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DANISH SCIENTIFIC INVESTIGATIONS IN ARGENTINA UNDER
THE AUSPICES OF FUNDACIÓN WILLIAMS, BUENOS AIRES

CONTRIBUTIONS TO
THE MIDDLE CAMBRIAN PALEONTOLOGY
AND STRATIGRAPHY OF ARGENTINA

BY

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Synopsis.

A new dolichometopid genus and two new alokistocarid species are established; a few previously established genera and species of stratigraphic significance are revised. It is shown that the *Glossopleura* zone probably constitutes the lowermost part of the Cambrian sequence in the provinces of Mendoza and San Juan. The *Glossopleura* zone in Mendoza comprises the horizons Crucense and Isidrense of Rusconi, and is characterized by genera such as *Mendospidella*, *Glossopleura*, *Alokistocare*, *Kistocare*, *Alokistocarella*. A close parallel is to be found in the Arrojos formation of Mexico.

INTRODUCTION

The geological and paleontological research carried out in Argentina from October 1954 to March 1955 by professor CHR. POULSEN and the writer was made possible through the great financial support from Mr. THOMAS J. WILLIAMS K.D., director of the Williams Foundation, Buenos Aires. The writer is greatly indebted to THOMAS WILLIAMS and all members of his staff also for their constant efforts to make our stay a pleasant and unforgettable experience. He likewise wishes to express his gratitude to the Carlsberg Foundation and to Statens almindelige Videnskabsfond for financial support covering expenses in connection with the voyage and provision of scientific equipment respectively.

Thanks are also due to professor Dr. ARMANDO F. LEANZA of the Geological Institute of the University of Buenos Aires for allowing the writer to study his collections from Mendoza and to borrow specimens of a new alokistocarid species.

Finally the writer is indebted to professor CARLOS RUSCONI of the Natural History Museum of Mendoza for kind permission to see his collections and for guiding an excursion to the localities at Cerillo Martillo.

The Middle Cambrian deposits in Mendoza were discovered in 1945, and have mainly been treated by RUSCONI, who, as stated by himself, favoured a quick spreading of the knowledge of these finds in preliminary treatments. However praiseworthy, this involved a great number of erroneous assignments resulting in some paleontological and stratigraphical confusion.

The systematic descriptions and revisions given in the present paper are mainly based on material collected by professor CHR. POULSEN and the writer; two specimens of *Alokistocare elongatum* n. sp. were borrowed from the Geological Institute of the University of Buenos Aires with the kind permission of Dr. LEANZA. Under the heading *Incerti ordinis* are listed a few of a large number of incorrectly identified species, which are not represented in the collections of the present writer. Nevertheless they are con-

sidered here, as they, due to the erroneous assignment, give a false impression of the stratigraphic range of the Middle Cambrian deposits in Mendoza.

The terminology used for systematic descriptions is essentially the same as that proposed by HOWELL et al. (1947). The term "fixed cheeks" covers the entire non-axial area of the cranidium; a distinction is made between anterior region, palpebral region, and posterior region of fixed cheeks. The terms "width", "length", etc. are qualified by the abbreviations "sag." (sagittal) and "tr." (transverse), whenever the direction of measurement is ambiguous.

MIDDLE CAMBRIAN FAUNAL ZONES IN THE CORDILLERAN REGION. GENERAL STATEMENT

The question of the number of faunal zones is rapidly becoming an important problem for writers dealing with Middle Cambrian stratigraphy. The problem is closely connected with the probable presence of different facies in corresponding time intervals; this was hinted at by RASETTI (1951, p. 80), when he suggested that the *Wenkchemnia-Stephenaspis* zone and the *Plagiura-Kochaspis* zone might represent different facies from one and the same time interval. This possibility was approved of by LOCHMAN (1953, p. 487). Assuming the above mentioned suggestion to be correct, future revisions of the stratigraphic sub-divisions should include the selection of trilobites, impartial to changes in facies, as zonal guide fossils.

The best known and most widely distributed of the Middle Cambrian faunas is that of the *Glossopleura* zone, a striking faunal feature of which is the great similarity in composition, when even widely separated localities are compared; many genera are universally distributed, and apart from that similarities may be found in very closely related genera, as in the case of *Clavaspidella-Athabaskia-Mendospidella*. Fortunately, many of the genera from this zone show an adequate impartiality toward different facies.

LOCHMAN, in discussing the *Wenkchemnia-Stephenaspis* zone (1953, p. 487), expresses the opinion that *Oryctocephalus* and *Oryctocephalites* appear to be characteristic of a more western, possibly deeper, part of the Cordilleran trough. In this connection the present writer would like to point out that *Oryctocephalus* is not always characteristic of a deeper environment, as the Argentine species are found in limestone containing an ordinary shallow water fauna.

SYSTEMATIC DESCRIPTIONS

Class **HYALOSPONGEA** VOSMAER, 1886.Order **Lyssakida** ZITTEL, 1887.Family **PROTOSPONGIIDAE** HINDE, 1887.Genus **Protospongia** SALTER, 1864.? **Protospongia** sp.1952 ? *Protospongia asperoensis* RUSCONI, Rev. Mus. Hist. Nat. Mendoza, vol. VI., Entr. 1-4, p. 115, pl. II, fig. 7.

