

- NEWTON, R. B. 1900. "On Marine Triassic Lamellibranchiata discovered in the Malay Peninsula." *Proc. Malac. Soc. London*, vol. iv. pp. 130-5, pl. xii.
 ———. 1923. "On Marine Triassic Shells from Singapore." *Ann. & Mag. Nat. Hist.* (9) xii. pp. 300-321, pl. ix.
 PATTE, E. 1926. "Etudes paléontologiques relatives à la géologie de l'est du Tonkin (Paléozoïque et Trias)." *Bull. Serv. géol. Indochine*, vol. xv. fasc. 1.

EXPLANATION OF PLATE IV.

(All figures, except 7 and 8, are of natural size.)

- Fig. 1. *Modiolus* cf. *raiblianus* Bittner (L. 63431).
 Fig. 2. *Modiolus raubensis* sp. n., holotype (L. 63430).
 Fig. 3. *Cassianella*? sp. (L. 63436).
 Fig. 4. *Hærnësia* cf. *bipartita* (Merian), rubber impression taken from natural mould (L. 63437).
 Fig. 5. *Hærnësia willbourni*, sp. n., holotype, rubber impression taken from natural mould (L. 63440).
 Fig. 6. *Gervillia* (*Langsonella*) *elongata* Mansuy (L. 63441).
 Figs. 7, 8. *Plicatula* (*Pseudoplicatunopsis*) cf. *carinata* Henloy, $\times 1\frac{1}{2}$ (L. 63445-6).
 Figs. 9, 10. *Grammatodon malayensis*, sp. n., holotype and paratype (L. 63425-6).
 Fig. 11. *Myophoricardium* cf. *lineatum* Wöhrmann (L. 63480).
 Figs. 12-17. *Myophoria* cf. *harpa* (Münster), plasticine impressions (except fig. 17) taken from natural moulds (L. 63450-5).
 Figs. 18-23. *Myophoria* cf. *chenopus* Laube, plasticine impressions taken from natural moulds (L. 63465-70).

XIX.—On the Liassic Brachiopod Genera *Orthoidea* and *Orthotoma*. By HELEN M. MUIR-WOOD, D.Sc., F.G.S.
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IN the course of research on the Zeilleriidae of the Lias it has been necessary to make a thorough examination of topotypes of *Orthoidea liasina*, the genotype of *Orthoidea*. Both genus and species were described by Friren in 1876 from the Middle Lias, *margaritatus* zone of Malroy, near Metz, and Montigny-les-Metz, France. There has been considerable difference of opinion about the affinities of this genus, and it has been placed in the families Orthidæ, Strophomenidæ, Terebratulidæ, and Zeilleriidae by various authors.

Friren (1876, p. 1, pl. i. figs. 1-6) describes his species as orthid-like, with the shell impunctate, and the shell-surface covered with numerous fine radiating striæ. The hinge-line is said to be straight, the larger valve alone having a triangular cardinal area, and no deltidium is

said to be developed. The beak is described as entire, and below it there is a large triangular delthyrium with a thickened margin, against which project two small ears from the right and left sides of the apex of the brachial valve. In the interior of the brachial valve no median septum is developed, but there is a median depression which appears as a ridge on internal casts. No brachial loop is preserved.

The absence of a median septum led Friren to believe, that no brachial loop could have been developed, and he consequently assigned his genus to the Strophomenidæ. Terquem examined Friren's specimens, and identified them as *Terebratula* [*Cincta*] *numismalis*, but did not publish any description of them. Friren, however, was not satisfied with this determination, although he admitted that the figures of a young specimen of *T. numismalis* given by Deslongchamps (1862, pl. xiii. figs. 1a, b, 2a, b) resembled his small shells from Malroy. This specimen of *T. numismalis* figured by Deslongchamps is 4 mm. in length, and has a convex pedicle valve and a flat brachial valve. Below the acute beak is an open triangular delthyrium. Deslongchamps stated that at a length of 7 or 8 mm. the beak was slightly truncated, and a rudimentary deltidium appeared at the base of the delthyrium. The deltidium is said to grow rapidly, and to be complete when the shell is 10-11 mm. in length. These growth-stages were unfortunately not figured by Deslongchamps, and Friren questioned the correctness of this description. In a series of growth-stages of *Orthoidea liasina*, Friren stated that the form of the beak and shape of the delthyrial opening did not vary in shells from 3-8 mm. in length. They could not, therefore, be identical with young shells of *T. numismalis*, as figured and described by Deslongchamps. In support of this, Friren remarked that adult shells of *T. numismalis* were not found in the *margaritatus* zone near Metz and that his specimens, 8 mm. long, appeared to be adult forms.

Haas and Petri (1882, p. 303, pl. xvii. figs. 12-14, 17) described and figured this species in their monograph of Jurassic Brachiopods of Alsace-Lorraine. Their figures are poor, and their description, beyond stating that the shell is punctate, is a repetition of that given by Friren.

In the synonymy they referred the young specimen of *T. numismalis* figured by Deslongchamps (1862, pl. xiii. figs. 1, 2) to Friren's species.

In 1884 Deslongchamps described various Brachiopod genera, and included some extremely caustic remarks about the work of Friren, and Haas and Petri. A series of early growth-stages of "*Terebratula*" *numismalis* was figured by Deslongchamps in this work, and he stated most emphatically that *Orthoidea liasina* was only an early growth-stage of *T. numismalis*.

Friren published further notes on *Orthoidea liasina* in 1887 (p. 73), and defended his species from Deslongchamps' attack, stating that he had sent specimens to Davidson, who regarded them as a remarkable form which he could not identify.

In spite of this second paper by Friren, Deslongchamps' opinion that *Orthoidea liasina* was only an early growth-stage of *Cincta numismalis*, and therefore a long-looped form, was accepted by Oehlert (1887), Hall and Clarke (1894), Marshall (1897), Schuchert (1913), and by Schuchert and Le Vene (1929).

Waagen (1884, p. 549), however, assigned the genus *Orthoidea* to the subfamily Orthinæ, and stated that the internal structure did not differ much from that of *Orthis*, but that the shell lacked radial striations. Rollier (1915, p. 46), on the other hand, placed *Orthoidea* with *Cadomella* in the Strophomenidæ, and in his discussion of the genus stated that no brachial loop was developed.

