

## REVISION OF THE GENUS *Calosoma* WEBER (COLEOPTERA: CARABIDAE) WITH TWO NEW SPECIES FROM PAKISTAN WITH THEIR CALDISTIC RELATIONSHIPS

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### ABSTRACT

Eleven species of the genus *Calosoma* Weber including two new species from Pakistan and Azad Kashmir are briefly described with reference to their taxonomic characters, male and female genitalia. A key to all the eleven species recorded from above areas is formulated and on the basis of their apomorphies the cladistic relationship is also briefly discussed.

**Keyword Index:** Coleoptera, new species, cladistic relationship, Pakistan and Azad Kashmir

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### INTRODUCTION

The members of the family Carabidae including the genus *Calosoma* Weber are distributed throughout Palaearctic, Oriental, Neotropical and Nearctic regions. They are carnivorous and feed on various lepidopterous larvae and others representatives of the insect orders. They were known as Carnivora in past but presently are called Adephaga (Andrewes 1929, Comstock 1950 and Kamaluddin and Hashmi 1997).

Andrewes (1929) has been described and keyed out 6 species of the genus *Calosoma* Weber in the fauna of British India including Ceylon and Burma and also reported from the areas now included in Pakistan. Comstock (1950) has been described three species viz. *C. calidum*, *C. scrutator* and *C. sycophonta*. Hatch (1953) has been described the structure of proventricular acanthae in *Calosoma altarnans*, Hashmi and Tashfeen (1992) gave a check list "Coleoptera of Pakistan" and listed only three species of the genus *Calosoma* viz. *C. beesoni* Andrewes, *C. indicum* Hope and *C. maderae* F., from Pakistan.

Kamaluddin and Hashmi (1997) have been described *C. orientale* Hope with reference to its internal aspects of alimentary, male and female reproductive organs from Pakistan and discussed the relationships with the representative of the genus *Carabus*. Kamaluddin *et al.* (1999) attempted the aspects of external morphology of the above species, and on the basis of its apomorphies also discussed the position within the tribe Carabinae. Kamaluddin *et al.* (1995) reviewed the genus *Carabus* L., formulating a key of 15-species and discussed the relationship of all the included species using their apomorphies with out group relationship with *Calosoma* Hope. Kamaluddin *et al.* (1996) attempted the cladistic analysis of the tribe Carabini Erichson from Indo-Pakistan subcontinent and discussed that the *Calosoma* appears sister group relationship with *Carabus* by its apomorphies in detail.

### MATERIALS AND METHODS

The representatives of the genus *Calosoma* Hope including two new species were collected from various localities of the Pakistan and Azad Kashmir by using conventional searching techniques and with the help of light trap. For the study of male and female genitalia the abdomen was removed from the base and boiled in 10% KOH solution on bench lamp for about 5-minutes. These were then washed with tap water and dissected out in the same medium. The examinations of various structures and their diagrams were made placing these on the cotton threads immersed in glycerine with the help of eye piece graticule. The abdomen and genitalia were preserved in microvials with a drop of glycerine, pinned with the specimens.

### RESULT

#### *Calosoma* Weber (1801)

*Calosoma*, Weber 1801. *Obsev. Ent.* 1: 20; Fabricius, 1801. *Syst. Eleuth.* 1: 211; Dejean, 1826. *Spec. Gen.* II: 190; Lacordaire, 1854. *gen. Col.* I; Thomas, 1859. *Skand. Col.* I: 173; Motch, 1865. *Bull. Soc. Nat. Mosc.* 37 (4): 309;

Ganglbauer, 1892. *Kaf. Mitteteur. I*: 33; Reitter, 1896. *best. Tab. Eur. Col.* 30: 46; Andrewes, 1924. *Mission Babault Ind.*: 6; 1929, *Faun. Brit. Ind. I*: 49; Junk, 1927. *Coleopterorum Catalogus, I*: 4. *Calitropa*, *Castrida*, *Charmosta*, *Camedula*, *Camplita*, *Cosmoplata*, *Clenosta*, *Callistraga*, *Callipara*, *Cladorepa*, Motchulsky, 1865, *Bull. Mosc. II*: 300-310.

### Diagnostical features:

Body generally black or brownish black and metallic green colour; Head rather wide not constricted behind eyes, neck swollen not constricted, eyes prominent distant from buccal disjunction with only one stiff bristle on head, clypeus short bisetigerous, labrum short wider than clypeus, deeply notched, pleurosetose in middle, each side of lobe bear only one setiferous pore, mentum notched, with a short and sharp tooth in the cavity, usually a seta on each side of its base, ligula small, ending abruptly or bent like elbow at apex and setae present laterally, maxillae strong, heavily fringed with hairs along inner margin and over the rounded apex, below the apex a sharp fine and smooth tooth at right angle of the limb, palpi stout, slightly dilated at apex, 2<sup>nd</sup> segment of labial palpi elongate, 3<sup>rd</sup> and 4<sup>th</sup> more or less equal to 2<sup>nd</sup> segment, pleurosetose on inner margin, antennae with 2<sup>nd</sup> segment short, 3<sup>rd</sup> longest, both compressed, 1 and 4 sometime feeble edged, furnished with soft hair from 5<sup>th</sup> segment; Thorax small, side evidently rounded, almost bordered, medially only one seta and one on before base present, hind angle normally bent aside, produced backward, scutellum small, elytra wide, shoulders well marked, in males rounded and pointed, in females narrowly bordered, border serrate, tuberculate, legs powerful, protibiae furrowed, mesotibiae and metatibiae curve; Abdomen convex beneath usually not passing elytra, segment 4 to 6 bordered, 1 to 3 more or less setose medially, 4<sup>th</sup> and 5<sup>th</sup> with seta on each side of median line, apical segment of male and female pleurosetose on apical margin.

### Male genitalia:

Aedeagus simple rod-like, curve, arcuate, membranous conjunctival appendages present, paramere articulating to the penis by a true condyle, theca membranous with or without hooks or spines.

### Female genitalia:

Hemisternites triangular or lobe-like, anterior piece of stylus concealed, posterior piece lobe-like with blunt pointed end.

### Comparative note:

This genus is most closely related to *Carabus* L., in having general body shape, mandibles without setae in scrobe, metacoxae contiguous, labrum emarginate, elytral epipleura not usually developed but it can easily be separated from the same in having antennae with 2<sup>nd</sup> segment about a third as long as 3<sup>rd</sup>, the later and generally both of them strongly compressed and mandibles usually striate on upper surface and by the other characters as noted in the description.

