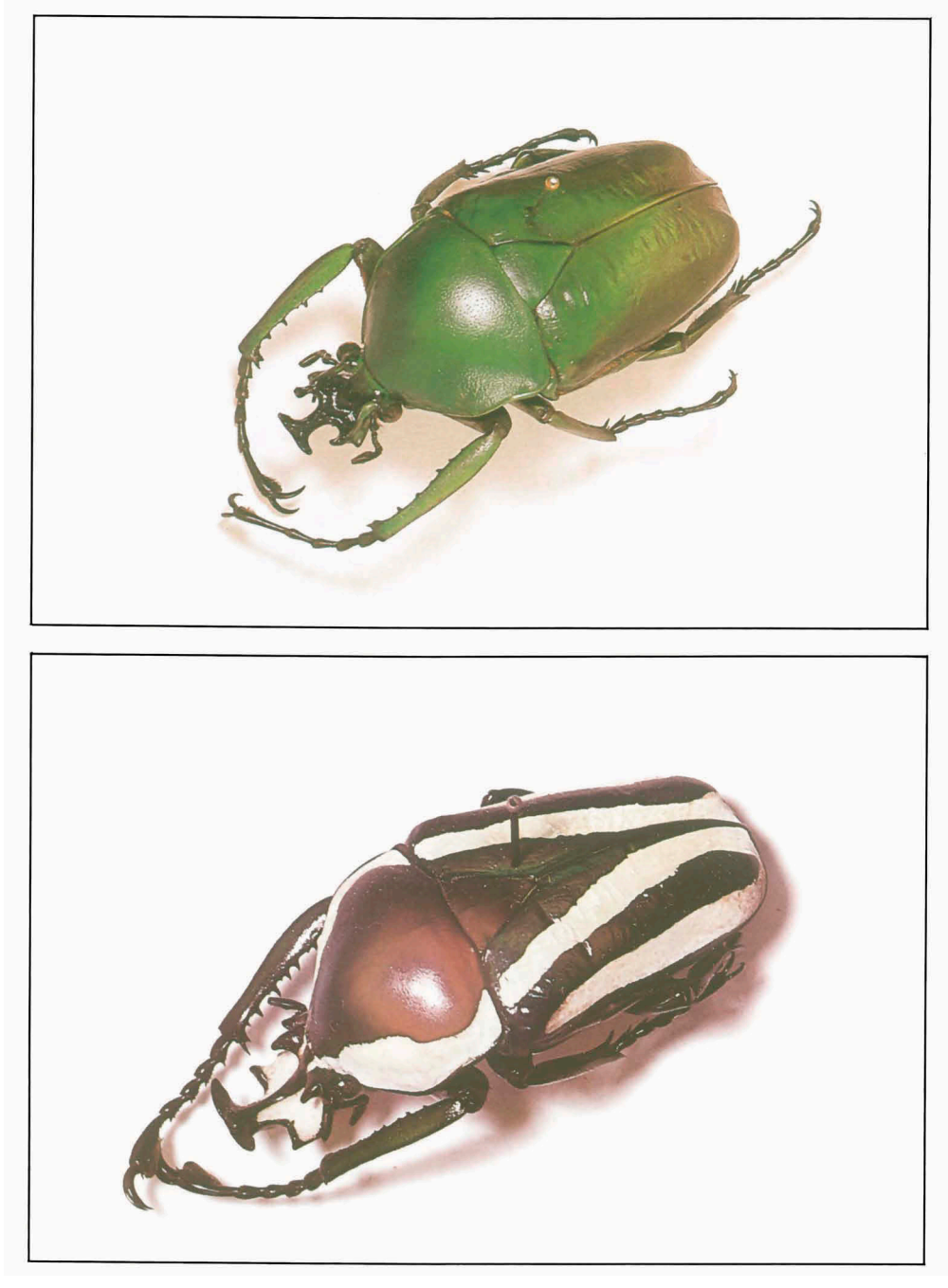

Frontispiece. Two characteristic *Dicronorhina* species, males; top, *D. cavifrons,* Djougou, Benin; bottom, *D. derbyana lettowvorbecki,* Makonde highland, Tanzania.

TAXONOMIC REVIEW OF THE AFROTROPICAL GENUS *DISRONORHINA* HOPE, WITH NOTES ON ITS RELATIVES (COLEOPTERA: CETONIIDAE)

by

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Key words: Coryphocerina; Afrotropical genera; *Dicronorhina*; key; species; variability.

The Afrotropical genus *Dicronorhina* Hope (= *Dicranorrhina* auctorum, unjustified emendation) is diagnosed and discussed. The characters of the species, subspecies and varieties are examined, and presented in a synoptic table and in an analytical key. An annotated checklist of the species, subspecies and varieties is given. Three species are recognized; in one species, five subspecies are recognized. Several varieties are discussed. Two new varietal names are proposed. A key to the genera of larger Afrotropical Goliathini with horned males is given. The phylogeny of the *Dicronorhina* species and their position among the other Afrotropical Coryphocerina is briefly discussed.

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CONTENTS

INTRODUCTION

In this paper the genus *Dicronorhina* Hope, 1837 (= *Dicranorrhina* auctorum), a genus of large horned goliath beetles from tropical Africa, is diagnosed and discussed. The species, subspecies and varieties are examined, their characters being presented in both a synoptic table and an analytical key; an annotated checklist of the taxa is given. The ranges of the species and subspecies are mapped. The treatment of *Dicronorhina* is followed by a key to all the horned genera of Afrotropical Goliathini. The phylogeny and the affinities of *Dicronorhina* with other Goliathini are also discussed.

The objectives of this series of reviews of cetoniid genera are to contribute to a supraspecific classification of the family, and to provide a catalogue of the species, primarily based on the collections and the documentation in the Leiden museum. In the case of *Dicronorhina* we had the opportunity to study numerous additional specimens from other museums. Reviews of other goliathine genera, including *Eudicella* White and *Cyprolais* Thomson, are in preparation.

TERMINOLOGY AND FURTHER EXPLANATION

The term basal piece is applied to the part of the phallus proximal to the ligaments that enable the distal part to move up- and downwards. The fused portion of the parameres adjacent to the ligaments is here termed the parameral base. The separated distal parts of the parameres are termed the distal pincers.

The male cephalic protrusions that are just in front of, and between, the eyes are termed postclypeal protrusions, because these protrusions seem not homologous to frontal and other protrusions that are found in certain other genera (e.g. the antegenal protrusions in *Chelorrhina*), but to the protrusions that evidently have evolved as a result of the backward extension of a (concave) clypeal area. This extension can be observed by comparing major and minor males, e.g. in *Cyprolais* (allometric growth). The anteromedian horn is usually termed "the clypeal horn".

Approximate total lengths were measured without actually extending the heads of the specimens; consequently the variation in size will be slightly exaggerated, although in most specimens the heads were fully extended. The length of the males is given without the length of the clypeal horn; the length of the horn itself was not measured, because allometric growth is poorly pronounced in *Dicronorhina*.

If further below, in the species accounts, the name(s), of (an) author(s) stand(s) between parentheses, following a collecting locality, this means that specimens from the same locality were not seen by the authors of the present paper. An exclamation mark following the year of publication means that we can confirm the occurrence, having seen specimens from the same locality. An asterisk preceding a locality name means that the record concerns an unreliable, and henceforth unmapped, locality. Two asterisks mean, that the locality could not be located, and henceforth, it is omitted from the maps. Inexact localities (district, province, country etc.) have been denoted on the maps by open circles (figs. 21, 22) or parentheses (fig. 23).

The annotated checklist of the species-group taxa comprises the essential taxonomic information: name, first description and reference, original combination, type status, type location and locality, synonymy, range.

In order to promote their consistent usage among workers in the Cetoniidae, we define here a few interrelated terms concerning taxa of different rank (not all the terms mentioned are actually used in the present paper). The main purpose of the following statements is to emphasize the (in principle) polymorphic nature of the subspecies, a concept frequently misapplied and confounded with individual variation.

A population is a local group of interbreeding individuals. The individuals in a population have a greater chance of mating with another individual in the same population than with an individual from another population; in our museum practice we assume a population to be represented by a series of apparently conspecific, more or less similar specimens from the same locality. A variety (var., varietas) is a group of specimens differing strongly by one or more genetically-determined character states from other such, apparently conspecific and sympatric groups (e.g. a different colour of the pronotum in some specimens). In the case of *Dicronorhina derbyana* (see below), varieties are based on a single character; in this case, characters of two varieties can be represented in the same individual; their names can be connected by a hyphen if the individual is to be named. A form (f., forma) is a group of specimens differing strongly by one (or more) environmentally-determined character states from other such, apparently conspecific, groups (e.g., directly: the total size of the specimens; indirectly: different developments of cephalic armature). A subspecies is a limited set of interbreeding populations differing strongly from one or more other sets in the occurrence (frequency) of one or more character states (e.g. 90% green, 10% brown in one part of the range of a species, the reverse in another part). Such subspecifically distinct populations may be polymorphic or monomorphic (i.e. include character states that occur sympatrically or allopatrically; the example just mentioned is polymor-

phy; 100% green here, 100% brown elsewhere is monomorphy). A species includes the entire set of interbreeding populations. The subspeciation ("populational variation"), be it polymorphic or monomorphic, may be (geographically) clinal or abrupt. Slight clinal variation is disregarded; strong clinal variation in a part of the range of a species (a "steep cline") is indicated here by recognizing at least the extreme populations as separate subspecies.

Summarizing: a species may consist of two or more subspecies, which may then each be made up of populations, characterized by the occurrence of differently frequent (genetically-determined) varieties. Different subspecies cannot occur mixed in their breeding range; varieties, however, can.

The following abbrevations have been used for collections and institutions from which specimens were studied:

A	Instituut voor Taxonomische Zoologie, Amsterdam
BH	Museum für Naturkunde, Humboldt Universität, Berlin
BM	British Museum (Natural History), London
BU	National Museums of Zimbabwe, Bulawayo
P	Muséum National d'Histoire Naturelle, Paris
PK	Collection of P.J. Kuijten, Leiden
RMNH	Rijksmuseum van Natuurlijke Historie, Leiden
T	Musée Royal de l'Afrique Centrale, Tervuren
W	Laboratorium voor Entomologie, Landbouwhogeschool Wageningen

THE GENUS *DICRONORHINA* HOPE

Hope (1837: 119) proposed the generic name *Dicronorhina* for several goliathine beetles, most of which are now placed in the genus *Eudicella* White, 1839. As type-species he designated *Cetonia micans* sensu Fabricius. According to the description given by Fabricius, this must be *Scarabaeus micans* Drury, 1773. Fabricius, however, had made a mistake in mentioning Sierra Leone as collecting locality in 1775; it is possible that he had only vaguely heard of the collecting locality of the beetles, because later he only mentioned "Africa" as the country of origin. Sierra Leone cannot be the collecting locality of *D. micans,* as only *D. cavifrons* occurs there. Burmeister (1842) emended the generic name because of the spelling in classical Greek. Like Distant (1911) we consider this emendation unjustified, especially because Hope and Westwood emphatically spelled the name as *Dicronorhina.* We think that, there not being any need to change the name, the original spelling has to be followed, instead of *Dicranorrhina.*

Generic diagnosis. — The outstanding generic features are the following: Fore tarsi of male rough on their underside, with little knobs and brush on the underside of the fifth segment (frontispiece); thicker and longer than in the female; first segment slightly larger than each of the three following segments. Mesosternal declivity glabrous. Genitalia very peculiar, figs. 7-14.

Head of male strongly modified; clypeus of male with Y- or T-shaped anteromedian projection; anterolateral angles more or less projecting; protuberant genal angle distinct, shifted rostrad along immarginate border of clypeus. Clypeus of female more or less squarish. Pronotal base very feebly triconcave, almost straight; lateral border marginate, halfway curved inward rostrad; pronotal disc evenly strongly convex. Scutellum broadly triangular, apex acute. Elytral disc very feebly convex, posthumeral emargination very shallow; apicosutural angle distinct. Antennal lamellae slightly longer than segments 2-7 combined. Preprosternum simply tectiform. Mesepimeron feebly protuberant. Mesometasternal protrusion broad, apex more or less rounded (ventral view), angulate (lateral view), projecting in front of middle coxae. Pygidium feebly convex, transverse, usually visible from above. Male fore tibiae with apico-external denticle blunted, multidentate internally, longer than in the female; middle and hind tibiae without external protrusion and with apico-external denticle blunted in the male, tibial apices inferiorly fairly straight, especially in the hind tibiae, but curved around the base of the termial spurs. Fore tibia of female tridentate externally, including apico-external denticle; middle and hind tibiae with both external and apico-external denticle; apex of middle tibia inferiorly tridentate, of hind tibia rather trilobate. Terminal tibial spurs simply acuminate in both sexes. Fore tarsi of male, see above; fore tarsi of female unmodified, first segment as large as each of the three subsequent segments. Length (males without horn) (22-)26-53 mm, females slightly smaller. Colour usually green, sometimes with a golden shine, or brownish to reddish brown, rarely blue; more or less vitreous, shiny, frequently with white or cream-coloured cretaceous markings. Abdominal venter of male at most slightly concave; terminal segment of maxillary palpi slightly longer in the male than in the female.

Type-species. — *Scarabaeus micans* Drury, 1773, by original designation (Hope, 1837).

Composition and distribution. — Three species, one of which is divided into five subspecies; Africa, widespread south of the Sahara, but not in the southern tip of the continent.

Ecology. — So little has been written on the ecology of the species, that it seems appropriate to give all the information at this point; the months in which specimens were collected are given in the species accounts.

