AUSTRALOSUTURA GEN. NOV. (TRILOBITA) FROM THE CARBONIFEROUS OF AUSTRALIA AND ARGENTINA

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ABSTRACT. A revised description of the Carboniferous trilobite *Cordania gardneri* Mitchell 1922 is given, based on some topotype material from Australia, and new material from Argentina. The species is assigned to a new genus *Australosutura* Campbell and Goldring 1960.

LOCATION AND STRATIGRAPHY OF MATERIAL FROM AUSTRALIA

Australosutura gardneri was first described by Mitchell (1922, p. 536) from the shore of Lake Boolambayt, one of the Myall lakes north of Newcastle, New South Wales. The stratigraphy of this area is still poorly known, though it is being studied at the present time. The specimens of *A. gardneri* occur in a richly fossiliferous bed an unknown interval (some hundreds of feet at least) above a very prominent sandstone containing the brachiopod *Marginirugus barringtonensis alatus* Campbell 1956, which is considered to be of Lower Viséan age. Fortunately the species is known from two other New South Wales localities where the stratigraphy has been more adequately studied; the Barrington area (Voisey 1940), and the Booral area (Osborne 1950); the successions in these areas have been re-examined recently, and the results are set out in the accompanying columns (text-fig. 1).

In all three areas *A. gardneri* is associated with a very distinctive fauna dominated by the productid *Levipustula* Maxwell 1957 and an undescribed acrospiriferid. However, though all three faunas have many elements in common and are quite distinct even at the generic level from the earlier Carboniferous faunas, they are not identical, and it is possible that they are only approximately contemporaneous.

The *Levipustula* fauna is also very prominent in Queensland where it occurs extensively in the Neerkol mudstones which overlie the late Viséan limestones of the Rockhampton Series of the Rockhampton area, and the Turner Creek Clastics of the Mt. Morgan area, the upper parts of which are Viséan (Hill 1934; Maxwell 1954). The Neerkol mudstones are generally considered by Queensland geologists to be of Muscovian age. Study of the brachiopods, bryozoa, and molluscs of the *Levipustula* faunas of the three New South Wales localities indicates a Westphalian age and hence broadly confirms the Queensland determination. A systematic study of the fauna is to be published shortly.

The most significant fossils for the determination of age are: Spirifers similar to the Pennsylvanian *Neospirifer triplicatus* (Hall); *Lissochonetes*, which is known only from post-Viséan deposits elsewhere; *Levipustula*, which is common in the Westphalian of western Europe, but is not yet known from elsewhere; *Limipecten*, which, although it is known from the Viséan of western Europe, does not appear until the Upper Carboniferous elsewhere in the world. None of the associated fifteen genera of fossils, many of them endemic, suggests an earlier age. K. S. W. C.

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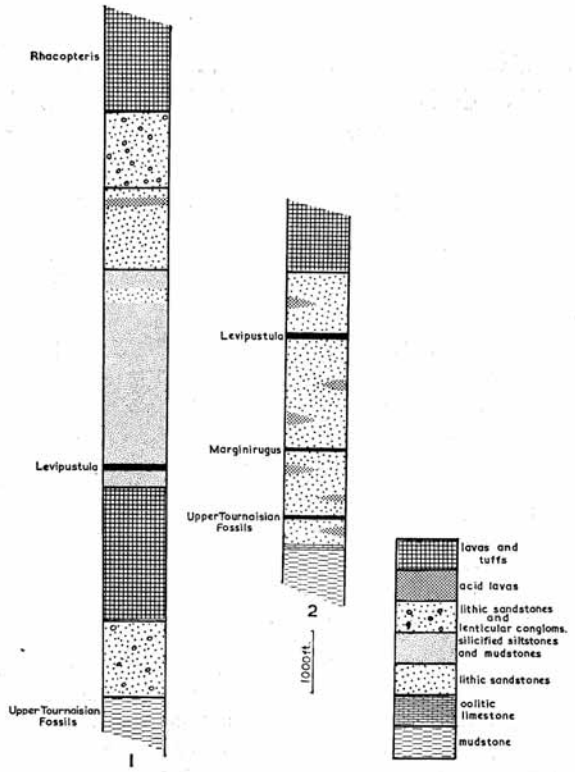

TEXT-FIG. 1. (1) Generalized stratigraphic succession east of the township of Booral on the south-eastern side of the Gloucester trough, New South Wales. (2) Generalized stratigraphic succession between Barrington and the Gloucester River, on the north-eastern side of the Gloucester trough, New South Wales.