**Type species:** *Calosoma sycophanta* L.

### Key to the species of the genus *Calosoma* Weber

1. Body black or brownish black, border of prothorax straight or convex, in males aedeagus with semisclerotized dorsal appendage.....2  
 --- Body metallic green, border of prothorax rounded, in male aedeagus without semisclerotized dorsal appendage.....*scrutator* F.
2. Maxillary palpi with 4<sup>th</sup> segment as long as 3<sup>rd</sup>, posterior angle of pronotum reduce, not prominent, metepisterna about as long as broad.....4  
 --- Maxillary palpi with 4<sup>th</sup> segment shorter than 3<sup>rd</sup>, posterior angle of pronotum markedly developed, metepisterna always longer than wide.....3
3. Body aeneous black, prothorax coarsely punctate at middle of the base and apex, elytra strongly imbricate, punctures on primary intervals as wide as the intervals, but not standing out at all distinctly 7-10 in numbers.....*beesoni* Andrewes.  
 --- Body blue-black, prothorax nearly uniformly punctate, elytra rather finally imbricate, punctures on primary intervals not quite as wide as intervals, standing out very distinctly, about a dozen in numbers.....*himalayanum* Gastro.

4. Gular setae present, prothorax with its side bisetose.....5  
 --- Gular setae wanting, prothorax with the pore and seta at hind angle wanting, mesotibiae strongly curved in both sexes.....*orientale* Hope.  
 5. Mesotibiae strongly curved, metatibiae moderately curved.....6  
 --- Mesotibiae slightly curved, metatibiae straight.....10  
 6. Elytra with the surface clearly imbricate, the striae fairly well define .....*auropunctatum* Herbst.  
 --- Elytra with surface more or less granulate or tuberculate.....7  
 7. Elytra with striae present, the granules, at least to some extent in rows.....*kashmirensis* Breun.  
 --- Elytra striae absent, except sometimes close to base, surface irregularly granulate or sculptured.....8  
 8. Elytra with the surface clearly sculptured, striae well marked, in males dorsal thecal appendage short, slightly curved.....*sculpturi* (sp.n.)  
 --- Elytra finally sculptured or striae absent, in males dorsal thecal appendage large.....9  
 9. Body blackish with surface irregularly granulate, in males dorsal thecal appendage curved, anteriorly hook-shaped, genital plate single walled.....*indicum* Hope.  
 --- Body brownish with surface irregularly sculptured, in males dorsal thecal appendage not curved, anteriorly straight, genital plate double walled.....*stratum* (sp.n.)  
 10. Antennae with joints 2<sup>nd</sup> and 3<sup>rd</sup> compressed, and 1<sup>st</sup> to 3<sup>rd</sup> carinated, pronotum distinctly wider than the head width.....*imbricatum* Klug  
 --- Antennae with joints 2<sup>nd</sup> and 4<sup>th</sup> compressed and carinated, pronotum about 1½X as broad as head width.....*olivieri* Dejean.

### ***Calosoma auropunctatum* (Herbst)**

**(Figs. 1 and 2)**

*Carabus auropunctatus*, Herbst, 1784. *Arch. Inst. gesch. (Fuessly)* 5: 131; Paykull, 1790. *Mon. Carab.*: 68; Ross, 1792. *Hant. Inst. Estr. I*: 75.

*Carabus sericeus*, F. 1792. *Ent. Syst. I*(1): 147.

*Calosoma auropunctatum*, Dejean, 1826. *Spec. Gen.* 2: 203; Dejean et Boisduval, 1831. *Icon. et Hist. Nat. Col. Eur.* 2: 51; Rosechke, 1900. *Ent. Nachr.*: 60; Lapouge, 1908. *Bull. Soc. Sci. Med. Quest.*: 158; Andrewes, 1924. *Mission Babault Ind. Carab.*: 6; id., 1927. *Ann. Mag. Nat. Hist.* 19 (9): 98; Junk, 1927. *Coleopterorum Catalogus, I* (91): 16 and 17.

### **Colouration:**

Head pronotum brownish black, dorsal surface rather dull, ventral surface shiny, foveae on elytra metallic green.

### **Head:**

Wider than long, posterior of head including eyes about 2½X the length anteocular distance, anterior margin obliterate, clypeus stripe-like, anterior margin slightly concave, labrum irregular, rounded laterally and depress anteriorly, antennae with basal segment stout, length of basal segment 0.9 mm, length anteocular distance 1.0 mm, posterior of head including eyes 2.4 mm, width of head 3.8 mm, interocular distance 2.6 mm.

### **Throax:**

Wider than the head, finely punctate, almost 1½X broader than long, anterior margin sinuate, laterally convex humeral angles pointed, length of pronotum 3.6 mm, width 5.5 mm, scutellum triangular more than 2X broader than long, length 0.7 mm, width 1.2 mm, elytral striae more or less well marked, elongated less than twice as long as wide, apex of elytra rounded, length of elytra 9.2 mm, width 5.2 mm, fore tibiae with two terminal spines, mid tibiae and hind- tibiae curved with two terminal spines.

### **Abdomen:**

Convex beneath, smooth, tip of last abdominal segment visible, each segments with one seta, but sometimes several along each side of median line. Total length 16.7 mm.

### **Female genitalia (Fig. 2):**

Hemisternites elongate, anterior lobe of stylus large with outer margin convex and inner margin concave, posterior lobe very short triangular with apex acute not passing fused posterior margin of 8<sup>th</sup> segment, bursa copulatrix inflated, almost triangular, ductus bursae tubular and medially dilated.

**Material examined:**

One female, Pakistan, Murree, on grass, 15.7.1995, leg. Syed Kamaluddin, lodged at authors collection.

**Comparative note:**

This species is most closely related to *C. kashmirensis* Breun in having the gular setae, prothorax with its sides bisetose and metepisterna about as long as broad but it can easily be separated from the same in having the elytra with striae and granulation at least to some extent in rows, and the other characters as noted in the key and description.

***Calosoma beelsoni* Andrewes****(Figs. 3-5)**

*Calosoma beelsoni*, Andrewes, 1919. *Ann. Mag. Hist.* 4 (9): 290; Beeson, 1925. *Ind. For.*: 570; Gardner, 1927. *Ind. For. Rec.* 13: 63; Junk, 1927. *Coleopterorum Catalogus*, I (91): 14; Breuning, 1927. *Mon. I*: 139, 147, 175; Andrewes, 1929. *Faun. Brit. Ind.* I: 52.

**Colouration:**

Head and pronotum above dull black, beneath shiny, sides of head and pronotum, elytra of abdomen almost brassy.