Raffray (1876) reported *D. derbyana oberthueri* living on leguminose trees in Zanzibar during the great rains in May and June, seemingly feeding on sap coming out of their wounded branches. The type-specimen of *D. derbyana derbyana* var. *inornata* was caught in Malawi on *Delonix* sp., a leguminose tree. Distant (1911) reported about *D. derbyana derbyana*; "Mr. Guy Marshall states that in Rhodesia it feeds on *Acacia* gum, but it is also found on the wounded branches of a species of *Combretum,* and it was on twigs or silky leaves of a species of *Combretum* that I found it in the Transvaal". Westwood (1843) remarked on the same subspecies: "the specimens . . . were taken on the trunks of a tree named *Zizyphus*; they flew exceedingly fast", and Schein (1960): "am Saft eines dornigen Baumes". P.J. Kuijten secured three females of *D. derbyana oberthueri,* one on maize flowers in an open field near Mombasa (Shimo-la-Tewa), and two in Dar-es-Salaam, one in the botanical gardens flying near rotten fruits and other waste products, the other in the city centre, also flying close to the ground. It seems that they feed on fruit, as one specimen of *D. derbyana oberthueri* was "clinging to *Annona* sp., wild custard apple", and one specimen of the subsp. *derbyana* was taken "on grape vine". They must occasionally be active at night as some specimens of *derbyana* and *cavifrons* were caught at light, and one was "flying at sundown". *D. cavifrons* and *D. micans* are probably restricted to rain forests; *D. derbyana* can also live in drier areas, especially savanna type vegetation.

SYNOPTIC TABLE OF CHARACTERS

The following characters proved to be most useful in the delimitation of species and subspecies. Characters marked with an asterisk are phylogenetically interpretable (fig. 24).

*1. Apex of clypeal horn (male): a, bifurcate; b, tridentate.
*2. Median longitudinal ridge over clypeus (male): a, present; b, absent.
*3. Postclypeal protrusions (male): a, present, long; b, present, short; c, absent.
4. Clypeolateral ridge proximally (male): a, well-developed; b, hardly developed; c, absent.
5. Anterolateral angle of clypeus (male): a, shaped like a blunted horn, projecting rostrally; b, forming an acute protrusion, projecting rostrolaterally; c, forming an obtuse angle (converging sides of clypeus); d, forming a sharp angle (diverging sides of clypeus).
6. Anterolateral angle of clypeus (female): a, rounded; b, more angulate.

*7. Cretaceous markings on clypeus: a, always present; b, always absent.
8. Basic colour of upper parts: a, bright green to dark green, rarely blue, sometimes with a golden shine; b, brownish or reddish-brown to dark brown; c, bronze-brown with a greenish tinge.
9. Cretaceous markings on upper parts: a, usually developed at least as a margin along elytra and pronotum, sometimes also as a band over the elytral disc; b, usually present as a pronotal margin, always as a short, more or less longitudinal, wide stripe over the elytral disc; c, often reduced, or as a pronotal margin, but sometimes completely developed; d, never present.
10. Shallow, round punctures, especially on the pronotum (less distinct on scutellum and elytra; female): a, taking the shape of distinct, shallow, round pits; b, smaller, more like normal punctures.
*11. Colour of underparts and legs: a, green, but often orange-gold; b, reddish-brown with dark green and/or brown to dark-brown ventral parts, legs usually reddish-brown, sometimes the underparts completely dark bluish-green; c, bronze-brown with a greenish tinge.
*12. Cretaceous markings on underparts: a, (nearly) always present as a wide band near the abdominal sternites 2-5; b, usually present only as a white spot near the abdominal stigmata, or absent; c, always absent.
*13. Distal pincers of parameres: a, straight, slightly downcurved distally, with a little knob dorsally; b, arched, very distinctly separated from parameral base.
14. Body size: a, usually large, 33-51 mm; b, medium-sized, 28-49 mm; c, usually small, 26-40 mm.
15. Allopatric occurrence (see fig. 23).

	CHARACTER													
TAXON	1	2	3	4	5	6	7	8	9	10	11	12	13	14
cavifrons	a	b	c	a	a	a	b	a	d	b	a	c	b	a
micans	a	a	c	b	b	b	b	a	d	b	a	c	b	a
derbyana														
d. derbyana	b	a	a	c	c	a/b	a	a	a	a	a	b	a	b
d. lettowvorbecki	b	a	a-b	c	d	a/b	a	c	a	a	c	a	a	b
d. oberthueri	b	a	b	c	d	a/b	a	a	c	a	a	a	a	b
d. conradsi	b	a	b	c	d	a/b	a	b	c	a	b	a/b	a	c
d. carnifex	b	a	b	c	d	a/b	a	a	b	a	b	a/b	a	c

Table 1. Synoptic table of character states of *Dicronorhina* species and subspecies. Symbols used: a-b, intermediate; a/b, both character states occur.

KEY TO THE SPECIES AND SUBSPECIES OF *DICRONORHINA* MALES

1. Apex of clypeal horn bifurcate; cretaceous markings absent 2
– Apex of clypeal horn tridentate; cretaceous markings present, at least on the clypeus. For varieties, see Table 2 ..... *D. derbyana,* 3
2. Median ridge on the clypeus absent; anterolateral protrusions of the clypeus obtuse, pointing more or less ahead, fig. 1 ..... *D. cavifrons*
– Median ridge on the clypeus present, from the frons onto the clypeal horn; anterolateral clypeal protrusions acute, pointing laterad, fig. 2 . ..... *D. micans*
3. Postclypeal protrusions short, not much protruding in front of the connecting ridge; anterolateral angles of clypeus sharp, because the sides of the clypeus are diverging rostrad, or, especially in small males, parallel, fig. 5, 6; distal pincers of parameres as in fig. 13. Various basic colours possible 4
– Postclypeal protrusions much more evident, longer; anterolateral angles of clypeus obtuse, because the sides of the clypeus are slightly converging rostrad, fig. 4; distal pincers of parameres, fig. 11. Basic colour green, sometimes with a golden shine. — S. Angola – SE. Zaire; SW. Tanzania-Mozambique-Natal-Namibia ..... subsp. *derbyana*
4. Basic colour of upper parts dark green to brownish green, sometimes dark blue, with a short white stripe on the elytral disc. Legs usually red-brown. — Interior Kenya, Mt. Kilimandjaro, Mt. Meru .... subsp. *carnifex*
– Basic colour of upper parts green, brown, reddish-brown or bronze-brown with a greenish tinge; pattern of cretaceous markings, if present, different 5
5. Basic colour green, no brown parts present. — Tanzania (not extreme S. and SW. and not just E. and SE. of Lake Victoria), coastal Kenya, Somalia, Uganda ..... subsp. *oberthueri*
– Basic colour brown, red-brown, or bronze-brown with a greenish tinge 6
6. Basic colour reddish-brown to dark brown. — Tanzania: Ukerewe Island and just E. and SE. of Lake Victoria ..... subsp. *conradsi*
– Basic colour a peculiar bronze-brown with a greenish tinge, especially on the elytra, and some golden shine, especially on the pronotum. — S. Tanzania; Makonde-plateau and Mikindani ..... subsp. *lettowvorbecki*

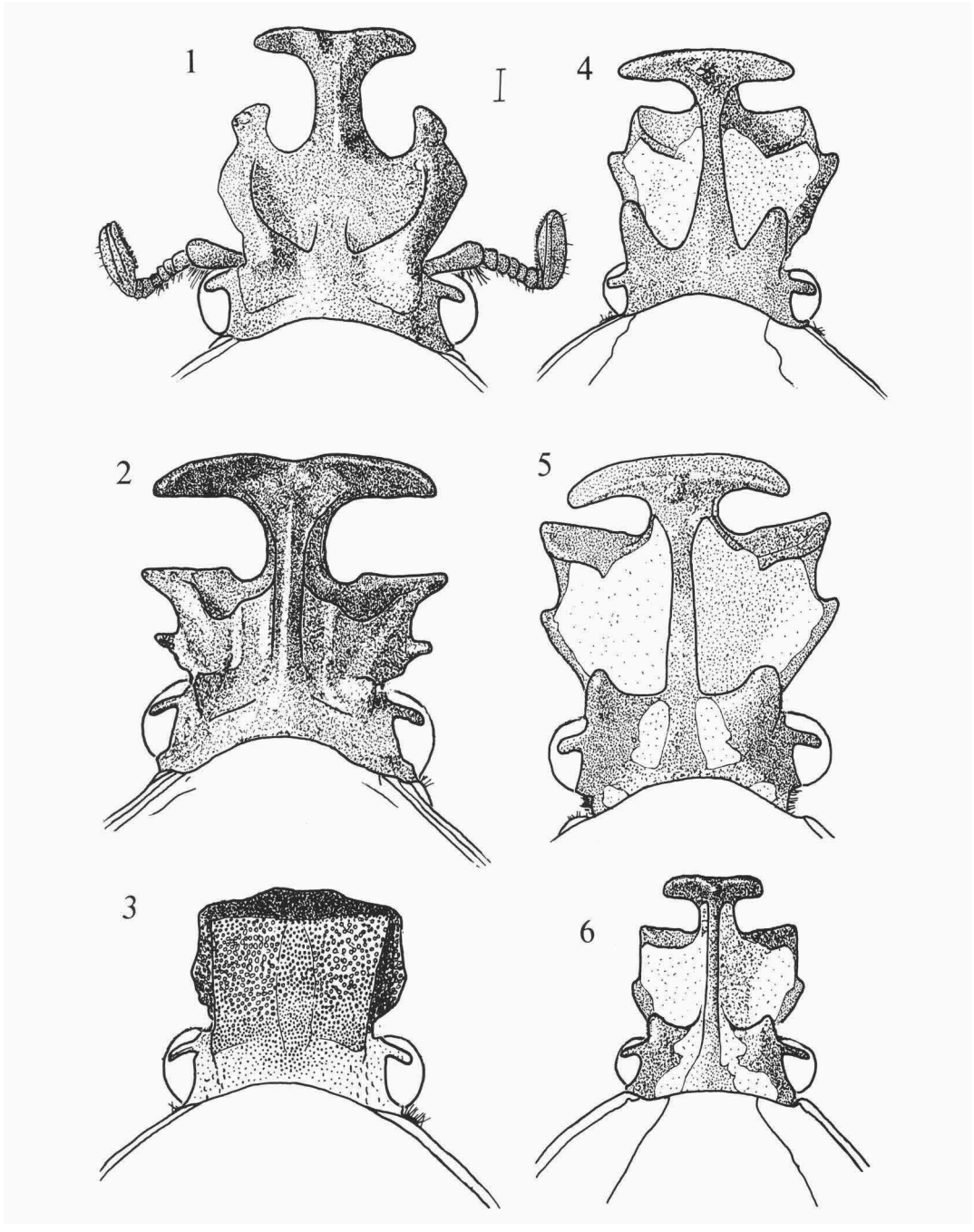
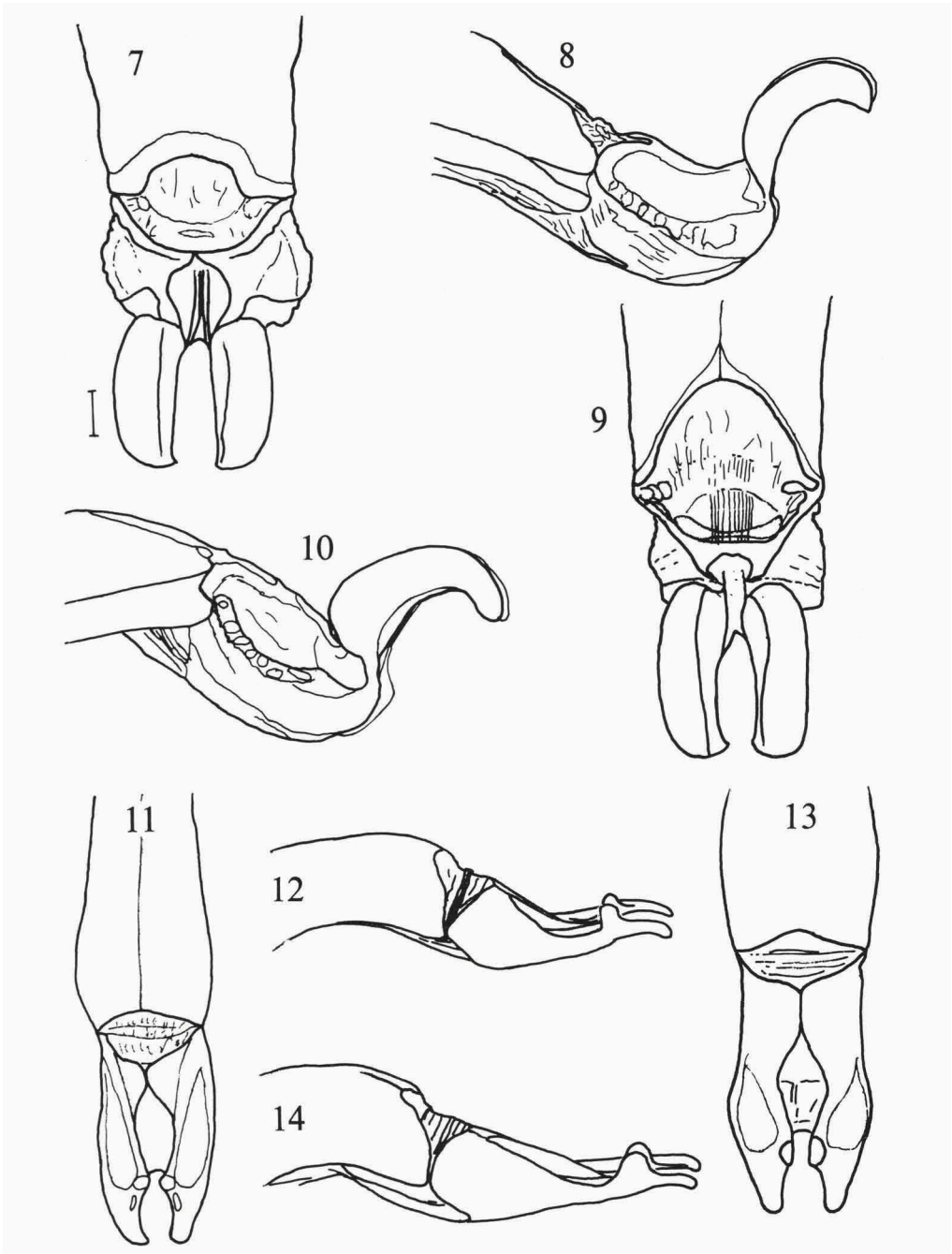
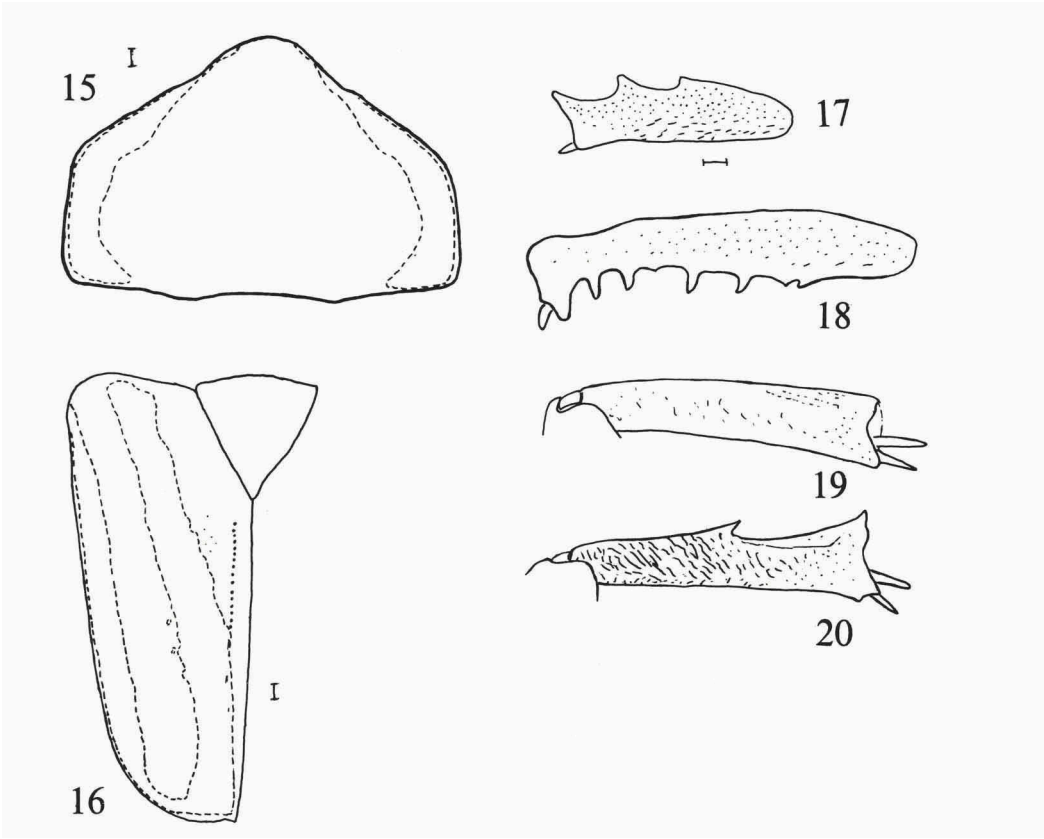