The only author who interpreted the genus *Orthoidea* correctly was Rau, who, in 1905, published descriptions of the Middle Lias Brachiopods of Swabia. In his description of *Orthotoma* sp., he pointed out the distinguishing characters of this form from *Orthoidea liasina*, which he obviously regarded as congeneric. . Rau investigated the internal structure of *Orthotoma*, and proved it to be a Terebratulid having a short loop, no dorsal median septum, and an acute umbo, below which is an open triangular delthyrium. The delthyrium is bordered by narrow deltidial plates. The pedicle valve is convex and the brachial valve flattened, while the anterior commissure is sulcate.

Investigation by the author of the internal characters of species of *Orthotoma* has shown that they correspond

perfectly with those of *Orthoidea*, and there is no doubt that the two genera are synonymous.

With regard to the systematic position of the genus *Orthotoma* (= *Orthoidea*) it is obviously impossible to place this genus in the family Terebratulidæ, the genera of which have a truncated umbo, a circular foramen, and fused deltidial plates, nor is it possible to assign this genus to any other family of the Terebratuloids.

It is necessary, therefore, to establish a new family belonging to the superfamily Terebratulacea, Division A, Terebratuloids (Schuchert & Le Vene, 1929). For this new family the name Orthotomidæ is proposed.

Superfamily TEREBRATULACEA Waagen, 1883.

Division A. TEREBRATULOIDS.

Family Orthotomidæ, nov.

Terebratuloids without median septa or dental lamellæ. Loop short, free. Hypothyrid. Adult shells with triangular delthyrium bordered by jugate deltidial plates below acute umbo.

Range.—Lias.

Remarks.—This family includes at present only the genus *Orthotoma* (= *Orthoidea*), and its relation to the other families of the Terebratulacea is uncertain. An open triangular delthyrium, imperforate beak, and jugate deltidial plates have not been observed so far in the Terebratulidæ, but careful examination of young growth-stages will possibly establish their existence. In species of *Cincta*, belonging to the Zeilleriidae, an open triangular delthyrium is seen in early growth-stages, but the deltidial plates are not jugate (figs. 7, 8). An imperforate beak is characteristic of the Stringocephalidæ, but the loop is of different form to that of *Orthotoma*.

Genus ORTHOTOMA Quenstedt.

Genotype.—*Terebratula heyseana* Quenstedt (non Dunker), 1869, pl. xlv. fig. 139 = *Orthotoma spinati* Rau 1905.

Orthotoma Quenstedt, 1869, pp. 315, 721.

Orthoidea Friren, 1876, p. 1.

Orthotoma Quenstedt : Dall, 1877, p. 53.

Orthoidea Friren : Dall, 1877, addenda p. 1; Haas & Petri, 1882, p. 303; Waagen, 1884, p. 549; Deslongchamps, 1884, pp. 171, 296; Friren, 1887, p. 73; Oehlert, 1887, p. 1318.

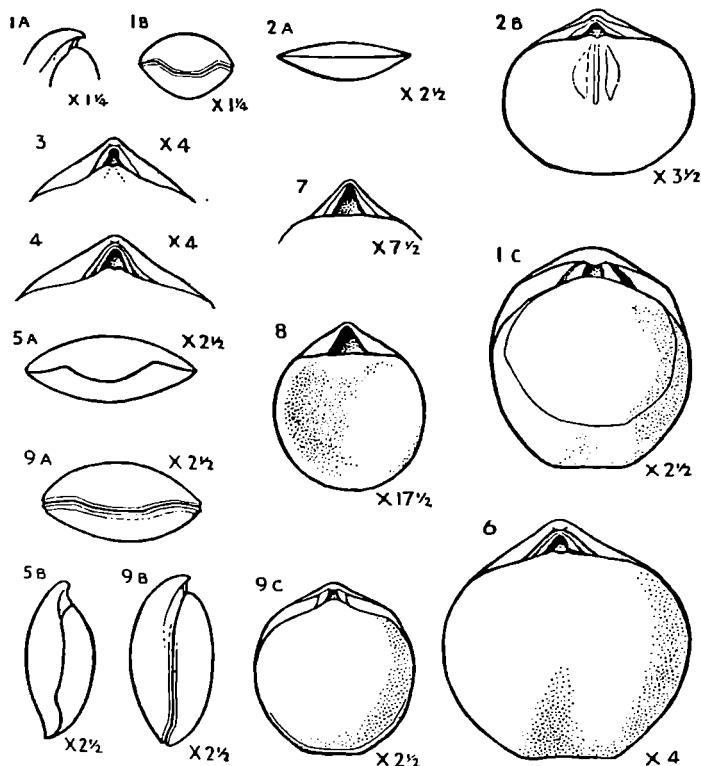
- Eudesia (Orthotoma)* Quenstedt : Oehlert, 1887, p. 1318.
Orthoidea Friren : Hall & Clarke, 1894, p. 887.
Orthotoma Quenstedt : Hall & Clarke, 1894, p. 885.
Eudesia (Orthotoma) Quenstedt : Schuchert, 1896, p. 332.
Orthoidea ? Friren : Schuchert, 1896, p. 332.
Orthotoma Quenstedt : Buckman, 1904, p. 389 ; Rau, 1905, p. 54 ; Schuchert, 1913, p. 406.
 ? *Orthoidea* Friren : Schuchert, 1913, p. 407.
Orthoidea Friren : Rollier, 1915, p. 46.
Orthotoma Quenstedt : Buckman, 1917, p. 96 ; Rollier, 1917, p. 179.
 ? *Orthoidea* Friren : Franceschi, 1921, p. 217.
Orthoidea Friren : Schuchert & Le Vene, 1929, p. 90.
Orthotoma Quenstedt : Schuchert & Le Vene, 1929, p. 92.

Diagnosis.—Shell biconvex in neanic stage becoming plano-convex to sulco-convex, circular to elongate-oval in outline, anterior commissure rectimarginate to sulcate. Umbo acute, tapering, suberect to incurved. Hypothyrid. Beak-ridges angular, defining concave triangular interareas. Triangular delthyrium bordered by jugate deltoidal plates. Cardinal process minute, projecting vertically as two small ears. Hinge-plates free, indistinguishable from inner socket-ridges. Loop terebratulid, extending for one-third of length of brachial valve. Dorsal adductor-scars trigonal in outline. Shell punctate.

Range.—Middle Lias, *margaritatus* and *spinatus* zones of Europe.

Species.—*Orthotoma liasina* (Friren) ; *O. quenstedti* S. S. Buckman (= *O. margaritatus* Rau) ; *O. solidorostris* Rau ; *O. spinatus* Rau ; *O. sp.* Rau ; ? *Orthoidea canavarii* Franceschi.

