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THE GENUS *BALLUS*: A REVISION OF THE EUROPEAN TAXA DESCRIBED BY SIMON TOGETHER WITH OBSERVATIONS ON THE OTHER SPECIES OF THE GENUS

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Of the European species of *Ballus* listed in Bonnet's (1945-1961) catalog, one only, *Ballus depressus* (Walck., 1802), can be considered sufficiently well-known, having been described and drawn in numerous works on regional faunas (Simon, 1876, 1937; Bosenberg, 1903; Lessert, 1910; Dahl, 1924; Locket and Millidge, 1951; Kekenbosch, 1961; Tullgren, 1970; Flanczenska, 1981; Roberts, 1985 (1). The other species have not been described and drawn thoroughly enough and for some of them the systematics is uncertain. Moreover, this situation is fairly frequent in the field of *Salticidae* systematics and that makes it indispensable to begin on a new description and definition of a large number of species (Prószynski, 1968).

The main purpose of the present study is to revise the European taxa described by Simon, the material of which is kept in the Muséum National d'Histoire Naturelle in Paris: *Ballus armadillo* (Simon, 1871). *Ballus depressus seguipes* (Simon, 1868), *Ballus rufipes* (Simon, 1868) and *Ballus variegatus* (Simon, 1876). In particular we have tried to identify various differential characters which allow us to consider the ascriptions as sure and to evaluate the validity of the taxonomy itself and the affinity of these taxa characterized by a considerable basic phenotypic uniformity. The knowledge obtained in this way has also led to a critical reexamination of the description of the other taxa attributed to the genus *Ballus* in the Bonnet catalog.

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(1) Prószynski (1976), Flaczenska (1981) and Nicolic and Polenec (1981) invert the synonymy accepted by Bonnet and the majorit of AA. by considering *Ballus depressus* (Walck., 1982) to be a synonym of *Ballus chalybeius* (Walck., 1802). For the history of the synonyms of this species, cf. the catalog of Bonnet.

A comparative examination of the taxonomic characters adopted precedes the redescription of the species. We have examined thoroughly the structure of the male and female copulatory organs. The other charatcters analyzed, the variability of which is pointed out, are: the coloration of the legs, the ratios of measurements, the distribution of spines on the tibiae and the teeth of the chelicera.

As regards the coloration, since the material examined has been kept for a long time in alcohol and is often in none too good a condition, we have thought it best to use the terms « dark » and « light » to describe chromatic patterns and not to attempt to describe colors in the strict sense of the word. The description of the prosoma and opisthosoma is based on the dorsal view.

In reexamining each species, the quotations at the start are those essential for synonyms and those related to the material directly examined. In addition, we have thought it useful to report the textual references, ascertained or probable, for the material examined.

We should like to express our thanks to Dr. Heurtault for having given us access to the material studied by Simon and to other material from the Berland collection kept in the Paris Museum.

CHARACTER ANALYSES

Copulatory organs

Bulb. The bulb (figs. 19-22) is formed by an unequal bilobate basal portion posteriorly and by a more highly sclerotized distal portion almost cylindrical in shape. This is the coil shaped distal part of the bulb. The coils are very close to each other and externally have a ridged laminar cuticle. The spermophor duct crosses the axial zone of the coils and enters the last laminar coil which forms the embolus. At its tip the embolus separates from the rest of the laminar structure to form a sickle-shaped loop with its apex just projecting from the anterior end of the alveolus.

The specimens examined displayed a very similar bulb, even if some differences were evident between *Ballus rufipes* (figs. 28-31) and the three other species. In particular, both the basal and distal portions of the bulb appear proportionally longer in *rufipes*.

Epigynum. The overall shape of the epyginum area is very similar in *Ballus depressus and Ballus armadillo* (figs. 3-8); in *Ballus rufipes and Ballus variegatus* (figs. 9-14) the area occupied by the copulatory canals appears to be proportionally smaller than in the other two species.

Two zones can be distinguished in the epigynum: an anterior one, the plate, where the copulatory canals (CL) are localized, and a smooth, convex posterior one bordering on the epigastric furrow; under the latter zone the spermathecae (Spt) can be seen due to transparency.

The external surface of the plate is laterally occupied by two sac-like copulatory canals which are anteriorly embedded under the cuticle and appear more or less prominent in the posterior portion.

Seen from the outside the copulatory canals present prominent and highly divergent in *Ballus armadillo and Ballus depressus*; in the other two species they are subparallel and do not protrude with respect to the plate surface. At the medial surface of the copulatory canals the cuticle invaginates. Medially each invagination is delimited by a more or less developed longitudinal ridge (lr). These ridges display a considerable individual variability, probably depending on the time having elapsed from the molt. In particular, in *B. armadillo* and *B. depressus* they are often not evident. In *B. rufipes* the ridges can be very raised or smoothed down over the copulatory canal openings. In *B. variegatus,* the only specimen we have been examined had molted quite recently and the ridges are very evident and marked. In *B. armadillo and B. depressus* these two entry zones to the copulatory canals have evident obliquely arranged ridges (or). The median area (MA) lying between the longitudinal ridges limiting the copulatory canal openings is more or less depressed according to the state of the ridges themselves. In *B. rufipes* a slight raised line, more evident in the posterior tract runs along the median area.

The copulatory canals continue with the spermathecae at the posterior margin of the plate; this transition zone is marked on the outside by a slight line on the cuticle. Each spermatheca continues with a fertilization canal (Fc) that is clearly seen after maceration in KOH solution and is formed by a highly sclerotized duct forming a complex series of loops and terminating in a delicate, elongated cuticle structure. In other genera of Salticidae, this formation has been interpreted by Prószynski (1968, 1976) as the distal portion of the fertilization canal (dFC). We have not been able to evidence differential characters

in these structures due to the complex spermotheca morphology, their basic uniformity and the evident individual variability in loops morphology.

Coloration of the legs

The leg coloration shows both inter and intraspecific variability. In the specimens kept in alcohol for a long time the characters which can be well evaluated are essentially the dark chromatic markings.

Of the four species *Ballus armadillo* displays evident chromatic markings only on pai I of the male legs (Fe dark-Pt light-Ti dark). In the other legs only a dark dorsal patch is more or less discernable on the Mt of pair IV.

For the other species (fig. 1) we shall analyze the characters of the males and females separately.

Males. Pair I: Fe and Ti are dark in all species; Pt is always light in *rufipes* and generally darkened in *depressus* (with a clearer dorsal area); in *variegatus* it is light with darker shades and dorsally has a small dark distal patch. The Mt are light and in *variegatus* there is dorsally a basal dark patch and a distal one, a basal one (sometimes absent) in *depressus,* whereas there is no dark patch in *rufipes.*

Pairs II to IV: the markings show considerable individual variations and yet the three species are easily distinguishable:

rufipes has no chromatic markings on the Fe and Pt of pair II but displays anteriorly a longitudinal dorsal stripe extending continuously on to the Ti and Mt IV (sometimes even to the Ta) and does not have on the Mt any dorsal, basal or distal dark patches.

variegatus has its Fe extensively darkened and is characterized by a very evident series of dorsal, transversal dark patches at the Pt-Ti, Ti-Mt and Mt-Ta joints.

depressus has chromatic markings similar to the *rufipes* as regards the longitudinal stripes on the Fe, Pt and Ti of pair III and the Fe and Pt of pair IV, but nearly always displays dark patches at the Ti-Mt joints as does *variegatus.* It is clearly different from *rufipes* in its absence of longitudinal stripes on Mt IV and from *variegatus,* apart from various details observable in the Figures, for the absence of dark patches at the Mt-Ta joints.