Fig. 1-6. Heads of *Dicronorhina* spp. 1, *D. cavifrons,* male; 2, *D. micans,* male; 3, *D. micans,* female; 4, *D. derbyana* subsp. *derbyana,* male; 5, *D. derbyana* subsp. *oberthueri,* male; 6, *D. derbyana* subsp. *conradsi,* male. Scale line equals 1 mm.



Figs. 7-14. Male genitalia of *Dicronorhina* spp. 7, 9, 11, 13: dorsal view; 8, 10, 12, 14: lateral view; 7, 8, *D. cavifrons*; 9, 10, *D. micans*; 11, 12, *D. derbyana* subsp. *derbyana*; 13, 14, *D. derbyana* subsp. *oberthueri*. Scale line equals 1 mm.



Figs. 15-16. *D. derbyana* subsp. *lettowvorbecki*. 15, pronotum, dorsal view; 16, left elytron and scutellum. Figs. 17-20. Tibiae of *D. micans*. 17, female right fore tibia; 18, male right fore tibia; 19, male left hind tibia; 20, female left hind tibia. Scale line equals 1 mm.

ANNOTATED CHECKLIST OF THE TAXA

Dicronorhina Hope, 1837: 119 (diagnosis) (= *Dicranorrhina*, Burmeister, 1842: 187 (emendation, diagnosis)), type-species *Scarabaeus micans* Drury, 1773: 59. — Afrotropical region, widespread.

1. *D. cavifrons* (Westwood, 1843: 172, *Ceratorhina* sectio *Dicronorhina*), syntypes (1 male, 1 female) in Oxford, from Senegal. — Senegal to Cameroun.
2. *D. micans* (Drury, 1773: 59, pl. xxxii, *Scarabaeus*), probably 1 male holotype, cf. in Sydney, from Callabar. Syn. *D. johnstoni* Waterhouse, 1902: 461, syntypes (2 males, 1 female) in BM, from Entebbe; *Goliathus*

splendens MacLeay, 1838: 34, holotype (male) cf. in Sydney, from Southern Africa (?). — Togo to W. Kenya and Angola.

3. *D. derbyana* (Westwood, 1843: 173, *Ceratorhina* sectio *Dicronorhina*), syntypes (at least 1 male, 1 female) cf. in Geneva, from between 25° and 26° S. lat. and 27° and 28° E long. Syn. *D. derbyana* subsp. *divortialis* Kolbe, 1901: 75, = *D. derbyana* subsp. *lateralis* Kolbe, 1909: 135 (intermediate between subsp. *derbyana* and *oberthueri*).
   1. subsp. *derbyana*. — Namibia to Natal, Mozambique, E. Zaire and S. Angola.
      var. *cyanea* Kraatz, 1896: 111.
      var. *lucida* (vide infra, subsp. *oberthueri*).
      var. *inornata* nov., holotype (male) in BU.
      var. *derbyana*.
      var. *layardi* Péringuey, 1892: 38.
   2. subsp. *lettowvorbecki* Kriesche, 1920: 78, syntypes (3 males) in BH, from "Makonde-plateau" and "Mikindani".
   3. subsp. *oberthueri* Deyrolle, 1876: LXXXII, as species of *Dicranorrhina*, syntypes (at least 2 males) in P, from Zanzibar. — Somalia to Zaire and Tanzania.
      var. *cyanea* Kraatz, 1896: 111.
      var. *lucida* Kraatz, 1896: 112.
      var. *oberthueri*.
      var. *marginata* nov., holotype (male) in RMNH.
      var. *bifasciata* Kraatz, 1896: 111.
   4. subsp. *conradsi* Kolbe, 1909: 135, syntypes (2 males, 3 females) in BH, from Neuwied, Ukerewe Isl., Lake Victoria. Syn. subsp. *schiratica* Kriesche, 1920: 79, syntypes (not thus labelled) (probably 7 males, 5 females), in BH, from Schirati. — E. and SE. of Lake Victoria.
      var. *conradsi*; syn. ab. *bimaculata* Csiki, 1909: 18.
      var. *marginata* (vide supra, subsp. *oberthueri*).
      var. *vittata* Kolbe, 1909: 135, syn. subsp. *schiratica* var. *fasciata* Kriesche, 1920: 79.
   5. subsp. *carnifex* Harold, 1878: 212, as species of *Dicranorrhina*, syntypes (1 male, 1 female) in BH, at least the male from Taita (Kenya). — Interior Kenya; Mts. Kilimanjaro and Meru in Tanzania.

Species-group names mentioned above have been combined with the following generic names other than *Dicronorhina* or *Dicranorrhina*: *Scarabaeus* Linnaeus, 1758; *Cetonia* Fabricius, 1775; *Goliathus* Lamarck, 1801; *Goliath* Latreille, 1807; *Atlas* Castelnau, 1840; *Ceratorhina* Westwood, 1843; *Mecynorhina* Hope, 1837.

SPECIES ACCOUNTS

Dicronorhina cavifrons (Westwood)
(figs. 1, 7, 8, 21, frontispiece)

Identification. — Length males 35.5-48 mm, females 31-48 mm. The males of this species are easy to identify by the distinct shape of their heads. *D. cavifrons* can only be confused with *D. micans*. In addition to the characters given in the synoptic table and the key, it should be noted that there is some difference between *D. cavifrons* and *D. micans* in the male genitalia. In *D. cavifrons,* the basal piece is shiny brown to a greater extent than is the case in *D. micans;* sometimes it is completely shiny, whereas in *D. micans* a large part of it usually is opaque. There is also a difference in the distal pincers of the parameres (compare figs. 8 and 10): the proximal part of these pincers is more slender in *D. cavifrons*. The females are sometimes indistinguishable, but most females of *D. cavifrons* have the anterolateral angles of the clypeus more rounded than those of *D. micans* (fig. 3).

The species is only slightly variable; infraspecific taxa have not been described.

Distribution. — Material examined: 63 males in A, BH, BM, P, PK, RMNH, T; 37 females in A, BH, BM, P. RMNH, T. Localities (fig. 21) as follows:

BENIN: Djougou; **Sokéli, Bas Dahomey.

CAMEROUN: Mongo-ma-Lobah.

CONGO: unspecified.

GHANA: Accra; Akropong; Bibianaka; Kumasi; Tafo.

GUINEA: unspecified (some authors, identifying the material concerned as *D. micans*!).

IVORY COAST: Abengourou; Adiopo-doumé; Kakpin.

LIBERIA: Cape Palmas (Harris, 1844, identifying the material concerned as *D. micans*).

NIGER: North Niger.

NIGERIA: Bari, Lagos; Calabar.

SENEGAL: unspecified; type-locality Senegal (Westwood, 1843! and many others, most of them identifying the material concerned as *D. micans*!).

SIERRA LEONE: unspecified (Westwood, 1843, also many authors identifying the material concerned as *D. micans*).

Phenology. — Months: v (Ghana); vi (Ghana); vii (Ivory Coast); xi (Ivory Coast); xii (Ivory Coast).

Further remarks. — *D. cavifrons* and the closely related *D. micans* form a

monophyletic group within the genus, as they share important synapomorphies, like the shape of the male genitalia. Until the appearance of Westwood's description of *D. cavifrons,* many specimens of this species were misidentified as *D. micans.* Yet, although the two species are sympatric from Ghana to Cameroun or even Congo, they seem to hybridize only rarely and are quite distinct. Of all the 367 males of the two species that were studied, only about five (from "Congo", "Guinea" and "Ivory Coast, Kakpin") were probably hybrids, being intermediate in the important characters of their head and genitalia between the two (parent) species.

Dicronorhina micans (Drury)
(figs. 2, 3, 9, 10, 17, 18, 19, 20, 22)

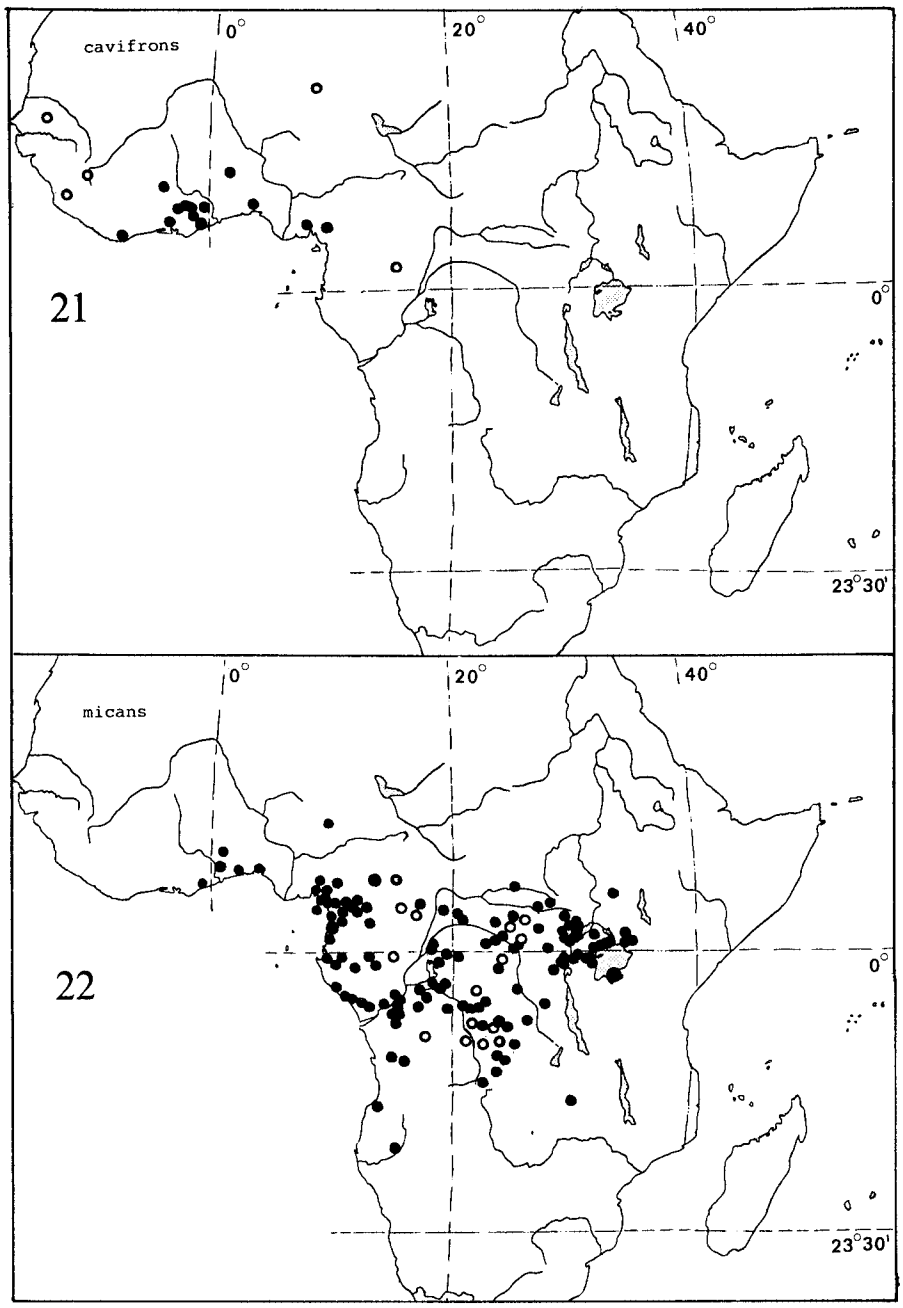
Identification. — Length males (38-) 40-51 mm, females 33-49.5 mm. Very similar to *D. cavifrons,* q.v. *D. micans* is somewhat more variable than *D. cavifrons.* In *D. micans* more specimens have a golden shine. More variation is also shown in the colour of the male clypeus, which usually has some greenish parts, especially proximally, next to the median ridge, but sometimes it is entirely black. The clypeus is entirely black in the specimens that were described as *D. johnstoni* Waterhouse from Entebbe, a form which is, among others, also found in Kamengo, Uganda and Mambasa, Zaire. *G. splendens* MacLeay (without type-locality but probably from the southern part of Africa, perhaps Angola) does not seem to differ from *D. micans* in any important character.