LOCATION AND STRATIGRAPHY OF MATERIAL FROM ARGENTINA

The specimens from Argentina came from three localities in the west of the Province of Chubut: (1) La Carlota, about 8 km. south-east of Tecka, (2) Cerro Mina, east of Sierra de Languineo and 75 km. east of Tecka, and (3) Sierra de Tepuel, about 25 km. south of Tecka. At these three localities the trilobites were found in silicious nodules at the top of the lower section of the 5,200 m. of Upper Palaeozoic sediments exposed in the Sierra de Tepuel, Sierra de Languineo, and Sierra de Tecka of Suero's (1948, 1953) 'Tepuel System'.

The lower section, 3,200 m. thick, consists of glacimarine conglomerates together with sandstones, quartzites, and greywackes with intercalated shales. The upper section,

2,000 m. thick, differs from the lower by the absence of glacial conglomerates and greywackes, but includes micaceous sandstones and shales with well-preserved plant remains.

The lower section has yielded brachiopods, pelecypods, bryozoans, gastropods, conulariids, corals, and fish scales. The upper section has also yielded brachipods including *Levipustula*, and the brachiopods from both sections are now being studied (Amos, in press). In the upper section goniatites have been found. Miller and Garner (1953, p. 821) described *Anthracoceras? argentinense* Miller and Garner 1953 and *Eoasianites sp. A.? argentinense*, although found at La Carlota together with the trilobites, was not found *in situ* but came from a pebble of dark limestone. Curiously no limestone beds are exposed in the neighbourhood and possibly the pebble came from a bed no longer exposed. Miller and Garner gave the age of the goniatites as Middle Pennsylvanian (Westphalian). Amos considers the age of the lower section to be Viséan on brachiopod evidence.

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DESCRIPTION

Family BRACHYMETOPIDAE Prantl and Přibyl 1950 emended Hupé 1955

AUSTRALOSUTURA gen. nov.

Type species *Cordania gardneri* Mitchell 1922

Derivation of name. From the southern hemisphere, and with facial sutures.

Range. Carboniferous. The age of the beds in which the trilobites occur is not known with certainty either in New South Wales or in Argentina. Although it is suggested that the age of the beds in Argentina is Viséan it is thought that the age of the beds in Australia is Westphalian. Further research may produce more conclusive data for the age determination in both countries.

Distribution. New South Wales, Burindi, and Kuttung Series; Argentina, top of lower section of 'Tepuel System'.

Diagnosis. Cephalon and glabella strongly inflated. Glabella subcylindrical with prominent, subtriangular basal lobes and deep glabellar furrows 1p. Glabellar furrows 2p clear. Preglabellar field short and high. Very broad, concave, and pitted border furrow preceded by short convex border. Sublunate, strongly convex eyes. Long genal spines. Facial suture curves strongly away from eye. β on crest of border and ω just inside genal spines. Surface of cheek area, preglabellar field, glabella and occipital ring with numerous tubercles. Thorax of nine tuberculate segments. Pygidium with fifteen rings and nine (+1–2) ribs. Axis semioctagonal in cross-section, and overhanging postaxial portion, but not border. Rings strongly arched and tuberculate with prominent median row. Ribs with anterior portions twice as strong as posterior portions and both tuberculate.

Comparisons with other genera. Mitchell (1922, p. 537) concluded that *A. gardneri* could not be included in either *Phillipsia* Portlock 1843 or *Griffithides* Portlock 1843. He commented on its very close similarity to species of *Brachymetopus* M'Coy 1847, but decided that the presence of facial sutures prevented its inclusion with this genus. On the suggestion of Vogdes he finally assigned the species to *Cordania* Clarke 1892.