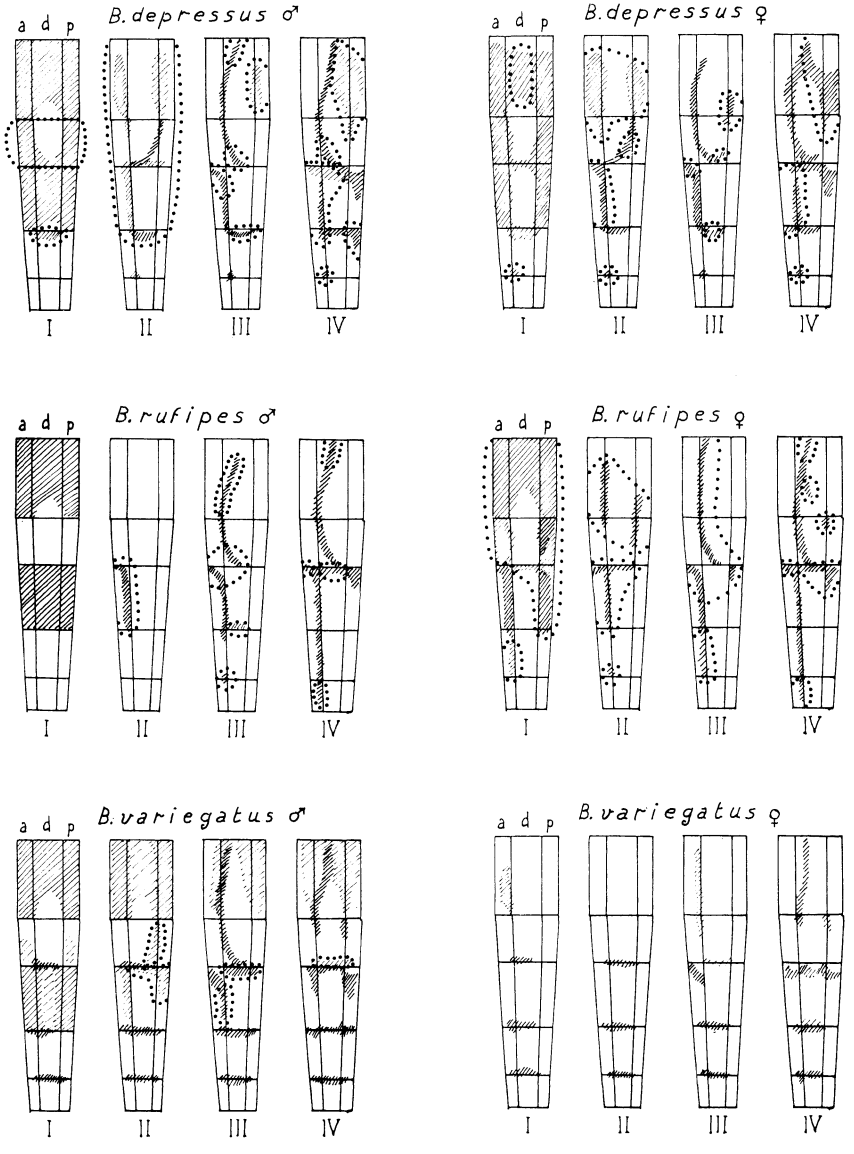

FIG. 1 - Chromatic markings of the legs of *Ballus depressus, Ballus rufipes* and *Ballus variegatus*: diagrammatic view of anterior (a), dorsal (d) and posterior (p) surfaces. Dotted lines encircle variable areas.

Females. In *variegatus* the chromatic markings are essentially limited to the presence of dark patches at the Mt-Ti, Ti-Mt and Mt-Ta joints and of dorsal longitudinal stripes on the Fe of III and IV.

In *rufipes* and *depressus* the coloration is very rich and variable and shows considerable resemblance. The most significant differences between these two species it the absence of dark dorsal patches at the Ti-Mt joints in *rufipes* and the absence in *depressus* of a longitudinal stripe on Mt III and IV.

Distribution of the spines on the tibiae

In the keys Simon (1937) uses the presence of spines on the Ti of pair II to separate *Ballus depressus seguipes* and *Ballus armadillo* from the other taxa. Examination of the specimens of all the species has allowed us to establish that the character is variable. The spines can be 1 or 2 with diversity even in the two legs of the same specimen.

Cheliceral teeth

For the posterior margin of the chelicerae Simon (1901, pp. 481-2) reports 2 teeth in females and 3 teeth in maler for all european species.

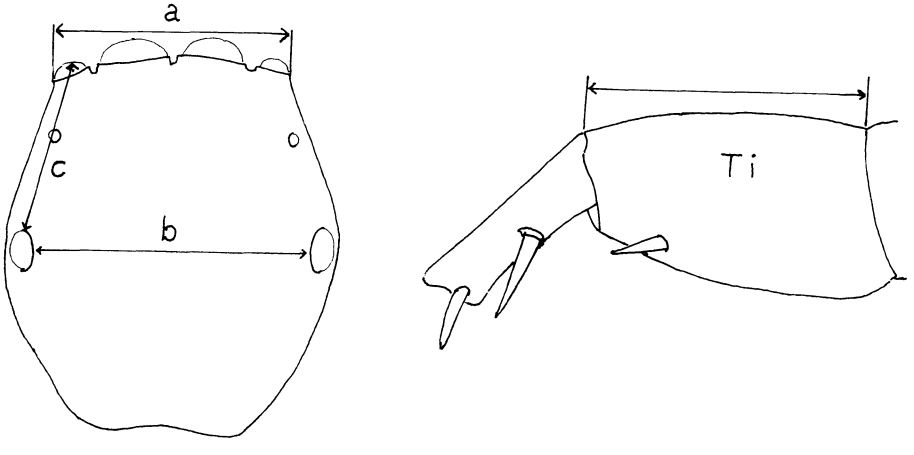

FIG. 2 - Diagram of the measurements taken on prosomas and legs: dorsal view of prosoma and lateral view of the tibia and metatarsus of the first legs.

In reality, the teeth appear to be formed by a serrated platelet rather than by distinct and contiguous teeth. There is considerable variation in the shape of this platelet with two or three teeth both in males and females. The character cannot therefore be used for distinguishing the various species.

Measurement ratios

The apparent phenotypic uniformity in the *Ballus* species led us to investigate whether the ratios of measurements between various parts of the body allow one to identify differences not evidenced at first sight. For this purpose we have measured prosomas and legs selecting parameters which can be measured with certainty and relative ease. These parameters are reported in Fig. 2.

The specimens available do not form a well assorted statistical sample, but one can obtain a first idea of intraspecies variations and of the differences and similarities between species.

After taking the measurements, some ratios were calculated bet-

TAV. I - Ratios of the measurements (see fig. 2) of prosoma and legs I-IV. Ranges are reported in brackets.

♂♂

	B. depressus	*B. armadillo*	*B. rufipes*	*B. variegatus*
a/b	0,94 (.88-.99)	0,94 (.90-.96)	0,86 (.82-.91)	0,85 (.83-.87)
c/b	0,62 (.59-.66)	0,61 (.59-.64)	0,65 (.61-.68)	0,60 (.58-.63)
I/b	0,54 (.55-.59)	0,47 (.44-.51)	0,61 (.55-.68)	0,47 (.46-.48)
IV/b	0,52 (.46-.58)	0,47 (.44-.53)	0,57 (.55-.64)	0,44 (.44-.45)
II/I	0,68 (.61-.75)	0,68 (.64-.71)	0,66 (.64-.70)	0,66 (.65-.67)
I/IV	1,05 (.96-1,19)	1,03 (.97-1,08)	1,06 (.99-1,09)	1,04 (1,03-1,06)
III/II	0,97 (.94-1,00)	0,97 (.92-1,00)	0,98 (.97-1,01)	0,95 (.93-.98)

♀♀

	B. depressus	*B. armadillo*	*B. rufipes*	*B. variegatus*
a/b	0,91 (.89-.96)	0,92 (.91-.95)	0,83 (.80-.85)	0,83
c/b	0,57 (.54-.59)	0,56 (.55-.58)	0,60 (.58-.63)	0,59
I/b	0,37 (.37-.38)	0,35 (.33-.38)	0,40 (.37-.43)	0,36
IV/b	0,52 (.51-.54)	0,48 (.47-.51)	0,57 (.53-.60)	0,99
II/I	0,83 (.79-.87)	0,81 (.79-.85)	0,85 (.82-.88)	0,81
I/IV	0,71 (.72-.73)	0,74 (.71-.76)	0,71 (.69-.75)	0,74
III/II	1,05(1,00-1,09)	1,04 (1,00-1,09)	1,03(1,00-1,09)	0,98

ween the measurements of the prosoma, between the measurments of the legs and between the measurements of the prosoma and those of the legs. The results are reported in Table I.