Distribution. — Material examined: 348 males in A, BH, BM, P, PK, RMNH, T; 353 females in A, BH, BM, BU, P, PK, RMNH, T, W, Warszawa (Polish Academy of Sciences, Zoological Institute). Localities (fig. 22) as follows:

ANGOLA: **Aquapim (Harold, 1879); Benguela; Chinchoxo (Kolbe, 1909!); Humbe (Oliveira, 1882); Kimbundo (Kolbe, 1887!); Loango; Malanje (Kolbe, 1909!); Pungo Andongo (Harold, 1879); Quango river (Quedenfeldt, 1884!); Quilo river (Oliveira, 1882).

BENIN: Porto-Novo.

CAMEROUN: Abong M'Bang district; Babungo; Bakossi; Barombi (Kolbe, 1892b!, 1909!); Batouri (De Lisle, 1945); **Bidunbi; Bimbia; Bitye, Ya river; Bombe Kumba; Buea (Janson, 1907!, Kolbe, 1892b!, 1909!); D'Ja Posten; Ebolowa (De Lisle, 1945); Edea (De Lisle, 1945!); Eseka (De Lisle, 1945); Kribi (Kolbe, 1909!); Lolodorf (De Lisle, 1945!); Mongo-ma-Lobah; Njong river; **Pama & Ubi junction; **Ratanga; Samba region; Soppo; **Tina;



Figs. 21-22. Distribution maps. 21, *D. cavifrons*; 22, *D. micans*; dots denote (nearly) exact localities, circles denote regions.

**Tuban; **Ubanga; Victoria; **Yangandi; Yaounde; unspecified (Duvivier, 1890!, Kolbe, 1887!, 1914!).

C.A.R.: Boukoko; Haute Sangha; Nana river; Zemio.

CONGO: Bateké; Brazzaville; Dieli, Alima river; Leketi; Pointe Noire; Voka.

EQ. GUINEA: Benito Mts.; Macias Nguema, Basilè (Janson, 1907); unspecified.

GABON: Basso Ogooue (Janson, 1907); Diélé; Franceville; Lambaréné; between Lambaréné and the sea; Libreville; Mayomba; N'Kogo.

GHANA: Accra (Kolbe, 1909!); Amedzowe; unspecified (Duvivier, 1890).

KENYA: Kaimosi; Yala river (Bourgoin, 1921!).

NIGERIA: Bari, Lagos; Calabar (type-locality, Drury, 1773, Schaum, 1844, 1845, Westwood, 1843); Old Calabar; Toro.

SUDAN: Nagichot.

TANZANIA: Bukoba (Kolbe, 1897b!, 1909!, 1913!, 1914!, Kriesche, 1920!, Pangella, 1909!); **Kisiba nr. Bukoba; Neuwied, Ukerewe Island.

TOGO: Yege (Kolbe, 1892c!; possibly is a specimen of *D. cavifrons* as there is only a female).

UGANDA: Budongo forest, Bunyoro; Bufumbe forest; Bugala (Janson, 1912); Entebbe (Kolbe, 1914!, Pangella, 1909!, Waterhouse, 1902!); George, South of Lake —; Kamengo; Kampala; Kayensa forest, Kigezi; Mawakota; Msozi; Sesse Islands (Pangella, 1909!); Tero forest; unspecified (Kolbe, 1909, 1914).

ZAIRE: Aruwimi valley (Kolbe, 1914); Bambesa; Bandundu; Ba-Ngala (Duvivier, 1890); Barumbu (Burgeon, 1932!); Basoko (Burgeon, 1932!); Beni (Burgeon, 1924!, 1932!, Kolbe, 1914!, Moser, 1913!); Binga; Bokoro; Bomboma; **Bongeya; Bumputu (Burgeon, 1932!); Buna; Bungundu (Burgeon, 1924); Bunia; Buta; **Dielya; Djuma; Eala; Elisabetha (Burgeon, 1924!, 1932!); Flandria; Galikoko (Burgeon, 1924!, 1932!); Geti; Go (Burgeon, 1924, 1932); Haut Congo (Burgeon, 1932!); Ibembo (Duvivier, 1892!); Ibélé; Ikela; Irumu, Kibali-Ituri; Kafakumba (Burgeon, 1932!); **Kahuzi (Kivu), Bitale; Kalina (Burgeon, 1932!); Kapanga; **Kasalala; Kassai-Mts. (Burgeon, 1932!); Katande (Burgeon, 1937); Katompe (Burgeon, 1932!); Katuka; Kilo; Kilomines; Kimwenza; Kinda; Kindu (Burgeon, 1924!); Kiniati (Burgeon, 1924); Kiniati-Yasa; Kiniati-Zobe (Burgeon, 1932!); Kinshasa; Kisangani (Burgeon, 1924!); Kisantu (Burgeon, 1924!, 1932!); Kisiba; Kondue (Burgeon, 1924!, 1932!); Kutu (Burgeon, 1924!, 1932!); Kwango (Burgeon, 1932!); Libenge; Lisala; **Lokandu; Luebo; Lukombe (Burgeon, 1924!, 1932!); Lukuli; Lulua (Kolbe, 1909!); Luluabourg (Burgeon, 1924!, 1932!); Lusambo; **Lutakira; Mabenga (Burgeon, 1937!); **Mahanga, N. Kivu;

Mambasa; Mawambi forest (Kolbe, 1914, Moser, 1913); Mayidi; May ya Moto (Burgeon, 1937!); Mbandaka; Medje (Burgeon, 1924!, 1932!); Mongbwalu; Mongoumba (Preiss, 1933); Moto (Burgeon, 1924!, 1932!); Mukinga (Kolbe, 1909); Munsenene, Medidi river; Mutshatsha; Mutsora; Mwenga (Burgeon, 1932!); Mwilambongo; **Ngokoi; Oycha; Panga (Burgeon, 1932!); Prov. Orientale (Burgeon, 1932!); Rutshuru; Sankuru; Sassa (Burgeon, 1924!, 1932!); Semliki plain; Shaba (Burgeon, 1924!, 1932!); Stanley Falls; Tshambi (Burgeon, 1937); Uele (Burgeon, 1932!); Uerre (Burgeon, 1924!, 1932!); Vieux-Kilo; Yangambi (Burgeon, 1932!); Yindi; Zilo.

UNKNOWN: Assinie break; Fort Gorilla, Fernan Bay.

Phenology. — Months: i (Cameroun, Zaire); ii (Uganda, Zaire); iii (Cameroun, Congo, Zaire); iv (Cameroun, Kenya, Tanzania, Zaire); v (Cameroun, Uganda, Zaire), v-vi (Uganda); vi (Tanzania, Zaire), vi-vii (Cameroun, Togo); vii (Zaire); viii (Cameroun, Uganda, Zaire), viii-ix (Eq. Guinea); ix (Eq. Guinea, Kenya, Uganda); x (Uganda, Zaire); xi (Zaire); xii (Gabon, Nigeria, Tanzania, Uganda, Zaire), xii-i (Sudan).

Dicronorhina derbyana (Westwood)

(figs. 4, 5, 6, 11, 12, 13, 14, 15, 16, 23, frontispiece)

Identification. — This highly variable species is identifiable from the shape of the male head and the shape of the male genitalia. These characters, however, vary slightly among the taxa here ranked as subspecies. Five groups of specimens are attributed this rank in view of the terminology explained further above (see Terminology and further explanation); some specimens from the contact zones could represent hybrids.

The five subspecies are treated hereafter according to their geographic distribution. A summary of the variation in *D. derbyana* is given in Table 2 further below. Numbers are the same as given on the map (fig. 23).

In order to be able to handle the complex variability, we make use of several varietal names. A few new names are proposed, not because this is so essential to taxonomy but to fill the gaps that existed. Transitional forms between the varieties described here also occur, but not so frequently. Some specimens were studied that were slightly aberrant in their cretaceous pattern, e.g. specimens with a narrow stripe laterally on the elytra but without cretaceous markings on the pronotum. Such unusually patterned specimens, however, are rare, and have been omitted from Table 2.

1. Subsp. *derbyana* Westwood (figs. 4, 11, 12, 17)

Identification. — Length males 31-47 mm, females 28-44 mm. The best characters on which this subspecies can be identified are the following: (1) the male cephalic ornamentation with converging sides of the clypeus and long postclypeal protrusions (fig. 4); (2) the distal pincers of the parameres distally converge, whereas in the other subspecies they are parallel (compare figs. 11 and 13); (3) there are never genuine cretaceous bands on the abdominal sternites, but at most some, rarely slightly elongate, spots, especially in some specimens from Zimbabwe and Mozambique (which could indicate the introgression of genes from the other subspecies). The subsp. *oberthueri* and *lettowvorbecki* from adjacent regions nearly always have bands. The following varieties are known (cf. Table 2):

var. *cyanea* Kraatz, from Transvaal, based on colour only.

var. *lucida*. Described in subsp. *oberthueri* by Kraatz (1896), but also occurring in this subspecies. Based on colour only. Two specimens in BH from Mozambique are extreme representatives of this variety, being deep red golden instead of greenish with an orange golden tinge.

var. *inornata* nov. This and the following varieties are based on the pattern of cretaceous markings on the upper parts. Var. *inornata* nov. is a very rare variety that occurs in Malawi. It has the cretaceous pattern on the upper parts completely reduced, the upper parts thus being uniformly coloured. It might also have a white pronotal margin, but such specimens have not yet been found; it is to be expected that they exist, given the variability in the other subspecies.

var. *derbyana*. The nominate variety of this subspecies shows a white cretaceous band along the margins of both pronotum and elytra; on the elytra, this band sometimes ascends from the apical declivity over about one-third of the elytral disc. This variety occurs in Transvaal, Natal and north to Zambia, SE. Zaire, Malawi, and Mozambique.

var. *layardi* Péringuey. This variety occurs sympatrically with the nominate variety in most of its range, but it is the only variety which is known from Namibia. In this variety, the band over the elytral disc is complete: it extends to the humerus, but it is never rostrolaterally connected with the cretaceous elytral margin. Sometimes the band over the elytral disc is interrupted in the proximal part of the elytra.

It should be noted that transitional forms between the varieties mentioned here do occur, but the great majority of specimens falls within just one of the varieties.

Distribution. — Material examined: 256 males in A, BH, BM, BU, P, PK,

RMNH, T; 141 females in A, BH, BM, BU, PK, RMNH, T, plus several in P.

Holotype (male) of var. *inornata* with label data "on *Delonix*/Monkey Bay/Malawi/iii-1968/leg. D. H. Eccles", in BU.

Localities (fig. 23) as follows:

ANGOLA: Humbe (Oliveira, 1882); **Merero (Oliveira, 1882).

BOTSWANA: Lake Ngami; Moremi Reserve.

MALAWI: Bunda College; Chiromo; **Kanjedja forest; **Malperera; Monkey Bay; Salima.

MOZAMBIQUE: Andrada; Beira (Péringuey, 1907); Delagoa Bay (Distant, 1911!); Inhacoro; Inhambane (Bertoloni, 1849!, Kolbe, 1909!, Kriesche, 1920!, Péringuey, 1907!); Lourenço Marques (= Maputo) (Kolbe, 1909!, Kriesche, 1920!, Péringuey, 1907!); Maputo; Marromen; Monteiro; Rikatla; **Sikumba; unspecified (Blanchard, 1850!, Thomson, 1880!).

NAMIBIA: Abenab; Damaraland (Distant, 1911, Kolbe, 1909, Péringuey, 1907); Gobabis (Kolbe, 1909!); Grootfontein; Herero; Karibib; Kombat; Okahandja (Kolbe, 1909!, Schein, 1960!); Omaruru (Kolbe, 1909!); Omoupanda; Outjo; Ovampoland (Distant, 1911!, Kolbe, 1909!, Péringuey, 1907!, Schein, 1960!); **Sissekab; Swakopmund; Tsumeb (Kriesche, 1920!); Waterbergen; Windhoek (Kolbe, 1909!); unspecified (Heyne & Taschenberg, 1908!, Schoch, 1896!).

RSA: Barberton (Distant, 1911, Péringuey, 1907); Caffraria, North (Dohrn, 1881); Durban (Kriesche, 1920!); Krugerpark (Schein, 1960); Lydenburg (Péringuey, 1907!); Magalisberg Mts. (type-locality "the hilly country between 25° and 26° S and 27° and 28° E", Westwood, 1843!); Natal (many!); Nylstroom; Pietersburg (Péringuey, 1907); Potchefstroom (Distant, 1911, Péringuey, 1907); Pretoria (Distant, 1897!, 1911!, Péringuey, 1907!); Rustenburg (Distant, 1897!, 1911!, Péringuey, 1907!); Transvaal (Burgeon, 1932!, Kraatz, 1882!, 1896!); Tugela river, Natal (Distant, 1911, Péringuey, 1907); Waterberg district (Distant, 1911!, Péringuey, 1907!); Waterval-Onder (Distant, 1911, Péringuey, 1907); Zoutpansberg (Distant, 1911, Péringuey, 1907).

TANZANIA: *Iringa (Kriesche, 1920); *Kilondo (Kriesche, 1920); *Konde to Unyika (Kolbe, 1901, 1909); *Madibira (Kolbe, 1909, Kriesche, 1920); *Mgololo (Kolbe, 1901); M'Pala region; *Neu-Helgoland (Kolbe, 1909); *Uhehe, Iringa to Mgololo (Kolbe, 1901, 1909); unspecified (Burgeon, 1924!).

ZAIRE: Baudouinville (Burgeon, 1924!, 1932!); Lusaka nr. Baudouinville.