The cephala of *Cordania* and *Australosutura* are similar in each having a highly inflated glabella, faint glabellar furrows 2p, and prominent detached basal lobes. In *Australosutura* the glabella is relatively longer, and the preglabellar field shorter and

steeper. Both genera have nine thoracic segments. The pygidia differ considerably. In *Cordania* it is transversely elliptical; in *Australosutura* it is comparatively longer, has a greater number of rings and ribs, fifteen rings and nine (+1–2) ribs as against thirteen rings and eight ribs in *Cordania cyclurus* (Hall and Clarke 1888), and the termination of the axis overhangs the postaxial portion, though not the border. The form and surface of the rings and ribs differ; in *Cordania* the anterior and posterior portions of the ribs are about equally developed and bear granules in addition to the tubercles on the anterior portions. Both portions continue to the margin.

In much of the material from Australia and Argentina the free cheeks are attached to the cranidium, and Mitchell (1922, p. 538) considered that fusion of the cheeks had begun. Whittington (personal communication) regards the facial suture of *Cordania* as normal and functional. Since isolated free cheeks and cranidia of *Australosutura* have been found in Australia the facial suture cannot be regarded as otherwise than functional. *Cordania* may possibly be ancestral to *Australosutura*.

Australosutura differs from the type species of *Brachymetopus* (type species *Phillipsia maccoyi* Portlock 1843, Goldring and Stubblefield 1957, p. 421) in possessing facial sutures, a longer glabella, and shorter preglabellar field. The details of the skeletal surface, in particular, the pair of prominent tubercles between the glabella and the anterior part of the eye, the row of tubercles on the border of the cephalon, and the tubercles on the pygidial axis, are very similar to that present in *B. maccoyi* and in *B. woodwardi* Whidborne 1896 (Goldring 1955). *B. strzeleckii* M'Coy 1847 also has similar features though the glabella is much shorter than in *A. gardneri*. In *B. ouralica* de Verneuil 1845 the anterior border is less arched than in either *A. gardneri* or *B. maccoyi*. The pygidium of *A. gardneri* is close to *B. maccoyi* and *B. ouralica* though the median tubercles of *A. gardneri* are of more even size on successive rings; the ribs of *B. woodwardi* and *B. maccoyi* are very similar to those of *A. gardneri*, but the ribs of *B. ouralicus* bear a greater number of tubercles on both portions.

Australosutura gardneri (Mitchell 1922)

Plates 39, 40

1922 *Cordania gardneri*, n. sp.—Mitchell, p. 536, pl. 54, figs. 1–7.
1924 *Cordania gardneri* Mitchell—Mitchell, p. 53, pl. 10, fig. 15.

Derivation of name. After Frank Gardner who first brought the species to notice.

Lectotype. Broken cephalon figured by Mitchell (1922, pl. 54, fig. 1, Australian Museum, Sydney, F.26974). Of the several specimens figured by Mitchell, those figured as pl. 54, figs. 2–5 and 7 are missing. Figure 6 of the same plate may be a reconstruction of F.27345. The specimen Mitchell figured later (1924, pl. 10, fig. 15) is F.27949.

Type locality. Brambles Farm, Myall Lakes, Eurenderee, Gloucester, New South Wales. Shore of Lake Boolambayt near grid reference 341812, Port Stephens, 1 inch: 1 mile Military Sheet.

Horizon. Upper Burindi Series (Voisey 1940, p. 196; David 1950, p. 290), Upper Kuttung Series (Osborne 1950, p. 24).

Material. Complete dorsal exoskeletons, together with independent cephala, thoracic segments, and pygidia. No hypostomes. The material from Argentina occurs as external and internal moulds in siliceous nodules and shows little or no sign of distortion. The Australian material occurs as internal and external moulds in very fine grained sandstones and siltstones at the type locality. Specimens are

mostly distorted. The type of preservation at the other Australian localities is similar, but the sediments are coarser grained.

Diagnosis. As for the genus.

Description of material from Argentina. Cephalon. Side view. Outline of the glabella almost a quadrant, with occipital ring prominently arched, in one specimen (Museo la Plata, Coll. Suero 5024) as high as the glabella, and occipital furrow strongly rounded. Preglabellar furrow broad, shallow, and facing anteriorly. Preglabellar area short (sag.) almost vertical, bearing strong tubercles, which terminate abruptly at commencement of border furrow. The border furrow has irregularly arranged pits, of varying sizes (8–10 per sq. mm.) and is strongly concave, though the side towards the glabella is a straight slope at 45°. Border a moderately convex ridge which bears tubercles near top of posterior slope.

