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LATE CAMBRIAN TRILOBITES FROM HIMALAYA

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ABSTRACT

The early Late Cambrian trilobite fauna has been collected from Magam and Trahagam sections of Kashmir and Parahio Valley of Spiti. The Kashmir fauna includes in addition to already described species of *Damesella, Blackwelderoides, Cyclolorenzella* and *Hundwarella,* the new species of *Pedinocephalus, Haniwa, Blountia* and the new genus *Amurticephalus.* The Spiti forms include species of *Hundwarella, Olenus, Tsinania* and the new genus *Spitella.* These have been systematically described. The horizon bearing the fauna in Kashmir can be correlated to *Agnostus pisiformis* zone, while that of Spiti compares to the *Aphelaspis* zone.

INTRODUCTION

In Himalaya, the Cambrian trilobite fauna is reported from Parahio Valley, Spiti and Kupwara district of Kashmir since the early part of the present century. While the bulk of the fauna reported so far belongs to middle part of Middle Cambrian, very little material is available from the Late Middle and Late Cambrian. However, some early reports of Late Cambrian fossils are available from Spiti (Reed, 1910) and Kashmir (Reed, 1934).

In Spiti three Late Cambrian forms were doubtfully identified by Reed as *Olenus haimentensis, Bathyuriscus stoliczkai* and *Dikelocephalus interpres.* Kobayashi (1967) has mentioned that all the Late Cambrian forms described by Reed from Spiti are synonymous and are congeneric to *Hundwarella* and he grouped them as *Hundwarella haimantensis.* While *Bathyuriscus stoliczkai* and *Dikelocephalus interpres* are congeneric and can be included in *Hundwarella* (Shah *et al.*, 1988), it is erroneous to club *Olenus haimantensis* with these forms, since the latter can be positively assigned to *Olenus.*

The genera *Chaungia* and *Saukia* reported by Reed (1934) from Kashmir have now been found to be wrong identifications since they are some poorly preserved ptychoparids of Middle Cambrian age (Shah, 1982).

Recently, however, some Late Middle and early Late Cambrian faunal elements have been reported (Shah, 1982, Shah and Sudan, 1983, 1984, 1987). Jell (1986) also described a trilobite faunule from Trahagam area of North Western Kashmir. While comparing these forms with Chinese and Australian forms, he assigned them to early Late Cambrian. There is no doubt regarding the stratigraphic age but his claim that the faunule is the first unequivocal report of Late Cambrian in Kashmir is not factual as is evident from the publications referred to above.

DISTRIBUTION OF EARLY LATE CAMBRIAN FAUNA IN HIMALAYA

The definite early Late Cambrian fauna in Himalaya is available from Kashmir and Spiti only. In Kashmir Trahagam Formation represents Upper Cambrian (Shah, 1982). The Formation is exposed in Trahagam and Magam sections of Kupwara district of North Western Kashmir (Fig. No. 1). The Late Cambrian fauna here is represented by a single assemblage Zone *Damesella* (Shah and Sudan, 1984), which conformably overlies the fossiliferous Middle Cambrian sequence. No Cambrian fauna younger than early Late Cambrian is known from any of these sections. The next fossiliferous unit belongs to Middle Ordovician.

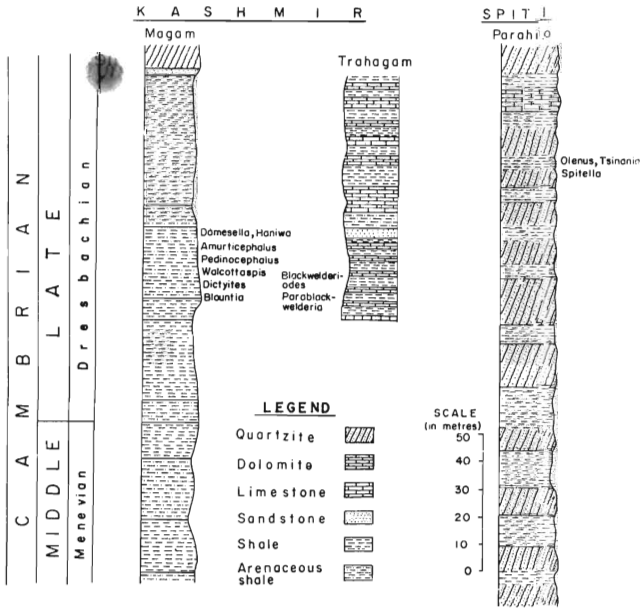

Fig. 1. Stratigraphic succession of Late Cambrian sequences in Kashmir and Spiti

The Late Cambrian fauna already reported by earlier authors includes the following taxa:-

Damesella shergoldi Shah and Sudan,
Blackwelderoides monkei Hupe
Cyclolorenzella sp.
Hundwarella kingi Shah *et al.*,

In addition to the above forms the present authors have identified the following taxa. All of these except *Parablackwelderia* have been collected from Magam Section about 3/4 kms to the south-west of water pumping station of Jagarpora above the *Bolaspidella* Zone. *Parablackwelderia* has been collected from Trahagam section near the famous Trahagam spring.