Discussion of Genotype.—The genus *Orthotoma* was defined by Quenstedt in 1869 (p. 315) in the middle of the description of the species *Terebratula heyseana* Dunker, and on p. 721 of the same work he said "*Orthotoma* . . . Zur Gruppe der *Terebr. Heyseana*." Quenstedt described more than one species as *T. heyseana*, and he was evidently aware that the forms he was describing might not be identical with Dunker's species, in which the beak-characters were insufficiently known. There is, however, no doubt about the identity of the genus *Orthotoma* from Quenstedt's description (1869), but his figures of *T. heyseana* on pl. xlv. figs. 139-142 represent three distinct congeneric species, none of which are *T. heyseana* Dunker. The specimen depicted as fig. 141 had already been figured by Quenstedt in 1852, pl. xxxvii. fig. 47, as *T. heyseana*.



Figs. 1 A-C.—*Orthotoma solidorostris* Rau. Lias δ oben, *spinatus* zone, Hechingen, Württemberg. B.M. [B. 90544].

Fig. 1 A.—Lateral view showing acute incurved umbo. $\times 1\frac{1}{4}$.

Fig. 1 B.—Anterior view of same specimen showing incipiently sulcate commissure. $\times 1\frac{1}{4}$.

Fig. 1 C.—Dorsal view of same specimen showing umbo incurved over jugate deltidial plates. $\times 2\frac{1}{2}$.

Figs. 2 A, B.—*Orthotoma liasina* (Fhren). Middle Lias, *margaritatus* zone, Malroy, near Metz. B.M. [B. 90538].

Fig. 2 A.—Anterior view showing plane commissure. $\times 2\frac{1}{2}$.

Fig. 2 B.—Dorsal view of same specimen showing jugate deltidial plates. The adductor muscle-scars are seen through the test. $\times 3\frac{1}{2}$.

Fig. 3.—*Orthotoma quenstedti* S. S. Buckman. Middle Lias δ , *margaritatus* zone, Goldbach, Gmünd, Württemberg. B.M. [B. 90541]. Dorsal view of umbonal region showing growth of deltidial plates medianly and decrease in size of delthyrium. $\times 4$.

Fig. 4.—*Orthotoma quenstedti* S. S. Buckman. Middle Lias δ , *margaritatus* zone, Salach, Württemberg. B.M. [B. 90546]. Dorsal

The specimens figured in 1852, pl. xxxvii. fig. 47, and in 1869, pl. xlv. fig. 139, represented Quenstedt's concept of the species *T. heyseana*, and fig. 139 was specially referred to in the description of the genus *Orthotoma*, and was apparently regarded as the typical form.

This insertion of *Orthotoma* with a hypothyrid beak in the middle of descriptions of species with epithyrid beaks led to considerable confusion in the interpretation of the genus.

The first author to quote a type for *Orthotoma* was Dall, who in 1877 mentioned it as a subgenus of *Terebratula* with "*Ter. heyseana*, Roemer, Verst. Nordl. Ool. 1836, p. 35, t. 12, f. 7," as type. As Roemer did not figure any specimen as *T. heyseana* this species cannot be accepted as genotype.

In 1894 (p. 885) Hall and Clarke mention *T. heyseana* Dunker as the type of *Orthotoma* without further comment, and the genus is placed with the Zeilleriids.

The next author to investigate the genus was S. S. Buckman, who, in 1904 (p. 389), stated erroneously that Quenstedt named *T. heyseana* Dunker as genotype of *Orthotoma*. As the form he figured was not Dunker's

view of umbonal region showing open triangular delthyrium and jugato deltidial plates having median sulcus. $\times 4$.

Figs. 5 A, B.—*Orthotoma quenstedti* S. S. Buckman. Middle Lias δ , Goldbach, Grönd. B.M. [B. 90543].

Fig. 5 A.—Anterior view showing sulcate commissure. $\times 2\frac{1}{2}$.

Fig. 5 B.—Lateral view of same specimen. $\times 2\frac{1}{2}$.

Fig. 6.—*Orthotoma quenstedti* S. S. Buckman. Same horizon and locality. B.M. [B. 90542]. $\times 4$. Dorsal view showing slightly incurved umbo and deep median sinus.

Fig. 7.—*Cincta* sp. Young specimen. Lower Lias, *ozynoti* zone, Aston Magna, Glos. B.M. [B. 90540]. $\times 7\frac{1}{2}$. Dorsal view of umbonal region showing open triangular delthyrium, truncated umbo, and separate deltidial plates, figured for comparison with *Orthotoma*.

Fig. 8.—*Cincta* sp. Very young specimen. Same horizon and locality as fig. 7. B.M. [B. 90539]. $\times 17\frac{1}{2}$. Specimen showing open triangular delthyrium, straight hinge-line, and concave dorsal valve.

Figs. 9 A-C.—*Orthotoma spinati* Rau. Lias δ oben, *spinatus* zone, Wilfingen, Württemberg. B.M. [B. 69737].

Fig. 9 A.—Anterior view showing slightly sulcate commissure. $\times 2\frac{1}{2}$.

Fig. 9 B.—Lateral view of same specimen. $\times 2\frac{1}{2}$.

Fig. 9 C.—Dorsal view showing slightly incurved umbo. $\times 2\frac{1}{2}$.

All specimens preserved in British Museum
(Natural History) collections.

species, Buckman stated that *T. heyseana* Quenstedt (non Dunker) was the genotype of *Orthotoma*. The specimen figured by Quenstedt in 1852, pl. xxxvii. fig. 47, as *T. heyseana* was renamed *Orthotoma quenstedti* by Buckman, and this species was selected by him as genolectotype. Unfortunately, Buckman's diagnosis of the genus was incorrect, as he regarded it as a Zeilleriid and described the long-looped species *T. anglica* Oppel, *T. reclusa* Quenstedt, and *Orthotoma toarciensis* S. S. Buckman as belonging to *Orthotoma*.

Rau (1905) gave an excellent description of *Orthotoma*, and figured four new species, *O. sp.*, *O. margaritati*, *O. spinati*, and *O. solidorostris* from the Lias δ of Swabia. The name *O. margaritati* was proposed for Quenstedt's specimen figured as *T. heyseana* in 1852, pl. xxxvii. fig. 47, and for the three forms figured in 1869, pl. xlv. figs. 141, 142, and ? 138. Buckman had already proposed the name *O. quenstedti* for this species, and *O. margaritati* Rau, therefore, is synonymous with *O. quenstedti*. The name *O. spinati* was proposed by Rau for the specimen figured by Quenstedt as *T. heyseana* in 1869, pl. xlv. fig. 139. The more massive form figured as *T. heyseana* in 1869, pl. xlv. fig. 140, was renamed *Orthotoma solidorostris*. No mention of genotype was made by Rau.