Front view. Occipital ring strongly arched with glabella similarly arched in front. Laterally basal lobes project beyond outline of occipital ring. Palpebral lobes slope upwards from axial furrows to prominent and strongly convex eyes. In outline posterior border of each cheek appears from behind eye and falls steeply towards genal spine. Below eye cheek descends with only slight convex slope to border furrow.

Plan. Excluding genal spines, outline of cephalon, subsemicircular, with length (sag.) rather greater than half breadth. Glabella subcylindrical, tapering anteriorly sharply between basal lobes, less so between lobes 2p and expanding very slightly beyond glabellar furrows 2p before broad, rounded termination. Basal lobes subtriangular and well defined. Glabellar furrow 1p sharp and very deep at axial furrows, becoming broad and shallow at bifurcation. Posterior branch merges into occipital furrow and anterior branch extends shortly on to glabella. Glabellar furrow 2p a broad, smooth knick, and glabellar lobe 2p only slightly inflated. No evidence from tuberculation of any more glabellar furrows. Occipital furrow deep and narrow posterior to basal lobes, expanding towards axial furrow and at junction with furrow 1p where it arches forward and becomes broad and shallow. Posterior to basal lobes, occipital ring very short (exsag.), but expanding where glabellar furrows 1p join the occipital furrow to twice this length (sag.). Small occipital node.

Area of fixed and free cheek broad. Centre of eye opposite junction of glabellar furrow 1p with axial furrow, and surrounded laterally by smooth terrace which extends to opposite glabellar furrow 2p and to half length of basal lobe. Palpebral lobe smooth. At axial furrow length of posterior border less than length of occipital ring, but border widens laterally. It is strongly convex and continues with equal prominence along genal spine. Posterior border furrow broad and smooth though narrower near axial furrow. Lateral border furrow very broad and pitted, joining posterior border furrow and continuing, with pits, down genal spine. Lateral border gently rounded, tapering gradually to base of genal spine, and then more strongly down it. Genal spine extends to fifth thoracic segment. Eye sublunate with minute facets.

Facial suture. Anterior branch curves strongly outwards, crosses border furrow and then turns inwards to margin; β at crest of border. Posterior branch curves sharply outwards and terminates only just inside base of genal spine, and rather farther from the median line than β.

Surface. Cheek area and preglabellar field with numerous close-set tubercles of variable

size (3–4 per sq. mm.), many with apical openings; one is particularly prominent on fixed cheek opposite glabellar furrow 2p. A row of slightly enlarged tubercles between palpebral lobe and axial furrow. Posterior part of fixed cheek smoother and with only a few small tubercles. Glabellar and occipital ring with tubercles of about equal size to those on cheek, but less closely spaced, and on crest of glabella very weak (on available material). Tubercles on basal lobe larger on inner part than toward axial furrow. Top of inner slope of border with a single row of tubercles which weaken laterally and are scarcely discernible along genal spine. Outer slope of lateral border and continuation of posterior border along genal spine with fine parallel terrace lines.

On ventral surface doublure, including rostrum, covered with terrace lines, and equal in breadth to border furrow plus border of dorsal surface. Facial suture continues inward course over anterior margin and meets rostral suture (rr) just below margin. There is no short connective suture but a suture ($r\omega$), which has a course comparable to that of the perrostral suture of olenellids, makes an acute angle with the facial suture and swings outwards in a long sweeping curve to cut the posterior border of the cephalon just inside the genal spine, and immediately below the termination of the facial suture on the dorsal surface. This suture makes a definite angle with the rostral suture (rr), equal to the angle between the rostral suture and the facial suture. Inner margin of doublure (in part, presumably, hypostomal suture) long and curved, following, and lying immediately and closely under inner margin of border furrow. Doublure of free

