ABSTRACT. Ten species of Late Cambrian trilobites occur in a limestone lens at the base of the Val d’Homs Formation in the Cesse Brook section at Ferrals-les-Montagnes in the Montagne Noire. Associated in this lens are species referred to *Ammagnostus* (*Ammagnostus*), *Kormagnostus?*, *Olentella*, *Stigmatoa*, *Shengia*, *Abbarella*, *Proceratopyge* (*Proceratopyge*), *Prochuangia*, *Palaeodotes* and *Paraacidaspis*. Of these, *Stigmatoa courtessolei* and *Paraacidaspis ultima* are described as new species. The Ferrals fauna has a decidedly Australo-Sinian palaeobiogeographical relationship, with the implication that previously developed models suggesting a high latitudinal position for southern France during the Late Cambrian should perhaps be revised.

KEY WORDS: Late Cambrian, trilobites, southern France, Ferrals-les-Montagnes, Montagne Noire, biostratigraphy, biogeography.

UNMETAMORPHOSED fossiliferous Cambrian rocks are preserved in recumbent fold structures of the Pardailhan and Minervois nappes that constitute the south-western part of the Montagne Noire (Text-fig. 1). The famous trilobite locality, Ferrals-les-Montagnes, from which the material described here originates, belongs to the northernmost unit (Ferrals-MalvieÁs digitation) of the Pardailhan nappe. This locality is well known since the works of Bergeron (1888), Thoral (1935) and Courtessole (1973) for its almost complete upper Lower and Middle Cambrian succession with an abundant trilobite record that is representative for the entire region.

The Cambrian sequence (Text-fig. 2) characterizes the Mediterranean area as it shows striking homogeneity in both its lithological succession and its faunal association, with Sierra de la Demanda (north-west Spain), Sardinia and Turkey. Lower Cambrian archaeocyathid-bearing lime- and dolostones are generally superseded, at the base of the Middle Cambrian, by nodular limestones turning to clayey siltstones when the shallower carbonate platforms were progressively drowned within an overall extensional regime. The famous trilobite and echinoderm faunas of these ‘Paradoxides shales’ allow detailed biostratigraphical correlations within a distinct Mediterranean subprovince of the Acado-Baltic realm (Courtessole 1973). The higher part of the sequence is characterized by thick deposits of monotonously alternating quartzitic sandstones and siltstones. In these beds faunas indicate a tendency towards palaeogeographical endemism and subsequent increasing distance from the Acado-Baltic realm, as indicated by the appearance of Asian faunal elements such as *Chelidonocephalus* associated with the last paradoxidids (Feist 1986; Courtessole *et al.* 1988).

The youngest known Cambrian rocks of the Montagne Noire, directly below a slightly unconformable contact with the basal Ordovician, consist of silty slates that include sporadic limestone lenses (Val d’Homs Formation, Text-fig. 2). One of these lenses, which crops out in a small natural exposure on the eastern slope of the Cesse Brook, 600 m south of Ferrals village (Text-fig. 3), has yielded the youngest Cambrian trilobite association yet recovered from of the Montagne Noire. From the rather diversified fauna which is presented in this work, only two taxa (described as *Bergeronites latefalcatus* and *Prochuangia gallica*) have been published previously as a preliminary contribution (Feist and Courtessole 1984).

The Cesse Brook section south of Ferrals (Text-fig. 3), known since Boyer and Guiraud (1964) and Courtessole (1973), exposes the basal part of the Val d’Homs Formation with basal fossiliferous limestone
nodules and decalcified slates and marlstones with phantom trilobite remains. These are situated about 30 m above the youngest occurrence of *Eccaparadoxides macrocercus* (level ‘H’ of Courtessole 1973) in the sandy higher part of the underlying La Gardie Formation. At 1 m above the base of the Val d’Homs Formation a compact limestone, 0.8 m thick, microsparitic, bluish and grey-greenish in colour, with light grey and pink patches, rich in pyrite, yields coquinas of trilobite shell debris, with less common echinoderm remains and nonarticulated (lingulate) brachiopod valves. The fauna described here is from this single layer.

This trilobite bed is overlain by one metre of pelitic shales that contain another dark grey limestone, 0.3 m in thickness, which although fossiliferous has not yielded determinable fossils. This bed is followed by five metres of pelitic and sandy slates with lingulids and a few thin limestone lenses. Overlying the slates is a massive intercalation of light grey, microcrystalline, unfossiliferous limestone, eight metres thick, that corresponds to the typical Val d’Homs limestone in the Minervois area (Gèze 1949). In La Cesse section, this limestone is unconformably overlain by lowermost Ordovician quartzites of the La Dentelle Formation.

**AGE AND PALAEOBIOGEOGRAPHY OF THE FERRALS FAUNA**

(Ayusokkanian in southern Kazakhstan and the Siberian Platform, Kushanian in China, late Mindyallan in Australia) and slightly younger late Cambrian (Sakian in southern Kazakhstan and Siberian Platform, Changshanian in China, Idamean in Australia) trilobites from more than one biostratigraphical zone. There is a possibility that emplacement of the entire lens may have resulted from slumping or downslope flow transport. However, the fauna described here comes exclusively from a single lens which internally reveals
no organized sedimentary structure, such as gradation of bioclasts, and there is no evidence of reworking, authigenic mineralization, or long distance transport. Accordingly, we consider the faunal elements as contemporaneous and briefly review the age-range of each genus and its geographical distribution (summarized in Table 1). For stratigraphical distribution and correlation of the biostratigraphical units noted, the reader is referred to Shergold (1997). We interpret the Ferrals association as a shallow-water benthic fauna because, apart from the agnostids, all taxa are normally occluded forms, and the agnostids that do occur are rare, effaced, cosmopolitan forms.

*Ammagnostus sensu lato* typically has a latest Mid Cambrian–early Late Cambrian age, *Lejopyge laevigata–Glyptagnostus reticulatus* zones. It is widespread, occurring in Antarctica (Ellsworth Mountains, Northern Victoria Land), Argentina (Mendoza), Australia (western Queensland, New South Wales), Canada (Northwest Territories), China (Hunan, Liaoning, Zhejiang), Greenland, Kazakhstan (Lesser Karatau), Russia (north-east Siberia, Sette-Daban Mountains), and the USA (Wyoming, Montana).

*Kormagnostus* also ranges from the uppermost Middle Cambrian to lower Upper Cambrian, *Lejopyge laevigata–Glyptagnostus solidotus* zones, and is similarly widespread occurring in Argentina (Mendoza), Australia (western Queensland, ?Tasmania), Canada (Northwest Territories, Quebec), China (Hunan, Liaoning, Zhejiang), Greenland, Kazakhstan (Lesser Karatau), Russia (north-west Siberia), and the USA (Alabama, Indiana, Missouri, Montana, Nevada, Tennessee, Texas, Wyoming). The record of *Kormagnostus* in Xinjiang Province, China (Zhang Tairong 1981), more properly refers to *Proagnostus*.

*Olentella* has a Late Cambrian, Sakian age, *Aphelaspis–Kujandaspis* Zone in Kazakhstan and equivalent interval on the Siberian Platform, late Idamean–early Iverian in Antarctica, late Steptoean in Canada. It occurs in Antarctica (Northern Victoria Land), Canada (Northwest Territories), central Kazakhstan, Morocco, Russia (north-west Siberian Platform, Kulyumbe River; north-east Siberia, Kharaulakh, Olenek River), and the Tadzhikistan-Uzbekistan border region.

*Stigmatoa* was originally described from the Upper Cambrian, upper Idamean–lower Iverian, *Erixaniunum sentum–Irvingella tropica* zones in Australia. Subsequently, it has been described from the

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**TEXT-FIG. 3.** Location of the Cesse Brook (II) section across the topmost Cambrian strata south of Ferrals-les-Montagnes from which the trilobite fauna described here has been recovered. It is located on the Labastide-Rouairoux 1:25,000 Topographic Sheet 2444 Ouest (x = 623.96, y = 3121.9).
Changshanian, *Ininitagnostus inexpectans-Proceratopyge (P.) protracta–Irvingella angustilimbata-Agnostotes clavata* zones in China, and the *Prochuangia-Paracoosia* Zone in Iran. It occurs in Antarctica (Northern Victoria Land, Ellsworth Mountains), Australia (western Queensland, north-west Tasmania), China (Hunan, ?'Liaoning), northern Iran (Alborz Mountains), and Russia (southern Siberia, Altay Sayan).

*Shengia* is a typically Late Cambrian genus, from the Changshanian, *Glyptagnostus reticulatus reticulatus-Chuangia wulingensis* Zone, in China. Prior to this account, it has been recorded only in China (Anhui, Hunan, Jiangxi, Liaoning, Qinghai, ?Shaanxi and Xinjiang).

*Prochuangia sensu lato* ranges from latest Mid Cambrian to Late Cambrian, *Lejopyge laevigata–Glyptagnostus reticulatus* zones. Sixteen named species, and 11 compared or left under open nomenclature, have a wide geographical distribution in Antarctica (Northern Victoria Land, Ellsworth Mountains), Australia (western Queensland), China (Anhui, Henan, Hunan, Guizhou, Liaoning, Qinghai, Xinjiang), France, Iran, Kazakhstan (Lesser Karatau), South Korea, Russia (north-east Siberia), Spain, Tadzhikistan, Turkey and Viet Nam. If Fortey (1994) is correct (see below), the geographical range of *Prochuangia sensu lato* may also extend to Afghanistan and Oman.

*Abharella* was originally described from Iran (Alborz Mountains), where it has a long range from the late Mid Cambrian, *Dorpyge-Abharella-Erbenia-Chelidonocephalus* Assemblage Zone to Late Cambrian, *Drepanura-Torifera-Eokaolishania* and *Prochuangia-Paracoosia* assemblage zones. It has also been questionably reported from south-east Turkey.