Walcottaspis sp.
Amurticephalus elongatus n. gen. & n. sp.
Pedinocephalus kashmirensis n. sp.
Haniwa transversa n.sp.
Blountia subangulata n.sp.
? Blountia sp.
Parablackwelderia sp.

All these species are new and are not known from any other part of the world.

In Spiti the Late Cambrian is represented by the upper part of Parahio Formation which is exposed on the left bank of Parahio (Barachu) river above Moopa camping ground. Faunistically it is represented by a single assemblage Zone viz. *Olenus* Zone which comprises characteristic faunal elements of early Late Cambrian age. Here the picture is more clear because there is a distinct angular unconformity above *Olenus* Zone. In this section also the next fossiliferous horizon yields Middle Ordovician brachiopods. The Late Cambrian forms listed from Spiti in the earlier publications as well as in the present work are:

Hundwarella interpres (Reed) Shah *et al.*,
Hundwarella rushtoni Shah *et al.*,
Olenus haimentensis Reed
Spitella barachuensis n. gen. & n. sp.
Tsinania, sp.

These forms are known from Spiti alone.

REPOSITORY

All the type material is housed in the Palaeontology museum of the Department of Geology in the University of Jammu and are numbered from (KUF 560 to 646).

SYSTEMATIC PALAEONTOLOGY

The classification followed in this work is the one adopted in the Treatise on Invertebrate Palaeontology (Part 0, Moore, 1959).

Order Ptychopariida SWINNERTON, 1915
Suborder Ptychopariina RICHTER, 1933
Superfamily Emmrichellacea KOBAYASHI, 1935
Family Inouyiidae CHANG, 1963
Genus *Cyclolorenzella* KOBAYASHI, 1960

? Cyclolorenzella sp.
(Plate I—c, f.i.)

Material : Four cranidia in a poor state of preservation in blocks of green shale. (KUF 602-605).

Description : Cranidium fairly convex, semicircular in outline, width exceeding the total cranidial length, gently rounded at the frontal margin, glabella small, as wide as fixed cheek, truncatoconical, convex, occupying approximately 0.6 of cranidial length, tapering forward, lateral glabellar furrows obsolete, axial furrows very deep, occipital furrow strong, occipital ring wider at the centre than at the sides, posteriorly directed, without occipital spine. Frontal area convex with very faint furrows running forward from axial furrow to give faintest impression of a median boss, anterior border narrow, of uniform width, flat but upturned anteriorly, short, distinct border furrow, eye ridges distinct, transverse from anterolateral corner of glabella, palpebral lobe small, situated just ahead of the glabellar mid length. Facial suture convergent ahead of eyes and divergent behind it, posterolateral areas wide and flat.

Dimensions (In mm) :

	KUF 602	KUF 603	KUF 604	KUF 605
Total cranidial length	4.1	6.5	5.4	8.6
Posterior cranidial width	6.9	12.7	9.8	15.2
Total glabellar length	2.7	4.9	3.2	6.2
Glabellar width at base	3.0	5.2	3.8	7.5
Sagittal width of preglabellar area	0.6	0.9	0.8	1.2
Sagittal width of anterior border	0.4	0.5	0.3	0.7
Width of the cranidium at eye lobe	4.9	7.3	6.2	10.7

Remarks : On the basis of general outline of the cranidium, truncatoconical glabella, obsolete lateral glabellar furrows, deep axial furrow, narrow anterior border, small eye lobes and medially elongate occipital ring, the specimens can easily be assigned to genus *Cyclolorenzella*. The specimens correspond in all its morphological characters to *Cyclolorenzella* sp. described from Kashmir by Jell (1986). But whereas Jell's form is from Trahagam section, the form presently being described is found in the Magam

section. The *Cyclolorenzella* sp. described from Zanskar in Ladakh Himalaya by Whittington (1986) is characterized by granular surface and is lacking in border and in this respect it differs from this form.