The Table showes that the great phenotypic uniformity macroscopically seen is generally confirmed by the measurements. However, some ratios show differences between species. In particular, the ratio a-b shows the prosoma to be narrower anteriorly in *rufipes* and *variegatus*; ratios I/b and IV/b evidence that the lges, with *B. depressus* as reference, are proportionally longer with respect to the width of the prosoma in *rufipes* (male and female) and shorter in *variegatus* (male) and in *armadillo* (male).

REVISION OF THE *BALLUS* TAXA DESCRIBED BY SIMON

Ballus depressus seguipes (Simon, 1868) = **Ballus depressus** (Walck., 1802)
Attus seguipes sp. nov., Simon, 1868 p. 631.
Attus seguipes Simon = *Attus biimpressus* Dol., Simon 1871 p. 229.
Ballus depressus seguipes, Simon 1937 p. 1149, 1245.

Material classified by Simon and Berland as *Ballus depressus seguipes* and examined by us: *
744 Z. Landes fin Avril 1917 - 6 ♂♂, Simon det. (Simon 1937 p. 1245: Landes: Labenne Signosa (de Dalmas, avril 1917).
940 Gallia merid. - 55 ♂♂, 15 ♀♀ 13 juv., Simon det.
941 Algerie - 6 ♂♂, 11 ♀♀, Simon det. (Simon 1937 p. 1245: « Algerie »).
2389 Dalmatia Keys. - 1 ♂ *B. dep. seguipes* E.S. (biimpressus) Simon det. (Simon 1878 p. 212: « *Ballus biimpressus* Dls., 1852 = *Attus seguipes* E.S. Mon. Att. p. 631 (1869) Dalmatie »).
Banyls s.mer (Pyr. or.es.) N.4 25.9.62 Collection Berland - 2 ♂♂, 1 ♀ Berland det.
Material of *Ballus depressus* (Walck, 1802) used as comparison:
403 Z. France - 2 ♂♂, 2 ♀♀, Simon det.
939 Gallia - 2 ♂♂, 2 ♀♀, Simon det.
12889 Naples - 1 ♂, 1 ♀, Simon det.
13941 Edough! - 10 ♂♂, 15 ♀♀, Simon det. (Simon 1937 p. 1245 « Algerie: Edough! »).

The synonym history is considerable complicated. Simon described this form as *Attus seguipes* sp. nov. from a female from Dalmatia (1868).

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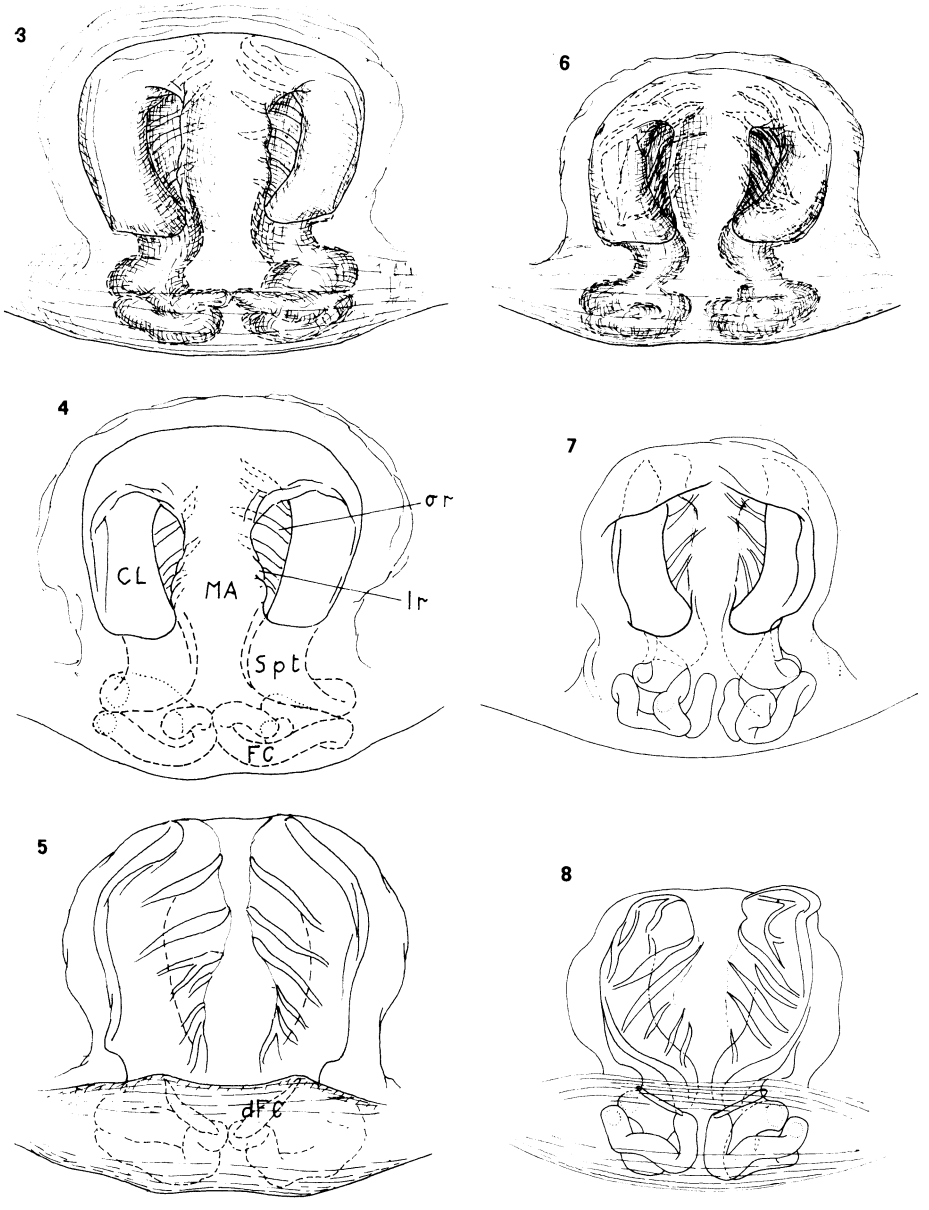
* The actual card number from the Paris Museum is reported and, when it was identified, the bibliographic quotation and relative text.



FIGS. 3-8 - Female copulatory organs of *Ballus depressus* (3-5: 940 Gallia merid. *B. depressus seguipes* Simon det.) and *Ballus armadillo* (6-8: 937 Corsica Simon det.): ventral (3, 4, 6, 7) and dorsal view (5, 8). Figs. 4, 5, 7, 8 after maceration in KOH.

The description he gives allows us to recognize a *Ballus* similar to *depressus* and *rufipes*. In the same work he mentioned among the specimens of uncertain origin and not examined *Attus biimpressus* Doleschal 1852, mistakenly saying it was from Dalmatia.