*Proceratopyge (Proceratopyge) sensu stricto* is long ranging, from the late Mid Cambrian *Lejopyge laevigata Zone* to the Late Cambrian *Olenus dentatus* Zone in Europe. It is also known from the *Lejopyge armata to Agnostotes clavata-Sinoproceratopyge kiangshanensis* zones in China. *Proceratopyge sensu lato* is one of the most cosmopolitan of Cambrian trilobites, occurring in Antarctica (Northern Victoria Land), Argentina (Mendoza), Australia (western Queensland, Tasmania), Canada (Northwest Territories), China (Anhui, Guizhou, Hunan, Jiangsu, Liaoning, Qinghai, Xinjiang, Zhejiang), Kazakhstan (central and southern), Norway, Russia (south and north-eastern Siberia), South Korea, Sweden, Tadzhikistan, UK, and USA (Alaska).

*Palaeadotes* ranges from the upper Middle Cambrian, *Lejopyge laevigata Zone* and equivalents, to the lower Upper Cambrian, *Glyptagnostos stolidotus* Zone. *Palaeadotes* is another genus with a wide geographic distribution, being known from Antarctica (Northern Victoria Land and West Antarctica), Australia (western Queensland, western New South Wales, north-west Tasmania), China (Anhui, Guizhou, Henan, Hunan, Jiangsu, Qinghai, Sichuan, Xinjiang, Yunnan), France, Iran, Kazakhstan, Russia (south and north-eastern Siberia), Sweden and south-east Turkey (see also Chang 1998a, b).

*Paraacidaspis* has a Late Cambrian age, Changshanian, *Chuangia-Prochuangia* Zone, in China, and Aksayan, *Pseudagnostos pseudangustilimbatus* and *Neoagnostos quadratiformis* zones in southern Kazakhstan. It is known in China (Anhui, Hunan, Qinghai), southern Kazakhstan (Lesser Karatau), and Russia (south Siberia).

The Ferrals assemblage certainly post-dates the paradoxidean Mid Cambrian of the Montagne Noire and may be confidently dated as Late Cambrian. However, in the absence of age-diagnosticagnostoid trilobites, such as *Lejopyge laevigata, Glyptagnostos stolidotus* and *G. reticulatus*, a precise age within the early part of the Late Cambrian cannot yet be determined. On the basis of the currently known ages of species of *Olenella, Stigmatoa, Shengia* and *Paraacidaspis*, which are not known to occur below the *Glyptagnostos reticulatus* Zone, we are inclined to regard the Cesse Brook lens as being of this age. Species referred to *Proceratopyge (Proceratopyge), Abharella* and *Prochuangia* are known to be long ranging and their occurrence would not contradict this age assignment. This means that the species we refer here to *Ammagnostos (Ammagnostos), Kormagnostos?* and *Palaeadotes* would have slightly extended ranges in the Montagne Noire.

As indicated in Table 1, the Ferrals faunal association at generic level is palaeobiogeographically most closely related to Late Cambrian assemblages in China (particularly Hunan), Korea, Australia and Antarctica, which occur at low latitude on the Asia-Australia Gondwana margin. If there are similarities to faunas from other palaeocontinents, then they are with other areas generally regarded as being situated at low latitude, such as southern Kazakhstan (Lesser Karatau) and Siberia. Accordingly, we question currently accepted palaeogeographical reconstructions which locate southern France at 60 degrees S in the Late Cambrian (e.g. Courjault-Radé *et al.* 1992).
Morphological terminology used in this paper is essentially that recommended by Whittington and Kelly (1997). The classification adopted is mostly that of Fortey and Chatterton (1988) and Fortey (1997), apart from the concept of Agnostida, where we follow Shergold et al. (1990). Material described in this paper is deposited in the collections of the Institute des Sciences de l’Evolution, Université de Montpellier II and is prefixed UM2 SFV.

**TABLE 1.** Palaeobiogeographical distribution of generic elements present in the Ferrals faunal association (stippled), showing greatest relationship with southern and central China, Australia and Antarctica. VN, Viet Nam.

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<th>Olentella</th>
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<th>Paraeoestes</th>
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**SYSTEMATIC PALAEOONTOLOGY**

Morphological terminology used in this paper is essentially that recommended by Whittington and Kelly (1997). The classification adopted is mostly that of Fortey and Chatterton (1988) and Fortey (1997), apart from the concept of Agnostida, where we follow Shergold et al. (1990). Material described in this paper is deposited in the collections of the Institute des Sciences de l’Evolution, Université de Montpellier II and is prefixed UM2 SFV.

**Order AGNOSTIDA Salter, 1864**

**Superfamily AGNOSTOIDEA M’Coy, 1849**

**Family AGNOSTIDAE M’Coy, 1849**

**Subfamily AMMAGNOSTINAE Opik, 1967**

**Genus AMMAGNOSTUS Opik, 1967**

**Subgenus AMMAGNOSTUS Opik, 1967**

 [=Agnostoglossa Opik, 1967; =Glyptagnostus (Lispagnostus) Opik, 1967]
Type species. *Ammagnostus psammius* Öpik (1967, pp. 139–141, pl. 55, fig. 3; pl. 66, figs 1–4), Mindyallan, Glyptagnostus stolidotus Zone, Georgina Basin, western Queensland, Australia. It is also recorded from rocks of this age in the Sette-Daban Mountains, eastern Siberia by Gogin and Pegel’ (in Gogin et al. 1997, p. 112, pl. 22, figs 3, 6, 9).


Remarks. Robison (1988, pp. 42–43) referred Balthagnostus beltensis Lochman (in Lochman and Duncan 1944, pp. 138–139, pl. 12, figs 3–5) to Ammagnostus. This extended the geographical range of Ammagnostus to Greenland and North America (Wyoming, Montana), and through synonyms, B. hospitus and B. mendozaensis (both Poulsen, 1960), to Argentina. The species beltensis was also recorded, as Kormagnostus?, in north-western Canada by Pratt (1992). Öpik (1967) originally classified Ammagnostus in his subfamily Ammagnostinae, within the family Diplagnostidae. Robison (op. cit.) placed Ammagnostus within the family Peronopsidae, but we, like Pratt (1992), consider that the shape of the posterior lobe of the pygidial axis does not support such an assignment. We also agree with Pratt (1992) regarding the relationship of Ammagnostus to Kormagnostus, differentiating these genera by the forward position of the posterior axial pygidial node in some, but not all, species of the former as distinct to a terminal position in the latter. We iterate that, since the position of this node is not always determinable in species of Ammagnostus, and also in its synonym, Agnostoglossa Öpik (1967), the latter should be regarded as a synonym of the former (Shergold et al. 1990; Shergold and Laurie 1997). Robison (1988, p. 42) suggested that the position of secondary nodes is of limited taxonomic significance. In that case the subfamily Kormagnostinae, erected by Pratt (1992, p. 30) for Kormagnostus, is unnecessary because the genus can be accommodated in Ammagnostinae. Here, we follow Shergold et al. (1990), Pratt (1992) and Shergold and Laurie (1997) in classifying Ammagnostinae within the family Agnostidae.

Sun Xiaowen (1989, 75) erected the genus Tentagnostus on the basis of Pseudagnostus adchinensis Schrank (1975, pp. 595–596, pl. 1, fig. 11; pl. 2, figs 1–6; pl. 3, figs 1–2), but subsequently (in Shergold et al. 1990) she re-evaluated it as a subgenus of Ammagnostus. It is characteristically considerably less effaced than Ammagnostus, and is possibly stratigraphically younger, occurring in the Kaolishania? quadriceps (now Prochuangia quadriceps) fauna of Saimaki, Liaoning, northeastern China.
Ammagnostus (Ammagnostus) aff. sinensis Peng, 1987

Plate 1, figures 1–19

aff. 1987 Ammagnostus sinensis Peng, p. 86, pl. 4, figs 1–4.

Material. Twenty one cephala, UM2 SFV 1–21, and nineteen pygidia, UM2 SFV 22–40.

Descriptive notes. Relatively undeformed cephala are characteristically subrectangular in shape, with stout borders and deliquiate border furrows. The acrolobe is very slightly constricted laterally, and lacks a median preglabellar furrow. The glabella is relatively long (sag.), subparallel-sided, with a prominent obtusely rounded anteroglabella, prominent straight or very gently posteriorly curved anterior glabellar furrow (F3), and on some specimens, an extremely faintly impressed transverse lateral furrow (F2). The axial glabellar node lies at the mid-point of the posteroglabella, and the glabellar culmination is obtuse. Basal lobes are large and triangular.

Undeformed pygidia are also subrectangular, and have wide borders, especially posterolaterally, and wide, deliquiate border furrows. Posterolateral spines are situated on a transverse level with the rear of the pygidial axis. The acrolobe is narrow (tr.) and laterally constricted. The axis is virtually effaced apart from a prominent axial node. On some specimens, there may be a faint trace of the terminal axial node lying in an advanced position. The posterior pygidial lobe is gently expanded (tr.), and extended (sag.) to the posterior border furrow.

Remarks. Ammagnostus (Ammagnostus) aff. sinensis Peng differs from the type species, A. (A.) psammius Öpik, and from A. (A.) integriceps Öpik, in its more deliquiate cephalic border furrows and wider (tr., sag.) borders. Pygidia are essentially similar to all of the Australian species described by Öpik (1967) except that the French material generally shows little convincing evidence of an advanced terminal pygidial node. In this characteristic, A. (A.) aff. sinensis differs from A. (A.) duibianensis Lu and Lin, A. cylindratus Guo and Luo, and material described as A. (A.) integriceps Öpik by Ergaliev (1980) from southern Kazakhstan. A. (A.) bellus Guo and Luo appears to have a residual median preglabellar furrow which is totally effaced in other species of Ammagnostus (Ammagnostus), and may not be congeneric. Overall pygidial morphology is shared with A. (A.) sinensis Peng. However, the cephalon assigned to this species by Peng is more effaced, and is illustrated by only a single specimen; hence the determination here with affinity.