**Head:**

Length of head equal to its width, posterior of head including eyes about  $2\frac{1}{2}X$  the length anteocular distance, anterior margin almost deflected, clypeus strip-like, anterior margin concave, labrum irregular, rounded, anterior-laterally deeply concave, medially slightly carinated, antennae with 2<sup>nd</sup> segment  $\frac{1}{2}$  of the basal segment, 3<sup>rd</sup> segment distinctly longer than 2<sup>nd</sup> and twice as long as 4<sup>th</sup> segment, length of antennal segments I 0.7 mm, II 0.4 mm, III 1.0 mm, IV 0.5 mm, length anteocular distance 1.0 mm, posterior of head including eyes 2.5 mm, width of head 3.5 mm, interocular distance 3.0 mm.

**Thorax:**

Moderately convex, coarsely punctate, about  $1\frac{1}{2}X$  broader than long, anterior margin concave, posterior margin rounded lateral margin straight, humeral angles concave and pointed, length of pronotum 4.0mm, width 6.0 mm, scutellum small conical  $2X$  broader than long, length of scutellum 0.4 mm, width 0.8 mm, elytra convex, shoulders well marked, elongated almost twice as long as wide, apex subrounded, length of elytra 15.0 mm, width 10.0, fore tibiae with two terminal spine, mid tibiae with two terminal spines, slightly curved in male, hind tibiae straight in male and all tibiae straight in female.

**Abdomen:**

Convex beneath, sinuated at sides, finely punctate, coarsely at sides of base, some faint longitudinal striae at side. Total length 22.5 mm.

**Male genitalia (Fig. 4):**

Aedeagus short, tubular curved distally pointed proximally broad, thecal appendage short inwardly curved, hook-like, membranous conjunctival lobe rounded, semisclerotized, genital segment double walled somewhat oblongate.

**Female genitalia (Fig. 5):**

Hemisternites elongated, anterior lobe of stylus large with outer margin convex and inner margin straight, posterior lobe short somewhat triangular with apex subacute not passing fused posterior margin of 8<sup>th</sup> segment, swollen, almost square-shaped, ductus bursae tubular and medially dilated.

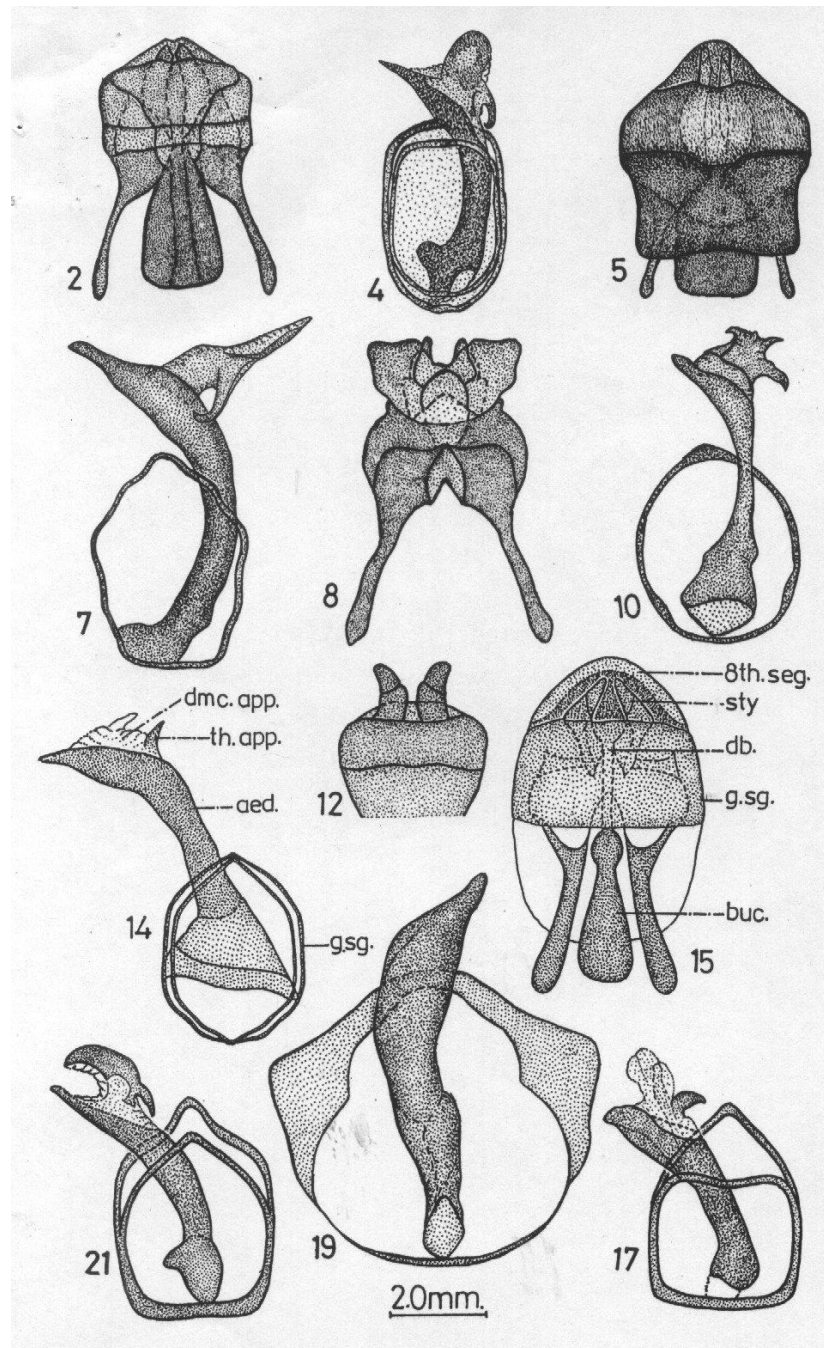


Fig. 2. *Calosoma auropunctatum* Herbst : 2. female terminalia, ventral view.

Figs. 4-5. *C. beesoni* Andrewes : 4. aedeagus, lateral view; 5. female terminalia, ventral view.

Figs. 7-8. *C. indicum* Hope : 7. aedeagus, lateral view; 8. female terminalia, ventral view.

Fig. 10. *C. kashmirensis* Breun. : 10. aedeagus, lateral view.

Figs. 12. *C. olivieri* Dejean : 12. female terminalia, ventral view.

Figs. 14-15. *C. orientale* Hope : 14. aedeagus, lateral view; 15. female terminalia, ventral view.

Fig. 17. *C. sculpturi* (sp.n.): 17. aedeagus, lateral view.

Fig. 19. *C. scrutator* F.: 19. aedeagus, lateral view.

Fig. 21. *C. stratum* (sp.n.): 21. aedeagus, lateral view.

#### Material examined:

Two males and one female; Pakistan: Karachi, on light, 5.6.94; leg. Naveed Ahmed Hashmi lodged at authors collection.

