A REVISION OF THE GENUS DIVERSINERVUS SILVESTRI, ENCYRTID PARASITES OF COCCIDS (HYMENOPTERA)

BY

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Diversinervus Silvestri

Cheiloneurus (in part) Motschulsky, Boll. Soc. Imp. Natur., Moscow, 36:52,
pl. 2, fig. 9. 1863.

The genus Diversinervus was erected by Dr. Silvestri, in 1914, for the single species elegans, reared from Saissetia oleae (Bernard), collected at Nefasit, Eritrea. Girault, in 1915, overlooked Silvestri's Diversinervus and described the new genus Cheiloneuroides for a species collected in Queensland, Australia. Subsequently, Girault recognized Diversinervus and made his genus a synonym. In this paper the species described by Girault, D. bicristatus, is recognized as a synonym of the genotype, D. elegans. In 1916, Dr. James Waterston described the species D. silvestrii from specimens reared from Coccus viridis (Green), infesting coffee on the Island of Mauritius. Mr. P. H. Timberlake has shown me a manuscript note made by J. C. Crawford, who examined the types of Cheiloneurus paradisicus Motschulsky.

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Crawford's note refers to generic characters which rather clearly indicate that the species is a *Diversinervus*. His notes do not enable recognition of the species nor do I have access to the original description, consequently the species is not included in this paper. Motschulsky's specimens were reared from *Saissetia hemisphaerica* (Targ.), infesting coffee, on the Island of Ceylon.

In this paper three new species are described, a key for the separation of the species is given, and a brief biological note on the biology of *D. elegans* is included. Heretofore *Diversinervus* was thought to be a genus of hyperparasites due to the close relationship of this genus to *Cheiloneurus*, the latter so far as known a genus of hyperparasites.

**KEY TO THE SPECIES OF Diversinervus, FEMALES**

1. Basitarsus of hind legs whitish or yellowish ........................................ 2
   Basitarsus of hind legs partly, if not completely, blackish .......................... 3

2. Mesoscutar and scutellar tufts well developed. Scape more than twice as long as wide .......................................................... 3
   Mesoscutar and scutellar tufts composed of short, sparse setae about twice as long as the adjacent, scattered setae, as shown in figure 1b. Scape widely expanded, exclusive of the radical joint, plainly less than twice as long as wide. Club as long as the funicle joints united .................................. 3
   Setae of the mesoscutar and scutellar tufts arranged in compact groups about as shown in figure 2a. Basal, ventral part of the scape blackish. Dorsum of pedicel blackish. First four funicle joints and apical two club joints fuscous or dark brown. Fifth and sixth funicle joints and basal club joint yellow. Club about as long as the preceding four funicle joints united .......................................................... 3

   Natal 1, *scutatus* n. sp. .......................... 3

3. Setae of the mesoscutar and scutellar tufts longitudinally arranged (as shown by Waterston's figure). Antennae yellowish or colorless except for a faint browning on the apical club joint, dorsal margin of pedicel and ventral margin of scape. Club as long as the preceding five and one-half joints united. Marginal fringe of the forewings longer than in the foregoing species.................. Mauritis 3, *silvestrii* Waterston

4. A dark metallic species, only the center of the mesoscutum, axillae, and the sides of the scutellum ferruginous .......................... 4
   A yellow species which, aside from the mesoscutar and promotal bands, has only the basal half of the abdomen, sides of propodeum, and mesopleura posteriorly more or less dark metallic .......................................................... 4

   Eritrea, Natal, Queensland 5, *elegans* Silvestri

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*2 Diversinervus paradisicus* (Motschulsky) is not included and it is possible that one of the species accepted as valid in this paper may be a synonym.

*3 In the original description, Bull. Ent. Res. 7(2):127–140, figs. 1–2, 1916, the ocellar triangle is described as obtuse. If this is not an error, then the species can be easily recognized as all the other species have the ocelli arranged in an acute triangle.*
KEY TO THE SPECIES OF Diversinervus, MALES

1. Femora and tibiae of hind legs distinctly marked with fuscous .................................. 2
   Femora and tibiae of hind legs entirely whitish or the latter slightly fuscous towards the base of the dorsal margin ........................................ elegans Silvestri

2. Femora and tibiae of hind legs more or less extensively whitish or yellowish .... 3
   Femora and tibiae of hind legs predominantly black or dark brown, only the basal end of the former and both ends of the latter narrowly marked with whitish ........................................ de santisi, n. sp.