Genus Kormagnostus Resser, 1938

Type species. Agnostus seclusus Walcott (1884, p. 25, pl. 9, fig. 14), Marjuman, Lejopyge laevigata–Glyptagnostus stolidotus zones (Robison 1988, p. 45), Nolichucky Formation, Tennessee, USA.

EXPLANATION OF PLATE 1

Figs 1–19. Ammagnostus (Ammagnostus) aff. sinensis Peng, 1987. 1, UM2 SFV 11; exfoliated, incomplete, sagittally compressed cephalon; ×12. 2, UM2 SFV 15; largely exfoliated, laterally compressed cephalon showing position of axial glabellar node at mid-point of posteroglabella; ×12. 3, UM2 SFV 18; exfoliated, laterally compressed cephalon; ×8. 4, UM2 SFV 19; latex cast of exfoliated cephalon; ×8. 5, UM2 SFV 7; exfoliated, sagittally compressed cephalon; ×8. 6, UM2 SFV 4; exfoliated cephalon; ×12. 7, UM2 SFV 8B; exfoliated cephalon; ×8. 8, UM2 SFV 9; exfoliated cephalon with hint of faint F2 glabellar furrow; ×8. 9, UM2 SFV 37; exfoliated, incomplete pygidium; ×12. 10, UM2 SFV 40; exfoliated pygidium showing a trace of second transverse axial furrow and third pair of muscle scar impressions; ×8. 11, UM2 SFV 28; exfoliated pygidium; ×12. 12, UM2 SFV 24; largely exfoliated, laterally compressed pygidium; ×12. 13, UM2SFV 26; exfoliated pygidium; ×12. 14, UM2 SFV 22; laterally compressed pygidium; ×8. 15, UM2 SFV 34; exfoliated pygidium; ×8. 16, UM2 SFV 27; sagittally compressed pygidium with hint of advanced terminal axial node; ×12. 17, UM2 SFV 30; laterally strongly compressed pygidium with three pairs of muscle scar impressions; ×8. 18, UM2 SFV 25; exfoliated pygidium; ×8. 19, UM2 SFV 23b; latex cast of laterally compressed pygidium with hint of advanced terminal axial node; ×6. All material from the basal Val d’Homs Formation, Cesse Brook, Ferrals-les-Montagnes, Montagne Noire, France.
SHERGOLD et al., Ammagnostus
Other species. See Peng (1987, p. 87), Robison (1988, p. 45) and Pratt (1992, p. 32); extensive synonymy listed by the last two authors.

*Kormagnostus*? sp. undet.

**Plate 2, figures 1–4**

**Material.** Two cephaloa, UM2 SFV 8C, 42B, and three pygidial fragments, UM2 SFV 43–45.

**Remarks.** Insufficient material is available to firmly determine this species. Of the two cephaloa, the least deformed is subovoid in shape. Both have evenly narrow (tr., sag.) borders and non-deliquiate border furrows, and unconstricted acrolobes. One specimen (UM2 SFV 42B, Pl. 2, fig. 1) is otherwise almost completely effaced. The second (UM2 SFV 8C, Pl. 2, fig. 2) has shallow, poorly defined axial furrows, an equally poorly defined anteroglabella, and an axial glabellar node situated almost at the glabellar midpoint. Both specimens lack a median preglabellar furrow.

Associated pygidia are ovoid, and characterised by relatively wide borders posterolaterally, and deliquiate border furrows. One specimen (UM2 SFV 45, not figured) has a narrow (tr.) acrolobe and traces of the right hand axial furrow. Of the other two, UM2 SFV 43 (Pl. 2, fig. 4), is virtually totally effaced apart from a hint of a right-hand axial furrow, but UM2 SFV 44 (Pl. 2, fig. 3), which is partially exfoliated, demonstrates a very faint left-hand axial furrow and a median axial node.

These specimens are questionably attributed to *Kormagnostus* by comparison with *K. flavi* Pratt (1992, p. 32, pl. 2, figs 27–33), especially in the degree of effacement of the pygidium. UM2 SFV 44 may be slightly more effaced than Pratt’s (*op. cit.*) figure 27, and the lesser effaced of the cephaloa may compare to his figure 29.

**Order Ptychopariida Swinnerton, 1915**

**Suborder Ptychopariina Swinnerton, 1915**

**Superfamily Ptychoparioidea Swinnerton, 1915**

**Family Pterocephalidae Kobayashi, 1935**

**Subfamily Aphelaspidinae Palmer, 1960**

**Genus Olenella Ivshin, 1955**

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**EXPLANATION OF PLATE 2**

Figs 1–4. *Kormagnostus?* sp. undet. 1, UM2 SFV 42B; mostly effaced cephalon; ×12. 2, UM2 SFV 8C; effaced cephalon with extremely faintly defined axial furrows, basal lobe and axial node; ×12. 3, UM2 SFV 44; partly exfoliated pygidium showing faint left-hand axial furrow and median axial node, ×8. 4, UM2 SFV 43; largely effaced pygidium with trace of right-hand axial furrow, ×12.

Figs 5–15. *Olenella cf. africana* Feist, in Destombes and Feist, 1987. 5, UM2 SFV 46; partially exfoliated, incomplete cranidium showing complex glabellar furrows and ocular ridge on internal mould; ×2. 6, UM2 SFV 48; partially exfoliated cranidium; ×2. 7, UM2 SFV 47; partially exfoliated cranidium; ×4. 8, lateral view; ×4. 9, UM2 SFV 51; partially exfoliated, sagittally compressed cranidium; ×2. 10, UM2 SFV 55; partially exfoliated, laterally compressed cranidium with faint nuchal node on mould; ×2. 11, UM2 SFV 58; internal mould of hypostome; ×4. 12, UM2 SFV 62; exfoliated, incomplete pygidium; ×2. 13, UM2 SFV 60; partially exfoliated pygidium, ×2. 14, UM2 SFV 67; incomplete pygidium; ×4. 15, partially exfoliated pygidium; ×4.

Figs 16–20. *Proceratopyge* (*Proceratopyge*) sp. undet. 16, UM2 SFV 152; exfoliated, incomplete, laterally compressed cranial fragment with pitted glabellar furrows and posteriorly sited axial glabellar node; ×12. 17, UM2 SFV 151; internal mould of cranidium; ×6. 18, UM2 SFV 150; mostly exfoliated, laterally compressed cranial fragment; ×4. 19, UM2 SFV 153; internal mould of incomplete pygidium; ×8. 20, UM2 SFV 154; internal mould of incomplete pygidium; ×8.

All material from the basal Val d’Homs Formation, Cesse Brook, Ferrals-les-Montagnes, Montagne Noire, France.
SHERGOLD et al., trilobites
Type species. *Olentella olentensis* Ivshin (1955, p. 117, pl. 1, fig. 7; 1956, pp. 66–67, pl. 5, figs 1–11; pl. 6, figs 6?, 10?; in Nikitin 1956, pl. 11, fig. 7), Sakian, Aphelaspis-Kujandaspis Zone, Tortkuduk Suite, central Kazakhstan.


Remarks. Cranial, librigenal, hypostomal and pygidial similarities to *Aphelaspis* confirm earlier opinions (Shergold and Cooper 1985; Pratt 1992) that *Olentella* should be classified within the subfamily Aphelaspidae. We follow Palmer (1960, 1965) and Pratt (1992) in accommodating that subfamily in the family Pterocephaliidae because of the obvious similarities in dorsal morphology. We presently prefer to classify this family alongside Elviniiidae and Dokimocephalidae in the Ptychoparoidae (order Ptychopariida) until such time as a comprehensive review of these families is developed. However, we are aware of the suggestions of Fortey and Chatterton (1988) and Fortey (1997) that Pterocephaliidae should be classified within the superfamily Anomocaroidea (order Asaphida) because younger Pterocephaliinae possess a median suture. There is possibly some evidence that median sutures may have evolved at different times through the reduction of the rostral plate to a rostellum with median suture and its eventual elimination in some advanced ptychopariids (Ludvigsen 1991). For documentation of the rostellum and discussion of its importance in the higher taxonomic classification of trilobites, see Chatterton et al. (1994a, b) and Chatterton and Ludvigsen (1998). Should Pterocephaliidae be confirmed as primitive Asaphida, then Aphelaspidae may require upgrading to familial status.

*Olentella* sp. cf. *africana* Feist, in Destombes and Feist, 1987

Plate 2, figures 5–15

*Material. Original type material of Olentella africana* is deposited in the Département des Sciences de la Terre, Université Claude Bernard, Lyon, France, and numbered DSTDLS350 300–350 316. Material from the Montagne Noire compared to it consists of ten cranidia (UM2 SFV 46–55), three hypostomata (UM2 SFV 56–58) and nine pygidia (UM2 SFV 60–68).

*Description. Olentella* cf. *africana* is characterized by a relatively short (sag.) preglabellar area, relatively wide (tr.) interocular width, aphelaspidinid type hypostome with maculae, small, lenticular aphelaspidinid pygidium with two (possibly three) axial rings and 2–3 sets of pleural furrows.

Relatively undeformed cranidia have a gently arcuate anterior contour. The glabella tapers gently forwards and is anteriorly obtusely rounded, sometimes truncate. It has three pairs of glabellar furrows most visible on exfoliated material. S1 is complexly sigmoidal, S2 arched posterosagittally, and S3 short and transverse. The occipital furrow is prominent, widest sagittally and gently arching anteriorly. The preglabellar area is flat, shorter (sag.) than the length (sag.) of the anterior cranidial border. There is a tendency to form a low boss sagittally which causes the anterior cranidial border furrow to shallower (sag.). The anterior cranidial border is gently upturned. Arcuate palpebral lobes are
situated between glabellar furrows S1 and S3, spanning the glabellar mid-point. The interocular width (tr.) is relatively broad. Palpebral areas are as wide (tr.) as the length (exsag.) of the palpebral lobes. Palpebral ridges are prominent only on exfoliated cranidia.