EXPLANATION OF PLATE 39

Material from Argentina

Figs. 1–11. *Australoşutura gardneri* (Mitchell 1922). 1–7, Latex cast from external mould of complete specimen (BM In 53675). Province of Chubut, Sierra de Tepuel, about 25 km. south of Tecka. 1, Plan, 2, front view, 3, side view of cephalon, 4, posterior view. 5, Side view of pygidium, ×2. 6, Free cheek, showing puncta in border furrow, and apical openings on cheek tubercles, ×5. 7, Portion showing method of articulation of segments, ×4. 8, 9, Latex casts from external moulds of pygidia, Province of Chubut, La Carlota, about 8 km. south-east of Tecka. 8, ×4 (Coll. Suero 5049, 5051). 9, ×2 (BM In 53676). 10, 11, Latex casts from internal moulds of dorsal surface of cephala showing rostral plate and ventral surface of free cheek, Province of Chubut, Cerro Mina, east of Sierra de Languineo, 75 km. east of Tecka, 10, ×2·5 (Coll. Suero 5029), 11, ×2·5 (Coll. Suero 5023).

EXPLANATION OF PLATE 40

Material from Australia

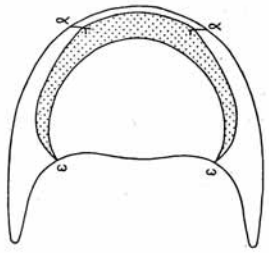
All specimens are from type locality. Catalogue numbers refer to the Australian Museum Collections. Specimens figured as numbers 9, 10, 13, 14, and 15 have been destroyed by fire.

Figs. 1–20. *Australosutura gardneri* (Mitchell 1922). 1, Latex cast from internal mould of F.44640, ×2. 2, 3, Dorsal and lateral views of internal mould of same specimen, ×2. 4, Lectotype, F.26974, ×2 (Mitchell 1922, pl. 54, fig. 1). 5, Latex cast from internal mould of free cheek, part of ventral surface of cephalon, and pygidium, F.26476c–e, ×2. 6, Ventral surface of same cephalon showing position of rostrum, ×3. 7, 8, Lateral and posterior views of same pygidium, ×2. 9, Dorsal view of same pygidium, ×3. 10, Interior view of latex cast from internal mould of cephalon, ×3. 11, Interior view of latex cast from internal mould of pygidium F.26476, ×2. 12, Latex cast from external mould of pygidium, ×3. 13, Posterior view of latex cast from external mould of incomplete pygidium, ×3. 14–16, Latex casts from external moulds of fragmentary cephalons, 14, 15, ×3, 16, F.25593, ×2. 17, Lateral view of latex cast from external mould of part of cephalon, showing facial suture, F.26476a, ×2. 18–20, Dorsal and lateral views of internal mould, F.27949, 18, ×2·2, 19, ×1·8, 20, ×2·2 (Mitchell 1925, pl. 10, fig. 15).

cheeks tapers very rapidly forwards, whilst rostrum broadens complementarily. There is no Panderian notch.

Hypostome. No hypostomes are present in the material from Argentina. One specimen from Australia, since lost, was figured by Mitchell (1922, pl. 54, fig. 4) but was not described.

Thorax of nine segments. Rings with strong bands which arch slightly forwards. Posterior rings slightly narrower (tr.) than those anteriorly, and outline of rings graduates from strongly rounded and close to outline of occipital ring in anterior rings, to outline of pygidial rings in posterior rings. Articulating furrow broad and shallow. Articulating half-ring as long (sag.) as ring. Rings with a weak transverse groove behind which is a very narrow posterior portion. Groove, which is finely pitted, broadens (sag.) towards axial furrow. At posterior margin of ring, at axial furrow, a deep notch. Main portion of ring with tubercles, seven prominent (+1 or 2 more), arranged in rows on successive rings; a median row and three rows on flanks. Distance between median and first lateral tubercle is $1\frac{1}{2}$ times distance between each of the three lateral tubercles. Ring process a strong node. Ventrally of articulating half-ring, front edge of each segment flexed forward to form narrow flange which runs down into ring process.



TEXT-FIG. 2. Outline reconstruction of the ventral surface of the exoskeleton of *Australosutura gardneri* (Mitchell 1922). Rostrum stippled.