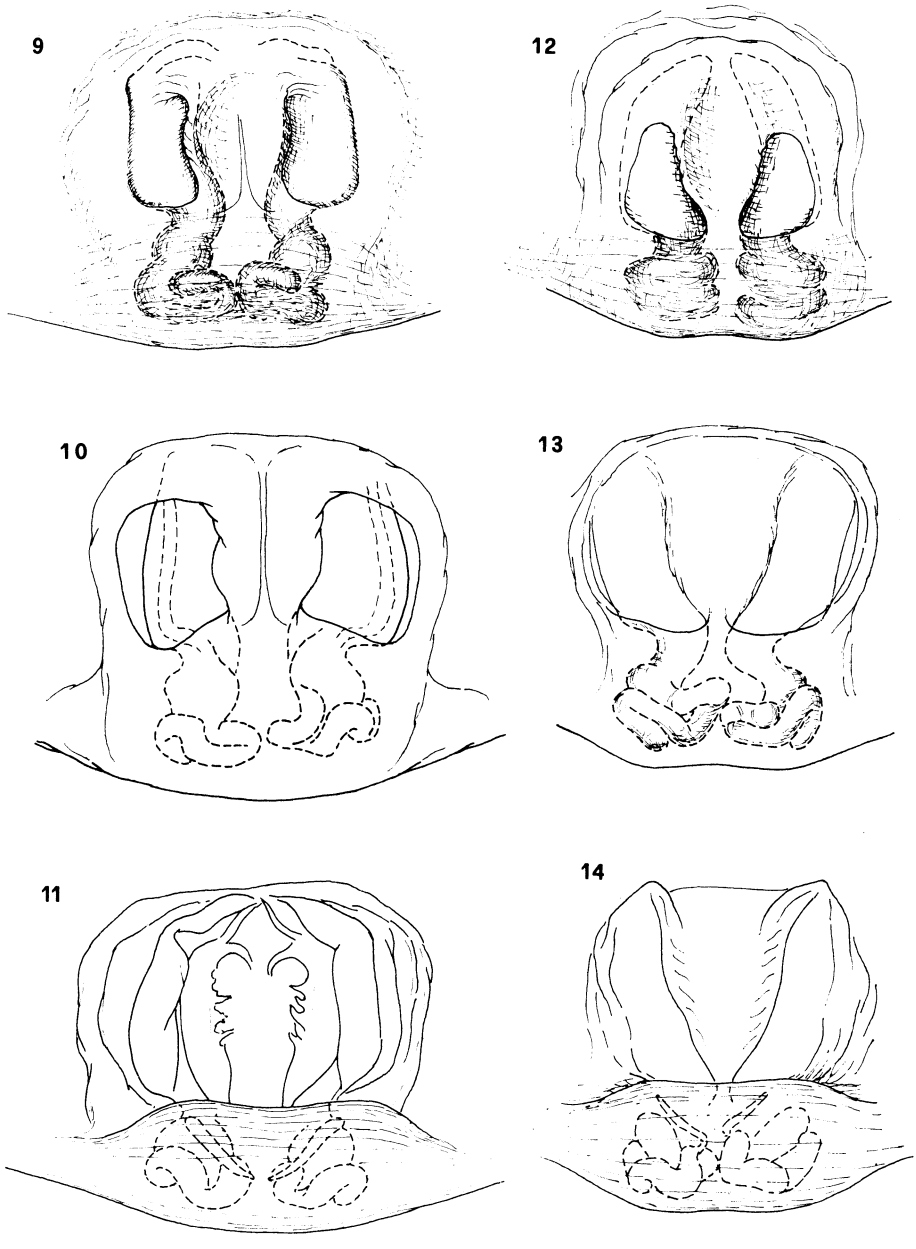
In 1871 Simon considered *Attus seguipes* synonym of *Attus biimpressus* Doleschal, ascribing to this species, and describing it, a male from Lugano given to him by Pavesi. In reality Simon's description shows clearly that it was not a *Ballus*. For example, he writes « *Les chelicères assez longues* » ... « *L'abdomen est ovale, allongé, retréci et arrondi en avant, nullement tronqué* » ... « *Le digital est un petit disque, simple, dont le milieu s'élève un peu en manière de cône trés bas* ». The fact that Simon saw the resemblances of *Attus membrosus* and *Attus cerussatus* (at present classified under *Neaetha*) means that this specimen probably belongs to the latter genus.

In 1878, giving *B. seguipes* Sim. as synonym, Simon ascribes to *Ballus biimpressus* (Doleschal, 1852) specimens from Dalmatia belonging to the Keyserling collection. These specimens were subsequently classified by Simon himself as *B. depressus seguipes (biimpressus)*; we have examined them and found them effectvely to be *Ballus*. Therefore, in that time Simon seems convinced that *seguipes* and *biimpressus* were synonyms.

The only topotypic material classified by Simon that we have examined are the Dalmatian specimens from the Keyserling collection (Simon, 1878, p. 212 sub *Ballus biimpressus*). It has one male and one female labeled *B. depressus seguipes (biimpressus)*. However, the female in fact belongs to *Ballus rufipes* and the male, instead, displays all the characters of the *depressus*. Therefore both of these species are present in Dalmatia.

As things stand at the present it is impossible to establish with any certainty what the *Ballus* female was which Simon classified as *Attus seguipes* nov. sp. Surely the synoymy of *Ballus biimpressus* ascribed to it by Simon was unfounded. On the other hand, even though it is not so very probable, one cannot exclude a priori that *Ballus biimpressus* (Dol., 1852) may be a valid species distinct from *depressus*. One would have to examine typical material.

Instead, the taxonomic value of the *Ballus depressus seguipes* of Simon 1937 can be established. In the first place the distribution characteristics of this form, that is to say its coexistence in various regions of the area with the typical form, means a priori that it cannot be



FIGS. 9-14 - Female copulatory organs of *Ballus rufipes* (9: 940 Gallia merid. *B. depressus seguipes* Simon det.; 10 e 11: 6378 Algeria *B. rufipes* Simon det.) and *Ballus variegatus* (12 e 14: 1582 Narbonne Simon det.); ventral (9, 10 12, 13) and dorsal (11, 14) view. Figs, 10, 11, 13, 14 after maceration in KOH.

considered a subspecies. A comparison with *Ballus depressus* also based on direct examination of numerous specimens of this species, all classified by Simon and coming from various places, shows it is absolutely impossible to distinguish the two forms. Moreover, Simon himself in the 1937 keys takes as distinctive characters the size and the presence of 1 or 2 ventral spines on the Ti II. Both these characters are variable and cannot be utilized. The measurement ratios, the leg coloration and copulatory organs were examined scrupulously by us and displayed no differences. Therefore, we consider the *Ballus depressus seguipes* to have no taxonomic value and therefore we propose to suppress this taxon.

Ballus armadillo (Simon, 1871)

Ballus armadillo sp. nov. Simon 1871 p. 227-28.
Ballus armadillo Simon 1876 p. 204-205.
Ballus depressus Cantarella 1980 p. 56.
Ballus depressus Alicata and Cantarella 1985 p. 135.

Material examined:

937 Corsica - 14 ♂♂, 111 ♀♀ Simon det. (Simon 1871 p. 227-28 « Corse »).
12889 Naples - 1 ♂ sub *Ballus depressus* Simon det.
Nebrodi - 1 ♂, 6-1982 Cantarella leg.
Portella Femmina morta (Nebrodi), 1 ♂, 19-5-1962 Alicata leg. (sub *Ballus depressus*, Cantarella 1980).
Vallone Santicelli (Pollino), 1 ♀, 16-6-1953 Ruffo leg. (sub *Ballus depressus*, Alicata and Cantarella 1984).
Bosco S. Pietro (Caltagirone) 1 ♂, 13-5-1962 La Greca leg. (sub. *Ballus depressus* Cantarella 1980).

Sizes: males 2.5-3.0 mm; females 2.9-3.7 mm.

Males. Prosoma dark with black patches around the eyes; light colored patterns sometimes appear due to transparency in the area between the eyes. The opisthosoma is truncated anteriorly, dark and with chromatic patterns in the posterior part. The pedipalps are uniform in color. Pair I legs have dark Fe and Ti. The other legs are uniformly light colored. A dorsal patch, slightly darker in color is often evident on the base of the Mt of pair IV.

Pedipalp and bulb, Figs. 23-27.

Females. Prosoma as for males. Opisthosoma with chromatic patterns extendings down the whole length. Pedipalps uniformly light. Legs uniformly light. A slightly darker dorsal patch on the base of Mt IV.

Epigynum, Fig. 6-8.

Ballus armadillo is remarkably similar to *Ballus depressus* from which it can be distinguished by:

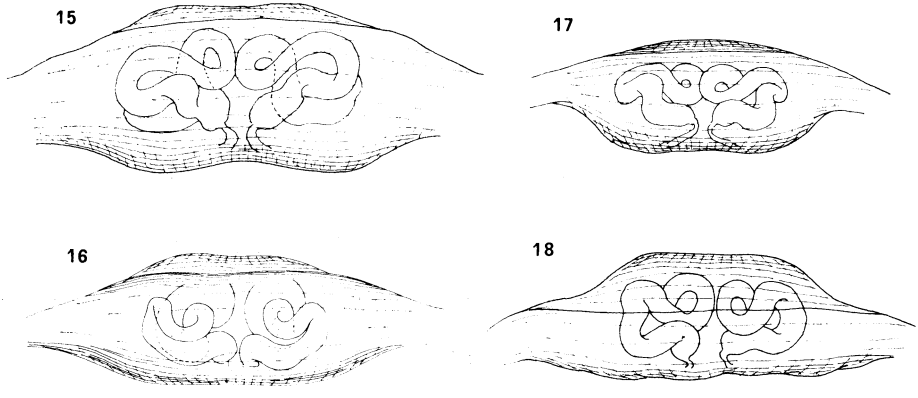
— the absence of chromatic patterns on the legs;

— prosoma larger posterior to the eyes;

— proportionally shorter legs with respect to the size of the prosoma in males;

— a uniformly light coloration of the pedipalps in females.