Discussion: There is no obvious reason for assigning the commonly occurring isolated spicules to species. Apparently only stauracts are known, and on this basis even a generic distinction is problematic. The spicules may just as well be referred to *Kiwetinokia* WALCOTT, 1920.

Horizon and locality: Lower part of *Glossopleura* zone, associated with *Chancelloria eros* WALCOTT, 1920, Co. Martillo.

Order **Heteractinida** HINDE, 1888.Family **CHANCELLORIIDAE** DE LAUBENFELS, 1955.Genus **Chancelloria** WALCOTT, 1920.**Chancelloria eros** WALCOTT, 1920.1954 *Chancelloria cruceana* RUSCONI, bol. paleont. Buenos Aires, no. 29, figs. 1a-b.

Discussion: RUSCONI's description and figures as well as specimens examined by the present writer show a great resemblance to *Chancelloria eros* WALCOTT, as also mentioned by RUSCONI. The shape of the body of the sponge is not known, but the individual anahexaenes are identical to those of *C. eros* WALCOTT. Under these circumstances the author finds no justification for establishing a new species.

This point of view is in full accordance with the opinion of LOCHMAN (1952, p. 112). Identical spicules are found in the basal part of the *Glossopleura* zone in Sonora, Mexico. For reasons similar to those set forth above LOCHMAN prefers to refer the spicules to *C. eros* WALCOTT.

Horizon and locality: Lower part of *Glossopleura* zone, Co. Martillo.

Class TRILOBITA

Order Zacanthoidida RICHTER, 1932.

Family ORYCTOCEPHALIDAE BEECHER, 1897.

Genus *Oryctocephalus* WALCOTT, 1886.

Oryctocephalus asperoensis RUSCONI, 1952.

- 1952 *Oryctocephalus* (*Vinākainella*) *asperoensis* RUSCONI, Rev. Mus. Hist. Nat. Mendoza, vol. VI, p. 97, pl. I, fig. 14 and pl. III, figs. 9–14 and 18–19. Text figure 5.
 1952 *Vinākainella spinulosa* RUSCONI, Rev. Mus. Hist. Nat. Mendoza, vol. VI, p. 100, pl. III, figs. 20–21. Text figure 6.

Discussion: The Middle Cambrian of Mendoza contains two species belonging to *Oryctocephalus*: *O. asperoensis* and *O. pentacantha* RUSCONI. *O. (Vinākainella) asperoensis* and *O. (Vinākainella) spinulosa* undoubtedly represent different developmental stages of one and the same species.

Both species agree perfectly with the general conception of *Oryctocephalus*, and as RUSCONI does not indicate any morphological differences that might favour a subgeneric distinction, the present writer suggests that the subgeneric name *Vinākainella* be abandoned. Furthermore, the name *Vinākainella* is an awkward choice, as it indicates a close relationship to *Kainella* WALCOTT, 1925, and *Pseudokainella* HARRINGTON, 1938. A comparison will show that these genera differ decisively in all diagnostically important respects; moreover *Kainella* and *Pseudokainella* are confined to the Ordovician.

Horizon and locality: *Glossopleura* zone, Co. Martillo. Associated with *Kistocare mendozanum* (RUSCONI).

Family DOLICHOMETOPIDAE WALCOTT, 1916.

Genus *Mendospidella* RUSCONI, 1952.

Type species: *Clavaspidella digesta* LEANZA, 1947.

(Designated by the present writer).

Mendospidella digesta (LEANZA).

Plate I, figs. 1–3.

- 1947 *Clavaspidella digesta* LEANZA, Rev. Mus. La Plata, Sec. Paleontol. tomo III, p. 228, pl. I, figs. 5, 7, 12 and 17.
 1952 *Mendospidella quebradensis* RUSCONI, Rev. Mus. Hist. Nat. Mendoza, vol. VI, p. 75, pl. I, figs. 3–5.

Apart from numerous adult specimens, which do not add to the knowledge of this species, the material contains a small number of apparently late meraspid cranidia, which are easily referred to *Mendospidella*, as they exhibit many of the characteristic features of the adult. Thus glabella and the glabellar furrows have obtained their final shape. The palpebral lobe is long, curved and extends from the anterolateral corner of glabella to a little short of posterior margin of cranidium. The cranidia measure from 0.5–1 mm in length and 0.8–1.3 mm in width.

Discussion: When RUSCONI established the genus *Mendospidella* in 1952 no type species was chosen. Two new species were assigned to *Mendospidella*, and the present writer has designated the most common of these as type species.

RUSCONI was of the opinion that the specimens referred to *Clavaspidella digesta* by LEANZA, represented two distinct species, and one of these (LEANZA 1947, pl. I, fig. 17) was included in *Mendospidella quebradensis*. However, an examination of numerous specimens has convinced the present writer that all of LEANZA's figured specimens belong to one and the same species. Consequently the specific name *quebradensis* is a junior synonym of *digesta* and must be abandoned.