3. Distal end of the hind femora whitish ........................................................................ 4
   Distal two-thirds or so of the hind femora fuscous, metallic, the basal part whitish. The distal one-half or more and the basal end of the hind tibiae whitish, the intermediate part fuscous. Middle tibiae faintly marked with brownish near the pale basal annulus which is faintly indicated. Middle coxae more or less fuscous. Remainder of the legs whitish ...................... scutatus n. sp.

4. Hind femora whitish on the ends, the intermediate parts fuscous. Hind tibiae whitish at the base and on the distal one-fourth or so, the intermediate part fuscous. In the single, slide mounted specimen at hand, the middle tibiae appear entirely whitish ........................................ meridionalis n. sp.

The males of neither D. paradisicus (Motschulsky) nor D. silvestrii are known. So far as can be observed the males of the three species described as new in this paper and those of D. elegans Silvestri are remarkably alike, differing principally in the color of the legs. The male of D. elegans as figured by Silvestri will serve equally well to illustrate the other species. The general color is bluish or greenish black. Face and cheeks more intensively bluish or greenish. Abdomen more predominantly black. Pedicel of antennae more or less fuscous, the remainder whitish or yellowish in parts with variable fuscous markings which are described.

Diversinervus scutatus n. sp.

Figure 1 a–c

This species can be distinguished by the widely expanded scape, large club, small setae of the tufts and their long drawn out arrangement. The description is from balsam mounted specimens.

FEMALE—

Frontovertex very narrow, orbits parallel for the greater part. Ocelli in an acute triangle, the anterior ocellus almost its own diameter from the orbits, the posterior pair slightly more than their own diameter from the occiput and almost one-half their own diameter from the orbits. Four rows of small setigerous punctures extend from the anterior ocellus to the frontal ledge where they scatter.
Scape widely expanded, slightly more than one and one-half times as long as wide. Pedicel a trifle less than twice as long as wide. First funicle joint a trifle longer than wide, the second and third about as wide as long, the succeeding plainly wider than long so that the sixth is almost twice as wide as long. Club large, almost as long as the funicle joints united and about one and one-half times as wide as the preceding joint. Other details of antennae as shown in figure 1a.

Fig. 1. *Diversinervus scutatus* n. sp. Female. *a*, Antenna; *b*, head and body; *c*, forewing.

Forewings as shown in figure 1c. In some specimens the apex of the wing is almost or completely hyaline. Hind wings with the small, fuscous cloud common to the other species.

*Vertex* with short, erect, black setae, as in the other species. Mesoscutar tuft composed of rather small setae longitudinally arranged. The metallic band occupying the posterior one-third of the mesoscutum clothed with numerous, silvery setae. Each axilla with five or six, short, black setae. Scutellar tuft composed of small setae longitudinally placed. The usual pair of erect, long setae at the apex of scutellum. Other details as shown in figure 1b.

It is difficult to determine the exact color from the balsam mounted specimens. Most of the ventral expansion and the base of the scape and the radical joint are blackish, the apex of seape white, and the
remainder yellow. Dorsal half of the pedicel black, ventral half white. The blackish color of the funicle is variable, usually the first four joints are definitely fuscous except for the dorsal and ventral margins which may be pale. In some specimens the fuscous is present on the fourth joint and more rarely on the fifth and sixth joints, but the prevailing color of the distal two funicle joints is yellow. Two basal club joints yellow, the oblique, apical joint blackish. Face yellow, the frontovertex and frontal ledge washed with dark metallic with violaceous reflections. Posterior one-third of mesoscutum with a dark metallic cross band, presumably bluish green but this does not appear to advantage in balsam. In balsam, the anterior one-fourth or so of the mesoscutum appears translucent and colorless without yellow pigment, probably indicative of the band which appears silvery white in tag mounted specimens. Remainder of the thorax yellow with dusky or blackish suffusions as follows: tegulae, a small spot on either side of the scutellum, declivous sides of propodeum and posterior part of mesopleura. These parts described as fuscous or dusky undoubtedly have bright color reflections. Dorsum of abdomen mostly dark metallic, more intense on the first tergite, becoming yellow laterally and at the apex. Exserted ovipositor sheaths yellow. All coxae and most of the femora white. Middle femora with a fuscous spot near the apex. Middle tibiae tipped at extreme base with blackish followed by a white annulus and this by a narrow, dusky blotch or annulus, the remainder pale yellow. The femora and tibiae of the fore and hind legs are marked somewhat similarly to those of the middle pair except that the fuscous areas are not as distinctly marked and are more extensive, in some specimens appearing as faint indefinite suffusions. All tarsi whitish to pale yellow concolorous with the distal ends of the tibiae.