This form does not match with any of the known species of this genus. *Cyclolorenzella quadrata* (Kobayashi, 1935) differs in possessing a subquadrate cranidium, posteriorly placed eyes and fixed cheek less wide than the Kashmir form. With *C. regularis* (Walcott, 1906) and *C. yentaiensis* (Chu, 1959) from China the resemblance is much less, as these forms are characterised by an unusual swelling in the frontal limb and a short pointed, posteriorly directed occipital spine.

As the material is poorly preserved a new specific name cannot be assigned to this form.

Superfamily Dikelocephalacea MILLER, 1889
Family Dikelocephalidae MILLER, 1889
Genus *Walcottaspis* ULRICH AND RESSER, 1930

Walcottaspis sp.
(Plate I—j,n)

Material : Two cranidia in a poor state of preservation in dark green shale.

Description : Cranidium subquadrate, gently arched at the front, nearly flat, width slightly more than its length. Glabella small, quadrate, gently rounded in front, occupies about 60 percent of cranidial length, nearly as wide as long and almost of uniform width. Axial furrow very shallow. Lateral glabellar furrow obsolete. Frontal area very wide having a length about one-third that of cranidium. Preglabellar furrow shallow, straight, preglabellar area wide, downsloping from the front of the glabella, anterior border narrow flat, of uniform width, no line of demarcation exists in the frontal area to separate the anterior border and preglabellar field. Eye ridges narrow, faint, starting from the anterior end of glabella, eyes of medium size situated near the glabellar mid length, palpebral area of fixigene about 0.4 the glabellar width. Occipital furrow shallow, faint, occipital ring well developed, with gently rounded surface of uniform width. Posterior limb narrow, straight, length nearly equal to posterior width of the glabella. Facial sutures divergent in front of eye lobes but turn gently and extend in a broad curve inward after reaching the border and then outward towards the anterior margin near azial line of cranidium, posterior course diverges behind eye lobes and continues in straight line till it reaches the posterior limb. Surface of the cranidium finely granulose.

Dimensions (in mm) :

	KUF 606	KUF 607
Total cranidial length	6.5	5.6
Posterior cranidial width	9.6	6.7
Total glabellar length	4.5	3.2
Glabellar width at base	3.9	3.0
Frontal area	1.9	1.5
Width of cranidia at eye	7.6	6.5

Remarks : The specimens correspond to *Walcottaspis* in cranidial morphologial characters especially in the glabellar details, the outline of glabella, eye ridges and frontal area. However, it does not match with any of the known species of this genus.

Walcottaspis vanhornei (Walcott, 1925) the genotype, differs in having comparatively larger eye, oblique eye ridges and curvature of the facial suture. Because of very poor preservation and scarcity of material, it cannot be assigned a new specific name.

The specimens also show some resemblance to *Haniwa transversa* (present work) from the same horizon and locality from Kashmir. But *H. transversa* differs in having a cranidium which is slightly longer than broad, glabella truncatotapering, glabellar width more at the posterior end than at the front and occipital ring gently curved posteriorly.

Family Pterocephaliidae KOBAYSHI, 1935
Genus *Amurticephalus* n. gen

Etymology : The name is derived from a Sanskrit word "Amurt" meaning featureless (featureless cranidium is the characteristic feature of the new genus).

General Diagnosis: Cranidium elongated, weakly convex, gently rounded to almost straight at the front, length more than its width, glabellar length about double its width and nearly three-fourth the total cranidial length, glabella tapering with a faint median longitudinal furrow, anterior border furrow lacking or very faint, preglabellar and axial furrow shallow and faint, narrow, almost straight and blunt at the end. Thorax and pygidium unknown.

Discussion : The genus does not match in totality with any of the known genera because of distinctive characters as discussed in the generic diagnosis. The form with which it shows nearest affinities is *Blan-*

dicephalus Palmer (1954). The similarity is in having a featureless cranidium, length being more than width, glabella tapering forward with a median longitudinal furrow, broad preglabellar area and anterior border, which is gently arched at the front. However, *Amurticephalus* is quite distinctive in possessing a cranidium which is gently rounded to almost straight anteriorly, glabellar length slightly more than double its width and three-fourth the total cranidial length, while in *Blandicephalus* the glabellar length is almost equal to its width and about half the total cranidial length. The genus also differs in having smaller eye lobes, anterior border and preglabellar area being less wide than in *Blandicephalus*, posterior limbs almost straight and nearly blunt at the end, whereas in *Blandicephalus* the posterior limbs are distinctly curved and sharply pointed.