The establishment of the genus *Mendospidella* was fully justified, as pointed out by RUSCONI. *Mendospidella* differs from *Clavaspidella* in having the pygidium provided with strongly impressed pleural furrows, and the cranidium of *Mendospidella* has short, oblique eye ridges, whereas those of *Clavaspidella* are long and at a right angle to the glabellar axis.

Furthermore it is generally assumed that the occurrence of *Clavaspidella* is restricted to Northwestern Greenland.

Horizon and locality: *Glossopleura* zone, Co. Martillo, Provincia de Mendoza, and about 2 miles west of Zonda, Provincia de San Juan.

Genus **Glossopleura** POULSEN, 1927.

Discussion: A study of RUSCONI's collections and an examination of specimens collected by C. POULSEN and the present writer clearly showed that a number of species referred by RUSCONI to *Asaphus* or ?*Asaphus* belongs to *Glossopleura*. A brief review of these corrections was published by RUSCONI in 1954 (Bol. Paleont. Buenos Aires, no. 29). It appears from the mentioned publication that RUSCONI believes in the assignment of Upper Cambrian species to *Glossopleura*. This must be an erroneous conception, the genus *Glossopleura* being restricted to the Middle Cambrian.

Horizon and locality: *Glossopleura* zone, Co. Martillo. The present writer is of opinion that the following species from this locality can be safely referred to *Glossopleura*:

- ?*Asaphus asperoensis* RUSCONI, 1952.
 ?*Ogygopsis martillensis* RUSCONI, 1952.
 ?*Asaphus inexasulcatus* RUSCONI, 1946.

Genus **Chilometopus** RUSCONI, 1952.

Chilometopus parabolicus RUSCONI, 1952.

Plate I, fig. 4.

Discussion: Supplementary material collected by the present writer allows of a few additions and corrections to the original description concerning the shape of glabella and the anterior portion of cephalon, the true nature of which, presumably owing to poor state of preservation, was not recognized by RUSCONI.

Glabella is not ovate, as described by RUSCONI, but practically cylindrical, slightly expanded anteriorly, truncate in front, and separated from the narrow anterior border by a narrow anterior border furrow. Anterior branches of facial suture follow a course parallel to the axial furrows. The original description of the other parts of the exoskeleton seems to be adequate.

It appears from the above correction that the relationship of *Chilometopus parabolicus* to *Chilometopus asperoensis* RUSCONI (1952, p. 89) is more close than suggested by the original description.

It must be pointed out that RUSCONI's restoration of *C. parabolicus* (text fig. 4) is incorrect and misleading, a fact which can easily be established by comparison of this figure with pl. III, figs. 5 and 23 in the same paper.

Horizon and locality: *Glossopleura* zone, Co. Martillo.

Genus **Asperocare** n. g.

Type species: *Asperocare argentinum* n. sp.

This new genus is represented by eight cranidia, all belonging to one and the same species; a couple of these are directly attached to thoracic segments.

Diagnosis: Cranidium sub-trapezoidal. Glabella sub-cylindrical, somewhat contracted anteriorly, reaching anterior border furrow, with four

pairs of glabellar furrows. Anterior region of fixed cheeks relatively wide; posterior region obliquely backward-directed, with acute lateral extremities. Palpebral lobes of medium length, moderately curved, situated somewhat posteriorly and fairly distant from glabella. Eye ridges prominent, oblique. Thorax of at least eleven segments, with narrow pleural region.

The relationship of this genus is discussed below in connection with description of the type species.

***Asperocare argentinum* n. sp.**

Plate I, figs. 5–10, text fig. 1.

Cranidium sub-trapezoidal in outline. Glabella 1,5 times as long as wide, sub-cylindrical to slightly conical, truncately rounded in front, strongly convex transversally and sagittally, profile highest a little behind midpoint. Four pairs of glabellar furrows, of which the three anterior are separated from the axial furrow; first and second pairs short, indistinctly marked, converging towards the front of glabella; third pair short, moderately impressed, directed slightly backward; fourth pair fairly long, strongly oblique, directed backward. Axial furrows well-impressed, fairly wide. Occipital furrow narrow, well-impressed laterally. Occipital ring wide (tr.), rounded triangular, provided with a pointed node. Anterior border furrow shallow, narrow medially, having a forward turn around anterior end of glabella, joining pre-glabellar furrow. Anterior border slightly concave, upturned. Anterior margin emarginate with the exception of a faint forward turn in front of glabella. Anterior region of fixed cheeks relatively wide, a little ex-

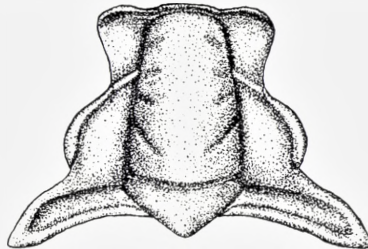


Fig. 1. *Asperocare argentinum* n. sp., cranidium (magnified).

panded towards the front, slightly downslowing laterally and anterolaterally. Palpebral region half as wide as adjacent part of glabella, of low convexity, horizontal. Eye ridges prominent, directed slightly forward, joining glabella between first and second glabellar furrow. Palpebral lobes well-defined,

upturned, of medium length, strongly curved posteriorly, delimited by a well-impressed furrow. Posterior region of fixed cheeks of approximately same width (tr.) as occipital ring, obliquely backward-directed, strongly sloping throughout, rapidly tapering to acute lateral extremities; posterior border furrow wide and well-impressed. Facial suture cutting anterior margin moderately out at side, curving out and back to anterior border furrow, then following a straight line back to the palpebral lobe, joining the latter a little behind anterior end; posterior branch swerving out and back to posterior margin.