**Comparative note:**

This species is most closely related to *C. himalayanum* Gastro in having maxillary palpi with 4<sup>th</sup> segment shorter than the 3<sup>rd</sup>, posterior angle of pronotum markedly developed and metepisterna always longer than wide, but it can easily be separated from the same in having body aeneous black, prothorax coarsely punctate at middle of the base and apex, elytra strongly imbricate and by the other characters as noted in the key and description.

***Calosoma indicum* Hope****(Figs. 6-8)**

*Calosoma indicum*, Hope, 1831. *Gray Zool. Misc.* 1: 21; Roeschke, 1900. *Ent. Nachr.* 25: 59; Andrewes, 1919. *Trans. Ent. Soc. Lond.*: 171; 1929. *Faun. Brit. Ind.* 1: 61; Gardner, 1927. *Ind. For. Rec.* 13: 64; Junk, 1927. *Coleopterorum Catalogus* 1 (91): 18.

*Calosoma scabripenne*, Chaudoir, 1869. *Ann. Soc. Ent. Fr.*: 371; Bates, 1891. *Entom. Suppl.*: 8; Andrewes 1921. *Trans. Ent. Soc. Lond.*: 145.

**Colouration:**

Head, pronotum, elytra black with light aeneous or cupreous tinge, all legs blackish, venter of abdomen blackish.

**Head:**

Broader than long, posterior of head including eyes about  $2\frac{1}{2}X$  the length anteocular distance, anterior margin deeply concave, clypeus deflected, strip-like, anteriorly slightly concave, labrum short, strip-like, anterior margin convex medially and biconcave antero- laterally, antennae with 2<sup>nd</sup> segment less than  $\frac{1}{2}$  the basal segment, 3<sup>rd</sup> more than  $2X$  of 2<sup>nd</sup> and more than  $1\frac{1}{2}X$  longer than 4<sup>th</sup>, length of antennal segments I 1.1 mm, II 0.6 mm, III 1.4 mm, IV 0.9 mm, length anteocular distance 1.0 mm, posterior of head including eyes 2.8 mm, width of head including eyes 4.2 mm, interocular distance 2.4 mm.

**Thorax:**

Pronotum almost square-shaped, width of pronotum distinctly more than  $1\frac{1}{4}X$  longer than its length, anterior margin sinuated, anterior angle acute, lateral margin convex, humeral angles convex, posterior angle acutely produced, length of pronotum 4.0 mm, width 5.6 mm, scutellum small, triangular, length 0.7 mm, width 1.2 mm, width less than  $2X$  of its length, elytra elongated, about  $1\frac{3}{4}X$  longer than its width, apex of elytra subacute, length of elytra 14.8 mm, width 8.4 mm, fore tibiae with two inner terminal spines, mid tibiae strongly curved hind tibiae moderately curved with rows of small spines.

**Abdomen:**

Convex beneath, shorter than elytra. Total length 23.6 mm.

**Male genitalia (Fig. 7):**

Aedeagus large, distinctly curved, proximal end broad, inner margin sinuate, outer margin convex, distal end blunt, subdistal area dilated, thecal appendage highly curved and hook-like, dorsal membranous conjunctival lobe elongated, apically sclerotized, genital segment somewhat oblongate appearing pentagonal margins, proximal end straight, distal end subacutely produced.

**Female genitalia (Fig. 8):**

Hemisternites somewhat triangular-shaped, anterior piece of stylus large, wide apart, outer margin slightly convex, inner margin straight, posterior margin shorter than the anterior, truncated, fused 8<sup>th</sup> paratergites deeply invaginated or U-shaped medially.

**Material Examined:**

One male, 1 female, Pakistan: Peshawar, on grass; leg. Syed Kamaluddin, 12.4.1980, lodged at authors collection.

**Comparative note:**

This species is most closely related to *C. stratum* sp.n., in having elytra faintly sculptured or striae absent, in males dorsal thecal appendage large, but it can easily be separated from the same in having the different body colour

with surface irregularly granulated, in males dorsal thecal appendage curved anteriorly hook-shaped, genital plate single walled and by the other characters as noted in the key and description.

***Calosoma kashmirensis* Breuning**  
(Figs. 9 & 10)

*Calosoma kashmirensis*, Breun, 1905. *Mon. 1*: 216; Lapouge, 1908. *Bull. Soc. Med. Ouest.*: 158; Andrewes, 1929. *Faun. Brit. Ind. 1*: 60.

**Colouration:**

Head, pronotum and elytra dull black with rugose sculpture, venter shiny.

**Head:**

Broader than long, posterior of head including eyes  $2\frac{1}{2}X$  the length anteocular distance, anterior margin almost concave, clypeus strip-like, anteriorly slightly concave, labrum rugose antero-laterally rounded, medially concave, antennae with 2<sup>nd</sup> segment  $\frac{1}{2}X$  the basal segment, 3<sup>rd</sup> segment  $1\frac{1}{2}X$  longer than 4<sup>th</sup>, length of segments I 1.0 mm, II 0.5 mm, III 1.3 mm, IV 0.9 mm, length anteocular distance 1.2 mm, posterior of head including eyes 2.8 mm, width of head 4.0 mm, interocular distance 2.5 mm.

**Thorax:**

Pronotum somewhat quadrangular shaped, distinctly broader than long, anterior margin concave, anterior angle subrounded, lateral margins convex, posterior acute and produced backward, length of pronotum 3.5 mm, width 5.4 mm, scutellum very small triangular, wider than long, length of scutellum 0.6 mm, width 1.0 mm, elytra elongate, about  $1\frac{1}{2}x$  longer than broad, lateral margins slightly convex, apex rounded, length of elytra 12.4 mm, width 8.0 mm, all tibiae with two inner spines.

**Abdomen:**

Convex beneath, slightly longer than apex of elytra. Total length 19.9 mm.

**Male genitalia:**

Aedeages moderate, distinctly curved, rod like, proximal end broad inner margin curved and smooth, outer margin sinuate, distal end blunt, short, constricted at subapical area and dilated below, thecal appendage distinctly divided into sclerotized and membranous area, membranous lobe with unequal spine-like sclerotized appendage, genital segment oval-shaped.

**Material examined:**

One male, Pakistan: Murree, on light, 26.4.1993, leg. Syed Kamaluddin, lodged at Kamaluddin's collection.

**Comparative note:**

This species is most closely related to *C. auropunctatum* Breun., in having gular setae present, prothorax with its sides bisetose and meso-tibiae strongly curved and meta-tibiae moderately curved but it can easily be separated from the same inn having striation on elytra and the granules at least to some extent in rows and the other characters as noted in the key and description.