Pleurae with convex bend at fulcrum, at about one-third length (tr.). Posterior portions strongly arched (exsag.) (those on posterior pleurae more strongly so than those on anterior pleurae), narrowing at fulcrum, then broadening slightly and curving posteriorly. Posterior portions of pleurae 1–4 with slight anterior swing near margin. Laterally from fulcrum posterior portion is divided by weak furrow into anterior higher and strongly arched part and posterior lower part. At the margin anterior part rises over posterior part so that furrow faces posteriorly. Anterior parts have four to six tubercles, the one at the fulcral angle and the one between the fulcral angle and the axial furrow largest. A deep rounded furrow, which expands slightly at fulcrum, separates posterior portion of pleurae from the anterior portion, which is moderately arched on inner parts and flattens into a broad (exsag.) facet laterally.

Pygidium. *Side view*. Axis with only gently convex slope to ring 6, thence falling sharply and terminates overhanging postaxial portion. Axial furrow clear, and postaxial portion weakly concave. Height of pleural lobes more than half total height of ring. Rings very prominent with furrows of about equal strength giving a corrugated outline. Anterior rings vertical, those posteriorly becoming increasingly inclined, reaching 60° to horizontal.

Rear view. Outline of axis semioctagonal. Inner parts of pleural lobes almost flat, then curving over strongly and falling very steeply. Border convex with concave curve to pleural lobes.

Plan. Outline subsemicircular, with length of axis rather greater than breadth of axis plus one pleural lobe. Axis with almost straight sides tapering to blunt rounded termination.

Fifteen rings which are even bands not narrowing towards axial furrows. Ring 1

rather narrower than ring 2, and furrow between these two rings longer (sag.) than second furrow. Anterior rings each bear nine to eleven tubercles arranged in somewhat irregular rows. Median row of tubercles, and lateral row of tubercles situated at rather less than half distance from median line to axial furrow larger than the rest giving the semioctagonal outline. A further three to four rows of smaller tubercles; one between median and lateral rows.

Nine ribs, plus three axially arranged rows of tubercles posterior to the axis. Ribs with sharp posterior bend half-way to margin. Anterior portions of ribs twice as strongly arched as posterior portions, and with prominent tubercles, five to eight on ribs 1–8. The tubercles at or near the fulcral angle and the tubercles between the fulcral angle and the axial furrow are more prominent than the others. On rib 5 and posterior ribs the anterior portion does not extend up to the axial furrow and the posterior portion swings diagonally forward across the anterior portion and between it and the axis. Anterior portions of ribs 1–3 join with axial rings so that the junction of the rings and ribs is strongly undulating. The anterior portion of rib 4 scarcely joins the axis and posterior ribs do not do so, so that posterior to rib 4 there is a clear axial furrow which is almost nonundulose. Posterior portions show clearly on ribs 1–6 and narrow to border but do not continue over border except on ribs 1–2. Posterior portions with only one to two tubercles at about half-length (tr.). Border not separated from pleural lobes by any distinct furrow. Border smooth and only slightly undulose but extensions of anterior portions of ribs clear over border and ribs 1–9 with prominent tubercles at margin. Pleural furrows strong and deep, whereas rib furrows clear but weak, deepening at change in slope preceding border. Doublure on pygidium gently convex under border, but inside this it sweeps up steeply. It bears about ten fine raised terrace lines.

Measurements (in mm.)

	Argentina		*Australia*			
	Brit. Mus. In 53675	*Coll. Suero 5049, 5051*				
Length of exoskeleton	36·0	..				
Breadth of exoskeleton between genal spines	20·0	..	14·0	(12·0)	..	(17·0)
Length of cephalon (sag.)	11·5	..	7·5	8·3	..	..
Length of glabella	9·0	..	(5·7)	6·2	4·2	..
Breadth of glabella	8·0	..	..	..	..	..
Breadth of occipital ring (trans.)	7·8	..	5·1	(5·0)	(3·0)	6·2
Length of pygidium	12·5	5·5				
Length of axis	11·0	4·9				
Breadth of pygidium	(16·0)	(8·0)				
Breadth of axis	7·0	3·0				

Comparisons with Australian material. The Australian specimens are all much smaller than those from Argentina, and in general they are not so well preserved. Further, the only external moulds of the thorax yet discovered are very fragmentary, and most of the external moulds of the cephalon are poorly preserved.

Mitchell (1922, p. 536) described the borders of the cephalon as 'abnormally wide, concave between the cheeks and the thickened margins, which concave portions are only finely and sparsely tuberculate; both inner and outer margins are granulate'. On none

of the specimens we have examined is there any indication of tuberculation on the concave border, and the region is invariably pitted. Mitchell did not mention the glabellar furrows 2p, but these are evident on all specimens, though much less distinctly impressed on the internal surface than in the Argentine specimens.