The attributed hypostome is long (sag.) and narrow (tr.), as are its borders, particularly the posterior border. The anterior wings are short (tr.) and triangular. A faint middle furrow, dividing the long (sag.) anterior lobe from a restricted posterior lobe, traverses the middle body, and is deepest at the poorly defined maculae. The lateral border furrows are slightly deepened posterior to the maculae, and also postilaterally.

The pygidium is small, transversely ellipsoidal, characterized by a short (sag.) elevated axis, containing three rings, which extends posteriorly to the pygidial border. There are two, faintly three, pairs of pleural furrows, the first of which is most prominent, extending on to the edge of the pygidial border. This is defined by a narrow (tr., sag.) border furrow which extends posteriorly to the maculae, and also posterolaterally.

Remarks. This taxon could represent one of a number of genera recorded from central Kazakhstan (Aphelaspis sensu Ivshin 1956, Kujandaspis, Olentella), the northern Siberian Platform (Amorphella, Nyaya, Monosulcatina, Pesaiella) and Novaya Zemlya (Pesai), which are typically of late Cambrian age. Assignment of the Montagne Noire species to Olentella is favoured here because this genus has a wider distribution and is better known than the others. It is compared to O. africana from Morocco as both occurrences are from the same palaeobiogeographic province. Possibly, the only essential difference between cranidia of the two species lies in the proportionate lengths of the glabella, preglabellar field and anterior cranial border. Pygidia have the same architecture and three axial rings. O. africana is preserved in calcareous sandstone, whereas O. cf. africana is preserved in carbonate, and accordingly more morphological detail is preserved. The French material has also been subjected to a greater degree of deformation which may account for minor differences of proportion and definition of furrows.

Olentella cf. africana appears also to be similar to O. cf. shidertensis Ivshin described from Antarctica (Shergold and Cooper 1985, fig. 6a–l), particularly in cranidial morphology. However, the pygidium of the French species is possibly smaller and more transverse. It resembles several species of Aphelaspis, e.g. A. nobilis Ivshin (1956, pl. 3, fig. 13), A. brachyphasis Palmer (1962, pl. 4, fig. 13), A. buttsi (Kobayashi) sensu Palmer (1962, pl. 4, fig. 26), and A. stenyrogenae Pratt (1992, pl. 15, fig. 10). The hypostome is similar to that of Aphelaspis brachyphasis Palmer (1962, p. F33, pl. 4, fig. 19; 1965, pl. 8, fig. 21) and to hypostome types D and A of Palmer (1960, pl. 11, figs 9 and 12 respectively). These are posited by Palmer (1960, p. F60) to belong to elviniiid or pterocephaliid trilobites (see also Rasetti 1965; Whittington 1988, text-fig. 17; and Pratt 1992, pl. 18, figs 28–29).

Family EULOMIDAE Kobayashi, 1955
Subfamily EULOMINAE Kobayashi, 1955

Genus STIGMATOA Öpik, 1963

Type species. Stigmatoa diloma Öpik (1963, pp. 89–90, pl. 4, fig. 2), Idamean, Erixanium sentum Zone, Georgina Basin, western Queensland, Australia (also Henderson 1976, p. 353, pl. 51, figs 5–7).

Other species. Stigmatoa silex Öpik (1963, pp. 90–91, pl. 4, fig. 4), age and occurrence as for type species. S. sidonia Öpik (1963, pp. 91–92, pl. 4, fig. 1), Iverian, Irvingella tropica Zone, occurrence as for type species (also Henderson 1976, pp. 353–354, pl. 51, figs 15–16). S. nysoni Öpik (1963, pp. 92–93, pl. 4, fig. 3), Iverian, Erixanium sentum Zone, occurrence as for type species (also Henderson 1976, pp. 354, pl. 51, figs 8–9). S. reticulata Romanenko (in Zhuravleva and Rozova 1977, pp. 179–180, pl. 24, figs 23–25; pl. 25, figs 1–3), Late Cambrian, Altay Sayan, Bol’shaya River, southern Siberia. S. plana Romanenko (in Zhuravleva and Rozova 1977, pp. 180–181, pl. 25, figs 4–7), age and occurrence as above. S. yangziensis Yang (1978, pp. 36–37, pl. 5, fig. 8), Changshanian, Chuangia-Prochuanxia Zone, western Hunan, China (also Peng 1992, p. 40, fig. 18A–C), Changshanian, Ininitagnostus inexpectans-Proceratopyge (Proceratopyge) protracta–Irvingella angustilimbata-Agnostotes clavata zones), S. singularis Wittke (1984, pp. 143–145, pl. 5, fig. 14), Late Cambrian, Prochuanxia-Paracoosia Assemblage Zone, Alborz Mountains, northern Iran. S. liaoningensis Guo and Zhang (1992, p. 3, pl. 1, fig. 1), Changshanian, Chuangia-Prochuanxia Zone, Liaoning, China. S. incita Romanenko (in Zhuravleva and Rozova 1977, p. 163) appears to be a nomen nudum. Eugonocare? sp. (Lu 1956, p. 386, pl. 1, figs 3–4; Lu et al. 1965, pl. 29, figs 1–2) has also been referred...
to *Stigmatoa* (Öpik 1963, p. 88). *Stigmatoa* sp. is recorded from the Smithton Trough of north-west Tasmania, where it has an Idamean age (Rickards *et al.* 1990, fig. 2n). Of these species *S. liaoningensis* Guo and Zhang is possibly non-congeneric since an occipital spine does not appear to be developed.

*Stigmatoa courtessolei* sp. nov.

Plate 3, figures 1–8

*Derivation of name.* Named in recognition of the contribution to the palaeontology of the Montagne Noire made by the late Abbé Robert Courtessole of Carcassonne.

*Holotype.* The cranidium, UM2 SFV 70, Plate 3, figure 4.


*Diagnosis.* A species of *Stigmatoa* Öpik, 1963 characterized by a short (sag.) preglabellar area, unevenly anteriorly tapering glabella bearing sinuous S1, relatively narrow (tr.) palpebral areas, small occipital spine, small semicircular pygidium with four axial rings and an evenly narrow border.

*Description.* The anterior cranidial outline is evenly and gently arched. The glabella is ovoid, anteriorly rounded, and defined by axial furrows which are gently curved and anteriorly tapered. It possesses three pairs of glabellar furrows: S1 are posterosagittally directed and gently sigmoidal; S2 arch gently posterosagittally; and S3 are short (tr.) and transverse. The occipital lobe bears a median spine of uncertain length. The preglabellar area is relatively short (sag.), nearly equivalent to the sagittal length of the anterior cranidial border which is convex (sag.). The anterior cranidial border furrow is a deep recess, and contains 10–12 pits. Gently arcuate, elevated palpebral lobes extend from mid L1 to S2. The palpebral areas are relatively narrow (tr.), less than half the maximum glabellar width (tr.). The extent of the posterolateral lobes is unknown.

The attributed pygidia are small and semicircular with a distinctive evenly narrow (tr., sag.) flat border. The axis is parallel-sided or slightly posteriorly tapering, posteriorly broadly rounded, and extends to the posterior border. It contains four rings and a short (sag.) terminal piece. Four pairs of pleural furrows are defined, terminating at the border. A border furrow is not developed. The margin is non-spinose.

*Remarks.* Two types of pygidium have previously been attributed to *Stigmatoa*. We agree with Henderson (1976) that the one assigned by Öpik (1963, text-fig. 32) is incorrectly attributed. The pygidia figured by Henderson (1976, pl. 51, figs 7, 9) are similar to those described herein but are more transverse. The French material compares most favourably with the pygidium of *Stigmatoa reticulata* E. Romanenko (*in* Zhuravleva and Rozova 1977, pl. 24, fig. 23), from the Altay Sayan, southern Siberia.

Of Australian and Antarctic species, *Stigmatoa courtessolei* resembles *S. tysoni* Öpik in having a convex (sag.) anterior cranidial border, an assumed small occipital spine and relatively narrow (tr.) palpebral areas. It shares these characteristics also with *S. singularis* Wittke from Iran. The Montagne Noire species differs from *S. yangziensis* Yang in having a shorter (sag.) preglabellar area, shorter occipital spine and axial furrows which define a less evenly anteriorly tapering glabella. The last characteristic also distinguishes *Stigmatoa courtessolei* from the Siberian species described by Romanenko (*in* Zhuravleva and Rozova 1977), but as noted above, the pygidium is essentially similar.

**Family LISANIIDAE** Chang, 1963

**Genus SHENGIA** Hsiang, in Jegorova *et al*., 1963

*Type species.* *Shengia quadrata* Hsiang (*in* Jegorova *et al.*, 1963, p. 57, pl. 13, figs 1–11), Changshanian, *Glyptagnostus reticulatus reticulatus-Chuangia wulingensis* Zone, western Hunan, southern Anhui, China (also illustrated by Peng 1992, p. 76, fig. 40A–e).

**Remarks.** Peng (1992) synonymized *Shengia wannanensis* Qiu, 1983, *S. minima* Qiu, 1983 and *S. convexa* Qiu, 1983 with the type species. Until the present report, all known species of *Shengia* have been described from China, although it may have been reported as *Lisaniella* from the Ayusokkanian (Kormagnostus simplex Zone) of Lesser Karatau, southern Kazakhstan (Ergaliev 1980).