Thorax of at least eleven segments, with wide axis and narrow pleural regions; axial rings carrying small nodes; pleurae slightly backward-curved, broadly furrowed proximally; pleural extremities poorly preserved, but the general shape of the pleurae seems to indicate terminations without spines.

Outer surface of test finely granulated.

The holotype cranidium has the following dimensions:

Length	4 mm
Width at posterior margin	6 -
Width between the eyes	4 -
Length of glabella	3 -
Width of glabella at base	2 -

Discussion: The relationships of *Asperocare* n. g. cannot be accounted for in detail, this genus being known only from cranidia and poorly preserved thoracic segments. It has many characters in common with *Chilometopus* RUSCONI, 1952, which must be a close relative, but differs from the latter in having a conical glabella, wider anterior region of fixed cheeks, slightly more divergent anterior branches of facial suture, anterior border of quite different proportions, and acute lateral extremities of posterior cheek region.

Judging from the general features of cranidium, thorax and pygidium, *Chilometopus* may safely be placed in the Dolichometopidae; the anterior branches of facial suture in *Chilometopus* as well as in *Asperocare* n. g. are much less divergent than those of the Zacanthoididae, accordingly, the two genera in question are not referable to that family.

Horizon and locality: *Glossopleura* zone, Co. Martillo.

Order Ptychoparida RICHTER, 1932.

Family ALOKISTOCARIDAE RESSER, 1939.

Genus *Alokistocare* LORENZ, 1906.

Type species: *Conocephalites subcoronatus* HALL and WHITFIELD, 1877.

Middle Cambrian ptychoparoid trilobites with a more or less flat cranium, long, usually concave anterior border, wide fixed cheeks, numerous thoracic segments, and a small pygidium may be referred to a number of genera. RASETTI (1951, p. 202) has emphasized some of the generic differences found in this group of trilobites.

In addition to this the present writer wishes to point out that *Amecephalus*, *Alokistocare* and *Amecephalina* are separable on basis of the nature of the anterior border alone. *Amecephalus* is distinguished by an essentially flat anterior border, of moderate width, and a moderately curving anterior margin. The strongly curved anterior margin and anterior border furrow as well as the narrow anterior border serve to separate *Amecephalina* from the other two genera. With regard to *Alokistocare* the present writer is of the opinion that the concave, upturned border, about half as broad as length (sag.) of pre-glabellar field, is an important feature; thus the species *Alokistocare modestum* LOCHMAN (1952) must probably be referred to another genus on account of the convex, descending anterior border. This species seems to be more closely related to *Kistocare* rather than to *Alokistocare*.

Unfortunately the above mentioned features may be seriously affected by the state of preservation, therefore great care is expedient when dealing with this group of trilobites.

Alokistocare elongatum n. sp.

Plate I, figs. 11–12.

Known from three cranidia, two of which, originating from Provincia de San Juan, were borrowed from the Geological Institute of the University of Buenos Aires with the kind permission of Dr. LEANZA. The third one was collected at Co. Martillo, Mendoza.

Cranidium sub-rectangular. Glabella tapered, moderately convex, somewhat truncated in front, less than half of cranidial length. Four pairs of glabellar furrows; fourth pair well-impressed, directed slightly backward; first, second and third pair are shallow, not well-preserved in any of the specimens. Axial furrows more impressed than pre-glabellar furrow. Oc-

cipital furrow shallow throughout. Occipital ring short (sag.) and simple. Pre-glabellar field as long (sag.) as glabella, with strong relief. An elongate, prominent boss covers the greater part of the frontal area; boss slightly expanded anteriorly, medially covering half of anterior border. Anterior border furrow narrow and shallow, slightly curved, becoming even more shallow when crossing pre-glabellar boss. Anterior border strongly concave, upturned, three-fifths (sag.) the length of pre-glabellar field. Anterior margin evenly curved. Palpebral region of fixed cheeks slightly convex, horizontal, as wide as adjacent portion of glabella. Palpebral lobe not preserved; apparently of size and position usual in the genus. Eye ridges straight, prominent, almost at a right angle to glabellar axis, joining glabella at anterior corner. Anterior region of fixed cheeks long (sag.), downsloping. Posterior region of fixed cheeks, not well-preserved in any of the specimens, seems to be slender, of moderate length (tr.). Posterior border furrow shallow, of same width as the occipital furrow. Facial suture cutting anterior margin moderately out at side, curving back to anterior border furrow, then running straight back to palpebral lobes following a course almost parallel to sagittal axis. Posterior branches of facial suture unknown.