Wherear the epigynum is indistinguishable form that of *depressus* it is clearly differentiated form that of *rufipes* due to the presence of



FIGS. 15-18 - Fertilization canals of *Ballus depressus* (15) *Ballus variegatus* (16) *Ballus armadillo* (17) and *Ballus rufipes* (18). Posterior view.

a depressed central area containing oblique ridges which are above all evident from the inner side or through transparency. The presence of these ridges clearly differentiates it from *variegatus* as well.

This species was described by Simon for Corsica and was quoted by Garneri (1902) for Sardinia and by Nicolic and Polenec (1981) for Croatia. Furthermore, on the basis of material studied by us, it is also present in the Italian peninsula (Naples and Mt. Pollino) and in Sicily. It has, therefore, a fairly wide distribution and overlaps partially that of *depressus*.

Among the Corsican material studied by Simon we have come across also 2 males of *Ballus depressus*. Unless this fact is due to sorting mistakes of Simon's, then *Ballus armadillo* coexists in Corsica with *Ballus depressus*.

Ballus rufipes (Simon, 1868)

Attus rufipes sp. nov. Simon 1868 p. 627-28.
Ballus rufipes Simon 1876 p. 208 (nota 1).
Ballus rufipes Fuente 1898 p. 99.
Ballus rufipes Simon 1937 p. 1149, 1246.
Ballus depressus Cantarella 1980 p. 56 (partim).
Ballus depressus var. poecilopus Forster and Bertkau 1883, p. 208 (*Syn. nov.*).

Material examined:

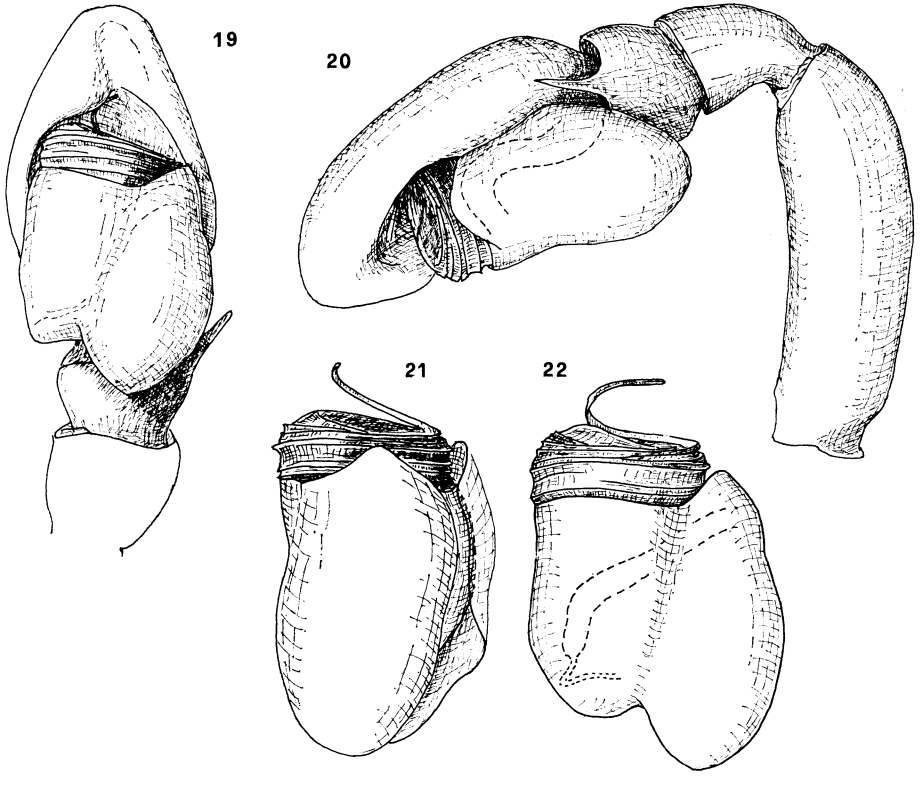
936 Sicilia - 1 ♂ (Typus), 2 juv. Simon det. (Simon 1868 p. 627-28: « Sicile. J'ai pris cette espece a Catane e Palerme).
2389 Dalmazia - 1 ♀ sub *Ballus depressus seguipes* (*biimpressus*) Simon det. (Simon 1878 p. 212: « *Ballus biimpressus* Dis. 1852 = *Attus seguipes* ». « ES. Monog. Att. p. 631 (1869). Dalmatie »).
6378 Algerie - 1 ♂, 9 ♀♀, Simon det. (Simon 1937 p. 1246: « Algerie (Teniet, Tlemcem, Sebdou, Tiout, Ain Sefra »).
23791 Pozuelo de Calatrava - 1 ♀, Simon det. (Fuente 1898 p. 99: « Pozuelo de Calatrava (Ciudad Real »).
12889 Jadas - 1 ♂, 1 ♀, Simon det. (Simon 1937 p. 1246: « Seine et Oise: Fontaine la riviere (L. Bedel Juin 1917) »).
4864 Bonn (Bertk) - 1 ♂, 1 juv. Simon det. (Simon 1937 p. 1246: « Allemagne (a Bonn par Bertkau) »).
940 Gallia merid. - 6 ♀♀, 3 juv. sub *Ballus depressus seguipes* Simon det.
Banyuls - 1 ♂, 1 juv. Berland det.
Banyuls - 2 ♀♀, 1 juv. sub *Ballus variegatus* Berland det.
Pozuelo de Calatrava - 3 ♂♂, 1 ♀ sub *Ballus depressus* Berland det.
Portella Femmina Morta (Nebrodi) - 1 ♂, 19-5-1962 Alicata leg. (sub *Ballus depressus* Cantarella 1980).

Sizes: males 3.0-3.9 mm; females 3.7-4.4 mm.

Males. Prosoma very dark with black patches around the eyes and greiyshwhite bristles evident in the well-preserved specimens. The areas between the eyes are lighter. Opisthosoma truncatd anteriorly, dark and without chromatic patterns. Generally the Pt of the pedipalps is lighter than the darkened Ti and Fe. The legs of pair I have variously darkened femurs, and very dark tibiae. The other legs display complex and variable chromatic patterns (Fig. 1) very similar to those of the *depressus*.

Pedipalp and bulb Fig. 28-31.

Females. Prosoma as for males. Opisthosoma dark and without chromatic patterns. Pedipalps with Fe and Pt dark and Ti and Ta light (Fig. 1) similar to those of *depressus*. Legs with complex chromatic patterns (Fig. 1). Epigynum (Figs. 9-11; 18).



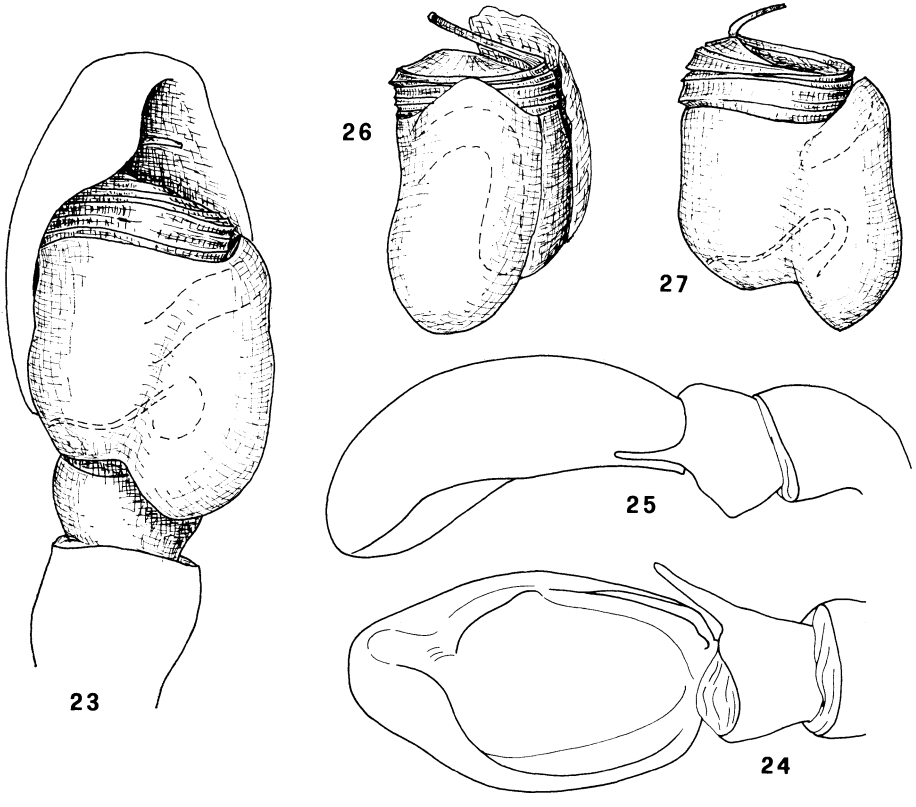
FIGS. 19-22 - Pedipalp and bulb of *Ballus depressus* (10 e 20: 940 Gallia merid. *B. depressus seguipes* Simon det.; 21 e 22: 13941 Edough *B. depressus* Simon det.): ventral (19) and lateral (20) view of the pedipalp and isolated bulb (21, 22). Fig. 22 after 90° rotation of 21.