When Rau's paper was published in 1905 Buckman realized that his diagnosis of *Orthotoma* in 1904 was incorrect, and in 1917 he rectified this, giving a new diagnosis as a Terebratulid genus, and he selected *Orthotoma spinati* Rau as genotype. He made no reference, however, to his selection of *O. quenstedti* as genotype in 1904.

In 1929 Schuchert and Le Vene, in their revision of the Brachiopoda genera, accepted Buckman's opinion of 1917, and stated "Genotype (S. d. B.[uckman]): *Terebratula heyseana* Quenstedt (non Dunker), 1868; Petref. pl. xlv. fig. 139 = *O. spinati* Rau, 1905, Brach. Mittl. Lias Schwabens, p. 54."

After careful consideration of Quenstedt's description and figures, and the work of subsequent authors on the genus *Orthotoma*, it is proposed to adopt the species *O. spinati* Rau, 1905, as genotype. There is considerable doubt from Quenstedt's drawings as to whether the specimen figured as *Terebratula heyseana* in 1852, pl. xxxvii. fig. 47, and refigured in 1869, pl. xlv. fig. 141, has a hypo-

thyrid beak. Quenstedt himself stated that it lacked the opening below the umbo, and that it appeared to have discrete deltidial plates. As this specimen is not preserved in the Quenstedt collection at Tübingen University, the specimen regarded as typical of *Orthotoma heyseana* by Quenstedt and renamed *O. spinati* by Rau is selected as genotype. The lectotype of this species is preserved at Tübingen.

Remarks.—Species of *Orthotoma* are readily distinguished by their hypothyril beak, triangular delthyrium, and jugate deltidial plates, as well as by their internal characters.

The name *Orthotoma* was given by Quenstedt to this genus on account of its straight hinge-line.

Dunker's species *T. heyseana* was described from the Belemniten-schichten [Lias γ] of Hainberg, Göttingen, Hanover. It was obtained, therefore, from a lower zone than species of *Orthotoma*, which only occur in the Lias δ = *margaritatus* and *spinatus* zones of the Middle Lias. The shell corresponds in general form with species of *Orthotoma*, but is broader than the specimens figured by Quenstedt. Examination of topotypes in the Mantell collection, British Museum (Nat. Hist.) [B. 90569–70] has shown that the shell has a long loop and a median septum in the brachial valve, and is, therefore, a Zeilleriid and distinct form *Orthotoma*. These specimens may be metatypes, as they have an original label in Latin with a reference to Dunker's paper in 'Palæontographica,' i., and they correspond very well with Dunker's original figures.

A specimen figured by Roemer in 1836 as *T. resupinata* Sowerby, from Hainberg, was identified by Quenstedt in 1852 as belonging to *T. heyseana* Dunker.

Further confusion about Dunker's species was caused by Oppel (1856, p. 304), who mentioned *T. bakeriæ* Dav. and *T. heyseana* Quenstedt, 1852, pl. xxxvii, fig. 47, in the synonymy of *T. heyseana* Dunker.

The small sulcate shells with epithyrid beak described by Deslongchamps in 1863 (pl. xxiv, figs. 1–5) as *T. (Waldheimia) heyseana* were redescribed in part by Quenstedt as *Terebratula reclusa*. The latter species was described erroneously by Buckman in 1904 as an *Orthotoma*.

Franceschi's species *O. canavarii* (1921, pl. i, fig. 2), from the Middle Lias of the Central Apennines, is doubt-

fully referred to *Orthotoma*. The species *Leptæna apenninica*, also described from the Middle Lias by Canavari (1884) and referred to the genus *Orthoidea* by Bittner in 1890 (p. 308), appears to have an epithyrid beak.

Rollier (1917, p. 179) gave a correct description of the genus *Orthotoma*, and separated it from *Terebratula*, placing it in a separate family, which is described as "Famille inconnue." He described the species "*Terebratula*" *heyseana* Dunker and *T. globulina* Dav. as belonging to *Orthotoma*, the former, however, is a Zeilleriid and the latter is a Terebratulid with an epithyrid umbo.

Buckman's diagnosis of this genus in 1917 (p. 96) does not refer to internal characters, but stated "morphogeny, biconvex to sulcate—liothyridina passing to *centronella* stage." This statement is open to criticism, since there is no proof that the loop in *Orthotoma* passes through a *centronella*-stage. The shell is certainly convex in early growth-stages and sulcate in later stages, but this cannot be taken as evidence of affinity with *Centronella*. The *centronella*-stage is an early stage of loop-development in many Terebratulids and in primitive Spiriferids.

Buckman pointed out that there are at least three homœomorphous stocks with sulcate anterior commissures in the Lias, (1) short-looped forms which are hypothyrid (*Orthotoma*), (2) short-looped forms which are not hypothyrid (? gen. nov.), (3) long-looped forms which are not hypothyrid (gen. nov.).

The following species have been incorrectly referred to the genus *Orthotoma* by various authors :—

Terebratula globulina Dav. Terebratulid.

—— *bakeriæ* Dav. Terebratulid.

—— *heyseana* Dunker. Zeilleriid.

—— *reclusa* Quenstedt. Zeilleriid.

—— *anglica* Oppel. *Cincta*.

Orthotoma toarciensis S. S. Buckman. Zeilleriid.

None of these species, with the exception of *T. anglica*, can be referred to existing genera, but the Zeilleriid forms will be examined and described in the near future by the author. Internal casts and transverse sections of specimens of *T. anglica* Oppel, from the Lower Inferior Oolite, show that this species belongs to the Liassic genus *Cincta*.

DESCRIPTION OF SPECIES.

Orthotoma liasina (Friren).

(Figs. 2 A, B, 10, 16.)

Orthoidea liasina Friren, 1876, p. 1, pl. i. figs. 1-6; Haas & Petri, 1882, p. 303, pl. xvii. figs. 12-14, 17; Friren, 1887, p. 73; Rau, 1905, p. 56; Rollier, 1915, p. 46.