Dimensions of holotype cranidium:

Length.....	7 mm
Width at posterior margin	8-10 -
Width between the eyes	6 -
Length of glabella.....	3 -
Width of glabella at base	3 -
Length of pre-glabellar field (sag.)..	2,5 -
Width of anterior border (sag.).....	1,5 -
Length of pre-glabellar boss.....	2 -

Discussion: *Alokistocare elongatum* n. sp. is readily recognized on basis of the frontal area alone, especially the pre-glabellar boss attracts attention. In some cases doubt has arisen as to the course of anterior border furrow in relation to a pre-glabellar boss. In *A. elongatum* n. sp. a shallow continuation of anterior border furrow is seen to cross the pre-glabellar boss. Even if effaced in most species this probably represents a general feature; consequently, a comparison of anterior border furrow to an eventual furrow in front of or back of the pre-glabellar boss should be avoided, whenever the boss crosses anterior border furrow.

Horizon and locality: *Glossopleura* zone, Quebrada de Juan Pobre in Sierra Chica de Zonda, San Juan, and Co. Martillo, Mendoza.

Alokistocare australe n. sp.

Plate I, figs. 13–15.

Known from two imperfect crania.

Cranidium somewhat wider than long. Glabella tapered, moderately convex, truncately rounded in front, half the length of cranidium. Traces of four pairs of glabellar furrows can be observed; the fourth pair seems to be longer and more deeply impressed than the other pairs. Axial furrows and pre-glabellar furrow well-impressed. Occipital furrow apparently shallow throughout. Occipital ring only preserved laterally, probably of shape usual in the genus. Pre-glabellar field half as long (sag.) as glabella, down-sloping, provided with an elongate boss covering most of pre-glabellar field and part of anterior border. Pre-glabellar field, apart from the boss, distinguished by a fine network of inosculating lines. Anterior border furrow shallow, slightly curved. It is not possible to see a continuation of anterior border furrow across the pre-glabellar boss; however, this may be due to the poor state of preservation. Anterior border concave, slightly upturned, about half as broad (sag.) as length of pre-glabellar field. Palpebral region of fixed cheeks convex, horizontal, two-thirds the width of adjacent portion of glabella. Palpebral lobes not preserved; apparently of size and position usual in the genus. Eye ridges prominent, slightly curved, directed a little forward. Anterior region of fixed cheeks long (sag.), down-sloping, showing a fine net of inosculating lines. Posterior region of fixed cheeks not well-preserved in any of the specimens, but seems to be slender, of moderate length (tr.). Posterior border furrow well-impressed. Facial suture cutting anterior margin far out at side, curving back to anterior border furrow, then approaching glabella when running back to the palpebral lobes, from here swerving out following a course almost parallel to posterior margin. The rear part of facial suture not known.

The holotype cranidium has following dimensions:

Length	8,5 mm
Width at base	about 12 -
Width between the eyes	9 -
Length of glabella	4 -
Width of glabella at base	4 -
Length of pre-glabellar field (sag.) . .	2 -
Width of anterior border (sag.)	1 -
Length of pre-glabellar boss . . about	2 -

Discussion: This new species is easily distinguishable from *A. elongatum* n. sp. by the difference in the basic dimensions, thus the frontal area is much wider (tr.) in *A. australe* n. sp.; moreover, the shape of the preglabellar boss and the tapering of glabella are quite different in the two species.

Horizon and locality: *Glossopleura* zone, Co. Martillo.

Genus **Kistocare** LOCHMAN, 1948.

Kistocare mendozanum (RUSCONI).

- 1945a *Plesioparabolina mendozana* RUSCONI, An. Soc. Cient. Argentina, CXXXIX, p. 216, text fig. 1.
 1947 *Amecephalus mendozanus* (RUSCONI) LEANZA, Rev. Mus. La Plata, Sec. Paleont., vol. III, p. 232, pl. I, fig. 13.
 1952 *Syspacephalus asperoensis* RUSCONI, Rev. Mus. Hist. Nat. Mendoza, vol. VI, p. 102, pl. V, figs. 4-5.

All of the numerous specimens collected by C. POULSEN and the present writer show the presence of a fourth pair of glabellar furrows; this pair, representing the anterior pair of glabellar furrows, is very faint, converging slightly forward. The three other pairs are in good agreement with the description given by RUSCONI (1952). A few, especially well-preserved specimens show a fine granulation on the outer surface of test.

Discussion: For several reasons the assignment to *Amecephalus* cannot be correct. Thus *Amecephalus* is not known to occur in the *Glossopleura* zone, and the proportions of the cranium do not agree with those of the type species (*Ptychoparia piochensis* WALCOTT, 1886 (part.)), and with regard to the pygidium of the species in question the distinct segmentation and the relatively slender axis further emphasize the difference.