ZAMBIA: **Baratsi land; Cuando river, Angolan border (Bourgoin, 1925); Lealui; Lusaka; Mabumbu; **Marotsé land; Mwengwa; Victoria Falls, Zimbabwean border (Bourgoin, 1921!, Péringuey, 1907!).

ZIMBABWE: Chilimanzi Reserve; Enkeldoorn (Péringuey, 1907); Harare

(Kolbe, 1909!, Péringuey, 1907!); Harare, Sheppard; Limpopo river, South African border (Boheman, 1857!); Mashonaland (Distant, 1911!); Matopos (Péringuey, 1907!); Mazoe (Péringuey, 1907); Sebakwe (Péringuey, 1907); Selukwe; Umtali (Péringuey, 1907); Umvuma; Unguza river, Bulawayo; unspecified (Distant, 1911, Kolbe, 1909).

Phenology. — Months: i (Malawi, Zambia, Zimbabwe), i-ii (Mozambique); ii (Malawi, Namibia); iii (Malawi, Namibia, Zimbabwe); iv (Botswana, Namibia, Zambia); 7-v (RSA); xi (Namibia, Zambia); xii (Botswana, Zambia, Zimbabwe).

1a. *derbyana* – *oberthueri* intermediates

Identification. — The intermediates between the subspecies *derbyana* and *oberthueri* have to be treated separately. Most, or, in some cases, all specimens from the localities mentioned below are somewhat intermediate in characters between the two subspecies; this applies to both the male genitalia and the cephalic ornamentation. It is often seen that the male genitalia are fairly similar to that in the subspecies *derbyana,* but that the cephalic ornamentation in the same specimen is more like that in the subspecies *oberthueri,* though with slightly longer postclypeal protrusions and parallel sides of the clypeus. Such intermediate specimens never show all four cretaceous abdominal bands of *oberthueri;* specimens with fully-patterned upper parts can usually be expected to show some trace of this character, e.g. one short abdominal band. Intermediate specimens having unpatterned upper parts, or having only a white pronotal margin, usually show no trace of white bands on the abdominal sternites, as is usually the case in southwestern specimens of subsp. *oberthueri* var *oberthueri.* It should be noted that in the male cephalic ornamentation some allometric growth is noticeable; larger males usually have more strongly divergent sides of the clypeus compared to smaller males, and most males have "medium-sized" postclypeal protrusions, that are on average longer in larger males.

There is no objective way to distinguish between specimens that can be considered to belong to one or the other subspecies and intermediate specimens. In adding this chapter, we want to express that in a limited area on the edge of the ranges of the two subspecies, a steep clinal variation is probably present, with the two subspecies as the extremes. Some of the intermediate specimens may be of hybrid origin, others seem to belong to intermediate populations; from the M'Pala region in Tanzania, numerous specimens were studied that probably represent such a population. Intermediates from Uhehe, Iringa to Mgololo, that were completely green above, having quite variably

developed bands on the abdominal sternites and an intermediate cephalic ornamentation, were described by Kolbe (1901) as a separate subspecies (subsp. *divortialis,* syn. subsp. *lateralis* from Madibira, Kolbe, 1909). In view of the facts given above we do not think that a subspecific rank can be attributed to the intermediates. Moreover, several specimens from the collecting localities of this so-called subspecies appeared to be typical *oberthueri.*

Distribution. — Material examined: 50 males in P, RMNH and T, also some in BH; the females have not been studied intensively, their numbers are incorporated in the numbers of specimens studied especially of subsp. *oberthueri.* Localities as follows (fig. 23):

TANZANIA: Kala; Konde to Unyika (Kolbe, 1901!, 1909!); Madibira (Kolbe, 1909); Manow; M'Pala region; Neu-Helgoland; Rukwa, Lake; Tanganika region; Ubemba; Uhehe, Iringa to Mgololo (Kolbe, 1901!); Utinto.

2. Subsp. *lettowvorbecki* Kriesche, 1920 (figs. 15, 16, frontispiece)

Identification. — Of this subspecies only the three male syntypes are known; two of them were sent for study by the Berlin museum. Their basic colour is not green but rather bronze-brown with a greenish tinge (especially on the elytra) and some orange-golden reflection (especially on the pronotum). This renders them rather easy to identify. They show the cretaceous bands on the abdominal sternites that *oberthueri* also has (see below); the upper parts are completely patterned. The characters of the male genitalia are somewhat intermediate between those of subsp. *derbyana* and subsp. *oberthueri*; the cephalic ornamentation is more like that of subsp. *oberthueri,* but the large male shows the "unexpected" combination of sharp anterolateral angles of the clypeus (like in *oberthueri*) and fairly long postclypeal protrusions (like in *derbyana*).

Distribution. — Material examined: 2 males, BH. Localities as follows (fig. 23):

TANZANIA: Makonde highland (Kriesche, 1920!); Mikindani (Kriesche, 1920!).

3. Subsp. *oberthueri* Deyrolle, 1876 (figs. 5, 13, 14)

Identification. — Length males 29.5-49 mm, females 32-44.5 mm. This subspecies can be distinguished from subsp. *derbyana* by the male cephalic ornamentation: it has diverging clypeal sides, thus rendering the anterolateral angles sharp (fig. 5); in some very small males the sides of the clypeus are

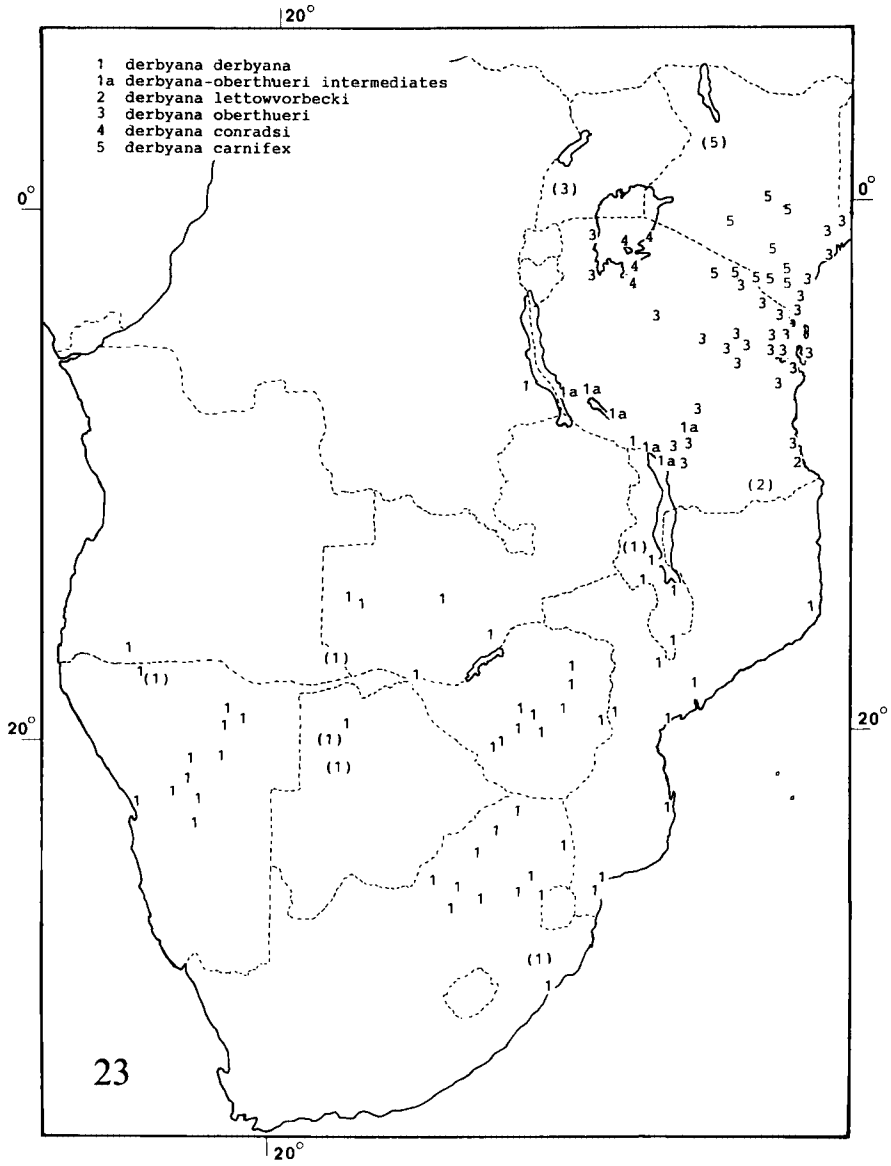


Fig. 23. Distribution map of *D. derbyana*; the numbers refer to the numbers given to the subspecies. Records between brackets refer to regions, not to exact localities.

parallel. The postclypeal protrusions are short. The male genitalia are also distinct from those in subsp. *derbyana* (compare figs. 11, 12 with 13, 14). Nearly all the specimens of *D. d. oberthueri* have a ventrally interrupted white cretaceous band on each of the abdominal sternites 2, 3, 4 and 5; these bands are occasionally absent in specimens from southwestern Tanzania and rarely in other specimens.

This subspecies is rather variable in the completeness of the cretaceous pattern on the upper parts. The following varieties are known (Table 2):

var. *cyanea* Kraatz, 1896.

var. *lucida* Kraatz, 1896. Both these varieties are colour varieties.

var. *oberthueri.* The nominate variety of this subspecies has no cretaceous pattern on the upper parts, or it has a cretaceous pronotal margin only. It usually has the abdominal bands, but these are frequently reduced or absent in specimens from the southwestern limits of the subspecies range (e.g. in Kijimbila, Madibira and Manow). In specimens from other regions, the bands are only rarely reduced; they are complete in the type-specimens.

var. *marginata* nov. In order to make the varietal subdivision of this subspecies more congruent with that in subsp. *derbyana* and *conradsi,* we introduce this name in subsp. *oberthueri* for specimens which are similar in cretaceous pattern to the nominate variety of subsp. *derbyana,* having both a pronotal and an elytral white cretaceous margin and occasionally a contiguous ascending marking over about one-third of the elytral disc. There may also be some small cretaceous spots near the humerus. If a lot of white patterning is present on the upper parts, the specimen should be attributed to the following variety.

var. *bifasciata* Kraatz, 1896. This variety corresponds to the var. *layardi* in subsp. *derbyana*: it has completely patterned upper parts. It is not rare, although the nominate variety is more commonly found.

Distribution. — Material examined: 210 males in A, BM, P, PK, RMNH, T, plus 143 in BH including some specimens (slightly) intermediate with subsp. *derbyana*; 86 females in A, BM, PK, RMNH, T and many in P, plus 105 in BH; including intermediates with subsp. *derbyana.*

Holotype (male) of var. *marginata* with label data "Madibira/D.O. Afrika", "Museum Leiden/verz. F.T. Valck/Lucassen", "Dicranorrh./ Oberthüri/*var.* Deyr.", in RMNH.

Localities as follows (figs. 23):

KENYA: Gedi; Ikutha; Kibwezi, W. of (Kriesche, 1920); Kilifi; Mombasa; Mombasa, Shimo-la-Tewa; Rabai; Solole (Preiss, 1902); Taru-Mombasa; Wasini Island.

SOMALIA: unspecified.

TANZANIA: Amani (Kriesche, 1920); Bagamoyo (Kolbe, 1892a!, 1897a, b!, Kraatz, 1896!, Kriesche, 1920!, Péringuey, 1907!, Raffray, 1876!, 1877!); Bukoba; Dar-es-Salaam (Kolbe, 1897b!, Péringuey, 1907!); Iringa (Kolbe, 1909!, Kriesche, 1920!); **Kasanga; Kidugala; Kijimbila; Kilimandjaro; Kilimatinde; Kilondo (Kriesche, 1920!): Kisarawe-Pugu; ?Konde (Kolbe, 1901); Lindi; Lutindi; Madibira (Kriesche, 1920!); Malinde; Mamboia; Mandera; Manow; Marangnom, Zanzibar interior; ?Mgololo (Kolbe, 1901); Mhonda; Mlalo; Moa; Morogoro; Moschi; Neu-Helgoland; Nguelo; Nguru (Kolbe, 1909!); Pangani; Tanga (Kriesche, 1920!); **Ubena-Kilondo; Ugogo; Ukami; Usagara Mts.; Usambara Mts. (Kolbe, 1897b!, 1909!, Péringuey, 1907!); Usaramo (Kolbe, 1909); Useguha (Kolbe, 1909!); Zanzibar (type-locality, Deyrolle, 1876!, Heyne & Taschenberg, 1908!, Péringuey, 1907!).

UGANDA: **Ansinge.

ZAIRE: one specimen, labelled "Congo".

* ZAMBIA/ZIMBABWE: one specimen, labelled "Rhodesia".

UNKNOWN: Tlisi, B.E.A.

N.B. Specimens labelled "Tsumeb", a place in Namibia, will most probably actually come from Tanzania, another former German colony. Delagoa Bay (Péringuey, 1907), in Mozambique, must also be incorrect.

Phenology. — Months: i (Tanzania); ii (Tanzania); iii (Tanzania); iv (Kenya, Tanzania); v (Kenya, Tanzania); vi (Kenya, Tanzania); vii (Tanzania); viii (Tanzania); ix (Tanzania); xi (Kenya, Tanzania); xii (Tanzania).

4. Subspecies *conradsi* Kolbe, 1909 (fig. 6)

Identification. — Length males 29-40 mm, females 28.5-35.5 mm. This subspecies from northwestern Tanzania can be distinguished from the subsp. *oberthueri* by its brownish to reddish-brown, occasionally very dark brown colour of the upper parts. The underparts are variable in colour; Kriesche claimed his subsp. *shiratica* to differ from *conradsi* in having red-brown tibiae and a ditto metasternum, which would be green in *conradsi*. This character, however, seems to be quite variable, so that *schiratica* is here considered a mere synonym. The underparts may have the same colour as the upperparts, or a dark green, bluish colour, with more or less additional brown. Bands on the abdominal sternites may be present. Variation in size may well be geographical; specimens from Shirati are fairly small, but the specimens from Old Shinyanga that were studied are closer to the average size of subsp. *oberthueri*; they also differ slightly in colour from the specimens from Shirati. This variation may well be clinal.