In general the topotypes do not have such a strongly inflated cephalon as do the Argentine specimens; the glabella does not form a quadrant in side view, but is much more depressed; the glabella does not approach quite so close to the border furrow; the tuberculation of the anterior and lateral border is much weaker and no tubercles have been observed on the posterior border of the fixed cheeks; the tubercles on the glabella are not weaker than elsewhere on the cephalon in well-preserved specimens; no occipital node or other occipital tuberculation has been observed, though this may be due to poor preservation; the crest of the axis of the pygidium does not drop so rapidly behind the sixth ring, and the concentric ornament of the doublure is coarser.

No specimens have been found showing a rostrum, but the course of the ventral margin of the free cheek suggests that the rostrum was similar to the Argentina form.

Repository of material. From Argentina. Museo la Plate, Buenos Aires, Colleción Suero: (1) La Carlota, 5048–54, (2) Cerro Mina 5018–46. British Museum (Natural History), London: (1) La Carlota In 53676, (2) Sierra de Tepuel In 53675.

From Australia. Australian Museum, Sydney: Lake Boolambayt, lectotype F.26974, F.26476, F.27345, F.27949, F.44640. Specimens from the two other localities, in Campbell's collection, have been involved in a fire.

K. S. W. C. and R. G.

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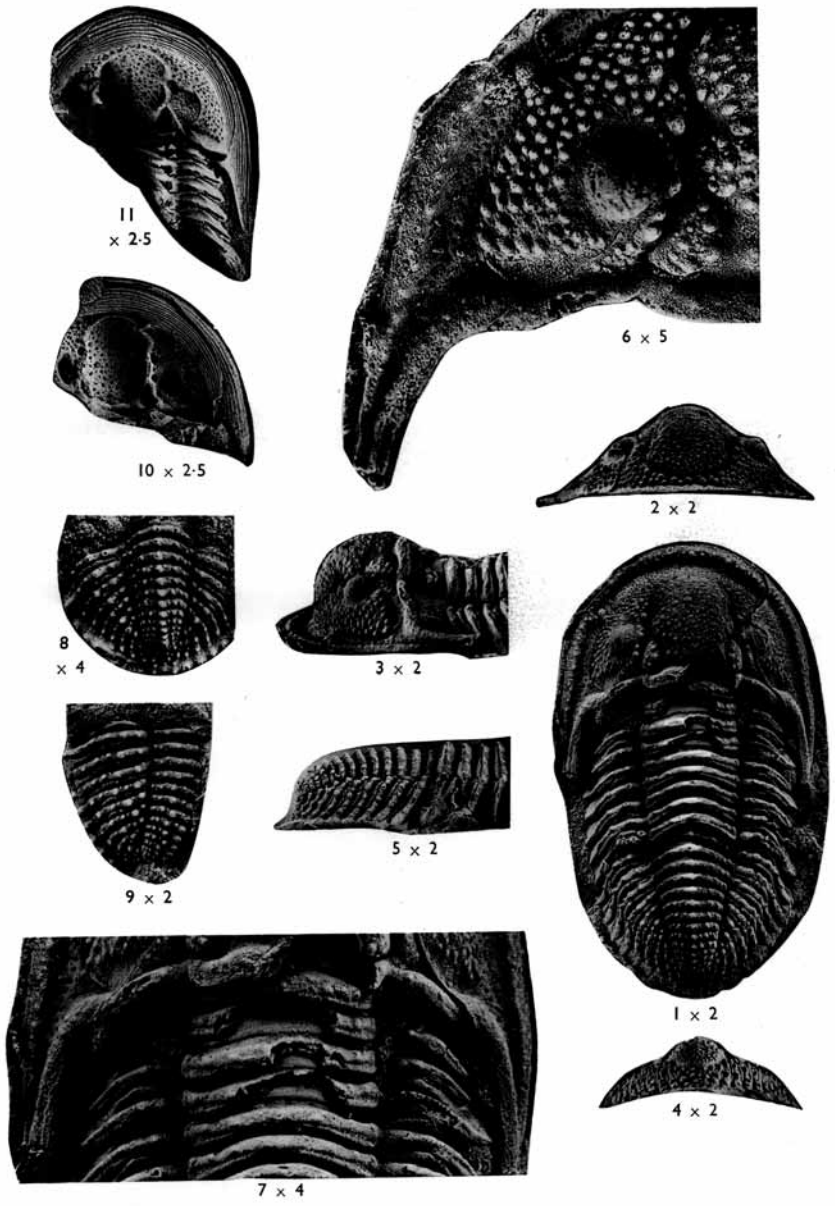