The species *Syspacephalus asperoensis* was based on obviously young individuals (cranidia about 2,5 mm in length); hence it is understandable that the identity with the previously established species *Amecephalus mendozanus* (RUSCONI) (= *Plesioparabolina mendozana* RUSCONI) was not recognized by RUSCONI. In this connection it must be noted that, unfortunately, the figure given by LEANZA in 1947 was not particularly enlightening.

Reference of the species to *Syspacephalus* RESSER (1936) must be left out of consideration, as it differs decisively in two important respects: The palpebral lobes are situated almost on posterior one-third line of glabella, and the anterior branches of the facial suture are clearly divergent; finally the present writer believes that *Syspacephalus* is restricted to the Lower

Cambrian and the Lower Middle Cambrian. It is true that RASETTI mentions the occurrence of *Syspacephalus* in the *Albertella* zone at Mount Stephen (RASETTI 1951, *Syspacephalus tardus*, p. 247). This species apparently only differs little from the type species, *Agraulos charops* WALCOTT, 1917, but it must be noticed that its stratigraphic position has not been established with certainty.

A comparison with *Kistocare* LOCHMAN, 1948, shows that the Argentine species very well matches the generic diagnosis. The plausibility of referring the species to *Kistocare* is supported by the stratigraphic position (apparently *Kistocare* is found only in the *Glossopleura* zone) and by the association with other, closely related members of Alokistocaridae.

Horizon and locality: *Glossopleura* zone, Co. Martillo, and two miles west of Zonda, Provincia de San Juan.

Genus **Alokistocarella** RESSER, 1938.

Alokistocarella mexicana LOCHMAN, 1952.

Plate I, figs. 16–19.

The material contains two cranidia, which agree perfectly with the original description. Due to poor state of preservation one of the cranidia fails to show the granulation, whereas the external surface of the other is covered with medium-sized granules except furrows and bulge on the anterior border. The Argentine specimens differ only in the somewhat higher convexity of the cranidia, so possibly the specimens described by LOCHMAN have been object to a certain amount of flattening. Evidently, an important feature in this species, as also demonstrated by the Argentine specimens, is the slight downslipping of anterior border.

Horizon and locality: *Glossopleura* zone, Co. Martillo.

Genus **Amecephalina** POULSEN, 1927.

Amecephalina argentina (KAYSER).

A single, somewhat fragmentary and distorted, cranidium, originating from Co. Martillo, may be safely included in this species in spite of the poor state of preservation. Reference to *Amecephalina* was made by HARR. & LEANZA in 1943.

Horizon and locality: *Glossopleura* zone, Co. Martillo.

Genus **Eteraspis** RESSER, 1935.**Eteraspis orbignyana** (KAYSER).

A few small cranidia, representing young holaspid stages, are referred to this species. The cranidia agree perfectly with the description and figures given by HARRINGTON and LEANZA (1943).

Discussion: This genus shows some similarity to *Alokistocarella* and *Kistocare*, and a reference to the Alokistocaridae may be plausible, the Ptychoparoid element of the *Glossopleura* zone in Argentina being represented almost exclusively by members of this family.

Horizon and locality: *Glossopleura* zone, Co. Martillo.

INCERTI ORDINIS

I.

"*Clavaspidella asperoensis*" RUSCONI, 1952, Rev. Mus. Hist. Nat. Mendoza, vol. VI, p. 108, pl. II, fig. 2.

Discussion: For reasons as mentioned in connection with *Mendospidella digesta* (LEANZA) p. 7 this species is not referable to *Clavaspidella*.

Horizon and locality: *Glossopleura* zone, Co. Martillo.

II.

"?*Glossopleura pedemontana*" RUSCONI, 1955, Rev. Mus. Hist. Nat. Mendoza, vol. VIII, p. 18, pl. I, fig. 15.

Discussion: The pygidium differs from that of *Glossopleura* in having a pleural platform, which gradually merges into a narrow and indistinctly defined border, and in the lack of a post-axial ridge, and finally in the peculiar course of the interpleural grooves, which are narrow and shallow proximally, expanded and deeply impressed distally.

Horizon and locality: *Glossopleura* zone, Co. Martillo.

III.

"?*Fieldaspis minuta*" RUSCONI, 1955, Rev. Mus. Hist. Nat. Mendoza, vol. VIII, p. 17, pl. II, fig. 5.

Discussion: The pygidium figured and described by RUSCONI can hardly be assigned to *Fieldaspis* RASETTI (1951) in spite of some similarity, especially to *Fieldaspis bilobata* RASETTI (1951, p. 161). The Argentine species

differs from *Fieldaspis* in some important respects. Thus the basic shape of the pleural platform varies somewhat, not being transversely elongate in a notable degree. The axis tapers considerably to terminate in a remarkably pointed terminal segment, moreover the border seems to be comparatively narrow. Finally the presence of *Fieldaspis*, which apparently is restricted to the *Plagiura-Kochaspis* zone, is not to be expected in the Middle Cambrian of Mendoza, all the more so because the available evidence indicates that deposits belonging to the *Glossopleura* zone constitute the lowermost part of the Cambrian sequence in Argentina.