Length.—2.1 mm.

Male. As described in the key.

Described from thirteen females and fourteen males (holotype, allotype, and paratypes) reared by E. W. Rust, from Ceronomia sp. on Ampelopsis, collected at Durban, Natal, September 7–8 and November 5, 1926. Rust’s No. M 12.

Diversinervus meridionalis n. sp.

Figure 2 a–c

In this species the scape is more than twice as long as wide, pedicel almost three times as long as wide; club length equal to that of the preceding four funicle joints. It is most readily separated from D. elegans by the white basitarsus of the hind legs, from D. scutatus by the longer and more compact tufts, from D. de santisi by color, from D. silvestrii by color and arrangement of the setae composing the tufts.
Female—
Head about like that of *D. scutatus* and *D. elegans*. Scapae expanded below, probably wider than as shown in figure 2b since the specimen was in a slightly oblique position. Pedicel about two and one-half times as long as wide. First four funicle joints subequal, each about as long as wide, the fifth and sixth appreciably larger, the latter about one and one-half times as wide as long. Club about one and one-half times as long as the sixth funicle joint and as long as the four joints preceding united. Other details of antenna as shown in figure 2b.

![Image of antenna and thorax](image)

**Fig. 2.** *Diversinervus meridionalis* n. sp. Female. *a*, Thorax; *b*, antenna; *c*, detail of venation and adjacent cilia.

The forewings are essentially like those of *D. scutatus* n. sp., as shown in figure 1c, except that the basal cloud is more extensive, similar to that of *D. silvestrii*, as figured by Waterston, and the apical area is plainly infuscated. Submarginal vein with nine setae.

Vestiture of the thorax about as shown in figure 2a. The scutellar tuft is composed of two, close, parallel rows of nine stiff, suberect, black setae and the usual longer, erect, apical pair. The setae of the mesoscutar tuft are grouped closer together than are those of the scutellar tuft. Figure 2a does not show the actual number of setae composing the tufts.

Color similar to that of *D. scutatus* n. sp. except that the yellow pigment is more dominant. Abdomen mostly yellow only the first tergite distinctly metallic and the sides anterior to the vibrissal plates slightly dusky. Middle and hind tibiae with a narrow, white annulus at basal ends followed by fuscous suffusions which blend to yellowish. The distal end of the hind tibiae is pale yellow more in contrast than
in the middle tibiae. Knees of the middle and hind legs blackish. Middle femora with a faint fuscous spot or band on the distal one-fourth. Scape blackish on the ventral margin and more broadly towards the base. Apical half of the pedicel blackish, the ventral half white or pale yellow. First four funicle joints fuscous or brown with the dorsal margin pale, slightly yellowish. Fifth and sixth funicle joints yellow. Basal club joint yellow, the apical two joints fuscous. Head and thorax predominantly yellow. Posterior one-third or so of the mesoscutum transversely by a bluish black band, in life, probably silvery. In the balsam mounts the silvery sheen of the pronotal band is destroyed and the derm appears transparent where it overlaps the fuscous concealed part of the mesoscutum. Sides of propodeum and the mesopleura dark metallic.

Length.—1.8 mm.

Male. As described in the key.

Described from five females and two males (holotype, allotype, and paratypes) reared by E. W. Rust from a Ceroplastes sp. collected at Durban, Natal, April 20–26 and May 21–29, 1926. Rust’s No. M 19.