The chromatic patterns of the legs can be confused with those of *depressus*; the essential differences with respect to the latter are:
— the longitudinal stripe all down the Mt IV is always present in *rufipes* and alway absent in *depressus*;

— the Pt of pair I legs is uniformly light in *rufipes* males;

— the absence of dark patches at the joints of Ti-Mt in the legs of *rufipes*.

Ballus rufipes is differentiated from *depressus* and *armadillo* also by the shape of its prosoma which is narrower anteriorly (this fact is evidenced by the a/b ratio) and from *depressus-armadillo* and *variegatus* by the greater length of the legs with respect to the width of prosoma (ratios I/b and IV/b). Finally it is different in the shape of its epigynum: from *B. armadillo* and *B. depressus* by the absence of the oblique ridges at the opening of the copulatory canals and by the

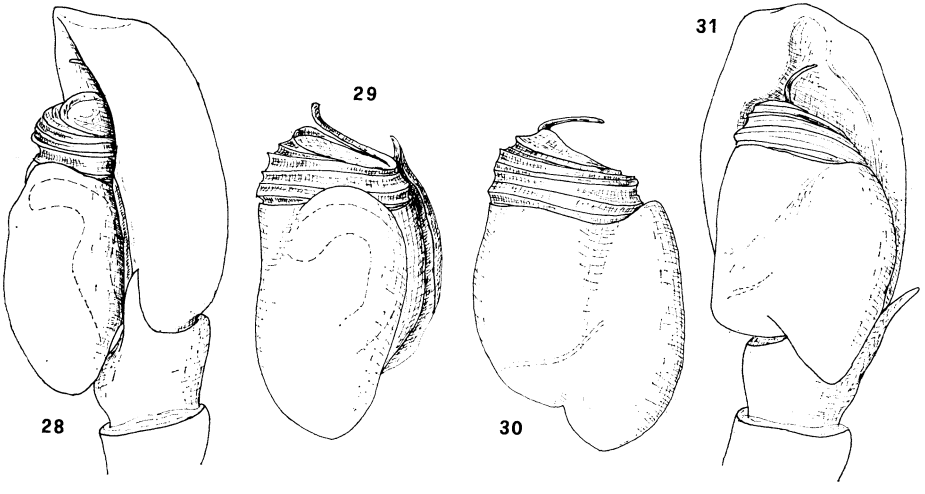


FIGS. 23-27 - Pedipalp and bulb of *Ballus armadillo* (937 Corsica Simon det.) ventral (23, 24) and lateral (25) view of Ti and Tarsus and isolated bulb (26, 27).

shape of those canals; from *Ballus variegatus* by its general shape and the presence of a slight raised line in the median area.

Bertkau (1883) on specimens collected in the surroundigs of Bonn described a « variety » of *B. depressus* named *poecilopus*. On the basis of that Author's description we would suggest its synonymy with *B. rufipes*. The descriptive elements pointing to such an ascription are:

— the bristles on the prosoma, more than in *depressus*;
— the reddish color of the legs;
— the particularly dark tibia in the pair I legs of the males;
— the coloration of the pedipalps in the female: Fe dark, Pt light, Ta dark;
— finally, the other indications regarding the chromatic patterns of the legs are in agreement with those found in *rufipes*.



FIGS. 28-31 - Pedipalp and bulb of *Ballus rufipes* (28 e 31: 936 Sicilia Simon det.; 29 and 30: Banyuls Coll. Berland) lateral view (28) and ventral (31) view of the pedipalp and isolated bulb (29, 30).

Bertkau did not note any difference in the shape of the bulb and epigynum with respect to *depressus*; but that cannot be considered surprising seeing that, as alrealy mentioned, the bulbus of the European species of *Ballus* show no evident differential characters and that only an accurate study of the epigynum will evidence differences.

The ascription to *rufipes* of the specimens described by Bertkau is made extremely probable also by the fact that Simon (1937) speaks of *Ballus rufipes* in Germany concerning material collected by Bertkau in Bonn which we have verifies; it is possible that those specimens are part of the ones for which Bertkau described the variety *poecilopus* and whose identity with *B. rufipes* would already have been noted by Simon. Even though, there is no trace of that in Simon's posthumous work.

On the basis of material we have directly examined, *Ballus rufipes* appears certainly to be present, in addition to Sicily its topotypical area, in France, Germany, Spain and North Africa; it is mentioned also in the Italian peninsula (Umbria) by Di Caporiacco (1950), in Greece by Simon (1884) and Bristowe (1935) and in Turkestan by Kronenberg (1875).

Ballus variegatus Simon 1876

Ballus variegatus sp. nov. Simon 1876 p. 205-206.
Ballus variegatus Simon 1937 p. 1149, 1245.

Material examined:

1582 Narbonne - 2 ♂♂, 1 ♀, 1 juv. Simon det. (Simon 1876 p. 206: Aude: Narbonne!. Simon 1937 p. 1245: « Aude: Narbonne, collines pierreuses sur la route de Carcassonne, 22 sept. 1875! »).

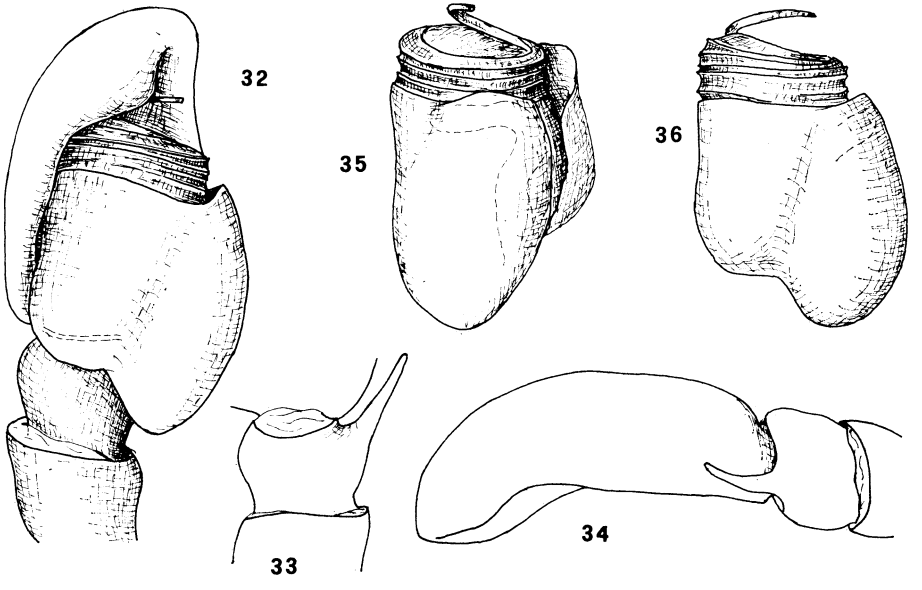
Sizes: males: 2.9-3.2 mm; females: 3.1 mm.