*Shengia* cf. *spinosa* Yang, 1978

Plate 3, figures 9–16

cf. 1978 *Shengia quadrata* Hsiang forma spinosa Yang, p. 52, pl. 8, figs 13–14.
cf. 1983 *Shengia brevispina* Qiu, in Qiu et al. 1983, p. 133, pl. 43, fig. 5.
cf. 1992 *Shengia spinosa* Yang, 1978; Peng, p. 76, fig. 40k.

**Material.** Eleven cranidia, UM2 SFV 81–91, and one pygidial fragment, UM2 SFV 92.

**Remarks.** The French material is variously deformed, and a detailed description is not given. Cranidia are characterized by a flat-lying anterior border and an anterior border furrow which is widened sagittally. There is no preglabellar area and sagittally the preglabellar furrow merges with the border furrow. Glabellar furrows S1 and S2 are sigmoidal; S3 is short (tr.), gently curved and transverse. The occipital ring bears a short spine posterior to a median node. One specimen (UM2 SFV 82, Pl. 3, fig. 13) displays poorly defined anterolateral occipital lobules. Palpebral ridges are prominent. A pair of fossulae lies in the axial furrows immediately anterior to their intersection by the palpebral ridges.

The attributed pygidial fragment has four sets of pleural furrows which discharge into an anterolaterally widened border furrow. Interpleural furrows are effaced. The border has a prosopon of inosculating raised ridges which extend on to the propleuron of the first pygidial segment. A small spine occurs at the anterolateral corners of the pygidial tagma. Peng (1992, fig. 40n) showed a similar projection on the pygidium of *Shengia quadrata* Hsiang, and a similar structure is present on *Eoshengia gaoxiaogouensis* Yang and Liu (in Yang et al. 1991/1992, pl. 16, fig. 10).

The presence of an occipital spine is not confined to *S. spinosa*. Yang (1978, pl. 8) illustrates them on *Eoshengia quadrata* and *E. spinosa*, and occipital spines also occur in species of *Lisaniella* (Lu et al. 1965, pl. 47) [=Redlichaspis Kobayashi, 1935, *fide* Zhang and Jell 1987] together with occipital median nodes. Ergaliev (1980, pl. 6, fig. 4) illustrated a similar combination in the specimen he referred to *Lisaniella* cf. elongata Chang, 1963. The differences between *Eoshengia* and *Shengia* are minimal, possibly preservational, and these genera may prove to be synonyms. They have a similar restricted palaeogeographical distribution. Stratigraphically, in China, *Eoshengia* predates *Shengia*, ranging from the late Middle Cambrian Hypagnostus vulgaris to Lejopyge laevigata-Clavagnostus (Paraclavagnostus) variatus assemblage zones in Sichuan to the early Late Cambrian Paradamesops jimaensis-Cyclolorenzella tuma Assemblage Zone in Hunan. *Redlichaspis* is typically a late Middle Cambrian (Zhangxian) genus, and the Kazakh record in the Late Cambrian Ayusokkanian must be queried.
Order CORYNEXOCHIDA Kobayashi, 1935
Suborder LEIOSTEGIINA Bradley, 1925
Family LEIOSTEGIIDAE Bradley, 1925
Subfamily PAGODINAE Kobayashi, 1935

Genus PROCHUANGIA Kobayashi, 1935

*Type species.* Prochuangia mansuyi Kobayashi [1935, pp. 186–187, pl. 10, figs 1–7, non pl. 7, fig. 8 (≡Chuangia nais Mansuy 1915, p. 20, pl. 2, fig. 14a–g, non Walcott 1911, pp. 84–85, pl. 15, fig. 5)], Changshanian, Chuangia-Prochuangia Zone, Saihsio, South Korea and north-east Viet Nam.


*Remarks.* Fortey (1994) has argued for the recognition of *Constrictella* Wolfart (1974) as a subgenus of *Prochuangia*. His case is based on substitution of Wolfart’s original non-spinose pygidial paradigm with spinose pygidia of the type that Wolfart illustrated (1974, pl. 11, figs 4–8) as *Crepicephalus* n. sp. While the cranidia figured by Fortey (1994, fig. 7) are in fact quite similar to those of *Prochuangia*, those

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**EXPLANATION OF PLATE 3**

Figs 1–8. *Stigmatoa courtessolei* sp. nov. 1. UM2 SFV 77; partially exfoliated cranidium with simple glabellar furrows; ×6. 2. UM2 SFV 74A; partially exfoliated cranidium with deeply impressed glabellar furrows and well defined ocular ridges on internal mould; ×4. 3. UM2 SFV 73; mostly exfoliated cranidium; ×4. 4. UM2 SFV 70; partially exfoliated cranidium; ×2. 5. UM2 SFV 69; internal mould of cranidium; ×4. 6. lateral view; ×4. 7. UM2 SFV 80; latex cast of incomplete pygidium; ×6. 8. UM2 SFV 79; partially exfoliated pygidium; ×4.

Figs 9–16. *Shengia* cf. *spinoso* Yang, 1978. 9. UM2 SFV 86; exfoliated cranidium; ×8. 10. UM2 SFV 87; exfoliated cranidium showing sigmoidal S1 and S2 glabellar furrows; ×8. 11. UM2 SFV 81; partially exfoliated cranidium with both nuchal node and spine; ×4. 12. lateral view; ×4. 13. UM2 SFV 82; exfoliated cranidium showing anterolateral occipital lobules; ×4. 14. UM2 SFV 85; partially exfoliated, laterally compressed cranidium; ×4. 15. UM2 SFV 84; mostly exfoliated, laterally compressed cranidium with nuchal node and spine; ×2. 16. UM2 SFV 92; exfoliated, incomplete pygidial fragment with border prosocon and anterolateral spinule; ×12.

All material from the basal Val d’Homs Formation, Cesse Brook, Ferrals-les-Montagnes, Montagne Noire, France.
SHERGOLD et al., Stigma toa, Shengia
assigned to Constrictella by Wolfart are characterized by a flat-lying anterior cranidial border, well-defined glabellar furrows and posteriorly situated palpebral lobes. Although leiosteiidi in construction, they are better not classified with Prochuangia. Furthermore, the pygidium assigned to P. (Constrictella) by Fortey (1994, fig. 7f) has a defined border furrow, in some respects more similar to Kaolishania than Prochuangia in which it is generally only faintly visible on exfoliated specimens. Accordingly, here we prefer to maintain Prochuangia and Constrictella as separate genera.

Prochuangia gallica Feist and Cour tessole, 1984

Plate 4, figures 1–15

v*1984 Prochuangia gallica n. sp., Feist and Cour tessole, p. 181, pl. 1, figs 1–7.


Descriptive notes. An extended diagnosis has been published previously by Feist and Cour tessole (1984, p. 181). With the considerably larger collection at our disposal, it is now possible to give an account of the morphological variation embraced by Prochuangia gallica. This appears to be directly related to mode of preservation, as both moulds and exoskeletons, and to degree of deformation. Specimens may be both sagittally and transversely compressed. All tagmata are represented by both smooth and finely granulose forms.

The anterior glabellar contour is obtusely rounded or truncate, and the glabella tends to be laterally gently constricted at about L2. S1 are bifurcate and the posterior branch may be also sigmoidal. The occipital furrow shallows sagittally on some specimens, but not all (see Pl. 4, fig. 6) and the central portion of the occipital ring is swollen. Its posterior edge is often angulate, and in laterally compressed cranidia often drawn into an occipital spine. An occipital node is also preserved. Initially, we interpreted the spinose condition to represent a taxon distinct from P. gallica, but now we can demonstrate morphological gradation from the relatively undeformed or sagittally compressed morphs into the laterally compressed spinose morphs. Wittke (1984, p. 140) has described four different types of occipital shape and structure in P. cf. mansuyi Kobayashi, and he illustrated one specimen (pl. 9, fig. 4c) with what might be interpreted as an incipient occipital spine, so that the condition of P. gallica may not be unusual. There is no preglabellar area and the anterior cranidial border is reflected. Ocular ridges are poorly defined on testate specimens but clearly defined when exfoliated. Fossulae may exist in the axial furrows immediately posterior to the intersection of the ocular ridges with them. Posterolateral limbs are transversely triangular.

The pygidial axis is long (sag.), gently tapering posteriorly, and terminating in a short post-axial ridge mostly visible
on testaceous specimens. Up to five axial rings are visible on exfoliated specimens. Only the first pair of pleural furrows is clearly defined, but two more may be faintly discerned. There is generally no marginal furrow when preserved with shell, but it is faintly defined when exfoliated. The posterolateral spines are derived from the opisthopleuron of the first and propleuron of the second pygidial segments, and are directed backward and slightly outward.

The attributed librigena is characterized by a relatively wide lateral border. The lateral border furrow is sharply incised anterolaterally but fades as it approaches the genal angle so that on some specimens it appears not to contact the posterior border furrow. The latter is short (tr.), as is the posterior border. The genal field is generally moderately convex (tr.), with a low eye socle sometimes preserved.

There is in the Ferrals collection one hypostome which resembles that assigned to *Eokaolishania constricta* Wittke (1984, pl. 6, figs 5, 10). If Wittke’s specimens are typically leiostegiid, then the possibility exists that this single hypostome belongs to *Prochuangia gallica*. It is subrectangular in shape, with prominent anterolateral wings, narrow (tr.) lateral borders widening posterolaterally, and a very narrow (sag.), wire-like posterior border. The anterior lobe of the middle body is very long (sag.) compared to the posterior lobe, and the middle furrow is very shallow. A pair of prominent, transverse maculae is situated on the posterior lobe half way between the lateral furrow and the sagittal line. Although Wittke (1984, p. 130) stated that maculae are not visible on *E. constricta*, the specimen illustrated (op. cit., pl. 6, fig. 10) demonstrates a pair of eroded structures lying in a position similar to the maculae on our specimen.