Diversinervus silvestrii Waterston


Waterston’s detailed description and the excellent drawings by Terzi will enable recognition of this species.

Diversinervus de santisi n. sp.

This species is more extensively dark metallic than are any of the others and can be recognized at a glance.

Female—

Frontovertex very narrow, hardly as wide as three times the diameter of the anterior ocellus. Ocelli in an acute triangle, the posterior pair separated from each other by about once their own diameter and slightly more than one-half their own diameter from the occipital margin and placed very close to the orbits. The longitudinal rows of setigerous punctures, anterior to the median ocellus, very faint.

Scape slightly less than three times as long as wide. Pedicel slightly more than twice as long as wide. Funicle joints gradually, successively increase in width so that the sixth is about one and one-half times as wide as long. Club large, about as long as the funicle joints combined.

Forewings more darkly infuscated than are those of the other species, although in general the pattern is similar. Hind wings with the infuscedot spot common to the other species.
Mesoscutter and scutellar tufts compact, composed of thick, black setae. A pair of erect setae longer than the tuft at apex of scutellum. Eyes with sparse, fine, whitish pubescence. Posterior half of the mesoscutum, narrowly on the sides and the anterior part blackish, metallic, the former strongly bluish, appearing as a transverse cross band set with silvery setae. On either side of the tuft the mesoscutum is blotched with orange or yellowish. Collar of pronotum faintly silvery. Axillae orange yellow with a variable fuscous suffusion. Scutellum mostly orange yellow, the sides and more widely opposite the tuft blackish. Sides of propodeum iridescent with greenish reflections predominating. Abdomen black, metallic with reflections. Tegulae fuscous. Frontovertex and cheeks dark brown, strongly metallic, face light brown. Mesopleura pale brown and translucent anteriorly blending to dark violaceous posteriorly. Lateral and under parts of thorax more or less brownish or fuscous. Fore and hind coxae and trochanters white; those of middle legs dark brown or blackish. Middle femora mostly white on the basal half and straw colored at apex, the intermediate part blackish or dark brown. Hind femora blackish. Middle femora mostly dark brown or blackish, the ends pale. Middle tibiae with a white annulus at base and straw colored on the apical one-third, the intermediate portion blackish or dark brown. Hind tibiae marked somewhat like the middle pair except that the ends are not as extensively pale. Fore tibiae dark brown, the ends obscurely paler. Basitarsi of hind legs black, the following joints white. Basitarsi of middle legs slightly darker brown than are the following joints. Fore tarsi dark brown. Ventral and dorsal margins of the scape broadly suffused with blackish, the remainder yellowish. Pedicel dark brown on the dorsal half, the remainder yellowish. Funicle joints dark brown, the two distal joints sometimes yellowish. First club joint usually yellow in contrast to the funicle which may have the distal two joints yellow, but owing to the blackish setae they appear fuscous. Apical two club joints dark brown to blackish.

Length.—1.8 mm.

Male—

Blackish with strong bluish or greenish reflections depending on the light. Mesoscutum with a broad, transverse bluish green, posterior band set with sparse, silvery setae. Frontovertex bronzy, face and cheeks greenish. Mesopleura violaceous. Middle coxae, hind femora, hind tibiae, except the ends of the latter and a suffusion on the basal half of the middle tibiae, distad of the annulus fuscous, the remainder of the legs mostly whitish blending to faintly brownish at the knees and on the basal part of the fore tibiae.

Length.—1.4 mm.

Described from 16 females and 3 males (holotype, allotype, and paratypes) reared from an undetermined species of Pulvinaria that commonly infests Croton macrostachys at the Abyssinian villages of Giglasciu and Ez’taclesan. These villages are located about 45 kilometers north of Asmara, Eritrea, on the plateau at an elevation of
about 7800 feet. The specimens issued on various days in April and May, 1930. The scales from which the parasites issued had five or more exit holes in their backs.

The species is named after Sr. Michele de Santis, a pioneer of Eritrea, who, at eighty years of age, commenced the study of entomology.