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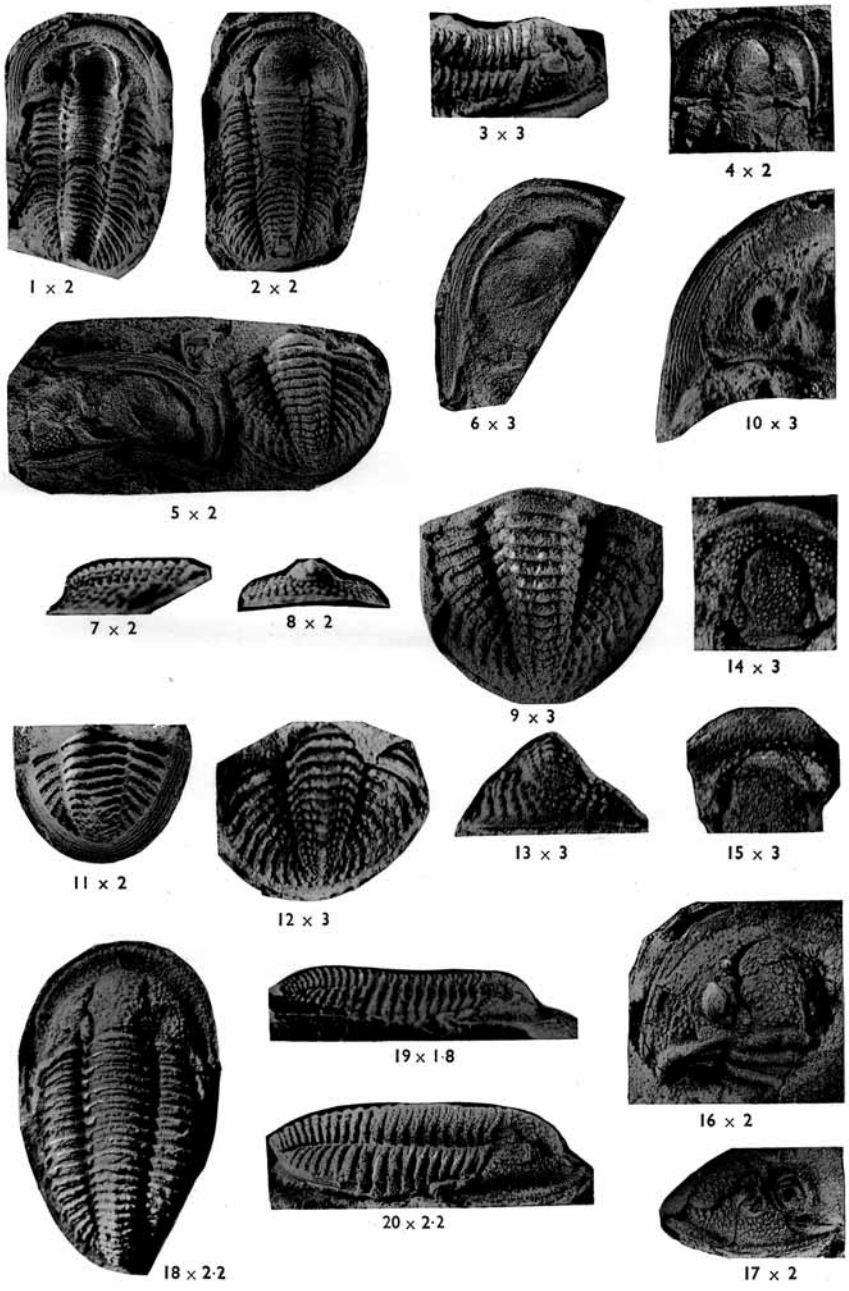

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