**Order ASAPHIDA Salter, 1864 emend. Fortey and Chatterton, 1988**

**Suborder ASAPHINA Salter, 1864 emend. Fortey and Chatterton, 1988**

**Superfamily ANOMOCAROIDEA Poulsen, 1927**

**Family ANOMOCARIDAE Poulsen, 1927**

**Genus ABHARELLA Wittke, 1984**

*Type species.* Abharella magnocula magnocula Wittke (1984, pp. 118–121, pl. 4, figs 1–16), upper Middle Cambrian, Dorypyge-Abharella-Erbenia-Chelidonocephalus Assemblage Zone and Upper Cambrian, Drepanura-Torifera-Eokaolishania and Prochuangia-Paracoosia assemblage zones, Mila Formation, Abhar, Alborz Mountains, northern Iran.

*Other species.* Abharella magnocula concava Wittke (1984, p. 121, pl. 4, fig. 17; pl. 5, figs 1–7), Upper Cambrian, Drepanura-Torifera-Eokaolishania Assemblage Zone, Mila Formation, Mila Kuh, Alborz Mountains, northern Iran. Abharella [sic] sp., Courtessole et al. (1988, p. 29, tab. 2, 47, pl. 5, fig. 17), Niveau H2, Grès de Sallèles, Sainte Colombe Sud (Pech Sadoul), Montagne Noire, France. *Abharella*? was reported by Dean and Monod (1997, p. 62, unfigured) from the Koruk Formation of south-east Turkey.

Remarks. It is not possible to confirm the previous record of *Abharella* in the Montagne Noire (Courtessole et al. 1988). This is based on a single incomplete pygidial external mould. Compared to Wittke’s (1984) Iranian material, it appears to have a very short (sag.) axis, and a post-axial ridge. However, the overall shape and structure of the pleurae is compatible.

*Abharella* sp. undet.

Plate 5, figures 13–17

**Material.** Two cranidia, UM2 SFV 146–147, and two pygidia, UM2 SFV 148–149.

Remarks. Our material is inadequate for detailed description. It is referred to *Abharella* on the basis of the following similarities: possession of a small sagittal plectrum on the cranidium; equidimensional (sag.) preglabellar area and anterior cranidial border; glabellar shape; long (exsag.) palpebral lobes; similarly structured pygidium with four axial rings and three pleurae indicated by pleural furrows. It differs from the Iranian material by its indistinct glabellar furrowing, and apparent lack of anterolateral lobules on the occipital ring.
Superfamily ASAPHOIDEA Burmeister, 1843
Family CERATOPYGIDAE Linnarsson, 1869
Genus PROCERATOPYGE Wallerius, 1895
Subgenus PROCERATOPYGE Wallerius, 1895

Type species. Proceratopyge (Proceratopyge) conifrons Wallerius (1895, pp. 56–57, fig. 6; also Westergård 1948, pp. 5–6, pl. 1, figs 7–16), upper Middle Cambrian, Lejopyge laevigata Zone, Gudhem, Falbygden, Västergötland, Sweden.

Other species. Over 40 species have been described; see comprehensive listings in Rushton (1983), Lu and Lin (1989) and Peng (1992).

Remarks. The classification of species of Proceratopyge has been widely debated. Rushton (1983) and Pratt (1992) favoured an undivided genus on the grounds that many species will eventually prove to be synonyms, and disputed criteria used for subgeneric definition. Lu and Lin (1989, p. 259) and Peng (1992, pp. 82–84) argued for the recognition of three subgenera, *Proceratopyge*, *Sinoproceratopyge* and *Lopnorites*, ‘appearing’ in stratigraphical order from late Middle Cambrian to late Late Cambrian. Lu and Lin (1989) believed there are no subgeneric differences in the thorax and pygidium, and recognized these subgenera on cranidial characteristics. Peng (1992, p. 84), however, recognized that earlier species ‘have more transverse pygidia with shorter but wider and less segmented axes while pygidia of later ones are longer, with more slender, multisegmented axes and furrowed pleural fields’, but the respective morphs are known to overlap in Sweden. Nevertheless, we are inclined to follow the Chinese in recognizing the three subgenera.

Proceratopyge (Proceratopyge) sp. undet.

Plate 2, figures 16–20


Descriptive notes. The material is insufficient to warrant detailed description. The cranidia are characterized by the possession of a long (sag.), anteriorly rounded, conical glabella and presence of an axial node, posteriorly situated slightly behind the adaxial ends of S1 which are elongated pits. S2 and S3 are represented on UM2 SFV 152 (Pl. 2, fig. 16) by rounded pits. The occipital ring on specimen UM2 SFV 151 (Pl. 2, fig. 17) is not sharply delineated from the glabella. Palpebral lobes are arcuate and situated astride the glabellar mid-point. The anterior cranidial border is gently concave, defined by paradoublural lines which meet sagittally at a short (sag.) plectrum. The pygidia are short (sag.) and transverse, and have a short (sag.) postaxial border. Specimen UM2 SFV 154 (Pl. 2, fig. 20) has three axial rings and there are three pairs of pleural segments faintly defined by pleural furrows. The posterior margin of the pygidium between the spine bases is only gently posteriorly curved.

Remarks. This combination of cranidia and pygidia represents a long-ranging species of *Proceratopyge*. Glabellar and preglabellar characteristics together with the paucifurrowed, transverse pygidia suggests comparison with the type species, *P. (P.) conifrons* Wallerius (see Westergård 1948, pp. 5–6, pl. 1, figs 7–16), from the late Mid Cambrian Lejopyge laevigata Zone of Västergötland, Sweden. They can also be compared to *P. (P.) nathorsti* Westergård (1947, p. 10, pl. 2, figs 2–7), from the Agnostus pisiformis Zone of Andrarum, Öland and Närke, Sweden. Other comparable species might be *P. (P.) cryptica* Henderson (1976, pp. 333–334, pl. 47, figs 19–24; pl. 48, figs 1–3), from the Glyptagnostus reticulatus and *P. cryptica* Zones (Idamean) of the Georgina Basin, western Queensland, Australia; *P. (P.) asiatica* Ivshin (1956, pp. 24–26, pl. 8, figs 17–23), from the Kujandaspis-Aphelaspis and Irvingella Zones (Sakian) of the Seleta River basin in central Kazakhstan (also Ivshin 1962); *P. (P.) tenuita* Lazarenko (1966, pp. 51–52, pl. 3, figs 10–16), Irvingella-Cedarellus felix Zone, Kutungdin Depression, Kharaulakh, north-east Siberian Platform; *P. (P.) corrugis* E. Romanenko (in Zhuravleva and Rozova 1977, pp. 178–179, pl. 24,
Order LICHIDA Moore, 1959
Superfamily DAMESELLOIDEA Kobayashi, 1935
Family DAMESELLIDAE Kobayashi, 1935
Subfamily DREPANURINAE Hupé, 1953

Genus PALAEADOTES Oè pik, 1967

[=Drepanura (Spinopanura) Kushan, 1973; =Bergeronites (Palaeadotes) Qian and Zhou, 1984; =Bergeronites (Palaeadotes) Peng, 1987; =Bergeronites (Palaeadotes) Yang, 1991 (1992); =Pseudobergeronites Jago and Webers, 1992 (pygidium only)]

Type species. Palaeadotes dissidens Oè pik (1967, pp. 341–343, pl. 50, figs 3–8), Mindyallan, Glyptagnostus stolidotus Zone, Georgina Basin, western Queensland, Australia.

Other species. See Zhang Wentang (1996, pp. 71–72). Omitted are the following species: Blackwelderia speciosa Mansuy (1915, p. 13, pl. 2, fig. 5), Damesella Zone, Dong Van, Viet Nam. Blackwelderia(? ) florens Lazarenko (1966, pp. 49–50, pl. 2, fig. 13), occurring with Olensus proximus and Glyptagnostus stolidotus, Kharaulakh, north-east Siberian Platform. Bergeronites langyashanensis Lu and Zhu (1980, p. 21–22, pl. 6, figs 4–7) and Bergeronites sp. Lu and Zhu (1980, pl. 6, fig. 8), Anhui, China. Bergeronites cf. hunanensis Yang, T. Zhang (1981, p. 178, pl. 65, fig. 4), Xinjiang, China. Bergeronites jiangsuensis Lin and Zhou (in Lin, Lin and Zhou, 1983, p. 406, pl. 3, fig. 1a–b), late Middle Cambrian, Kunshan, south-east Jiangsu, China. Bergeronites kunshanensis Lin Tian-rui (in Lin et al. 1983, p. 406, pl. 3, fig. 2), occurrence as above. Also possibly representing Palaeadotes are Bergeronites kaipingensis Kuo (1965, pl. 1, fig. 8), Kushanian, Kaiping Basin, Liaoning, China; and B. yunshanensis Lin Tian-rui (in Lin et al. 1983, p. 406, pl. 3, figs 3–4), Kunshan, south-east Jiangsu, China. Drepanura binodosa Jegorova (1984, pp. 24–26, pl. 5, figs 8–9), Kerby River, Yakutia (also Gogin and Pegl’, in Gogin et al. 1997, p. 125, pl. 29, fig. 6), from the Ayusokkanian, Toxotis venusta Zone, Sette Daban) may also belong to Palaeadotes, but the bifurcate glabellar S1 needs to be confirmed. Palaeadotes cf. italops Öpik has been reported from the Mariner Glacier (Cooper et al. 1976), and subsequently Bergeronites sp. indet. (Cooper and Shergold 1991; Cooper et al. 1996, p. 380, fig. 7A–B) and B. cf. dissidens (Öpik, 1967) (Cooper et al. 1996, p. 380, fig. 62A) have been described from Reilly Ridge, Northern Victoria Land, Antarctica. Palaeadotes is also reported from the Dundas Trough, north-west Tasmania, Australia (Jago 1979, p. 224). The pygidium of the species Damesella(?) latus E. Romanenko (in Romanenko and Romanenko 1967), subsequently assigned to Palaeadotes by E. Romanenko (in Zhuravleva and Rozova 1977, p. 177, pl. 24, fig. 22b), is now referred to Paradamesella Yang by Zhang Wentang (1996). The type pygidium of Drepanura eremita Westergård (1947, pp. 12–14, pl. 3, figs 9–11), from Västergötland, Sweden, referred to Bergeronites (Falkopingia) by Qian and Zhou (1984), is also reassigned to Paradamesella by Zhang Wentang (1996), and its associated cranidium is assigned to Palaeadotes dissidens Öpik, 1967 (Zhang Wentang 1996, p. 72, pl. 9.1, fig. 2)