**Diversinervus elegans** Silvestri

_Figure 3, a, b_


With a few minor exceptions specimens of *D. elegans*, reared from *Saissetia oleae* (Bern.) collected in Eritrea, are in agreement with Girault's description of *D. biocristatus*. In Girault's description no mention is made of the silvery, pronotal cross band, the black streak on the dorsal margin of the pedicel, nor the fuscous or brownish appearance of the first five funicle joints. In the collection of P. H. Timberlake is a single specimen, determined by Girault as *D. biocristatus*, bearing the label "On black scale, Brisbane, Queensland, George Compere, August 27, 1900." This specimen is paler than Girault's description indicates the types to be, yet it clearly shows the pronotal cross band, blackish streak on the pedicel, and the dusky funicle. The Brisbane specimen differs from those from Eritrea by being paler or faded, less refringent and having smaller setae composing the tufts. Since no good characters can be observed that will separate the two forms, it is thought that they are specifically alike. The fact that they were discovered in widely remote localities is not considered as grounds for maintaining their separate identity since other black scale parasites of African origin also occur in Australia. This is just another one of those cases where a parasite has been accidentally transported with its host from one country to another. Although we do not have a record of *Saissetia oleae* (Bern.) occurring at Townsville, Queensland, where Girault obtained his type specimens, we do know that it occurs at Brisbane where it is attacked by other parasites of African origin.

In the Rust collection there are thirty-three specimens, mostly reared from *Saissetia perseae* taken at Durban and Mayville, Natal, 1926. No characters can be noted which distinguish them from the Eritrean specimens. In regard to one pair, it is stated that they were
taken in coitus after emerging from a parasite inhabiting a species of *Inglisia*. In regard to the other species of *Diversinervus* reared by Rust, on some of the slide labels it is also stated that they were reared from a parasite inhabiting the coccid but I have recorded the coccid as the host under the supposition that a mistake was made in alleging them to be hyperparasitic. Heretofore *Diversinervus* was supposed to be a genus of hyperparasites but this supposition was not based on biological observations. It is now known that *D. elegans* is a primary parasite and presumably the other species are likewise primary. However, this should be verified before any of the other species are transported from one country to another and colonized.

In April and May, 1930, while in Eritrea investigating the parasites of the black scale, *Saissetia oleae* (Bern.), for the University of California Citrus Experiment Station I obtained living specimens of *D. elegans*. The attempt to transport a colony of live parasites to California was unsuccessful and efforts to obtain this species are being continued. The following notes on the biology of the species were made at Nefasit, Eritrea.

*Diversinervus elegans* was frequently reared in small numbers from black scale collected at various places on the Asmara Plateau. The species was more abundant in the material collected in the town of Asmara than it was in material collected at Giglasciu and Ez’taclesan. According to my rearings this species ranks about fifth in point of numbers, being exceeded by *Scutellista cyanea* (Motsch.), *Metaphycus lounsburyi* (Howard), *Coccophagus saintebeauvei* Girault, *Coccophagus ochraceus* Howard, and *Coccophagus baldassarrii* Compere. However, more rearings over a longer period of time may alter this rating.

**Oviposition**

*Diversinervus elegans* attacks about the same sized black scale as does *Metaphycus lounsburyi*. If an opportunity for a selection is offered the parasites first oviposit in the larger mature scales. In the absence of mature scales they readily attack the smaller specimens. The oviposition habits of this parasite are peculiar. By a slow and deliberate antennal inspection the parasite locates the anus through which the ovipositor is inserted. In the vial where the ovipositions were watched two and three parasites often competed for the same host. At first they were wary, shying off at the approach of another. After having made a successful oviposition they became more per-
sistent and would make successive ovipositions without leaving the host or without entirely withdrawing the ovipositor, even though harrassed by others attempting to oviposit through the same opening.

**The Eggs**

The eggs are of the aeriferous type. They are found on dissection, enclosed in the hind intestine suspended on a long stalk, the end of which is inserted through the anal tissue. As many as twelve eggs were found, packed closely together, in the intestine of one host, presumably the result of several parasites ovipositing. In one case an individual was seen to deposit four eggs in the same scale before withdrawing her ovipositor. A drawing of an egg is shown in figure 3a.