The variation in the cretaceous pattern in this subspecies is congruent with that in the subsp. *derbyana* and *oberthueri* (cf. Table 2). The unbanded variety is the nominate variety; the variety with a pronotal and an elytral margin may be named var. *marginata*, like in the subsp. *oberthueri,* and the completely patterned variety is named var. *vittata* Kolbe. The cretaceous cover may be creamy or white. A form without a cretaceous pronotal margin, but with a spot on either sides of the pronotal margin, was named ab. *bimaculata* Csiki, 1909, a name here abandoned, this "variety" being included in the nominate variety. Many more names would be needed to cover such varietal details, and we only treat the salient features of variation.

Distribution. — Material examined: 31 males in BH, BM, P, RMNH; 27 females in BH, BM, P, RMNH. Localities as follows (fig. 23):

TANZANIA: **Katona; Kirumba nr. Muanza; Old Shinyanga; Shirati (Csiki, 1909!, Kolbe, 1913!, 1914!, Kriesche 1920!); Ukerewe Island (type-locality Neuwied, Ukerewe) (Kolbe, 1909!, 1913!, 1914!, Kriesche, 1920!).

Phenology. — Months: ii; iii, iii-v; v; vi; xii.

5. Subsp. *carnifex* Harold, 1878

Identification. — Length males 26-35 mm, females 27.5-33 mm. This subspecies can easily be identified by the short, broad white stripe over the discomedian area of each elytron. The pronotum has a white cretaceous margin. The basic colour of the upper parts is dark-green, occasionally with a brownish tinge. Dark-blue specimens, which rarely occur, should be named var. *cyanea,* this name already being in use for such specimens in the other subspecies (cf. Table 2). Legs and underparts are partially of the same colour as the upper parts, but with a varying amount of red-brown, especially on the legs. Forms intermediate between this subsp. and subsp. *oberthueri* occur just north of Tanga, Tanzania, according to Kriesche (1920). The specimen examined from Fort Jesus (in Mombasa) was also intermediate, being large for a *carnifex,* and light-green, like *oberthueri.* Most specimens of *carnifex* are much smaller than the average *oberthueri*; this is perhaps the reason why the male fore tibiae are less elongate in this subspecies (allometry).

Distribution. — Material examined: 31 males in BH, BM, P, RMNH, T; 31 females in BH, BM, P, RMNH, T. Localities as follows (figs. 23):

KENYA: Bura (Bourgoin, 1919); Dana; El Barta; Ikutha (Kraatz, 1896!, Kriesche, 1920!); Kibwezi; Mbungu; Mulango; Naarengare; Pori de Serengeti (Bourgoin, 1919); Taita (= Teita) (type-locality; Harold, 1878!, Kolbe, 1897b!, 1909!, 1910!, 1914!, Kriesche, 1920!); Taveta (Bourgoin, 1919!); Thika River (Bourgoin, 1921!); Yatta-plateau; Ziwani. — Intermediate with subsp. *oberthueri*: Fort Jesus; north of Tanga (Kriesche, 1920).

	1. derbyana	2. lettowvorbecki	3. oberthueri	4. conradsi	5. carnifex
I. Colour		no variability known; no varietal names		only slightly variable; no varietal names	
1. green	usual colour		usual colour		---
2. dark green	---		---		usual colour
3. green with a golden shine	var. lucida		var. lucida		---
4. blue	var. cyanea		var. cyanea		---
5. dark blue	---		---		var. cyanea
II. Cretaceous markings on upper parts					only slightly variable; all specimens have an elongate patch on the elytral disc; no varietal names
1. no pattern or pronotal margin white only	var. inornata n.	---	var. oberthueri	var. conradsi	
2. both pronotal and elytral margin white	var. derbyana	---	var. marginata n.	var. marginata n.	
3. completely patterned	var. layardi	var. lettowvorbecki	var. bifasciata	var. vittata	

Table 2. Summary of the variation in *Dicronorhina derbyana*.

TANZANIA: Kilimandjaro (Kolbe, 1909); Meru (Kolbe, 1910, 1914).
UNKNOWN: **Muguu.
Phenology. — Months: i-iv (Kenya); iv (Kenya); xi (Kenya); xii (Tanzania).

PRELIMINARY KEY TO AFROTROPICAL GENERA OF HORNED GOLIATH BEETLES (males)

Including all the genera of Goliathini containing males with one or two clypeal horns (some of the included genera also have species lacking clypeal horns, variable apomorphism). For nomenclatural details, cf. Krikken (1984). The main objective of this key is to enable the identification of *Dicronorhina* and other goliath beetle genera to be treated in the near future. Cf. also character details in discussion of phylogeny below (Table 3).

1. Middle coxae distinctly separated by mesometasternal protrusion ... 2
– Middle coxae approximated, not separated by mesometasternal protrusion. — Subtribe Ichnestomina, one genus with horn (others not looking like Goliathini) .... *Ichnestoma* Gory & Percheron, 1833 (= *Ischnostoma* auctt.).
2. Pronotum with base (apart from shallow basomedian emargination) more or less straight, with distinct posterolateral angles; sides rounded to anterolateral angles, frequently more or less sinuate behind. Fore tibial spur movable. Also many genera lacking horns. — Subtribe Coryphocerina 6
– Pronotal shape different, dorsal outline more or less polygonal or transversely elliptic, posterolateral angles shifted forward or rounded off completely. Fore tarsal segment 1 more or less elongated. — Subtribe Goliathina 3
3. Fore tibial spur movable. Vertigial cavity present. Fore tibia with 3 external denticles ..... *Hypselogenia* Burmeister, 1840
– Fore tibial spur reduced, usually accrete. Vertigial cavity absent 4
4. Hypostomal angle absent. Pronotum with anteromedian protrusion. Middle and hind tibia with external protrusion .... *Hegemus* J. Thomson, 1881
– Hypostomal angle present. Pronotum without anteromedian protrusion. Middle and hind tibiae without external protrusion 5
5. Fore tibia with 3 large external denticles. Clypeal horn T-shaped and bent

down. Fore tarsal segment 1 short (slightly longer than 2) .... *Fornasinius* Bertoloni, 1853

– Fore tibia with 3 reduced external denticles or less. Anterior clypeal projection(s) more or less erect. Fore tarsal segment 1 distinctly elongated ..... *Goliathus* Lamarck, 1801

6. Dorsum distinctly velutinous or otherwise completely opaque (in one case this is due to heavy microsculpture and/or pilosity; this layer can rarely be worn off, then the animal appears shiny) 7

– Dorsum, apart from light-coloured cretaceous markings, never velutinous, most of derm more or less shiny 18

7. Fore tibia with distinct anteapical external denticles (usually 2 + apicoexternal one) 10

– Fore tibia without anteapical external denticles 8

8. Postclypeus ("pseudofrons") with pair of recurved projections. Clypeolateral area without ridge or any other longitudinal elevation. Anteromedian clypeal horn long, bifurcate .... *Amaurodes* Westwood, 1844

– Postclypeus without pair of recurved projections, usually with one or two horizontal projections 9

9. Anteromedian clypeal horn simply laminiform. Postclypeus usually with horizontal lamella ..... *Lophorrhina* group, not treated.

– Cephalic ornamentation different 10

10. Postclypeus with single median horizontal projection. Elytron with 3 longitudinal costae. Derm black, heavily microsculptured .... *Gnorimimelus* Kraatz, 1880

– Postclypeus different, with pair of projections, with upright median projection, or unmodified 11

11. Clypeus with bifurcate anteromedian horn and with very distinct, deep lateral cavities, posteriorly limited by crest. Elytral disc flattened. Habitus narrow, elongate ..... *Smicorrhina* Westwood, 1847

– Clypeus different; if with cavities at all, these are posteriorly not limited by crest. Elytral disc evenly curved in cross-section 12

12. Anteromedian clypeal projection simply laminiform; postclypeus with slight, simple protrusion. Internal denticulation of fore tibia reduced ..... *Brachymitra* Kolbe, 1904

– Anteromedian clypeal projection more complex, usually more or less bifurcate (in one case strongly acuminate, long); postclypeus without median projection, or with strong, usually bifurcate projection 13

13. Clypeus with pair of elongate, variably deep lateral impressions. Middle and hind tibiae usually with external protrusions 14

– Clypeus lacking pair of lateral impressions. Middle and hind tibiae usually lacking external protrusions 16

14. Fore tibia broad, with 3 external denticles, without internal dentation. Clypeus with anterolateral projections .... *Dicellachilus* C.O. Waterhouse, 1905

– Fore tibia always with distinct internal dentation 15

15. Postocular thoracic cavities present .... *Compsocephalus* White, 1845

– Postocular thoracic cavities absent ..... *Stephanocrates* Kolbe, 1892

16. Anteromedian horn long, not bifurcate .... *Mecynorhina* Hope, 1837

– Anteromedian clypeal horn bifurcate 17

17. Antegenal protrusions very long. *Chelorrhina* Burmeister, 1842

– Antegenal protrusion short, if present at all .... *Megalorhina* Westwood, 1847

18. Fore tarsal segment 1 strongly elongated, its apex dentate internally; fore tarsal segment 5 with brush on underside. Proximal-internal side of fore tibia also with brush. Derm largely black or brown, with cretaceous markings ..... *Cheirolasia* Westwood, 1843

– Fore tarsal segment 1 not elongated 19

19. Postclypeus ("pseudofrons") with pair of slender hooks. Fore tarsal segment 5 with conspicuous brush on underside. Clypeal surface strongly expanded, without isolated cavities. Cretaceous cover of vitreous green derm extensive ..... *Rhamphorrhina* Klug, 1855 (= *Ranzania* Bertoloni, 1855, non Nando, 1840, = *Neoranzania* Distant, 1911)

– Postclypeus different 20

20. Fore femur with distinct lateral projection. Anteromedian clypeal horn with ridge running onto clypeal disc 21

– Fore femur without distinct lateral projection 22

21. Postclypeus lacking projections ..... *Neptunides* J. Thomson, 1878

– Postclypeus with strongly recurved, laminate, sometimes paired projection ..... *Taurhina* Burmeister, 1842

22. Elytron usually with 8 or more small roundish cretaceous spots on vitreous green or reddish derm. Clypeus usually with pair of upright anterolateral projections. Internal side of fore tibia frequently with brush-like fringe of setae ..... *Stephanorrhina* Burmeister, 1842

– Lacking at least two of these features 23

23. Clypeus usually with pair of upright anterolateral projections. Sides of abdomen with longitudinal ridge. Mesometasternal protrusion very long and slender ..... *Melinesthes* Kraatz, 1880

– Clypeus different. Sides of abdomen gradually rounded. Mesometasternal protrusion short, only slightly projecting in front of middle coxae 24

24. Length usually over 35 mm (exclusive of clypeal horn). Clypeal cavities in front of eye canthus level. Elytron without dark patches, and without connecting bar. Fore tarsal segment 5 with conspicuous brush on underside ..... *Dicronorhina* Hope, 1837
– Length only rarely over 40 mm (exclusive of clypeal horn), usually under 35 mm. Fore tarsal segment 5 without brush on underside. Elytron usually with two dark patches, one humeral, one apical, sometimes connected by bar 25
25. Clypeal cavities situated in front of eye-canthi; if reaching the eye canthus level, pronotum covered with well-visible, round pits. Anteromedian clypeal horn usually long, bifurcate. Fore tibia usually internally dentate ..... *Eudicella* White, 1839
– Clypeal cavities extending behind eye-canthi. Anteromedian clypeal horn short, broad. Fore tibia never internally dentate .... *Cyprolais* J. Thomson, 1880 (= *Coelorrhina* auctt.)

SYNOPTIC TABLE OF GENERIC CHARACTERS

1. Anteromedian protrusion of clypeus (male); a, absent; b, fused (more or less) with the extended clypeal area; c, present.
2. Anterolateral angles of clypeus (male): a, strongly reduced; b, slightly reduced; c, normally developed; d, rounded.
3. Postclypeal protrusion(s) (male): a, absent; b, two, strongly reduced; c, two, small; d, two, well developed; e, one, strongly reduced; f, one, small; g, one, distinct.
4. Antegenal protrusions (male): a, absent; b, present.
5. Median clypeal costa (male): a, absent, middle of clypeus concave or flat; b, absent, but the middle of the clypeus convex; c, present.
6. Phallus: a, simple, lobiform; b, simple, but with an asymmetrical groove between the distal pincers of the parameres; c, more flattened, with a flat and wide distal section; d, narrow and asymmetrical; e, simple, but with two longitudinal grooves on the parameres; f, more or less simple but dilated distally and asymmetrical; g, distal pincers more apart, not simple, 2 types; h, simple, but more recurved, distal pincers more apart; i, like e, but parameres ventrally not straight; j, slightly recurved distally, parameres ventrally not straight; k, more or less recurved because the parameres are thinner distally, parameres ventrally nearly straight.
7. Inner side of fore tibia (male): a, simple, smooth or nearly so; b, setose and lobate; c, simple, but with a hairy comb proximally; d, dentate.
8. Outer side of fore tibia (male): a, simple, smooth; b, with one subapical

denticle on the underside; c, with one or two, much reduced, denticles; d, with three very distinct denticles, including apico-external denticle.

9. Apico-external denticle on fore tibia (male): a, blunted; b, more or less distinct.
10. Lateral projection on fore femur (male): a, absent; b, present.
11. Tibiofemoral brushes: (male fore legs): a, absent on the femora, a thin row of hairs on the tibiae; b, present on the femur, absent on the tibia; c, present on the femur and on the proximal half of the tibia.
12. Length of the first male fore tarsal segment, compared to the length of the individual segments 2-4; a, short; b, about as long; c, longer; d, much longer.
13. Length of the fifth male fore tarsal segment: a, normal; b, narrower, more elongate.
14. Brush on the underside of the fifth male fore tarsal segment: a, absent; b, present, compact; c, present, not compact.
15. Male fore tarsal segments (in cross-section): a, normal, slightly complanate laterally; b, complanate laterally; c, very thick.
16. Apico-internal denticle on the male first fore tarsal segment: a, absent; b, present.
17. Male middle and hind tibiae: a, without external denticles; b, with one external denticle on the middle tibia; c, with two external denticles on the middle and one on the hind tibia; d, with two external denticles on both the middle and the hind tibia; e, with reduced denticulation, at least one external denticle on the hind tibia.
18. Steepness of mesosternal declivity: a, not steep; b, moderately steep. c, steep.
19. Pilosity of mesosternal declivity: a, glabrous; b, somewhat hairy; c, hairy.
20. Shape (ventral view) of mesometasternal protrusion: a, truncate; b, rounded; c, moderately acute; d, very acute.
21. Cretaceous markings: a, absent; b, present.
22. Velutinous cover: a, absent; b, present.