Horizon and locality: *Glossopleura* zone, Co. Martillo.

IV.

"*Amecephalus cormoranus*" RUSCONI, 1955, Bol. Paleont. Buenos Aires, no. 32 and Rev. Mus. Hist. Nat. Mendoza, vol. VIII, p. 23, pl. I, fig. 7.

Discussion: RUSCONI based this species on pygidia, which unfortunately fail to show any convincing resemblance to *Amecephalus* WALCOTT, 1924 (type species *Ptychoparia piochensis* WALCOTT, 1886, (part.)). On the contrary some notable differences may be pointed out. The pygidium of *Amecephalus* is characterized by the effaced segmentation of the pleural platform, the width of the axis (half of pygidial width) and the small number of axial segments (three to four). The pygidium of the Argentine species is distinguished by a slender axis, a distinctly segmented pleural platform, six axial segments, and moreover by being much wider than that of the type species. Finally, *Amecephalus* is nowhere known to occur in the *Glossopleura* zone.

Horizon and locality: *Glossopleura* zone, Co. Martillo.

THE MIDDLE CAMBRIAN FAUNA OF SAN JUAN

HARRINGTON and LEANZA (1943, p. 217) listed the following species from two localities in San Juan:

At QUEBRADA DE LA LAJA: *Amecephalina argentina* (KAYSER), *Ehmania* (?) *lajensis* (KAYSER), *Ehmania* (?) *hypselogena* HARR. & LEANZA, *Billingsella* (?) sp. indet.

At QUEBRADA DE JUAN POBRE: *Eteraspis orbignyana* (KAYSER), *Eteraspis prosorysa* HARR. & LEANZA.

An addition to the fauna at Quebrada de Juan Pobre is *Alokistocare elongatum* n. sp. (associated with *Billingsella* (?) and *Eteraspis*).

From a new locality by the roadside, about two miles west-northwest of Zonda (N) (Zonda (N) about eight miles west-northwest of San Juan), a fauna, collected by the present writer, contains the following species: *Zacanthoides ferula* LEANZA, *Mendospidella digesta* (LEANZA), *Kistocare mendozanum* (RUSCONI), *Amecephalina argentina* (KAYSER).

Thus the fauna now comprises following species:

- Alokistocare elongatum* n. sp.
Amecephalina argentina (KAYSER)
Ehmania (?) *lajensis* (KAYSER)
— *hypselogena* HARR. & LEANZA
Eteraspis orbignyana (KAYSER)
— *prosorysa* HARR. & LEANZA
Kistocare mendozanum (RUSC.)
Mendospidella digesta (LEANZA)
Zacanthoides ferula LEANZA
Billingsella sp. indet.

STRATIGRAPHY

The presence of a Middle Cambrian fauna in San Juan was first recognized by HARRINGTON and LEANZA in 1943. Their study of collections from Sierra Chica de Zonda in addition to a revision of older collections, described by KAYSER in 1876, resulted in a comparison to the Maryville formation of Tennessee, Georgia, and Alabama.

The Middle Cambrian deposits in the province of Mendoza were originally referred to Ordovician or Lower Silurian by RUSCONI in 1945. Later in 1945 he proposed a Cambrian age after having made new collections.

However, the first well-founded reference of these deposits to Middle Cambrian was made by LEANZA in 1947.

In the recent years Cambrian faunas, younger than that found at Co. Martillo, were discovered and described by RUSCONI (1950–1955). These younger faunas will not be considered in the present paper.

It appears from a consideration of all the known Argentine Middle Cambrian trilobites that genera diagnostic of levels lower than the *Glosso-*

pleura zone have never been found. It is true that some species have been referred to genera such as *Amecephalus*, *Fieldaspis*, and *Syspacephalus*; however, it soon became evident that in all instances the generic references were erroneous.

In related regions transgressions reached a maximum in Upper Middle Cambrian; thus it seems reasonable to assume that not until that time did the transgression penetrate as far south as Argentina.

MIDDLE CAMBRIAN OF MENDOZA

In 1955 (Rev. Mus. Hist. Nat. Mendoza, vol. VIII) RUSCONI presented following sub-divisions of the Middle Cambrian of Mendoza:

Isidreana formation	{	Horizon Villavicense (Cerillo El Solitario)	} Cerillo Martillo
	{	Horizon Isidrense	
	{	Horizon Crucense	

Horizon Crucense: Localities at base of, and in the vicinity of Co. Martillo. RUSCONI is of opinion that this horizon belongs to Upper Lower Cambrian or Lower Middle Cambrian; however, well-founded species such as *Mendospidella digesta* (LEANZA), *M. asperoensis* RUSC. (*Mendospidella* undoubtedly substituting the closely related *Athabaskia* from the North American and Mexican Cordilleran region), *Kistocare mendozanum* (RUSC.), *Glossopleura asperoensis* (RUSC.), *Gl. inxsulcata* (RUSC.), and *Gl. martillensis* (RUSC.) unquestionably indicate an age corresponding to the *Glossopleura* zone.