***Calosoma olivieri* Dejean**  
(Figs. 11&12)

*Calosoma olivieri*, Dejean, 1831. *Spec. gen. Col. 5*: 559; Bedel, 1895. *Cat. Rais. Col. N. Afr. 1*: 18; Lapouge, 1918. *Bull. Soc. Sci. Med. Quest. 1*: 162; Andrewes, 1921. *Trans. Ent. Soc. Lond.*: 145; 1925. *Ann. Mus. Civ. Genova 50*: 60; 1927. *Ent. Mitt.*: 143; 1929. *Faun. Brit. Ind. 1*: 65. Breuning, 1927. *Mon. 1*: 140, 149, 224; Junk, 1927. *Coloepterorum Catalogus 1* (91): 18.  
*Calosoma azoricum*, Heer, 1862. *Ueber fossil. Calos.*, in Leonhar u. Bronn. *N. Jahrb. Mineral. (Stuttgart)* : 55; Wallaston, 1864. *Cat. Col. Canar.*: 4.

**Colouration:**

Head pronotum and elytra black with medially shiny, ventral side shiny, punctures on primary intervals green.

**Head:**

Slightly wider than long, posterior of head including eyes about 3X the anteocular distance, anterior margin almost deflected, clypeus strip-like, anterior margin slightly concave, labrum strigose, antero-laterally convex, notched medially, setose, antennae with second segment almost slightly less than half of the basal segment, 3<sup>rd</sup> segment distinctly longer than 2<sup>nd</sup> and slightly less than twice as long as 4<sup>th</sup> segment, length of antennal segments, I 0.9 mm, II 0.4 mm, III 1.2 mm, IV 0.7 mm, length anteocular distance 0.7 mm, posterior of head including eyes 2.2 mm, width of head 3.0 mm, interocular distance 1.7 mm.

**Thorax:**

Moderately convex, closely punctate, about  $1\frac{1}{2}$ X broader than long, anterior margin, concave, antero-laterally rounded, length of pronotum 2.9 mm, width 4.2, scutellum small triangular shaped,  $1\frac{1}{2}$ X wider than long, length of scutellum 0.6 mm, width 0.9 mm, elytra convex, with well marked shoulder, elongated, less than twice as long as width, apex rounded, tip of last abdominal segment visible, length of elytra 11.2 mm, width 7.0 mm, fore tibiae slightly and mid tibiae strongly curved, hind tibiae straight.

**Abdomen:**

Uneven at sides, punctate, minutely towards apex, 2<sup>nd</sup> and 3<sup>rd</sup> abdominal segment medially with small soft hairs, 4<sup>th</sup> and 5<sup>th</sup> abdominal segments generally with several setae on each side of median line. Total length 17.50 mm.

**Female genitalia (Fig. 12):**

Hemisternites moderate sized, stylus with outer margin concave and inner margin convex, almost triangular, medially wide apart, the anterior margin medially produced into lobe-like structure, posterior margin convex distinctly longer than anterior piece.

**Material examined:**

Three females, Pakistan: Northern area, Murree; on grass; 14.7.1985; leg. Naveed Ahmed Hashmi, Syed Kamaluddin, lodged at Kamaluddin's collection.

**Comparative note:**

This species is most closely related to *C. imbricatum* Klug in having mid tibiae strongly curved and hind tibiae straight but it can easily be separated from the same in having antennae with joints 2<sup>nd</sup> to 4<sup>th</sup> compressed and carinated, pronotum about  $1\frac{1}{2}$ X as broad as head width and by the other character as noted in the key and description.

***Calosoma orientale* Hope  
(Figs. 13-15)**

*Calosoma orientale*, Hope, 1833. *Trans. Zool. Soc. Lond.* 1 : 92; Andrewes, 1919. *Trans. Ent. Soc. Lond.* : 145; 1929. *Faun. Brit. Ind.* 1 : 67. Junk, 1927. *Coleopterorum Catalogus*, 1 (91) : 41; 1928. *Kol. Rundsch.* 3 : 95. *Calosoma squamigerum*, Chaudoir, 1869. *Ann. Soc. Ent. Fr.* : 368; Andrewes, 1921. *Trans. Ent. Soc. Lond.*: 145; Roceschke, 1900. *Ent. Nachr.*: 59; Breuning, 1927. *Mon.* 1 : 139, 147, 184, 223.

**Colouration:**

Head, pronotum and elytra black, with bronze sheen, venter dull.

**Head:**

Head distinctly broader than long, posterior of head including eyes longer than  $2\frac{1}{2}$ X the length anteocular distance, anterior margin concave, clypeus concave anteriorly and convex posteriorly, labrum transverse anteriorly deeply emarginated, antennae with 2<sup>nd</sup> segment less than  $\frac{1}{2}$ X of the basal segment, 3<sup>rd</sup> almost longer than  $1\frac{1}{2}$ X the 4<sup>th</sup>, length of antennal segments I 1.1 mm, II 0.5 mm, III 1.4 mm, IV 1.0 mm; length anteocular distance 1.0 mm, length posterior of head including eyes 2.5 mm, width of head 4.3 mm, interocular distance 2.2 mm.