Remarks. Palaeadotes has been reviewed and rediagnosed by Zhang Wentang (1996) based on the discovery in Hunan of a complete articulated exoskeleton. Zhang (1996) listed the following diagnostic characters which differentiate Palaeadotes from Bergeronites: shape of glabella, proximally bifurcate S1, presence of bacculae and lateral preoccipital lobes, shape of pygidial spines, distinct anterior and posterior pleural bands, and a very broad pygidial doublure which is prominently folded. Using these characteristics, and others relating to the librigena and hypostome, it is possible to categorically reassign the species Bergeronites latefalcatus Feist and Courtoiselle, 1984, already described from the Montagne Noire, to Palaeadotes, as also recommended by Zhang Wentang (1996; and Chang 1998a).

Palaeadotes latefalcata (Feist and Courtoiselle, 1984)

Plate 5, figures 1–12


Descriptive notes. Feist and Courtessole (1984, p. 178) have provided an extended diagnosis of Palaeadotes latefalcata. Here, we describe the newly discovered librigena and hypostome, and discuss aspects of morphology not previously covered.

Additional cranidial characteristics of P. latefalcata not observed on the originally described material includes the possession of a bicomposite L1. Faint anteriorly arched furrows define a pair of gently convex (exsag.), ovoid lobulae posterolaterally. These are shown more strongly developed on Palaeadotes erbeni (Kushan) (1973, e.g. pl. 29, fig. 8 and text-fig. 12) from northern Iran. They are mirrored by the anterolateral lobulae of the occipital ring which are equally faint on P. latefalcata, exsagittally narrow but transversely quite extensive. The occipital node is very faint. The bacculae are well defined, especially posterolaterally, by an oblique furrow which cuts across the proximal end of the posterior cranidial border furrow. The bacculae occupy the whole of the fixigenal area between the posterior ends of the palpebral lobes and the axial furrows. The palpebral areas are accordingly restricted (exsag.). Posterolateral limbs are strap-like and bear a deep border furrow.

The librigena is extensive (tr., exsag.), characterised by a broad, flange-like, lateral border. It bears paradoublural lines close to its margin which give the appearance of a false border. These extend well into the genal spine base. The genal field is appreciably convex (tr.), but only about half as wide (tr.) as the border. It is encircled by an evenly deep border furrow which is continuous with the posterior cranidial border furrow. Compared to the extensive lateral borders the genal spines are relatively slender.

The hypostome of P. latefalcata is a complicated structure, more so than those assigned to P. dissidens and P. italops by Öpik (1967, pl. 50, fig. 3 and pl. 51, figs 1–2, 4, respectively). It is, however, very similar to the hypostomata described for P. erbeni (Kushan) (1973, pl. 30, figs 1–3) and P. Hunanensis (Yang, 1978) (sensu Peng 1987, pl. 11, figs 4–5, text-fig. 14) from Hunan, China. As in the latter species, the hypostome of P. latefalcata is transversely extensive, and characterized by a deep posterior invagination flanked by a pair of posterior spines, and wide (tr.) lateral borders, each as wide (tr.) as the anterior lobe of the middle body. Posterolaterally, the borders bear a pair of deep pits situated anterior to the the bases of the posterior spines. Lateral border furrows are sharply incised adjacent to the anterior lobe of the middle body and they continue posterosagittally into a weaker middle furrow which separates the long (sag.) anterior and much shorter (sag.) posterior lobes. Furrows defining the posterior lobe laterally shallow, but are again sharply incised posteriorly. The posterior border of the hypostome is very narrow (sag.) between the posterior spine bases. Maculae are poorly defined. Morphology of the anterolateral wings is not preserved.

Pygidial morphology has been adequately illustrated by Feist and Courtessole (1984, figs 10a–b, 11, 13). The present material confirms Öpik’s (1967, p. 342) interpretation that the pits separating the spines across the border are the distal ends of the interpleural furrows and that they shallow towards the axial furrows. The anterior pleural segment bears an extremely narrow (exsag.) articulating facet which extends transversely as far as the axial furrows. As in P. erbeni (Kushan), the axis characteristically has only three clearly defined rings, followed by a fused posterior portion passing into a post-axial ridge which fails to reach the posterior pygidial margin (Pl. 5, figs 11–12). The type species, P. dissidens Öpik, has five rings anteriorly defined; P. Hunanensis Yang has four.

Superfamily ODONTOPLEUROIDEA Whittington, 1959
Family EOACIDASPIDAE Poletaeva, 1957
Genus PARAACIDASPIS Poletaeva, 1963

Type species. Paraacidaspis hunanica Jegorova (in Jegorova et al. 1963, pp. 53–54, pl. 12, figs 6–8), Late Cambrian, Changshanian, Chuangia-Prochuangia Zone, Tingziguan, Chatian, Fenghuang County, Hunan, China (also Lu et al. 1965, pl. 130, figs 15–16; Poletaeva 1977, pl. 1, fig. 13, not described; Yang 1978, pp. 71–72, pl. 13, figs 13–14, text-fig. 9a–b; Liu 1982, p. 342, pl. 239, fig. 8; Qiu, in Qiu et al. 1983, p. 252, pl. 88, fig. 8; Zhang Wentang 1990, pp. 174–177, pl. 1, figs 5–9; Zhou et al. 1996, pl. 7, figs 11–12, not described).

Other species. Paraacidaspis sibirica Poletaeva (1960, pp. 70–71, pl. 3, fig. 2), Altay Mountains, southern Siberia. P. latelimba Yang (1978, p. 72, pl. 13, fig. 15), Changshanian, Chuangia-Prochuangia Zone, Hunan, China. Paraacidaspis sp., Yang (1978, p. 72, pl. 13, fig. 16), age and occurrence as above. P. hunanica Jegorova, Ergaliev (1980, p. 187, pl. 16, fig. 12, not described), Aksaian, Neoagnostus quadriformis Zone, Lesser Karatau, southern Kazakhstan. Paraacidaspis sp., Ergaliev (1980, p. 186, pl. 14, fig. 21, not described), Aksaian, Pseudagnostus...
Remarks. Zhang Wentang (1990) has provided an English translation of Jegorova’s (1963) Chinese text relating to *Paraacidaspis*. He has also given a synonymy list for the type species (references updated above), and has rediagnosed the genus.

*Paraacidaspis* was introduced by Poletaeva in 1956, but it was neither described nor illustrated at that time. The genus was subsequently diagnosed by Poletaeva in 1960 (p. 68), and a type species, *P. hunanica* Jegorova sp. nov., was nominated, described and illustrated (pl. 3, fig. 1). Bruton (1983, p. 879) considered *P. hunanica* Jegorova as a *nomen nudum*, thinking that the type species was informally described. He therefore regarded *Paraacidaspis* as invalid. Furthermore, he considered a second species described by Poletaeva, *P. sibirica* (1960, pp. 70–71, pl. 3, fig. 2), to leave ‘little doubt that *Paraacidaspis* is a subjective synonym of *Eoacidaspis* Poletaeva, 1960.’ Bruton was apparently unaware of Jegorova’s subsequent full description of *P. hunanica* (Jegorova, in Jegorova et al. 1963, pp. 52–53, pl. 12, figs 6–8) and validation of *Paraacidaspis*. There can be no question that this genus is distinct from *Eoacidaspis*. We concur with the observations of Zhang Wentang (1990) regarding the validity of *Paraacidaspis* and the date of its publication (Poletaeva 1963).

We also agree with Zhang (1990) that *Paraacidaspis* should be retained in the family *Eoacidaspididae* Poletaeva, 1957, and that this family should exist separately from *Lichakephalidae* Tripp, 1957, thus disagreeing with the synonymy of *Eoacidaspididae* and *Lichakephalidae* proposed by Thomas and Holloway (1988). This is because we cannot accept their suggestion that *Belovia* Poletaeva, 1956 may also be a subjective synonym of *Eoacidaspis*. Our concept of *Eoacidaspididae* is that this family contains the time-successive, and morphologically and phylogenetically related genera *Usoviana* Poletaeva, 1977, *Belovia* Poletaeva, 1956, *Paraacidaspis* Poletaeva, 1963, *Eoacidaspis* Poletaeva, 1956 and *Archikainella* Liu, 1982, which range in age from the late Middle Cambrian (*Lejopyge laevigata* Zone) to the late Late Cambrian (Fengshanian equivalents in Yunnan). We accept *Lichakephalidae* as presented by Thomas and Holloway (1988), but without *Eoacidaspis*, thus having a Late Cambrian to Arenig time span.

*Paraacidaspis ultima* sp. nov.

Plate 6, figures 1–17, Text-figure 4

*Derivation of name*. Latin, *ultima*, feminine, farthest located species from the previously established geographic range of the genus.