Diagnosis.—*Orthotoma*, about 6 mm. long, 6 mm. wide, 2.5 mm. thick, circular in outline, plano-convex in all growth-stages. Anterior commissure incipiently sulcate. Lateral commissure vertical. Umbo sub-erect.

Type-specimen.—The specimen figured by Friren in 1876, pl. i. figs. 2-4, from the Middle Lias, *margaritatus* zone, Malroy, near Metz, is hereby selected as lectotype.

Horizon and Locality.—Middle Lias, *margaritatus* zone of Malroy, near Metz, on the banks of the Moselle, and of Montigny-les-Metz. Topotypes are preserved in the Davidson collection, British Museum (Nat. Hist.) [B. 90550-9, B. 90537-8, B. 90705]. One specimen in the Davidson collection from Vassy, ? Calvados, France [B. 6587].

Dimensions.—Specimen no. [B. 90550]. Maximum length 6.8 mm., maximum width 6.9 mm., maximum thickness 2.6 mm., or 1 : 1.01 : 0.38.

Description.—The hinge-line is straight and is slightly less wide than the maximum width of the shell. The pedicle valve is convex in all growth-stages, and the brachial valve flat or very slightly convex. The umbo is frequently imperfect and the acute apex missing. The beak-ridges are angular and the concave interareas are well demarcated. The narrow jugate deltidial plates are slightly elevated above the level of the interareas and border the triangular delthyrium. The two lobes of the cardinal process project beyond the anterior margin of the delthyrium as two small ears. The shell-surface is ornamented by very fine striæ.

Internal casts preserved in limonite or iron pyrites show a narrow median ridge corresponding to a median cavity in the brachial valve, on each side of which are the dorsal adductor muscle-scars, which are triangular in outline, with the outer margin curved. The shape of the scars in the pedicle valve is somewhat obscure, but they are posteriorly placed. Traces of vascular sinuses are frequently seen in the brachial valve from the lateral

and anterior margins of the adductor scars (fig. 10). The cardinal process, hinge-plates, etc. (fig. 16), are similar in form to those described in *O. spinati*. The loop is usually poorly preserved.

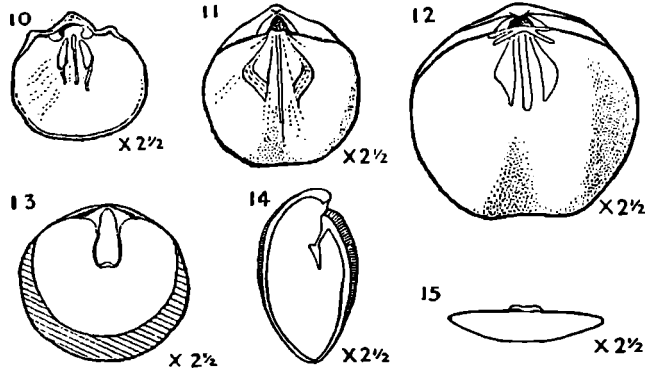


Fig. 10.—*Orthotoma liasina* (Friren). Middle Lias, *margaritatus* zone. Malroy, near Metz. B.M. [B. 90537]. $\times 2\frac{1}{2}$. Natural internal cast showing adductor muscle-scars and vascular sinuses. The ridge on the cast corresponds to a sulcus in the interior of the valve.

Fig. 11.—*Orthotoma quenstedti* S. S. Buckman. Lias δ , *margaritatus* zone, Salach, Württemberg. B.M. [B. 90545]. $\times 2\frac{1}{2}$. Dorsal view of artificially prepared internal cast showing adductor muscle-scars and vascular sinuses.

Fig. 12.—*Orthotoma solidorostris* Rau. Lias δ oben, *spinatus* zone, Ohmenhausen, Württemberg. B.M. [B. 90549]. $\times 2\frac{1}{2}$. Dorsal view of artificially prepared internal cast showing adductor muscle-scars.

Fig. 13.—*Orthotoma spinati* Rau. Lias δ oben, *spinatus* zone, Hechingen, Württemberg. B.M. [B. 90678]. $\times 2\frac{1}{2}$. Specimen from which pedicle valve has been removed and brachial loop dissected out in dorsal valve. Cardinal process not preserved. Exterior of shell ruled.

Fig. 14.—*Orthotoma spinati* Rau. Same horizon and locality as 13. B.M. [B. 90676]. $\times 2\frac{1}{2}$. Specimen ground longitudinally to show lateral view of brachial loop.

Fig. 15.—*Orthotoma spinati* Rau. Same horizon and locality as fig. 13. B.M. [B. 90677]. $\times 2\frac{1}{2}$. Umbo of brachial valve showing two lobes of cardinal process projecting ventrally. These lobes appear at base of delthyrium in fig. 11.

All specimens preserved in the British Museum
(Natural History) collections.

Remarks.—This small species is at present only known from the Middle Lias of three localities in France.

Friren (1876) figured two specimens of *Orthoidea* (= *Orthotoma*) *liasina*, one of which is an internal cast.

The specimen depicted as figs. 2-4, and selected as lectotype, was reproduced by Haas and Petri in 1882, pl. xvii, figs. 14 A, B.

Orthotoma quenstedti S. S. Buckman.

(Figs. 3, 4, 5 A, B, 6, 11, 17.)

Terebratula heyseana Dunker : Quenstedt, 1852, p. 471, pl. xxxvii. fig. 47.

Terebratula cornuta Sowerby : Quenstedt, 1856, p. 180, pl. xxii. figs. 19, 20.

Terebratula heyseana Dunker : Quenstedt, 1869, p. 314, pl. xlv. fig. 141.

Orthotoma quenstedti S. S. Buckman, 1904, p. 391.

Terebratula (Orthotoma) margaritai Rau, 1905, p. 56, pl. iii. figs. 37-43; text-figs. 3 a-g.

? *Orthotoma amalthæi* Rau, 1905, p. 83 (name only).

Orthotoma quenstedti S. S. Buckman, 1917, pp. 97, 234, pl. xx. fig. 35.

Orthotoma margaritai Rau : S. S. Buckman, 1917, p. 97 (name only).

Orthotoma margaritata Rau : Rollier, 1917, p. 180.

Diagnosis.—*Orthotoma*, about 8 mm. long, 8 mm. wide, and 3 mm. thick, moderately biconvex in early growth-stages, becoming plano-convex to concavo-convex. Circular in outline. Anterior commissure sulcate. Lateral commissure slightly bowed. Umbo suberect.