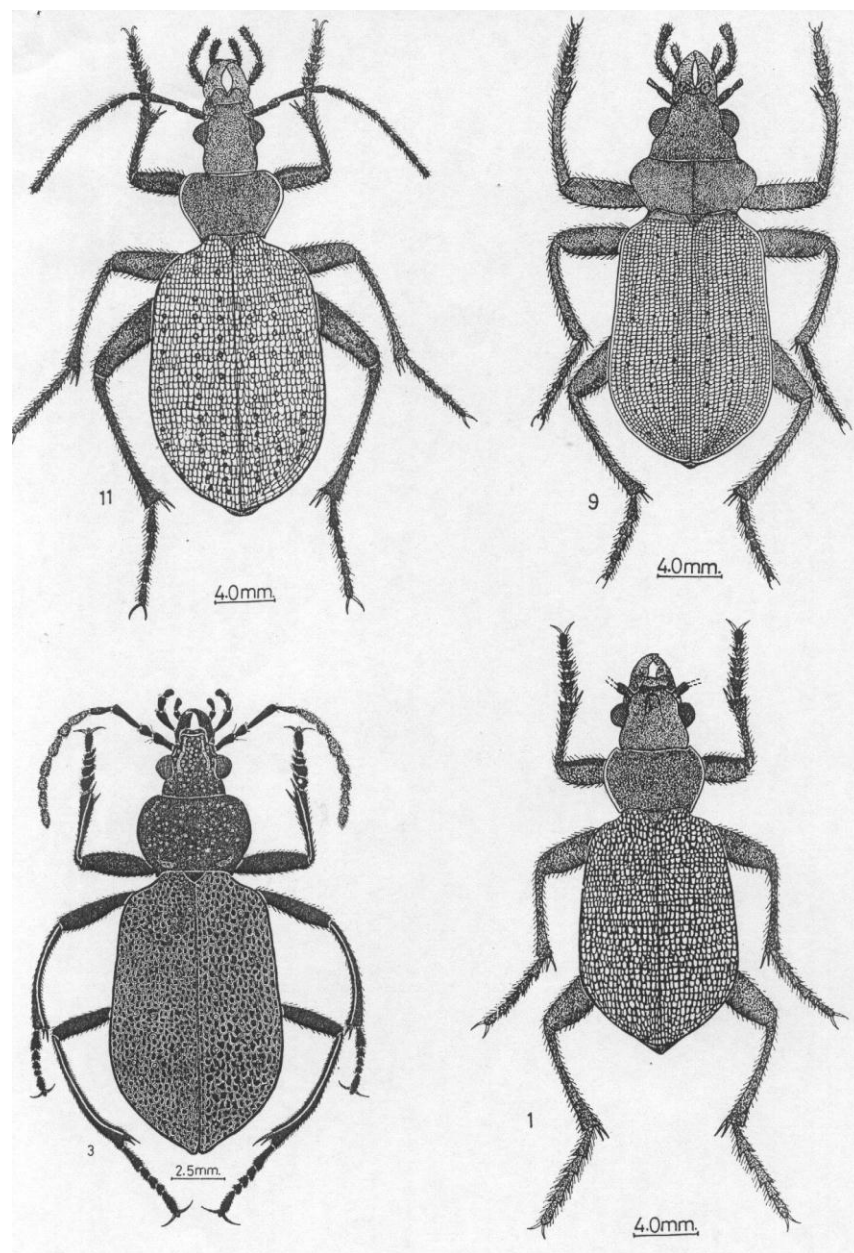


Fig. 1 *Calosoma auropunctatum* Herbst : 1. entire, dorsal view;

Fig. 3 *C. besoni* Andrewes : 3. entire, dorsal view;

Fig. 9. *C. kashmirensis* Breun. : 9. entire, dorsal view;

Fig. 11 *C. olivieri* Dejean : 11. entire, dorsal view;

#### Thorax:

Pronotum rectangular, distinctly wider than long, anteriorly truncated, dorsally convex, posteriorly constricted than anterior margin, base rather bisinuate, lateral margins convex, length of pronotum 3.5 mm, width 5.4 mm, scutellum small, triangular, broader than long, length of scutellum 0.6 mm, width 1.0 mm, elytra elongated wide posteriorly, cover the abdomen except the last abdominal segment, apex subacute, length of elytra 13.6 mm, width 8.4 mm, all tibiae with two equal terminal spines on inner margin.

#### Abdomen:

Convex beneath, distinctly longer than apex of elytra. Total length 21.2-23 mm.

**Male genitalia (Fig. 14):**

Aedeagus tubular, curved, proximally broad, distally produced into beak-like structure, outer and inner margin sinuated, single semisclerotized acutely produced thecal appendage, dorsal membranous conjunctival appendage produced into a membranous lobe, genital segment double walled somewhat oval-shaped rim with distal margins acutely produced.

**Female genitalia (Fig. 15):**

Hemisternites large triangular, anterior piece somewhat rhomboidal-shaped, posterior piece triangular with apex sub-rounded not passing fused posterior margin of 8<sup>th</sup> segment, bursa copulatrix oblongate, proximally dilated, ductus bursae tubular.

**Material examined :**

Ten males, 10 females; Pakistan : Karachi; on grass, and on plants; 10.6.1994; leg. Naveed Ahmed Hashmi and Syed Kamaluddin, lodged at Kamaluddin's collection.

**Comparative note:**

This species is most closely related to *C. beelsoni* and *C. himalayanum* in having the body black, border of prothorax straight or convex, aedeagus in males with semisclerotized dorsal appendages but it can easily be separated from the both in having the gular setae wanting, prothorax with the pore and setae at hind angle wanting, meso-tibiae strongly curved in both sexes and by the other characters as noted in the key and description.

***Calosoma sculpturi* (sp.n.)**

(Figs. 16 & 17)

**Colouration:**

Head, pronotum, elytra, all antennal segments, all legs, venter of abdomen black; eyes ochraceous brown.

**Head:**

Length of head equal to its width, posterior of head including eyes about  $3\frac{1}{2}X$  longer than anteocular distance, anterior margin distinctly straight, clypeus broad, anteriorly and posteriorly straight, labrum punctate, antero-lateral margins convex, antennae with 2<sup>nd</sup> segment slightly more than  $\frac{1}{2}X$  the basal segment, 3<sup>rd</sup> segment almost  $3X$  longer than the 4<sup>th</sup>, length of antennal segments I. 0.7 mm, II. 0.4 mm, III. 1.4 mm, IV. 0.5 mm; length anteocular distance 0.6 mm, posterior of head including eyes 2.1 mm, width of head 2.7 mm, interocular distance 1.8 mm.

**Thorax:**

Pronotum somewhat rectangular shape, anterior margin broader than posterior margin, distinctly  $1\frac{1}{2}X$  wider than long, anterior margin distinctly concave, anterior angles broadly rounded, lateral margins convex, humeral angles subacute, length of pronotum 2.4 mm, width 3.8, scutellum  $2X$  broader than long, small, apex sub-rounded, striation on scutellum, length of scutellum 0.4 mm, width 0.8 mm, elytra elongated, apex subacute, length of elytra 8.6 mm, width 5.4 mm, all tibiae with two inner terminal spines.

**Abdomen:**

Convex beneath, slightly shorter than elytra. Total length 13.7 mm.

**Male genitalia (Fig. 17):**

Aedeagus short, broad proximal end rounded, inner and outer margin sinuated, distal end blunt, subdistally dilated, dorsal membranous conjunctival appendage produced into a membranous lobe and spine-like thecal appendage, genital segment double walled, ventral wall distally prolonged into sub-acute apex, dorsal wall short, square-shaped, distally concave.

**Material examined:**

Holotype male; Pakistan : Devsai, Northern areas; on light : other data unknown, lodged at Kamaluddin's collection.

**Comparative note:**

This species is most closely related to *C. indicum* Hope and *C. stratum* sp.nov. in having surface irregularly granulate or sculptured and the striation on elytra absent except sometimes close to base but it can easily be separated from the both in having the surface of elytra clearly sculptured, and striation well marked, dorsal thecal appendage short, and slightly curved and by the other characters as noted in key and description.