Dimensions (in mm.) :

Specimen numbers	KUF 608 (a)	KUF 608 (b)	KUF 609	KUF 610	KUF 611	KUF 612 (a)	KUF 612 (b)
Maximum cranidial length	14.0	11.0	13.0	8.5	10.5	10.2	10.6
Posterior cranidial width	11.0	8.0	10.5	7.0	8.2	8.0	9.0
Maximum glabellar length	10.8	7.4	10.2	6.2	7.0	6.8	7.2
Glabellar width at base	5.2	3.6	4.9	3.0	3.4	3.0	3.5
Glabellar area (sagittal width)	2.5	1.9	2.3	1.4	1.7	1.5	1.8
Sagittal width of anterior border	1.0	0.8	1.1	0.6	0.7	0.6	0.9
Cranidial width at eye lobes	11.5	10.0	11.6	7.5	9.0	8.5	9.4

Amurticephalus elongatus n. gen. & n. sp.
(Plate I—l,b,e,h,m)

Material : Fifteen cranidia in a poor state of preservation (generally moulds only) in blocks of greenish brown sandy shale. The species is known from cranidia only.

Diagnosis : Same as for the genus.

Description : Cranidium gently rounded to almost straight anteriorly, weakly convex, tapering forward, distinctly elongate, total cranidial length being one and a half time more than the maximum width. Glabella subquadrate in shape, twice as long as its posterior width, parallel sided, tapered forward, gently curved anteriorly, weakly convex with a faint median longitudinal glabellar ridge. Preglabellar furrow very faint, nearly straight, axial furrow shallow, faint, three pairs of weakly developed faint to obsolete lateral glabellar furrows, preglabellar area broad, gently downsloping from the front of the glabella, axial length of anterior border, anterior border wide, flat, border furrow absent and separated from preglabellar area by a slight break in slope. Occipital furrow shallow, faint, occipital ring faint and of uniform width. Fixed cheek gently downsloping from dorsal furrow, width including palpebral lobes about one half the maximum width of glabella. Eye ridges narrow, faint to obsolete, nearly straight with narrow eye lobes situated at the glabellar mid length.

Posterior limbs narrow, almost straight, blunt at the end, length usually distinctly less than greatest width of glabella, marginal furrow shallow. Facial suture divergent in front of palpebral lobes but turn sharply and extend in a broad curve inward after reaching border and cut anterior margin near axial line of cranidium. Posterior course of facial suture diverges widely behind eye lobes and continues in a straight line until it crosses the marginal furrow.

Remarks : *Amurticephalus elongatus* shows some resemblance to *Haniwa transversa* from the same stratigraphic horizon in Kashmir, in having a forwardly tapering glabella, faint lateral glabellar furrows and also in the general outline of the cranidium but in *H. transversa* the cranidium is not elongated, preglabellar and axial furrows are well impressed, eyes are large, glabellar length and width nearly equal and in these characters it differs from *A. elongatus*.

Genus Pedinocephalus IVSHIN, 1956

Pedinocephalus kashmirensis n.sp.
(Plate I—a,d,g,k,p)

Etymology : The name is derived from the place Kashmir.

Material : Fifteen cranidia in a poor state of preservation in green shale (Nos. FUF 613 to KUF 620).

Diagnostic Characters : Cranidium gently curved to almost straight anteriorly, weakly convex, tapering forward, glabella truncatotapering with its width at the front nearly two-third its width at the base, three pairs

of faint lateral glabellar furrows. Anterior border narrow, of uniform width, gently raised because of which it is differentiated from the flat preglabellar area, which is slightly more than double the sagittal width of the anterior border, distinct eye ridges with medium size, crescent shaped eye. Occipital ring broad in the middle and tapers towards the sides.

Facial suture with long anterior branches which diverge from the eyes to the front, after intersecting the border they turn inward, posterior branches run obliquely from the eyes towards the sides and are then deflected backwards and cross the posterior border at places separating it from the occipital ring at a distance equal to three-fourth the glabellar width at base.