Type-specimen.—Holotype, the specimen figured by Quenstedt in 1852, pl. xxxvii. fig. 47, as *Terebratula heyseana* from the Upper Lias of Hinterweiler, Württemberg. This specimen has not been identified in the Quenstedt Coll. in the Geological-Palæontological Institute of the University of Tübingen, Württemberg.

Horizon and Locality.—Middle Lias δ , *margaritatus* zone of Württemberg. Specimens are preserved in the British Museum (Nat. Hist.) from Salach [B. 90545-8]; and Goldbach, Gmünd [B. 90648-9, B. 90704, B. 90541-3].

Dimensions.—Brit. Mus. [B. 90546]. Maximum length 8.5 mm., maximum width 8.3 mm., maximum thickness 3.3 mm. or 1 : 0.97 : 0.38.

Description.—The hinge-line is slightly curved, and the maximum width occurs about midway between the posterior and anterior extremities. The pedicle valve is subcarinate umbonally, then becomes convex with the development of a low rounded median fold anteriorly. The brachial valve is slightly convex near the umbo, then flattens, and a median sinus, increasing in width and depth anteriorly, is developed about 4 mm. below the umbo. The beak-ridges are angular, and are traceable to the

postero-lateral slopes. The interareas are small and slightly concave, and are separated from the jugate deltidial plates by a sulcus.

Growth-lines are prominent on the anterior portion of the shell, and fine radial striæ are frequently observed.

Internal Characters.—An artificially prepared internal cast showed the trigonal adductor muscle-scars of the brachial valve and vascular sinuses well preserved. The scars are separated by a narrow median ridge. Vascular sinuses are given off from the anterior and lateral extremities of the scars (fig. 11).

Transverse sections (fig. 17) showed similar internal characters to those described in *O. spinati*.

Remarks.—*Orthotoma quenstedti* is distinguished from *O. spinati* by the greater sulcation of the brachial valve and by its more erect and tapering umbo.

Buckman's species, *O. quenstedti*, with *Terebratula heyseana* Quenstedt (non Dunker), 1852, pl. xxxvii. fig. 47, as holotype, is synonymous with *O. margaritai* described by Rau a year later (1905).

Buckman, in 1917 (p. 234, pl. xx. fig. 35), stated that Rau (1905) had figured a broad and narrow form as *O. margaritai*, but that the narrow form only could be called *O. margaritai* as the broad form had been described by Buckman in 1904 as *O. quenstedti*. As the "broad and narrow forms" alluded to by Buckman are only small variations of one species it is proposed to retain the name *O. quenstedti* for both forms. Buckman (1917, pl. xx. fig. 35) figured one of Rau's syntypes of *O. margaritai* from the Lias δ mitten, of Eislingen, Württemberg. The lectotype of *O. quenstedti* has unfortunately not been identified in the Quenstedt collection at Tübingen, and there is a distinct doubt as to whether Quenstedt's specimen is really an *Orthotoma*. It may therefore be necessary in the future to redefine Rau's species, and to assign *Orthotoma quenstedti* to the Zeilleriidae.

Rau described his species from the upper part of the *margaritatus* zone, Middle Lias δ , of Balingen and Gmünd, Württemberg, and gave excellent figures of this form. On p. 83 of the same work Rau referred to *Orthotoma amalthei* as occurring in the Lias δ mitten. No other reference is made to this species, and it appears to be quoted erroneously instead of *O. margaritai*.

Fig. 16.

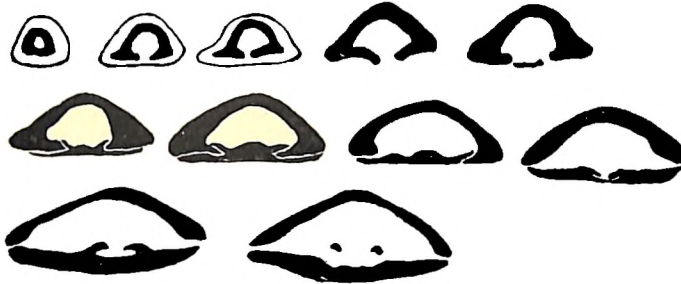


Fig. 17.

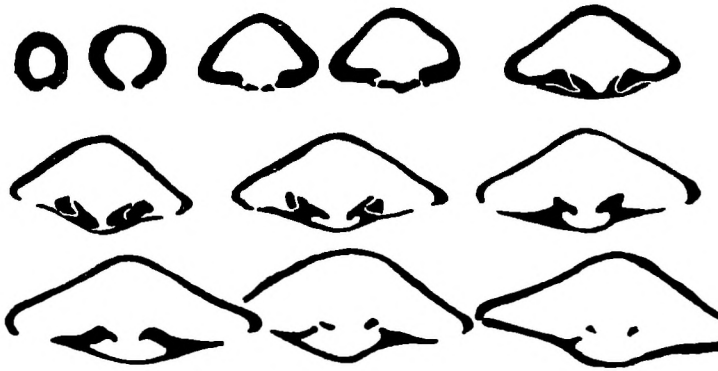


Fig. 16.—*Orthotoma liasina* (Freren). Eleven transverse sections* through the umbones at distances of 0.1 mm. to 0.3 mm. apart, showing the shell somewhat imperfectly preserved in iron pyrites. Middle Lias, *margaritatus* zone, Malroy, Motz. B.M. [B. 90705]. $\times 5$.

Fig. 17.—*Orthotoma quenstedti* S. S. Buckman. Eleven successive transverse sections* through the umbones at distances of 0.1 mm. to 0.3 mm. apart. The cardinal process is seen in sections 3 and 4, and the slightly inclined hinge-plates in sections 5-8. The loop appears in sections 10 and 11. Lias δ , *margaritatus* zone, Goldbach, Gründ, Württemberg. B.M. [B. 90704]. $\times 5$.

* A full description of the method employed and of the structures seen in the transverse sections is given by the author in Philos. Trans. London, ser. B, cccxiii. no. 505 (1934).

Quenstedt, in 1856 (pl. xxii. figs. 18–21), figured four small specimens as young examples of *Terebratula cornuta* from the Lias δ . Of these, figs. 19, 20 were referred by Rau (1905) to the species *Orthotoma margaritati* (= *O. quenstedti*).