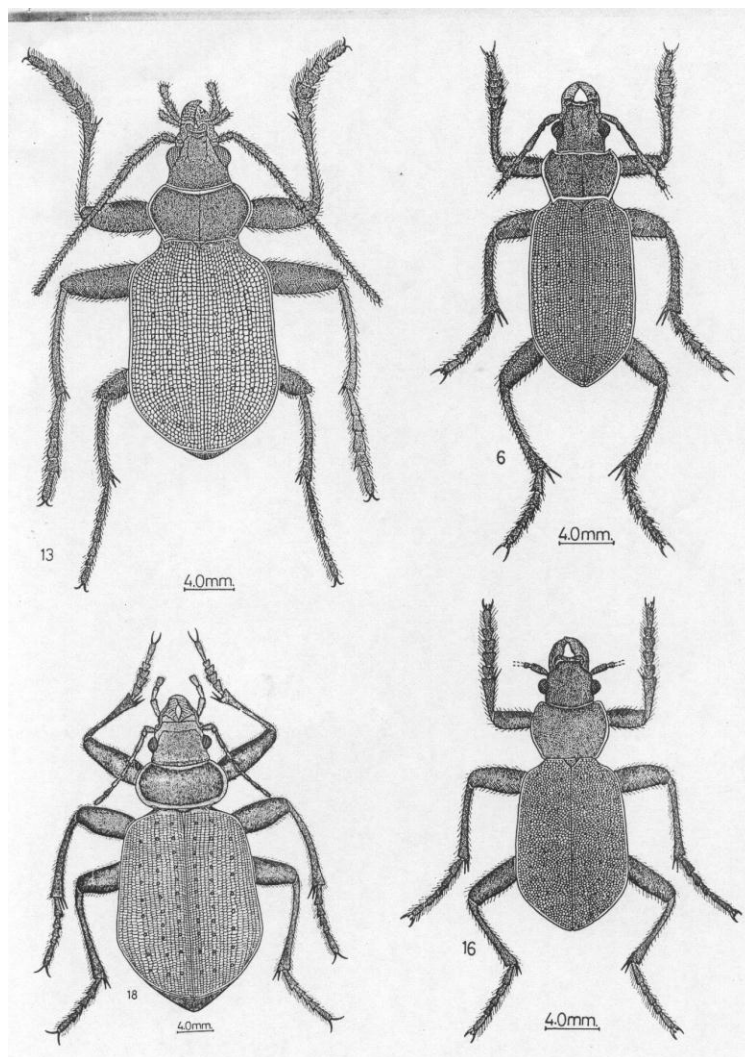


Fig. 6. *C. indicum* Hope : 6. entire, dorsal view;  
 Fig. 13. *C. orientale* Hope : 13. entire, dorsal view;  
 Fig. 16. *C. sculpturi* (sp.n.): 16. entire, dorsal view;  
 Fig. 18. *C. scrutator* F.: 18. entire, dorsal view;

### ***Calosoma scrutator* F.**

**(Figs. 18 & 19)**

*Calosoma scrutator* F. 1775, *Syst. Ent.* 1 : 239; 1792. *Ent. Syst.* 1 : 149; Say, 1825. *Trans. Amer. Phil. Soc.* 2 : 73; Motsch., 1862. *Bull. Soc. Nat. Mosc.* 38 (4) : 310; Fletcher, 1880. *Canad. Ent.* 11 : 35; Bates, 1881. *Biol. Centr. Amer. Col.* 1 (1) : 20; Blactley, 1910. *Col. Indiana* 1 : 46-47; Junk, 1927. *Coleopterorum Catalogus* 1 (91) : 8.

### **Colouration:**

Body metallic green, lustrous, ventre shiny, mandibles piceous black, head medially black, metallic green laterally, antennae piceous black, pronotum black medially with metallic green border and bristle sheen reflection, all legs bristle sheen, elytra metallic green with cuprous tinge border.

**Head:**

Distinctly broader than long, posterior of head including eyes about 2X the length anteocular distance, anterior margin slightly concave, gular setae present in single row, clypeus well marked, bisetose, slightly strip-like, concave anteriorly, labrum short, anterior margin deeply concave, antero-lateral margins rounded, antennae with 2<sup>nd</sup> segment  $\frac{1}{2}$  of the basal segment, 3<sup>rd</sup> 2X longer than 4<sup>th</sup>, length of segments I 1.0 mm, II 0.5 mm, III 1.5 mm, IV 0.8 mm, length anteocular distance 1.5 mm, posterior of head including eyes 2.5-3.0 mm, width of head 4.8-5.0 mm, interocular distance 2.8-3.3 mm.

**Thorax:**

Somewhat rectangular-shaped, lateral margins broadly convex, almost less than twice as long as wide, length of pronotum 4.0-4.5 mm, width 7.2-7.8 mm, scutellum small, much wider than long, length 0.5 mm, width 1.2 mm, elytra slightly convex, shoulders well marked, elongated almost  $1\frac{1}{2}$ X longer than wide, apex of elytra semi-rounded, length of elytra 16.8-18.5 mm, width 10.0-12.0 mm, fore-tibiae, straight with two terminal spines, mid-tibiae curved with two terminal spines, hind-tibiae straight with two terminal spines.

**Abdomen:**

Convex beneath, longer than apex of elytra, 1 to 3 more or less setose in middle, 4 and 5 generally with a single setae on each side of median line. Total length 27.5-24.8 mm.

**Male genitalia (Fig. 19):**

Aedeagus large, slightly curved, dorsal membranous lobe absent, distally narrowed, apex sub-acute without thecal appendage, dilated sub-apically, genital segment large, single walled, laterally and distally broad, laterally more dilated.

**Material examined:**

One male and one female, Releigh. No. Car. Walker collection; 4.01.1963. J. Ernst, lodged at Kamaluddin's collection.

**Comparative note:**

This species is most closely related to *C. beelsoni* in having antennae with 2<sup>nd</sup> segment about a third as long as the 3<sup>rd</sup> segment, both 2<sup>nd</sup> and 3<sup>rd</sup> antennal segments compressed, mandibles striated but this species can easily be separated from the same in having different body colour and size, border of pronotum rounded, and in males the aedeagus without sclerotized dorsal appendage and by the other characters as noted in the key and description.

***Calosoma stratum* (sp.n.)  
(Figs. 20 & 21)****Colouration:**

Head black, pronotum, elytra, all antennal segments all legs, venter of abdomen brownish.