TAXON	CHARACTER																				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Taurhina	c	c	g	a	c	h	d	a	a-b	b	b	a	a	a	b	a	a	b	b	b	a	a
Neptunides	c	c	a	a	c	h	d	a	a	b	b	a	a	a	b	a	a	b	c	b	a	a
Eudicella 1	c	c	b	a	b	k	d	a	b	a	b	a	a	a	a	a	a	a	c	c	a	a
Eudicella 2	c	c	c	a	b	i	a	a	b	a	b	a	a	a	a	a	a	a	c	c	a	a
Cyprolais	c	c	c	a	b	j	a	a	a	a	b	a	a	a	a	a	a	a	c	c	a	a
Amaurodes	c	b	c	a	a	a	d	a	b	a	b	a	a	a	a	a	a	b	c	b	b	b
Megalorrhina	c	b	b	a	a	a	d	d	b	a	b	a	a	a	a	a	a	b	c	b	b	b
Chelorrhina	c	a	a	b	a	a	d	d	b	a	b	a	a	a	a	a	b	b	c	c	b	b
Mecynorhina	c	a	a	b	a	a	d	d	b	a	b	a	a	a	a	a	b	a	c	d	b	b
Compsocephalus	c	c	g	a	b	a	d	d	b	a	b	b	a	a	c	a	d	c	b	c	a	b
Stephanocrates	c	c	g	a	b	a	d	d	b	a	b	b	a	a	a	a	d	c	c	b	a	b
Brachymitra	c	c	e	a	a	a	a	d	b	a	b	b	a	a	a	a	d	c	c	a-b	a	b
Dicellachilus	c	c	a	a	b	b	a	d	b	a	b	b	a	a	a	a	d	c	c	a-b	a	b
Smicorrhina	c	b	c	a	b	a	d	c	b	a	b	a	a	a	a	a	c	c	a	b	a	b
Gnorimimelus	c	c	f	a	b	c	a	c	b	a	b	a	a	a	a	a	e	c	c	d	b	b
Asthenorrhina	a	d	a	a	a	d	b	a	a	a	a	b	a	a	a	a	a	c	b	c	a-b	b
Rhamphorrhina	b	c	d	a	a	e	d	b	b	a	b	a	a	b	a	a	a	c	b	a	b	a
Cheirolasia	c	c	c	a	c	f	c	a	a	a	c	d	b	c	a	b	a	c	b	b	b	a
Dicronorhina	c	c	c	a	b/c	g	d	a	a	a	b	c	a	b	a	b	a	c	a	b	a/b	a

Table 3. Synoptic table of character states of potential relatives of *Dicronorhina*. Symbols used: a-b, intermediate; a/b, both character states occur.

PHYLOGENETIC DISCUSSION

It is difficult to reconstruct the phylogeny of *Dicronorhina* and its relatives because very few, genuinely indisputable synapomorphies are available. Arrow's views (1941) as to the use of particular characters (especially sexually dimorphic characters) in the classification of the goliathines were criticized before by one of us (Krikken, 1984), and we freely use secondary sexual characters, e.g. the shape of the head. Additionally, there is the problem termed variable apomorphism, particularly with respect to these characters (Krikken, l.c.), i.e. the phenomenon of complex (homologous) sexual features being variably expressed or even completely absent in particular genera or in infraspecific groupings. A cladogram down to the infraspecific levels, as pointed out below, presents problems of its own. We must refrain here from an in-depth discussion of the methodological aspects of the present phylogenetic reconstruction.

One of the things we have done is look at all the other Goliathini, par-

ticularly the Afrotropical ones, to find candidates for a sister group status in relation to *Dicronorhina*. Although undoubtedly much more research has to be done, especially in view of the need to find new synapomorphies, we will not withhold our preliminary findings. Our primary intention in all this is to clarify the position of *Dicronorhina* by briefly commenting on the characters of the Afrotropical genera of goliath beetles that are evidently more closely related. For details, see Table 3, as well as the analytical key preceding this discussion.

There are some evidently monophyletic coryphocerine groups related to *Dicronorhina* in the sense that the differences with the genus are not so excessive as to make a search for synapomorphies useless. These groups all share with *Dicronorhina* an apparently synapomorphous male cephalic armature (cf. Krikken, 1984, for more complications). One such group is constituted by *Neptunides* and *Taurhina*. Their own group synapomorphies include laterally complanate fore tarsi, a distinct projection laterally on the fore femur and an adjacent tibial angle, the male genitalic structure, the shape of mesometasternal protrusion, details of the male cephalic armature. In all these features the group differs from *Dicronorhina*.

The genera *Eudicella* and *Cyprolais* also form a monophyletic group. (Two separate reviews of these genera are in preparation.) Schein (1960) gave as his opinion that the two genera are artificial, pointing to the similarity of the females and the lack of what we nowadays term synapomorphies. The elytral colour pattern is, however, certainly apomorphous, with its humeral and subapical patch of black, connected by a dark bar, the juxtasutural zone being more or less infuscated. This pattern is apparently reduced in some species. On direct comparison the features that distinguish *Eudicella* and *Cyprolais* from *Dicronorhina* include their less steep mesometasternal declivity, their setose mesosternum, the simply structured male genitalia, the lack of a brush on the underside of fore tarsal segment 5 of the males, and their short fore tarsal segment 1. These characters all seem to be unmodified in *Cyprolais* and *Eudicella,* and would be plesiomorphous in a three-taxon context including *Dicronorhina*. Two species, roughly "intermediate" between the two genera, present special problems (further discussion in forthcoming papers). The overall similarity of *Eudicella* and *Cyprolais* with *Dicronorhina* is strong, but presumably based entirely on symplesiomorphies.

A group of large goliath beetles is constituted by *Amaurodes, Megalorrhina, Chelorrhina,* and *Mecynorhina*. These genera share some evident apomorphies, e.g. the peculiar cretaceous cover (at least on the head). Within this group, two pairs may be recognized, *Amaurodes & Megalorrhina* on the one hand, *Chelorrhina & Mecynorhina* on the other. These generic pairs ap-

pear to be monophyletic, as may be concluded from apomorphies in the shape of the fore and hind legs, in the male cephalic armature, and in the shape of the mesometasternal protrusion. The four genera mentioned may be more closely related to *Eudicella* and *Cyprolais,* and this whole complex may in turn be related to *Neptunides* and *Taurhina.* Indisputable synapomorphies on these levels in the phylogeny, however, have yet to be found.

Finally, three genera, *Rhamphorrhina, Cheirolasia,* and *Dicronorhina,* though superficially rather dissimilar, share a remarkable apomorphous feature, here considered a synapomorphy: the males have a distinct brush on the underside of their last fore tarsal segment. Other features of minor importance are also considered synapomorphous, like the cretaceous pattern and the steep mesometasternal declivity. It then seems that it is in this group that the sister group of *Dicronorhina* has to be found. We consider *Cheirolasia* the sister group of *Dicronorhina,* primarily on the basis of a similarity in

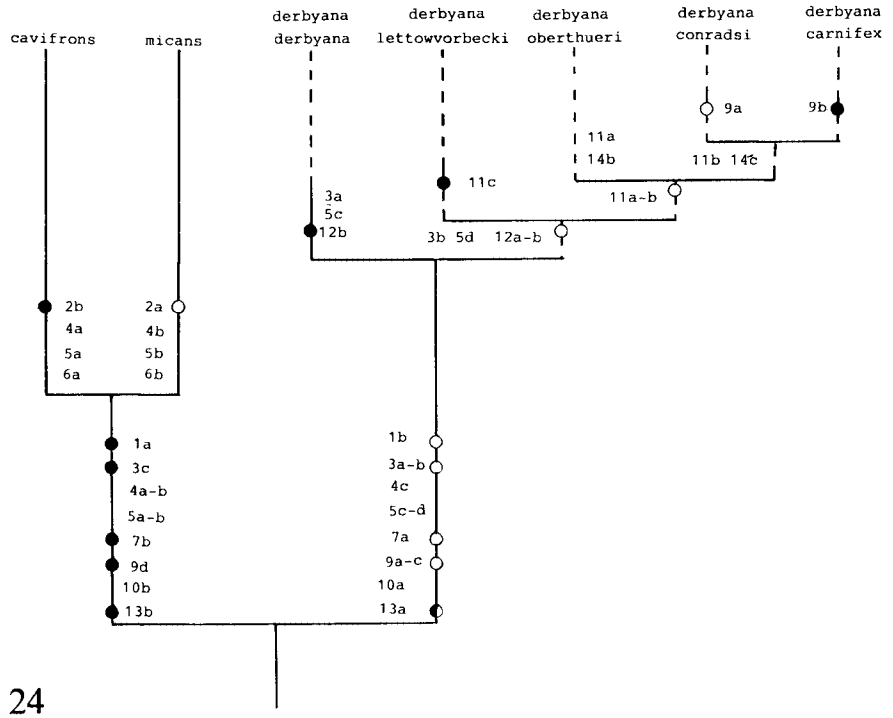


Fig. 24. Phylogenetic tree of the *Dicronorhina* species and subspecies. Numbers correspond to character numbers in the synoptic table of character states (table 1); dots indicate apomorphic character states, circles indicate plesimorphic character states. Some character states which are not phylogenetically interpretable are also included.

synapomorphous cephalic armature. Formerly *Dicronorhina* was usually placed near *Eudicella* and *Cyprolais* (see above). Only proof of a parallel evolution of the fore tarsal brush can lead to a reconsideration of the position of *Dicronorhina*.

Among the other large Afrotropical Coryphocerina there are no direct relatives of any of the genera discussed above. These are the genera listed in Table 3 from *Compsocephalus* to *Asthenorrhina*. At this point it should be emphasized that the phylogenetic qualification of the cephalic armature is extremely difficult. In a global context (within the Goliathini) the evolution of the T- or Y-shaped clypeal horn, the backward shift of the clypeus etc. is a descendent feature. The details are characteristic for each genus (or species-group). However, what the precise status of this character state would be in a three-taxon context (apomorphous, plesiomorphous, parallel) remains to be clarified for each case.

The phylogeny of the *Dicronorhina* species as depicted in the cladogram (fig. 24) is largely self-explanatory (cf. also Table 1, the synoptic table of species characters). As long as the higher-level synapomorphies are clear, one has to accept that terminal species-group taxa are included in this cladogram, although the distinguishing characters may not, or not all, be phylogenetically interpretable. It may be questioned whether subspeciation patterns should be included in a cladogram, the separation (reproductive isolation) not being complete (cf. definition of subspecies above, under Terminology and further explanation). Obviously geographic isolation has played, and may still play, an important role judged from the allopatric occurrence of the 7 species-group taxa. The supraspecific differences (*cavifrons & micans* versus *derbyana*) are considerable, not in the least in the shape of the parameres. The parameres of both groups are so strongly modified that this feature virtually cannot be qualified as a generic synapomorphy. There are no intermediates between these parameres of the *Dicronorhina* species and those of other goliathines.

On the grounds discussed above and on the distributional evidence (cf. figs. 21-23), it seems not unreasonable, 1, to position the origin of *Dicronorhina* in southern Africa (sister group, as well as least differentiated *Dicronorhina* taxa occur there), and to assume the following further stages in their speciation: 2, separation in two major groups (many different characters); 3, expansion over Africa of the *cavifrons-micans* group and 4, their apparently allopatric speciation (there is partial, possibly secondary range overlap); 5, the possibly more recent expansion of *derbyana* to eastern and central Africa, followed by 6, extensive variation and subspeciation.

GAZETTEER OF COLLECTING LOCALITIES

ANGOLA: Aquapim; Benguela 12°34'S 13°24'E; Chinchoxo ca. 5°34'S 12°12'E; Cuando river 16°-18°S 22°-23°30'E; Humbe 16°41'S 14°55'E; Kimbundo = Mona Quimbundo 9°51'S 19°58'E; Loango 6°01'S 14°58'E; Malanje 9°36'S 16°21'E; Merero; Pungo Andongo 9°44'S 15°35'E; Quango river 3°-11°S 16°30'-19°E; Quilo river 7°30'-11°S ca. 19°30'E.

BENIN: Djougou 9°40'N 1°47'E; Porto-Novo 6°30'N 2°47'E; Sokèli.

BOTSWANA: Moremi reserve 19°23'S 23°33'E; Ngami, Lake ca. 20°30'S 22°50'E.

CAMEROUN: Abong M'Bang district 3°58'N 13°10'E; Babungo 6°04'N 10°26'E; Bakossi 5°59'N 14°26'E; Barombi ca. 4°40'N 9°20'E; Batouri 4°26'N 14°27'E; Bidunbi; Bimbia 3°57'N 9°14'E; Bitye, Ya river 3°54'N 12°30'E; Bombe Kumba 4°32'N 9°27'E; Buea 4°09'N 9°13'E; D'Ja Posten 3°15'N 13°30'E; Ebolowa 2°56'N 11°11'E; Edea 3°47'N 10°13'E; Eseka 3°40'N 10°48'E; Kribi 2°56'N 9°56'E; Lolodorf 3°17'N 10°50'E; Mongoma-Lobah 4°12'N 9°11'E; Njong river 3°10'N-4°N 10°-13°E; Pama & Ubi junction; Samba 4°26'N 12°58'E; Soppo 4°09'N 9°17'E; Tina; Tuban; Ubanga; Victoria 4°01'N 9°12'E; Yangandi; Yaoundé 3°51'N 11°31'E.

CENTRAL AFRICAN REPUBLIC: Boukoka 3°54'N 17°56'E; Haute Sangha ca. 4°N 16°E; Nana river ca. 4°-6°N 15°-16°E; Zemio 5°00'N 25°09'E.