Males. Prosoma reddish with black patches around the eyes and light areas between them. Opisthosoma light with darker chromatic patches. Pedipalps fawn-colored with brownish femora. Pair I legs with dark Fe and Ti and dark rings around Mt-Ta joints. The other legs with darkened Fe and evident dark rings at the Ti-Mt and Mt-Ta joints and at the base of the tibiae.

Pedipalp and bulb Fig. 32-36.

Females. Prosoma as in males. Opisthosoma lighter with less marked chromatic patterns. Pedipalps uniformly light. Legs light with dark stripes on the Fe of I, III and IV and dark rings at the Pt-Ti, Ti-Mt and Mt-Ta joints. Eipgynum, Fig. 12-14; 17. This species is clearly differentiated from the others by the opisthosoma coloration and the chromatic patterns on the legs. As in *rufipes*, the prosoma is narrower anteriorly than in *depressus* and *armadillo*. The leg-length prosoma

ratio is lower than in *depressus* and *rufipes* in the males, whereas in the females it is clearly less only with respect to *rufipes*. The epigynum structure is much less marked than in the other species and in shape is comparable to that of *depressus* and *armadillo*; there is the absence of the fish-bone ridges which are evident in those last two species. On the basis of literature reports, this species is present in France, Spain (Fuente, 1898), Portugal (Oliveira, 1900) and the Italian peninsula (Di Caporiacco, 1934: Romagna).



FIGS. 32-36 - Pedipalp and bulb of *Ballus variegatus* (1582 Narbonne Simon det.) ventral (32, 33) and lateral (34) view of Ti and Ta and isolated bulb (35, 36).

OBSERVATIONS ON THE OTHER SPECIES OF *BALLUS* LISTED IN BONNET'S CATALOG

European species

Ballus lendlii Kolosvary 1934

Ballus lendlii sp. nov. Kolosvary 1934 p. 17.

This Hungarian species, described by Kolosvary for a female and never again reported seems, on the basis of the opisthosoma description and the drawing of the epigynum made by the Author, to be similar to *Ballus variegatus*. Only direct examination of the material (if it still exists) will allow one to establish whether it is valid taxon.

Ballus obscuroides (Canestrini and Pavesi 1868)

Europhrys obscuroides sp.nov. Can. and Pav. 1868 p. 821, 869 (Trentino).
Attus obscuroides Can. and Pav. 1870 p. 32 Tav. IV, fig. 5,5a.

In the genus *Ballus* Bonnet includes the species *obscuroides* described by Canestrini and Pavesi (1868) as *Europhrys* probably following Reimoser's catalog (1919). However, the description and drawing of the male pedipalps given by Canestrini and Pavesi (1870, Table IV 5,5a) allows one to exclude its being a *Ballus*. Moreover, Simon (1937 p. 1265) considers this species synonym of *Bianor aenescens tantulus* (Simon, 1868) even it with some doubt.

Ballus sociabilis Franganillo 1910

Ballus sociabilis sp. nov. (?), Franganillo 1910 p. 18.

The description given by Franganillo on Portuguese specimens is completely insufficient and his indication of « species nova » is followed by a question mark. On the basis of the description, there can be no certainly even of its ascription to the genus. Even the collecting environment (Cyperaceae from the Mino estuary) is unusual for *Ballus*. Without an examination of the typical material, and where it now is not known, this should be considered a nomen nudum.

Ballus vulpinus (Westring 1851)

Attus vulpinus sp. nov. Westring 1851 p. 56.

Westring described this species from a single female specimen kept in Sundewall's collection and labeled there with this name. He suggested a possible synonymy with *Dendryphantes auratus Koch* (Westring, 1861 p. 554). In his description he associates the species with *Attus brevipes* (subsequently given synonymy with *Ballus depressus*) and on the basis of this Thorell (1872, p. 373) considers it possibly to be a species of *Ballus*. Simon (1876 p. 208, note 1) considers the descrip-

tion insufficient and says that the type has been lost. We therefore maintain it is impossible to establish the systematics of this species and its validity. It should merely be considered a nomen nudum.

African species

Ballus decempuctatus sp.nov., Szombathy 1915
Ballus decempuctatus Szombathy 1915 p. 472.

The species was described from one New Guinea female and the drawing of the front legs and body are compatible with its being classified as a *Ballus*. The Author neither describes nor draws the epigynum.

Ballus piger Pick.-Cambridge 1876
Ballus piger sp. nov. Pick-Cambridge 1876 p. 609.

Described from one specimen only from Egypt and compared by the Author with *Ballus heterophtalmus* Koch (later given synonymy with *depressus*). The differences consist in the different coloration of the pair I legs and the pedipalps. It certainly belongs to the genus *Ballus* and the species is probably a valid one.

Asiatic species

Ballus clathratus Simon 1901
Ballus clathratus Simon 1901 pp. 482, 485.

It is mentioned by Simon (1901, p. 482, 485) together with *Ballus segmentatus* and *Ballus sellatus* as one the three species of Ceylon. However, it is not mentioned in any other work. In Bonnet's catalog it appears as a nomen nudum.

Ballus japonicus Saito 1939
Ballus japonicus sp. nov. Saito 1939 p. 36.

The Author describes it from one female specimen form Japan and gives drawings of the body and epigynum. In the drawing given the epigynum appears to be considerably different from those of the European species.

Ballus planus Schenkel 1936

Ballus planus sp. nov., Schenkel 1936 pp. 11, 244.

It is described from Chinese females. The Author points out a resemblance between the pair I legs of these females and those of the *Ballus depressus* male. The epigynum is described and drawn; it appears to be comparable with that of the *Ballus japonicus* and very different from that of the European species.

Ballus segmentatus Simon 1900 and **Ballus sellatus** Simon 1900

Ballus segmentatus sp. nov., Simon 1900 p. 398.
Ballus sellatus sp. nov., Simon 1900 p. 398.

The description of these two species from Ceylon is very short. The first is described from one female and the second from one male. Since the places where the specimens were collected are in part identical. the doubt arises that these may be two sexes of one and the same species. The Author gives drawings neither of the bulb nor the epigynum and the very short descriptions allow no comparison with European species.

Ballus tabupumensis Petrunkevitch 1914

Ballus tabupumensis sp. nov., Petrunkevitch 1914 pp. 170, 174.

It is described from one Burmese female. From the description and drawing given of the chelicerae considerable differences are evident, both in the overall shape and in the anterior margin teeth, compared with the European *Ballus* species. The drawing of the epigynum is also very schematic and without a description, this leads one to think that there is considerable difference from the European species.

North American species

Ballus immaculatus, Peck in Scheffer 1905

Ballus immaculatus Scheffer 1905 p. 186.

Mentioned by Scheffer in a catalog of Kansas spiders. Bonnet reports it as a nomen nudum.

Ballus youngi Peckham 1888

Ballus youngi sp. nov., Peckham 1888 p. 87.

The description given by Peckham of one male and one female from Pennsylvania (USA) and that by Kaston 1948 (from Connecticut specimens) and their drawings of the bulb and epigynum allow one to recognize a certain affinity with the European species, but also notable differences in the shape of bulb and epigynum.

Banks (1905) classified this species in a new genus *Attidops*, but there seems to be not enough reason for such an ascription. In fact, observing one tooth only in the lower margin of the chelicera of *B. youngi* instead of the several teeth typical of the *Ballus*, Kaston considered Banks' classification justifiable, but at the same time he placed *youngi* in the *Ballus*.

CONCLUDING REMARKS

In his monumental work *Histoire naturelle des Araignées* (1901), Simon placed the genus *Ballus* in the group of Balleae which in addition to *Ballus* includes some tropical genera (*Cylistella, Peplometus* and *Pachiballus*). Whether this group has any real philogenetic basis or not is hard to evaluate. This is one of the innumerable problems of Salticidae systematics which will have to be faced in the future. But also the affinity existing between the species ascribed today to the genus *Ballus* appears problematic.

As can be seen from this paper, several species are too incompletely described to allow comparison to be made, and it is even doubtful whether some species belong to the genus. However, it can be held that the present day European species form a group with such internal affinity as to leave no room for doubt about their common phylogenetic origins. The Egyptian *Ballus piger* and the North American *Ballus youngi* are probably in some way related to this group. As regards the other extra-European species, there seems to be a certain affinity between the Japanese *B. japonicus* and the Chinese *B. planus*. From these short remarks on affinity, it is clear that little can yet be said on the real distribution of the genus.