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**Explanation of Plate 5**

Figs 1–12. *Palaeadotes latefalcata* (Feist and Courtessole, 1984). 1, UM2 SFV 156b; latex mould of cranidial fragment showing bifurcate S1 glabellar furrows; ×4. 2, UM2 SFV 157; exfoliated cranidial fragment showing composite L1 glabellar lobes, faint anterolateral occipital lobulae and faint nuchal node; ×4. 3, UM2 SFV 156a; partially exfoliated cranial fragment; ×4. 4, lateral view; ×4. 5, UM2 SFV 162; exfoliated librigena showing full extent of the lateral border and paradoxublural lines; ×2. 6, UM2 SFV 165; partially exfoliated librigena; ×2. 7, UM2 SFV 159; hypostome with prosopon; ×4. 8, UM2 SFV 161; hypostome with prosopon; ×4. 9, UM2 SFV 175; exfoliated, sagittally compressed pygidium; ×1.5. 10, UM2 SFV 173b; latex mould of laterally compressed pygidium; ×4. 11, UM2 SFV 170; latex mould of partially exfoliated pygidium; ×2. 12, UM2 SFV 172; pygidium showing pitting of interpleural furrows across the border region; ×4.

Figs 13–17. *Abharella* sp. undet. 13, UM2 SFV 146; partially exfoliated cranidium; ×4. 14, lateral view; ×4. 15, UM2 SFV 147; exfoliated, laterally compressed cranidium; ×6. 16, UM2 SFV 148; exfoliated pygidial fragment; ×12. 17, UM2 SFV 149; exfoliated pygidium; ×6.

All material from the basal Val d’Homs Formation, Cesse Brook, Ferrals-les-Montagnes, Montagne Noire, France.
SHERGOLD et al., Palaeadotes, Abarella
Holotype. The cranidium, UM2 SFV 185, Pl. 6, figs 1–2.


Diagnosis. A species of Paraacidaspis Poletaeva, 1963 with late holaspid glabellar structure and degree of effacement similar to species of Belovia Poletaeva, 1956, and long (sag.), wide (tr.) preglabellar area with prominent paradoublural lines more typical of Paraacidaspis. Pygidium with entire margins, slightly emarginate posteriorly, and short (sag.) axis having fused rings after the third or fourth; five well-defined pleural segments.

EXPLANATION OF PLATE 6
Figs 1–17. Paraacidaspis ultima sp. nov. 1, UM2 SFV 185; holotype cranidium showing extent of fixigenal bacculae flanking L1 glabellar lobes and paradoublural lines; ×8. 2, lateral view; ×8. 3, UM2 SFV 186; exfoliated early holaspid cranidium, length 2 mm, with paradoublural lines transversely bisecting preglabellar field; ×12. 4, UM2 SFV 187; exfoliated early holaspid cranidium, length approx. 1-4 mm, showing preglabellar morphology; ×16. 5, UM2 SFV 184a; exfoliated, incomplete cranidial fragment; ×4. 6, UM2 SFV 181; exfoliated, laterally compressed cranidium; ×3. 7, UM2 SFV 183; cranidial fragment showing postocular fixigenal and occipital morphology; ×3. 8, UM2 SFV 188; cranidial fragment showing possible S4 glabellar furrow; ×4. 9, UM2 SFV 192; exfoliated librigena with unconnected lateral and posterior border furrows at genital spine base; ×8. 10, UM2 SFV 190B; partially exfoliated forked hypostome attributed to this species; ×4. 11, UM2 SFV 205; latex mould of incomplete pygidium; ×8. 12, UM2 SFV 195a; exfoliated pygidium; ×4. 13, UM2 SFV 204; latex mould of obliquely deformed pygidium; ×1-5. 14, UM2 SFV 194; exfoliated pygidium; ×2. 15, UM2 SFV 195b; latex mould of incomplete pygidium; ×4. 16, UM2 SFV 201; exfoliated early holaspid pygidium, length 1-5 mm; ×16. 17, UM2 SFV 199a; exfoliated pygidium; ×4. All material from the basal Val d’Homs Formation, Cesse Brook, Ferrals-les-Montagnes, Montagne Noire, France.
SHERGOLD et al., *Paraacidaspis*
Description. The late holaspide cranidium is broadly rounded anteriorly. The glabella is defined by sinuous axial furrows which are deepened posteriorly adjacent to L1. It is appreciably waisted (constricted) at the level of S1 posterior to the maximum glabellar width (tr.) which approximately coincides with the mid-points of the palpebral lobes. Anteriorly it is obtusely rounded. Four pairs of glabellar furrows are faintly indicated: S1 are transverse or posteriorly curving; S2, S3 and S4 curve gently anteriorly with the convexity of the glabella. Glabellar lobes L2 are represented by faintly ovoid swellings. The occipital furrow is abaxially deepened, shallow and anteriorly curved sagittally. The occipital ring is slightly wider (tr.) than the maximum width (tr.) of glabellar lobes L1, and bears a faint occipital node. A pair of large ovoid bacculare flank L1 and occupy the fixigenal area between the axial furrows and the posterior ends of the palpebral lobes (Pl. 6, fig. 7). The latter are arcuate, raised above the palpebral areas, and extend from adjacent S1 to S3. Palpebral areas are narrow (tr.). Ocular ridges run parallel to the axial furrows from S3 forwards in late holaspides. Paradoublural lines are prominent, arcuate, and coincide with the preglabellar furrow sagittally. The preglabellar field is long (sag.) and wide (tr.), approximately half the glabellar length (sag.) and slopes gently forwards (sag.). The anterior cranidial border furrow is shallow, delineating a relatively narrow (sag.) anterior cranidial border. Posterolateral limbs are about 0.75 as wide as the occipital ring (tr.), distally tapered, and bear shallow posterior border furrows. Cranidial morphological components are illustrated on Text-figure 4.

The associated librigena is characterized by relatively shallow border furrows which are unconnected to the posterior border furrow at the base of the genal spine which is short and slightly advanced. The genal field is gently convex (tr., exsag.), marginally more extensive than the maximum dimension of the lateral border.

A single hypostomal fragment (Pl. 6, fig. 10) is assigned to Paraacidaspis ultima. It is long (sag.) and distinctly waisted at approximately half way along the anterior lobe of the middle body. Lateral border furrows are clearly incised only anterior to small well defined maculae. They continue into a weak middle furrow. The posterior lobe of the middle body is virtually effaced, as is the posterior border furrow. The lateral borders flare posteriorly from the lateral constriction and merge posteriorly into a pair of broad-based spines (forks). A pair of pits lies subjacent to the maculae, and a faint node appears to be present sagittally at the middle of the anterior lobe of the middle body.

The pygidium is broadly semicircular, posteriorly truncate or gently emarginate. The axis is relatively narrow (tr.), tapering only gently posteriorly to the inner edge of a broad doublure, but continued posteriorly almost to the posterior margin by an often crest-like postaxial ridge. It contains only three or four rings, and an equally long (sag.) fused portion. Five (or six) pleural segments are defined by pleural furrows. Only segments 1–3 are separated by faint interpleural furrows. None of the furrows reach the pygidial margins, but on some specimens the pleural furrows may be slightly deepened across the inner portion of the doublure. A border furrow is not developed.

Morphogenesis. Two early holaspide cranidia measuring approximately 1.4 (UM2 SFV 187, Pl. 6, fig. 4) and 2 mm (UM2 SFV 186, Pl. 6, fig. 3) long (sag.), and one pygidium (UM2 SFV 201, Pl. 6, fig. 16) measuring (sag.) 1.5 mm can be morphologically distinguished from late holaspides in our present collection. In the cranidia the palpebral lobes are situated further away from the axial furrows and bacculare, and the ocular ridges are more transverse. In the preglabellar area, the paradoublural lines bisect the preglabellar field and a preglabellar furrow is distinct. This gives the impression of a pseudoborder. The pygidium appears to lack a post-axial ridge and the axis terminates at the inner edge of the doublure. Its pleural furrows are distinctly deepened across the doublure. This juvenile morphology is remarkably similar to the late holaspide morphology of Usoviana minuta Tchernysheva (in Jegorova et al. 1982, p. 122, pl. 30, figs 2–5; pl. 42, fig. 14; pl. 45, figs 10–13) which occurs in the late Mid Cambrian Lejopysae laevigata- Aldansaspis truncata Zone in the Maya and Chabde River area of the Siberian Platform. It represents good evidence for the derivation of Paraacidaspis by peramorphosis from earlier eoacidaspidids like Usoviana.

Remarks. Only the cranidium of Paraacidaspis ultima can be compared with other described or illustrated specimens, mostly assigned to P. hunanica Jegorova, the type species. Material described by Jegorova (1963) and other authors noted above show deeper glabellar furrows and more prominent L2 glabellar lobes. In ocular and baccular characteristics, and those of the preglabellar area, French and Chinese taxa are essentially similar. We prefer to separate Paraacidaspis ultima from other species until comparison with other tagmata, presently unknown, can be made. Degree of effacement in Paraacidaspis ultima is similar to the specimen from Kazakhstan referred to P. hunanica by Ergaliev (1980, pl. 16, fig. 12), and also to Paraacidaspis sp. Ergaliev (1980). P. latilimbata Yang (1978), based on a single cranidium, may have a proportionately shorter (sag.) glabella, but this is difficult to assess on our material due to deformation. P. sibirica Poletaeva (1960) cannot be compared because of poor preservation.

Glabellar characteristics of Paraacidaspis ultima resemble those of species assigned to the type species of Belovia, B. calva Tchernysheva (in Poletaeva 1956, pl. 32, fig. 10; Bruton 1983, pl. 88, figs 1–2) from...
the upper Middle Cambrian of the north-east Siberian Platform, but *Belovia* has a short (sag.) preglabellar field and lacks the paradoubtural lines so distinctive of *Paraacidaspis*. Comparison of the early holaspid cranial morphology with that of late holaspides of *Usoviana minuta* Tchernysheva is noted above.

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