A scale oviposited in by *Diversinervus elegans* on May 5 and 6, was dissected on the morning of May 12. In the intestine were six
unhatched eggs, in a late stage of development, and one newly hatched larva. The newly hatched larva is shown in figure 3b.

These data were considered sufficient to justify the colonization of the species in the cages for propagation. Several hundred specimens were released in the cages and allowed to oviposit for several weeks prior to the departure for California. It was the intention to complete the life history observations by following the entire larval development before the material was released from the quarantine room and the species colonized in California. En route through the Red Sea, all the material was killed so that the later larval stages of this interesting parasite were not observed.

**Taxonomy of the Adults**

The original description and illustrations were prepared from three specimens and although they admirably illustrate the general characters there are a few discrepancies which should be explained. I have not seen the type of *D. elegans* and the determination of our specimens is based on the fact that they were reared from the same host as were the types and that these hosts were obtained within 15 miles of Nefasit, the type locality. Also, the differences between the description and our specimens are of a kind that are easily made when a species is described from only several specimens. Silvestri's figure of the antenna of the female does not show the correct shape and proportions of a lateral view, the expansion of the scape is not shown and a narrow aspect of the club is given. The body is obviously copied from a specimen that had been unnaturally expanded by pressure of the cover slip, the abdomen being actually more slender than is shown in his figure.

**Female—**

Head, dorsal view, apparently similar to that of *D. scutatus* n. sp. as shown in figure 1b. Scape only a trifle more than twice as long as wide, not three times as shown in the original figure. Pedicel two and one-half times as long as wide. First three funicle joints each a trifle longer than wide, the fourth and fifth about as long as wide, the sixth wider than long. In general there is no appreciable widening of the funicle before the fifth and sixth joints. Club as long as the four preceding and a portion of the second joint combined and one and one-half times as wide as the distal funicle joint.

The forewings are accurately shown in the original figure.

In our series of specimens the setae composing the mesoscutal and scutellar tufts are much stronger and more compact than is shown in the original figure. This character may be variable or the illustrator, for the sake of clearness, may have desired to show the number
and arrangement of the individual setae in which case they would not appear as a thick, black tuft. In the preceding pages some use has been made of the tufts for diagnostic purposes but this character taken alone is not entirely dependable.

General color yellow. Posterior one-fourth of the mesoscutum marked by a sharply defined, bluish black, metallic cross band set with silvery setae. Posterior margin of the pronotum silvery white, in life or in tag mounted specimens. Sides of propodeum and mesopleura posteriorly more or less dark with metallic reflections. Dorsum and sides on the basal half of the abdomen more or less dark metallic with reflections. Frontovertex and the cheeks just under the eyes slightly brownish with strong metallic reflections. Remainder of head and body straw colored except for traces of brownish or fuscous margining some of the lateral and ventral sclerites. Ventral margin of the scape narrowly margined with blackish. Dorsum of pedicel with a longitudinal black streak. First four or five funicule joints dark brown or fuscous in contrast to the sixth funicule joint and basal club joint which are yellow or straw colored. Two apical club joints blackish or dark brown. Legs marked with whitish as follows: fore and hind coxae and trochanters, basal one-third or so of the fore femora, basal one-half or two-thirds of the middle femora, a narrow annulus near the base of the middle tibiae, both ends of the hind tibiae, three intermediate tarsal joints of the middle legs. Legs marked with fuscous or blackish as follows: basitarsus of hind legs except narrowly at the base which may be whitish, basal end of middle tibiae and a suffusion following the white annulus, hind tibiae with a suffusion following the white at basal end and another suffusion preceding the white apical end, middle femora with a suffusion on the apical one-third following the white and preceding the yellow end, hind femora faintly suffused apically, fore femora on the dorsum of the apical half, fore tibiae faintly towards the base. In some specimens the fuscous markings are faint or absent and the areas mentioned as fuscous may be brownish not contrasting greatly with the remainder of the legs which are yellow or yellowish brown, straw colored.

Male—

As figured and described by Silvestri and as diagnosed in the key.

Types of new species to be deposited in the United States National Museum.