In the type section of the Arrojos formation in Sonora, Mexico, a layer containing *Chancelloria eros* WALCOTT appears above the lowermost *Glossopleura* beds; as the same species occurs in the basal layers of the Middle Cambrian section at Co. Martillo, the lower part of the *Glossopleura* zone here may possibly be absent.

Horizon Isidrense: Localities west of Estancia San Isidro and at Co. Martillo. Well-founded species from this horizon are such as *Kistocare mendozanum* (RUSC.), *Kootenia incerta* (RUSC.), *Zacanthoides ferula* LEANZA, *Glossopleura inxsulcata* (RUSC.), *Alokistocarella mexicana* LOCHMAN, all except the last one also known from horizon Crucense. From horizon Isidrense RUSCONI lists a number of genera definitely younger than the normal *Glosso-*

pleura fauna; this younger element, probably originating from overlying beds, seems to be of Upper Cambrian age.

It will appear that all evidence justifies the incorporation of the two mentioned horizons in the *Glossopleura* zone; the present writer prefers the use of the term *Glossopleura* zone, as it facilitates comparisons with other regions.

A distinction between faunules within this zone is not possible until a thorough revision of previously established species has been made, as genera and species listed by RUSCONI comprise forms from widely separated stratigraphical levels (Middle Cambrian-Ordovician) as well as from definitely separate faunal realms.

MIDDLE CAMBRIAN OF SAN JUAN

Of the ten species listed from San Juan six are known from the *Glossopleura* zone in the Co. Martillo region, and of these species *Kistocare mendozanum* (RUSC.) and *Mendospidella digesta* (LEANZA) must be regarded as diagnostic of the *Glossopleura* zone. Consequently it is safe to include the deposits at Quebrada de La Laja, Quebrada de Juan Pobre, and the new locality two miles west of Zonda (N) in this zone.

CONCLUSIVE REMARKS ON THE GLOSSOPLEURA ZONE IN ARGENTINA

As pointed out above, a thorough revision of previously established genera and species will be necessary in order to enable a detailed correlation with other regions. However, the occurrence of genera such as *Glossopleura*, *Mendospidella* (substituting *Athabaskia*), *Alokistocare*, *Kistocare*, *Alokistocarella*, *Zacanthoides*, and *Kootenia* indicates that part of the Argentine Middle Cambrian forms a close parallel to the upper half of the Arrojós formation of Mexico; of special interest is the Argentine occurrence of *Alokistocarella mexicana* LOCHMAN.

The youngest Middle Cambrian deposits in Mendoza are found at Cerillo El Solitario, Canota (Horizon Villavicense of RUSCONI). The fauna from this

locality apparently cannot be compared to that of the Tren dolomite in Mexico, therefore it is probable that the connection between Mexico and Argentina was completely interrupted towards the end of *Glossopleura* time. The fauna at Canota seems to have affinities mainly to North American faunas east of the Cordilleran trough.

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Plate I.

Mendospidella digesta (LEANZA). — Page 6.

- Figs. 1–3. Three meraspid cranidia; figs. 1–2, somewhat early meraspid stage, $\times 25$. Fig. 3, late meraspid stage, $\times 25$.

Chilometopus parabolicus RUSCONI. — Page 8.

- Fig. 4. Cranidium attached to thoracic segments, $\times 3$.

Asperocare argentinum n. g. et n. sp. — Page 9.

- Figs. 5–10. Figs. 5–7, cranidium (holotype), dorsal, lateral, and frontal view, $\times 4$. Fig. 8, cranidium (paratype), $\times 3$. Fig. 9, cranidium with attached thoracic segments (paratype), $\times 3$. Fig. 10, cranidium (paratype), $\times 3$.

Alokistocare elongatum n. sp. — Page 11.

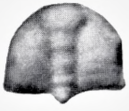
- Figs. 11–12. Two cranidia. Fig. 11, paratype, $\times 3$. Fig. 12, holotype, $\times 3$.

Alokistocare australe n. sp. — Page 13.

- Figs. 13–15. Cranidium (holotype), dorsal, frontal, and lateral view, $\times 3$.

Alokistocarella mexicana LOCHMAN. — Page 15.

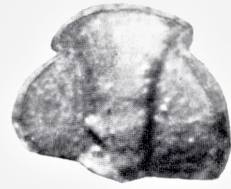
- Figs. 16–19. Figs. 16–18, cranidium, dorsal, frontal, and lateral view, $\times 3$. Fig. 19, approximately dorsal view of a cranidium showing the granulation, $\times 8$.



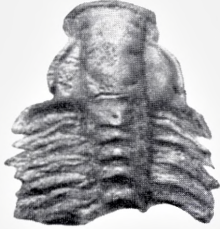
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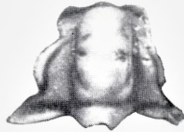
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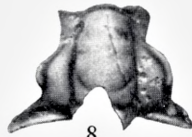
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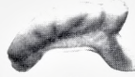
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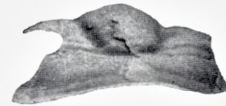
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