**Head:**

Width of head is equal to its length, posterior of head almost longer than 4X the length anteocular distance, anterior margin slightly concave, clypeus narrow, almost straight, labrum broad, antero-laterally rounded, slightly concave anteriorly, antennae with 2<sup>nd</sup> segment  $\frac{1}{2}$  of the basal segment, 3<sup>rd</sup> segment distinctly longer than 4<sup>th</sup>, length of segments I 0.6 mm, II 0.3 mm, III 0.8 mm, IV 0.5 mm, length anteocular distance 0.5 mm, posterior of head including eyes 1.9 mm, width of head 2.4 mm, interocular distance 1.6 mm.

**Thorax:**

Pronotum almost quadrangular, about  $1\frac{1}{2}$ X broader than long, anterior margin distinctly concave, anterior angles produced into sub-rounded apices, lateral margins convex, humeral angles produced into subacute apices, length of pronotum 2.0 mm, width 3.4 mm, scutellum small, triangular, distinctly broader than wide, length of scutellum 0.4 mm, width 0.7 mm, elytra elongated more than  $1\frac{1}{2}$ X longer than broad, lateral margins of elytra bordered, apex sub- rounded, length of elytra 7.5 mm, width 4.6 mm, fore-tibiae with two terminal spines on inner sides, mid-tibiae strongly curved.

**Abdomen:**

Convex beneath, longer than apex of elytra. Total length 11.9 mm.

**Male genitalia (Fig. 21):**

Aedeagus short, broad, proximal end with a short outgrowth, inner and outer margin smooth, distal end pointed, sub-distal end dilated, dorsal conjunctival appendage produced into a hood-shaped membranous lobe and spine-like thecal appendage, genital segment double walled, ventral wall medially distally prolonged into lobe-like structure, dorsal wall slightly shorter and sub-acutely produced.

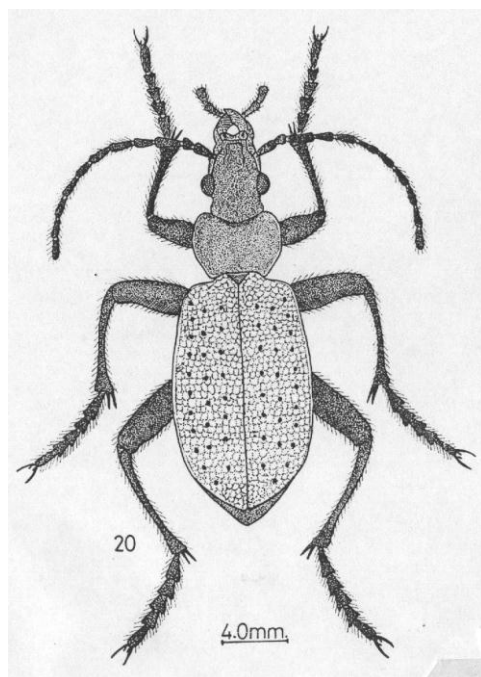


Fig. 20. *C. stratum* (sp.n.): 20. entire, dorsal view.

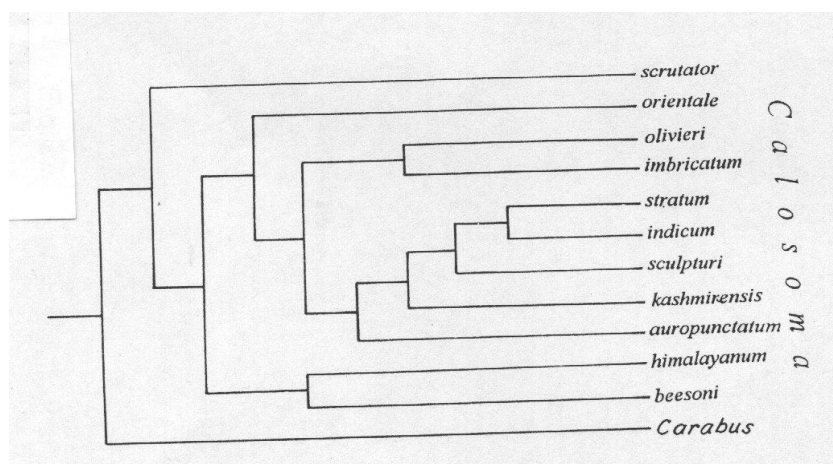


Fig. 22. Cladogram showing relationship of included species of the genus *Calosoma* Weber.

**Material examined:**

Holotype male, Pakistan : Northern areas, on light, other data unknown, lodged at Kamaluddin's collection.

**Comparative note:**

This species is most closely related to *C. indicum* Hope in having the faintly sculptured elytra with striation absent and dorsal thecal appendage large in male but it can easily be separated from the same in having brownish body colour with irregularly sculptured surface, and the dorsal thecal appendage not curved, anteriorly straight, genital plate double-walled and by the other characters as noted in the key and description.

## DISCUSSION

The representatives of the genus *Calosoma* distributed tropical and sub-tropical regions of the world from higher attitude to plans of the sub-tropical region. In Pakistan these are found in high attitude towards north upto the plans towards south. Abdullah (1971) has been discussed the primitive and advanced characters of the families of Coleoptera. In the present cladogram (Fig. 22) the genus *Calosoma* appears to play sister group relationship with *Carabus* by their synapomorphies viz. labrum emarginate and metacoxae contiguous.

Among the genus *Calosoma* which includes eleven species, the *scrutator* plays an out-group relationship by having body metallic green and lateral margins of pronotum distinctly rounded with rest of the ten species. Among these the *himalayanum* and *beesoni* appear sister group relationship with each other in having posterior angle of pronotum markedly developed and metepisternum always longer than wide. These also plays an out-group relationship with *scrutator*, *orientale*, *olivieri*, *imbricatum*, *stratum*, *indicum*, *sculpturi*, *kashmirensis* and *auropunctatum*. Among these the *imbricatum* and *olivieri* appear sister group relationship with each other by meso-tibiae slightly curved and out group relationship with *stratum*, *indicum*, *sculpturi*, *kashmirensis* and *auropunctatum* in having gular setae present and prothorax with its side bisetose. The *stratum* and *indicum* appear sister group relationship with each other in having dorsal thecal appendage large with *sculpturi* as an out group in having elytral surface irregularly granulated or sculpture. The species *kashmirensis* appears an out group relationship with the above taxa in having elytra granular or tuberculated. Further *auropunctatum* appears as an out- group relationship with *stratum*, *indicum*, *sculpturi* and *kashmirensis* in having meta-tibiae moderately curved. The species *olivieri*, *imbricatum*, *stratum*, *indicum*, *sculpturi*, *kashmirensis* and *auropunctatum* appear to play sister group relationship with each other in having gular setae present and prothorax with it sides bisetose with *orientale* the out group in having the maxillary palpi much shorter, almost as long as 4<sup>th</sup>. Further the *scrutator* plays out group relationships with entire clad.

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