The specimen figured by Quenstedt in 1852, pl. xxxvii. fig. 47, as *T. heyseana* is said by that author to be refigured in 1869, pl. xlv. fig. 141. It is doubtful whether Quenstedt's specimen depicted as fig. 138 of pl. xlv. as *Terebratula heyseana* can be ascribed to the genus *Orthotoma*. Rothpletz (1886, p. 127) compared his species *Waldheimia frontensis* with *W. heyseana* Deslongchamps (non Dunker) [= "*Zeilleria*" *reclusa* Quenst.], and referred Quenstedt's specimen figured in 1869, pl. xlv. fig. 138, to Deslongchamps' species.

Orthotoma solidorostris Rau.

(Figs. 1 A–C, 12, 18.)

Terebratula cornuta Sowerby : Quenstedt, 1856, p. 180, pl. xxii. fig. 18.

Terebratula heyseana Dunker : Quenstedt, 1869, p. 314, pl. xlv. fig. 140.

Terebratula (Orthotoma) solidorostris Rau, 1905, p. 58, pl. iii. figs. 52–61.

Orthotoma solidorostris Rau : Buckman, 1917, p. 97, pl. xix. fig. 29 ; Rollier, 1917, p. 180.

Diagnosis.—*Orthotoma*, about 11 mm. long, 10 mm. wide, and 7 mm. thick, circular to elongate-oval in outline, biconvex-globose becoming plano-convex in gerontic stage. Anterior commissure incipiently sulcate. Lateral commissure flexuous. Umbo incurved, partially concealing delthyrium.

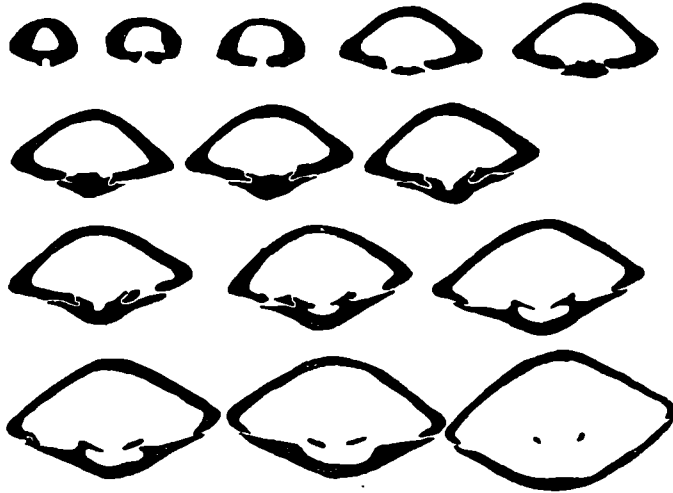
Type-specimen.—The specimen figured by Quenstedt in 1869, pl. xlv. fig. 140, as *Terebratula heyseana*, Lias δ oben, *Leptaena* Bed, is hereby selected as lectotype. This specimen is preserved in the Geological-Palæontological Institute of the University of Tübingen, Württemberg.

Horizon and Locality.—Middle Lias, *spinatus* zone = Lias δ oben, *Leptaenenschicht* of Württemberg. Specimens are preserved in the British Museum (Nat. Hist.) from Boll [B. 90647] ; Eislingen [B. 90642, 90702] ; Hechingen [B. 90640–41, B 90544] ; Ohmenhausen [B 90549] ; Wilfingen [B. 90643] ; Zell [B. 90644–46].

Dimensions.—Lectotype. Maximum length 10·8 mm., maximum width 10·7 mm., maximum thickness 7·4 mm., or 1 : 0·99 : 0·68.

Description.—The hinge-line is gently curved, and the greatest width of the shell occurs at about one-third of the distance from posterior to anterior extremity. The pedicle valve is subcarinate posteriorly, becoming convex about 3 mm. below the umbo. The brachial valve is globose posteriorly, but flattens in the gerontic stage. The angular beak-ridges converge towards the shell-margin and disappear on the postero-lateral slopes. The

Fig. 18.



Orthotoma solidorostris Rau. Fourteen transverse sections through the umbones at distances of 0.1 to 0.3 mm. apart. The cardinal process is seen in sections 4-7, and the highly inclined hinge-plates in sections 8-12. The brachial loop appears as two dots in the last section, at a distance of 2 mm. from the first section. Lias δ , spinatus zone, Eisligen, Württemberg. B.M. [B. 90702]. $\times 3\frac{1}{2}$ approx.

jugate deltidial plates are demarcated from the interareas by a deep sulcus running parallel to the outer margin of each deltidial plate. The umbo is acute, tapering and incurved. Growth-lines are prominent anteriorly, and the shell is thickened along the anterior commissure. No radial striæ were observed.

Internal Characters.—Transverse sections of this species (fig. 18) show that the shell is thickened with callus

posteriorly in both valves. The cardinal process is medianly sulcate and short postero-anteriorly. The hinge-plates are scarcely differentiated from the inner socket-ridges and extend dorsally at an angle of about 25° to the horizontal.

The adductor muscle-scars of the brachial valve are trigonal in outline, with the inner margins parallel, and tapering to an acute extremity anteriorly. The scars are 4 mm. long in a brachial valve 10 mm. in length (fig. 12).

Remarks.—*Orthotoma solidorostris* is distinguished from *O. spinati* and *O. quenstedti* by its slightly larger dimensions, greater convexity of both valves, and more tapering and incurved umbo.

Rau (1905) figured this species from Wilflingen, Geislingen, and Balingen in Swabia, but he did not select a type.

The specimen figured by Quenstedt in 1856 (pl. xxii. fig. 18) as a young example of *Terebratula cornuta* from the Lias δ was referred to the species *O. solidorostris* by Rau.

Examination of Quenstedt's specimen (the lectotype) has shown that it agrees perfectly in form and dimensions with the specimens figured by Rau from Swabia.

Orthotoma spinati Rau.
(Figs. 9 A–C, 13–15.)

Terebratula heyseana Dunker: Quenstedt, 1869, p. 314, pl. xlv. fig. 139.

Terebratula (Orthotoma) spinati Rau, 1905, p. 57, pl. iii. figs. 44–51; text-figs. 3 h–l.

Orthotoma spinati Rau: S. S. Buckman, 1917, p. 96, pl. xix. fig. 28.

Orthotoma spinata Rau: Rollier, 1917, p. 180.

Diagnosis.—*Orthotoma*, about 7.5 mm. long, 7 mm. wide, and 4 mm. thick, elongate-oval in outline, biconvex becoming plano-convex. Anterior commissure sulcate. Lateral commissure gently waved. Umbo tapering, slightly incurved.