CONGO: Bateké 2°-4°S 16°E; Brazzaville 4°14'S 15°14'E; Dieli, Alima river ca. 1°-2°S 14°-17°E; Lékéti 1°36'S 14°57'E; Pointe Noire 4°46'S 11°53'E; Voka 4°40'S 14°40'E.

EQUATORIAL GUINEA: Benito Mts. ca. 1°35'N 9°37'E; Macias Nguema, Basilè ca. 3°30'N 8°30'E.

GABON: Basso Ogoue ca. 0° 10°-12°E; Diélé 1°40'S 13°45'E; Franceville 1°40'S 13°31'E; Lambaréné 0°41'S 10°13'E; Libreville 0°30'N 9°25'E; Mayomba 3°25'S 10°39'E; N'Kogo 0°20'S 10°28'E.

GHANA: Accra 5°33'N 0°15'W; Akropong ca. 6°N 1°W; Amedzowe 6°51'N 0°26'E; Bibianaka 6°30'N 2°08'W; Kumasi 6°45'N 1°35'W; Tafo 6°15'N 0°20'W.

GUINEA: unspecified.

IVORY COAST: Abengourou ca. 6°45'N 3°30'W; Adiopo-doumé nr. Abidjan 5°20'N 4°08'W; Kakpin 8°39'N 3°48'W.

KENYA: Bura 3°30'S 38°19'E; Dana (= Tana?, 2°30-0°S 38°-40°30'E); El Barta ca. 1°40'N 36°55'E; Fort Jesus 4°04'S 39°41'E; Gedi 3°18'S 40°01'E; Ikutha 2°05'S 38°10'E; Kaimosi 0°08'N 34°47'E; Kibwezi 2°50'S 37°57'E; Kilifi 3°37'S 39°50'E; Mbungu 4°05'S 39°23'E; Mombasa 4°04'S 39°40'E; Mulango 1°35'S 38°00'E; Naarengare (Ngorengore) 1°03'S

35°30'E; Pori de Serengheti 3°30'S 38°19'E; Rabai 3°55'S 39°34'E; Solole 1°41'S 40°25'E; Taita 3°20'S 38°35'E; Taru-Mombasa (Taru 3°45'S 39°10'E); Taveta 3°25'S 37°40'E; Thika River 1°03'S 37°05'E; Wasini Island 4°40'S 39°23'E; Yala River 0°00' 34°35'E; Yatta-plateau (Luitpoldkette) ca. 2°S 38°E; Ziwani 3°23'S 37°48'E.

LIBERIA: Cape Palmas 4°25'N 7°50'W.

MALAWI: Bunda College 14°10'S 33°48'E; Chiromo 16°33'S 35°10'E; Kanjedja Forest; Malperera; Monkey Bay ca. 14°10'S 35°E; Salima 13°45'S 34°29'E.

MOZAMBIQUE: Andrada 18°52'S 32°53'E; Beira 19°49'S 34°52'E; Delagoa Bay ca. 25°58'S 32°35'E; Inhacoro 16°44'S 34°15'E; Inhambane 23°51'S 35°29'E; Maputo 1 (Lourenço Marques) 25°58'S 32°35'E; Maputo 2 14°51'S 40°43'E; Marromen 18°20'S 35°56'E; Monteiro 24°38'S 33°09'E; Rikatla 25°46'S 32°31'E; Sikumba.

NAMIBIA: Abenab 19°20'S 18°08'E; Damaraland ca. 22°S 17°E; Gobabis 22°30'S 18°58'E; Grootfontein 19°32'S 18°05'E; Herero (large area); Karibib 21°59'S 15°51'E; Kombat 19°43'S 17°42'E; Okahandja 21°59'S 16°58'E; Omaruru 21°28'S 15°56'E; Omoupanda ca. 17°45'S 15°45'E; Outjo 20°08'S 16°08'E; Ovampoland ca. 18°S 16°E; Sissekab; Swakopmund 22°40'S 14°34'E; Tsumeb 19°13'S 17°42'E; Waterbergen 20°28'S 17°13'E; Windhoek 22°34'S 17°06'E.

NIGERIA: Bari, Lagos 6°27'N 3°28'E; Calabar 4°56'N 8°22'E; Old Calabar ca. 5°N 8°E; Toro 10°05'N 9°05'E.

RSA: Barberton 25°48'S 31°03'E; Caffraria, North (= N. Transvaal); Durban 29°53'S 30°00'E; Krugerpark ca. 24°S 31°30'E; Limpopo river (northern border); Lydenburg 25°10'S 30°29'E; Magalisberg Mts. 25°-26°S 27°-28°E; Natal; Nylstroom 24°42'S 28°20'E; Pietersburg 23°54'S 29°23'E; Potchefstroom 26°42'S 27°06'E; Pretoria 25°45'S 28°12'E; Rustenburg 25°40'S 27°15'E; Tugela river, Natal ca. 29°S 30°-31°E; Waterberg district ca. 24°S 28°E; Waterval-Onder 25°40'S 30°23'E; Zoutpansberg 22°45'S 30°00'E.

SENEGAL: unspecified.

SIERRA LEONE: unspecified.

SOMALIA: unspecified.

SUDAN: Nagichot 4°20'N 33°32'E.

TANZANIA: Amani 5°09'S 38°36'E; Bagomoyo 6°26'S 38°55'E; Bukoba 1°20'S 31°49'E; Dar-es Salaam 6°48'S 39°17'E; Iringa 7°49'S 35°29'E; Kala 7°30'S 31°34'E; Kasanga; Katona (near Shirati); Kidugala 9°07'S 34°32'E; Kijimbila 9°17'S 33°39'E; Kilimandjaro (Mt.) ca. 3°S 37°30'E; Kilimatinde 5°52'S 34°55'E; Kilondo 9°47'S 34°22'E; Kirumba nr. Muanza

ca. 2°30'S 32°54'E; Kisarawe-Pugu 6°57'S 39°03'E; Kisiba nr. Bukoba; Konde 9°20'S-9°30'S 33°50'-34°E; Lindi 10°00'S 39°20'E; Lutindi 4°54'S 38°37'E; Madibira 8°12'S 34°50'E; Makondiplateau 10°30'S 38°15'E; Malinde 2°45'S 31°31'E; Mamboia 6°18'S 37°05'E; Mandera 6°13'S 38°26'E; Manow 9°15'S 33°48'E; Marangnom (Zanzibar interior) ca. 6°10'S 39°30'E; Meru (Mt.) 3°15'S 36°44'E; Mgololo 6°48'S 37°44'E; Mhonda 6°07'S 37°36'E; Mikindani 10°16'S 40°05'E; Mlalo 4°34'S 38°21'E; Moa 4°49'S 39°10'E; Morogoro 6°49'S 37°40'E; Moschi 3°21'S 37°20'E; M'Pala 9°24'S 34°51'E; Neu-Helgoland (islet nr. Liuli, 11°05'S 34°40'E); Nguelo 4°36'S 38°23'E; Nguru ca. 6°S 37°-38°E; Old Shinyanga 3°34'S 33°24'E; Pangani 5°27'S 39°00'E; Rukwa, Lake 8°S 32°E; Shirati 1°10'S 34°00'E; Tanga 5°00'S 38°15'E; Ubena (6°28'S 39°30'E)-Kilondo; Ubemba 8°16'S 35°42'E; Ugogo 5°04'S 34°04'E; Uhehe 7°05'S-9°S 35°-36°E; Ukami 8°30'S 35°44'E; Ukerewe Isl. 2°09'S 32°52'E; Unyika ca. 8°50'S 33°E; Usagara Mts. ca. 6°30'S 36°30'E; Usambara Mts. 4°45'S 38°30'E; Usaramo ca. 7°20'S 38°40'E; Useguha ca. 5°30'S 38°20'E; Utinto 7°10'S 30°30'E; Zanzibar ca. 6°10'S 39°20'E.

TOGO: Yege 8°11'N 0°40'E.

UGANDA: Ansinge; Budongo Forest, Bunyoro 1°46'N 31°33'E; Bufumbe Forest 1°06'N 34°15'E; Bugala 0°39'S 32°50'E; Entebbe 0°05'N 32°29'E; George, S. of Lake ca. 0°30'S 30°10'E; Kamengo 0°40'S 31°28'E; Kampala 0°19'N 32°35'E; Kayenza forest, Kigezi 1°16'S 29°45'E; Mawakota 0°00' 32°08'E; Msozi 0°53'S 31°45'E; Sesse Islands ca. 0°30'S 32°20'E; Tero Forest 0°50'S 31°40'E.

ZAIRE: Aruwimi valley ca. 1°30'N 23°30'-27°E; Bambesa 3°25'N 25°43'E; Bandundu 3°20'S 17°24'E; Ba-Ngala ca. 4°S 27°30'E; Barumbu 1°15'N 23°29'E; Basoko 1°14'N 23°36'E; Baudouinville 7°03'S 29°42'E; Beni 0°29'N 29°27'E; Binga 2°17'N 20°33'E; Bokoro 2°50'S 18°23'E; Bomboma 2°23'N 19°03 E; Bongeya see V.N.P.; Bumputu 0°20-0°23'S 20°06'E; Buna 3°14'S 18°59'E; Bungundu 4°08'S 20°42'E; Bunia 1°33'N 30°13'E; Buta 2°48'N 24°44'E; Dielya see V.N.P.; Djuma 4°14'S 18°21'E; Eala 0°04'N 18°17'E; Elisabetha 1°09'N 23°39'E; Flandria 0°23'S 19°05'E; Galikoko 4°58'S 21°15'E; Geti 1°15'N 30°12'E; Go 2°57'N 20°07'E; Haut Congo ca. 0°30'N 25°E; Ibembo 2°36'N 23°40'E; Ibélé 1°03'S 18°28'E; Ikela 1°06'S 23°06'E; Irumu 1°32'N 29°49'E; Kafakumba 9°42'S 23°41'E; Kahuzi, Bitale; Kalina 4°18'S 15°17'E; Kaponga ca. 6°48'S 22°32'E; Kasalala see V.N.P.; Kassai Mts. 4°-6°S 20°-22°E; Katande 0°50'S 29°22'E; Katompe 6°08'S 26°21'E; Katuka (= Katuka-Mwenda) 0°32'N 29°48'E; Kilo 1°49'N 30°10'E; Kilomines 1°48'N 30°14'E; Kimwenza 4°28'S 15°17'E; Kinda 9°20'S 25°06'E; Kindu 3°00'S 25°56'E;

Kiniati (= Kiniati-Zobe) 5°19'S 12°58'E; Kiniati-Yasa 4°28'S 18°03'E; Kinshasa 4°18'S 15°18'E; Kisangani 0°33'N 25°14'E; Kisantu 5°08'S 15°09'E; Kisiba 5°55'S 24°54'E; Kondue 4°57'S 23°21'E; Kutu 2°42'S 18°10'E; Kwango ca. 7°S 18°15'E; Libenge 3°39'N 18°39'E; Lisala 2°08'N 21°37'E; Lokandu; Luebo 5°21'S 21°25'E; Lukombe ca. 7°10'S 29°05'E; Lukuli 5°21'S 13°02'E; Lulua 6°-7°S 21°-23'E; Luluabourg 5°53'S 22°26'E; Lusaka 7°06'S 29°22'E; Lusambo 4°54'S 23°26'E; Lutakira see V.N.P.; Mabenga, Kasali-mass. 4°22'N 29°47'E; Mahanga, N. Kivu; Mambasa 1°20'N 29°05'E; Mawambi-forest 1°03'N 28°36'E; Mayidi 5°11'S 15°09'E; May ya Moto 0°53'S 29°21'E; Mbandaka 0°03'N 18°28'E; Medje 2°25'N 27°18'E; Mongbwalu 1°57'N 30°02'E; Mongoumba 3°40'N 18°35'E; Moto ca. 3°00'S 29°30'E; Mukinga 12°30'S 29°30'E; Munsenene, Medidi river; Mutshatsha 10°39'S 24°27'E; Mutsora 0°19'N 29°45'E; Mwenga, Kivu 3°00'S 28°28'E; Mwilambongo 4°55'N 19°45'E; Ngokoi see V.N.P.; Oycha 0°43'N 29°32'E; Panga 1°52'N 26°23'E; Prov. Orientale 1°-5°N 23°-30° E; Rutshuru 1°10'S 29°26'E; Sankuru ca. 3°30'S 22°-24°40'E; Sassa region ca. 3°55'N 27°59'E; Semliki plain ca. 0°-1°N 29°40'-30°E; Shaba province ca. 10°S 27°30'E; Stanley Falls 0°18'N 25°30'E; Tshambi 0°44'S 29°14'E; Uele ca. 3°40'N 22°24'E; Uerre 3°42'N 25°24'E; Vieux-Kilo 1°50'N 30°08'E; Virunga National Park ca. 0°30'S 28°40'E, many localities not exactly located: Bongeya affl. Talya, Dielya affl. Talya, Kasalala affl. Mbongia/Talya, Lutakira affl. Semliki, Ngokoi affl. Talya; Yangambi 0°47'N 24°24'E; Yindi 1°35'N 27°40'E; Zilo 10°30'S 25°28'E.

ZAMBIA: Baratsi (tribe); Lealui 15°13'S 23°02'E; Lusaka 15°26'S 28°20'E; Mabumbu 15°10'S 23°10'E; Marotséland (tribe); Mwenga 15°17'S 25°59'E; Victoria Falls 17°55'S 25°52'E.

ZIMBABWE: Chilimanzi Reserve ca. 19°30'S 30°30'-31°E; Enkeldoorn 19°01'S 30°53'E; Harare 17°43'S 31°05'E; Harare, Sheppard 17°50'S 31°02'E; Mashonaland 18°-20°S 31°-33°E; Matopos 20°27'S 28°30'E; Matoppo Hills, just E. of Matopos, q.v.; Mazoe 17°30'S 31°03'E; Sebakwe 19°00'S 30°31'E; Selukwe 19°40'S 30°00'E; Umtali 19°00'S 32°40'E; Umvuma 19°19'S 30°35'E; Unguza river, Bulawayo 20°05'S 28°30'E.

Unknown: Assinie Break (W. Africa); Fort Gorilla, Fernan Bay (Central Africa); Muguu (East Africa); Tlisi B.E.A. (Kenya, Uganda or Tanzania).

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