There are four undoubtedly valid European species: *Ballus depres-*

sus (Walck.), *Ballus rufipes* (Simon), *Ballus armadillo* (Simon) and *Ballus variegatus* (Simon). The male copulatory organs show great uniformity and it has not been possible to evidence any clear difference between the species as regards this structure. Instead, the female copulatory organs allow us to distinguish *B. rufipes* and *B. variegatus* both from each other and from *B. armadillo* and *B. depressus*. The latter two cannot be distinguished from each other on the basis of this organ.

Distinguishing one species from another is always possible, instead, by observing the chromatic patterns of the body and its appendices. Also the prosoma morphology and the measurement ratios between legs and prosoma are useful elements for distinguishing the species.

The existence of clear differences in chromatic patterns at a specific level seems to be related to the role that these play in courtship, which in the Salticidae is based to a considerable extent on visual perception.

On the overall basis of characters, the two most closely related species are *B. depressus* and *B. armadillo*. They are found in areas which the revision we have made show to be overlapping: the former has a Euro-Mediterranean distribution, from the North of Europe to Northern Africa, whereas the latter as far as is known at present, lives in a more limited area contained within that of the former, including Corsica and Sardinia, the Italian peninsula, Sicily and Yugoslavia.

The relation between the two areas suggets that *armadillo* is derived from *depressus*. This hypothesis seems to be confirmed by the fact that *B. rufipes*, a more distant species phylogenetically, shares with *depressus* the same chromatic patterns on the legs. In fact, if one were to hypothesize that *depressus* is derived from *armadillo*, the resemblance of the cromatic patterns between *rufipes* and *depressus* would have to be interpreted as a convergence without any apparent reason.

The area occupied by the two other species overlap those of the first two. *Ballus rufipes* has a European-Mediterranean distribution more limited in Europe than *Ballus depressus* in Europe (it is absent in England and Northern Europe) while *variegatus* is so far known with certainty to live only in Southern France. The phylogenetic relationship between *rufipes* and *variegatus* and between these two and other two species is not definable on the basis of the data at present available.

List of the material examined from the Paris Museum.

Original cards	Number of specimens	Corrections to the determinations
744 *Ballus depressus seguipes* E.S. Z. Landes fin Avril 1917	5 ♂♂	= *Ballus depressus*
940 *B. dep. seguipes* E.S. Gallia merid.	55 ♂♂, 15 ♀♀, 16 juv.	55 ♂♂, 9 ♀♀, 13 juv. = *B. depressus*; 6 ♀♀, 3 juv. = *B. rufipes*
941 *B. depressus seguipes* E.S. Algerie	6 ♂♂, 12 ♀♀	= *B. depressus*
2389 *B. depressus seguipes* E.S. (*biimpressus*) Dalmazia Keys.	1 ♂, 1 ♀	1 ♂ = *B. depressus* 1 ♀ = *B. rufipes*
13941 *Ballus depressus* W. Tipyque Edough!	10 ♂♂, 15 ♀♀	
Ballus depressus Naples (preserved in the same tube of 12889)	2 ♂♂, 1 ♀	1 ♂ = *B. armadillo*
939 *Ballus depressus* WK Gallia	2 ♂♂, 2 ♀♀	
403 *Ballus depressus* WK Z. France	2 ♂♂, 2 ♀♀	
Ballus depressus seguipes E. Simon Banyuls s/mer (Pyr. Or. es.) n° 4 25-9-62 Collection Berland	2 ♂♂, 1 ♀	= *B. depressus*
Ballus depressus W.L. Berland det. 1914 Espagne Pozuelo (Ciudad Real) J.M. de la Fuente 1913	3 ♂♂, 1 ♀	= *B. rufipes*
1582 *Ballus variegatus* E.S. Narbonne Ciudad Rodrigo	2 ♂♂, 1 ♀, 1 juv.	
Ballus variegatus E.S. Banyuls VI 09 (preserved in the same tube of n° 4 25.9.62 Collection Berland)	2 ♂♂, 1 juv.	= *B. rufipes*
936 *Ballus rufipes* E.S. Sicilie!	1 ♂, 1 juv.	
4864 *Ballus rufipes* E.S. Bonn (Bertk.)	1 ♂, 1 juv.	
6379 *B. rufipes* E.S. Algeria: Teniet (L.B.) Sebdou, Tlemcem Tiout A. Sefra (Vibert)	1 ♂, 9 ♀♀	
23791 *B. rufipes* E.S. Pozuelo de Calatrava	1 ♀	
12889 *B. rufipes* E.S. Jodas? (L. Bedel Juin 1917)	1 ♂, 1 ♀	
937 *B. armadillo* Corsica	14 ♂♂, 111 ♀♀	2 ♂♂ = *B. depressus*
Ballus rufipes Banyulus IV 09	1 ♂, 1 juv.	
Ballus rufipes Benyuls IV 11! Entrèe n° 4 25.9.62 Collection Berland		

SUMMARY

The AA. revise the European taxa of the genus *Ballus* descrived by Simon and carry out a critical reexamination of the descriptions of the other species attributed to this genus. Various differential characters are studied in order to establish a valid taxonomy. In particular the morphology of the male and female copulatory organs and the legs chromatic markings are carefully analyzed.

Four European species are undoubtedly valid and form a group with common phylogenetic origin: *Ballus depressus* (Walck.), *Ballus rufipes* (Simon), *Ballus armadillo* (Simon) and *Ballus variegatus* (Simon). Their male copulatory organs show great uniformity. The female copulatory organs allow to distinguish *Ballus rufipes* and *Ballus variegatus* both from each other and from *Ballus armadillo* and *Ballus depressus*. The latter two cannot be distinguished from each other on the basis of this organ.

Distinguishing one species from another is always possible by observing the chromatic patterns of the body and of its appendices. The two most closely related species are *Ballus depressus* and *Ballus armadillo*. The relation between their distributions suggests that *armadillo* is derived from *depressus*.

Among the extra European species the Aegiptian *Ballus piger* and the North American *Ballus youngi* are probably related to the European group.

Incomplete descriptions do not allow to evaluate the affinity nor in some cases, even the ascription to *Ballus*, of several other species.

On the basis of the material examined, the AA. consider *Ballus depressus seguipes* (Simon) to have no taxonomic value.

Ballus armadillo is reported for the first time for Italian peninsula and Sicily.

K e y w o r d s : Araneae Salticidae, Sistematic.

RIASSUNTO

Gli AA. rivedono le specie di *Ballus* descritte, riesaminano criticamente le descrizioni delle altre specie attribuite a questo genere e studiano diversi caratteri differenziali per stabilire una valida tassonomia. Particolare attenzione è riservata alla morfologia degli apparati copulatori maschili e femminili e ai modelli cromatici delle zampe.

Le specie europee certamente valide sono quattro e formano un gruppo con origini filogenetiche comuni: *Ballus armadillo, Ballus depressus, Ballus rufipes* e *Ballus variegatus*. I loro apparati copulatori mostrano una notevole uniformità, mentre gli apparati copulatori femminili permettono di distinguere *Ballus rufipes* e *Ballus variegatus* sia tra loro sia da *Ballus depressus* e *Ballus armadillo*. Queste ultime due non possono essere distinte neanche in base alla morfologia di questi organi. È invece possibile distinguere sempre le quattro specie europee in base ai disegni cromatici delle zampe e del corpo.

Le due specie più strettamente affini sono *Ballus depressus* e *Ballus armadillo*; la relazione tra le loro distribuzioni suggerisce che *Ballus armadillo* sia derivato da *Ballus depressus*.

Tra le specie extra-europee *Ballus piger* di Egitto e *Ballus youngi* del Nord America sono probabilmente affini al gruppo europeo. Le descrizioni incomplete e le carenze di figure non permettono di valutare le affinità ed in qualche caso neanche la appartenenza al genere, di diverse altre specie.

Gli AA. sulla base dell'esame di abbondante materiale ritengono che *Ballus depressus seguipes* (Simon) non abbia alcuna validità tassonomica.

Ballus armadillo è citato per la prima volta per l'Italia peninsulare e per la Sicilia.

Parole chiave: Araneae Salticidae, Sistematica.

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