing it under the same name. However, if it could be proved later on that the specimen belongs to a new species, as we suspect, then a suitable name could be easily proposed. The description already exists.

References

1. R.H. Arnett, Jr., *The beetles of the United States* (1960-62) xi+1112 pp., Washington, D.C.
2. G. J. Arrow, *Fauna of British India including Ceylon and Burma (Coleoptera, Lamellicornia I: Celoniinae and Dynastinae)*, (Taylor & Francis, London, 1910), xiv+322 pp.; pls. I-II.
3. G. J. Arrow, *The Fauna of British India including Ceylon and Burma (Coleoptera, Lamellicornia II: Rutelinae, Desmoneinae and Eucirinae)*, (Taylor & Francis, London, 1917), xiii+387 pp., pls. I-V.
4. R.A. Crowson, *The natural classification of the families of Coleoptera*. 1955, vii+187 pp., London.
5. H. Maxwell-Lefroy, *Indian Insect Life* (W. Thacker & Co., London, 1909) xii+786 pp.