Type-specimen.—The specimen figured by Quenstedt as *Terebratula heyseana* in 1869, pl. xlv. fig. 139, from the upper Lias δ was selected as lectotype by S. S. Buckman in 1917. This specimen is preserved in the Quenstedt collection, Geological-Palaeontological Institute of the University of Tübingen, Württemberg.

Horizon and Locality.—Middle Lias, *spinatus* zone = Upper Lias 8, Leptaenenschicht of Württemberg. Specimens are preserved in the British Museum (Nat. Hist.) from Zell (B. 90650–51); Wilflingen (Rau coll.) [B. 69737]; Hechingen [B. 90676–8].

Dimensions.—Lectotype. Maximum length 9.7 mm., maximum width 8 mm., maximum thickness 4.9 mm., or 1 : 0.82 : 0.50.

Description.—The hinge-line is gently curved and is approximately equal to the greatest width of the shell. The brachial valve is moderately convex posteriorly, but is flattened about 3 mm. from the umbo. The pedicle valve is subcarinate posteriorly, but becomes convex in the ephebic stage.

Growth-lines are prominent anteriorly, but no radial striae were observed.

Internal Characters.—Investigation of the interior of the brachial valve has shown that in a specimen having a brachial valve 7.5 mm. in length the loop was 2.5 mm. in length. In a brachial valve 7.6 mm. in length the loop was found to be 2.3 mm. in length. The loop is Terebratulid in outline with the curved descending branches flattened dorso-ventrally, and appearing thread-like in dorsal view. The transverse band is broad and projects ventrally slightly above the level of the descending branches.

The longitudinal sections parallel to the plane of symmetry of the shell show that the crura supporting the loop are 1.25 mm. in length (fig. 14).

The cardinal process is narrow postero-anteriorly and projects posteriorly as two small lobes into the cavity of the pedicle valve. The hinge-plates are fused with the inner socket-ridges and are inclined dorsally at an angle of about 33° to the horizontal. The teeth are small and tapering, and deeply inserted into the narrow sockets. The crural bases project anteriorly in the same plane as the hinge-plates. Transverse sections showed a similar internal structure to that figured in *O. quenstedti* and *O. solidorostris*.

Remarks.—*O. spinati* is distinguished from *O. solidorostris*, by its less globose shell and less incurved beak, and from *O. quenstedti* by the non-development of a sulcus in its brachial valve.

Rau (1905) described this species from the "Costaten schicht" and Leptaenenschicht of Wilfingen, Swabia, and figured the loop and an enlargement of the jugate deltidial plates and beak of the brachial valve in this species.

Buckman (1917) figured much enlarged beaks of specimens of *Orthotoma spinati* and *O. solidorostris* for comparison with the beaks of *Zeilleria*, *Epithyris*, *Homœorhynchia*, etc.

SUMMARY.

Investigation of the internal, as well as of the external, characters of *Orthoidea liasina* Friren, the genotype of *Orthoidea* (1876), has shown that it belongs to the Terebratuloids, and not to the Terebratellids, as has been generally accepted. The internal structure as well as the external characters, hypothyril beak-ridges, jugate deltidial plates, etc., of this genus have proved to be similar to those of *Orthotoma* Quenstedt (1869), and *Orthoidea* is therefore synonymous with *Orthotoma*. The affinities of this genus have been discussed and a new family, Orthotomidæ, belonging to the superfamily Terebratulacea, division Terebratuloids, has been created. The genotype of *Orthotoma* has been discussed and the four species, *Orthotoma liasina* Friren, *O. quenstedti* S. S. Buckman, *O. solidorostris*, and *O. spinati* Rau, have been diagnosed and figured. Transverse sections of *Orthotoma liasina*, *O. quenstedti*, *O. solidorostris*, and *O. spinati* show the similarity in the internal structure, and artificially prepared internal casts of three of the species show similarly placed dorsal adductor muscle-scars.

I am much indebted to Professor Baron von Huene for the loan of two of the specimens figured by Quenstedt as *Terebratula heyseana* in 1869. The remaining specimens figured by Quenstedt as *T. heyseana* cannot at present be found in the Geological-Palæontological Institute of the University of Tübingen, Württemberg.

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XX.—*Insects of the New Hebrides : Chrysomelidæ.*

By G. E. BRYANT, F.R.E.S.

AMONG the Coleoptera collected by Miss L. E. Cheesman in the New Hebrides in 1929–30 there are 570 specimens of Chrysomelidæ, representing 38 species, of which I now describe 14 new species.

The various subfamilies are represented as follows :—

Cryptocephalinæ.....	1 species.
Eumolpinæ	16 „
Chrysomelinæ	1 „
Halticinæ	11 „
Galerucinae	7 „
Hispinæ	2 „

No species of the subfamilies Criocerinae, Clytrinae, and Cassidinae were met with. The number of new species is greater than 14, as there are many very obscure Eumolpinæ, represented in some cases by single specimens, which I have not dealt with. In all probability 23 out of the 38 species are new. The types of the new species are in the British Museum.

Ten of the previously described species occur in neighbouring groups of islands—Fiji, Samoa, and New Caledonia.

Halica corrusca Er. and *Aulacophora similis* Ol. have a wide distribution.

CRYPTOCEPHALINÆ.

Pycnophthalma ænea, sp. n.

Upperside metallic bronze-green; underside pitch-black, clothed with short grey pubescence. Legs and

THE ANNALS
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XV.—*The African Species of Teleasinae (Hym., Proctotrupoidea, Fam. Scelionidae).* By G. E. J. NIXON, B.A.,
Department of Entomology, British Museum (Natural History).

[Concluded from p. 141.]

9. *Hoplogryon schæneus*, sp. n.

♀.—Black, with the legs reddish brown. A stout medium-sized species.

Head a little, but quite obviously, wider than the thorax, about 21 : 20 (figs. 1 *d*, 7 *e*). There is no trace of a ridge between the anterior ocellus and the antennal insertions. Frons in greater part entirely smooth and shining; immediately in front of, and to the sides of, the anterior ocellus, the surface becomes finely punctate, the punctures close, not sharp, and the surface between them finely alutaceous. Vertex between the ocelli as closely punctured as possible, but the surface appearing dull. Posterior (declivous) part of the vertex more or less finely rugulose with a tendency towards an aciculate condition. Eyes bare. Antennæ (fig. 2 *e*): when the head is seen from the side, the scape does not reach by a considerable distance to the level of the top of the eye; funicle 1 about $1\frac{1}{2}$ times longer than wide; 2 hardly longer than wide; 3 and 4 strongly transverse; club clearly 6-segmented.

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