Dimensions (in mm.) :

Specimen numbers	KUF 613	KUF 614	KUF 615	KUF 616	KUF 617	KUF 618	KUF 619	KUF 620
Maximum cranidial length	4.2	10.5	7.1	7.5	6.5	5.9	4.8	5.6
Posterior cranidial width	5.4	13.8	8.5	9.2	7.9	6.8	5.6	6.2
Maximum glabellar length	2.9	7.6	5.2	4.8	3.8	3.4	3.0	3.2
Glabellar width at base	3.0	8.0	6.1	5.2	4.2	4.1	3.5	3.4
Sagittal width of preglabellar area	0.8	1.9	1.2	1.2	1.0	0.9	0.8	0.9
Sagittal width of anterior border	0.4	1.0	0.6	0.7	0.5	0.4	0.3	0.3
Cranidial width at eye lobes	3.5	9.6	6.2	6.8	5.4	4.9	3.9	4.1

Thorax and pygidium unknown.

Description : Cranidium gently curved to almost straight anteriorly, length nearly equal or slightly more than the posterior cranidial width, weakly convex, gently tapering forward. Glabella truncato-tapering with subtrapezoidal outline, weakly convex with length nearly equal to its width at the base, the width of the glabella at the front is nearly two-third its width at the base and it covers nearly sixty per cent of the total cranidial length, glabella with a faint median keel. Three pairs of very faint lateral glabellar furrows. Anterior border very shallow, almost straight to gently curved, axial furrow distinct. The frontal area consists of a wide, flat preglabellar area which slopes slightly to the front and forward, preglabellar area nearly twice the width of the anterior border, anterior border furrow very faint to nearly obsolete, border very narrow, of uniform width, gently curved to straight anteriorly. Eye ridges distinct starting from just near the anterior and of the glabella, then gently curving backward, eye of medium size, crescent-shaped and situated at the glabellar mid-length. Occipital furrow shallow, moderately wide and somewhat grooved. Occipital ring broad in the middle, posteriorly projected and tapering towards the sides. Posterior border narrow, prominent and nearly straight. Fixigenae flat and almost horizontal, comprise nearly half the glabellar width measured along the middle, the part that forms the continuation of the cheeks behind the glabella slope gently towards the posterior border furrow.

Remarks : The specimens compare with *Pedinocephalus* in truncato-tapering glabella, with median keel, faint lateral glabellar furrows, distinct eye ridges, medium size eye, situated at the centre of glabella and in the outline of the facial suture. However, they do not match with the other known species of this genus.

P. bublichenkoi Ivshin (1962), the genotype differs in having a curved anterior border furrow, anterior border being more wide at the centre than the sides and a large eye. *P. bykovae* Ivshin (1962) differs in having a cranidium with a complete arcuate anterior border, general outline of the cranidium and glabella which is nearly of uniform width. *P. kasachstanensis* Ivshin (1962) differs in the pattern of anterior border, in the outline of the facial suture and also in the ratio of anterior border to preglabellar area which is 2:3 in *P. kasachstanensis* but in the Kashmir form the preglabellar area is slightly more than double the anterior border. With *P. simplex* Ivshin (1962) the resemblance is less close because it has a preglabellar area which is one and a half times more than the anterior border, lacks lateral glabellar furrows, has narrow occipital furrow and ring. It also differs in the general pattern of the anterior border and border furrow.

This form does show some resemblance to *Haniwa transversa,* presently being described from the same horizon from Kashmir, especially in having a nearly flat cranidium, truncato-tapering glabella which is straight at the front, but *H. transversa* is

characterized by obsolete eye ridges, lack of anterior border furrow and glabella of uniform width. With *Amurticephalus elongatus* the resemblance is limited as *A. elongatus* has a very elongated cranidium, whose length is nearly double its width, a very long glabella and obsolete eye ridges.

Superfamily Olenacea BURMEISTER, 1843
Family Olenidae BURMEISTER, 1843
Subfamily Oleninae BURMEISTER,
Genus *Olenus* DALMAN, 1927

Olenus haimantensis REED
(Plate I—a,b,h,p,e)

Olenus haimantensis Reed 1910, p. 40, pl. V. Fig. 14-18.
Hundwarella haimantensis Kobayashi, 1967 p. 487

Material : Fifteen well preserved complete exoskeletons and sixteen cranidia and fragments of cranidia fairly preserved in dark grey shale (Nos KUF 621 - KUF 625).

Description : Exoskeleton oval to elongate. Cephalon broadly semicircular. Cranidium moderately convex. Anterior border narrow, weakly convex, almost straight, about as wide as the preglabellar area, border furrow shallow, distinct. Preglabellar area very narrow convex, of uniform width. Glabella broad, parallel sided, oblong to subtrapezoidal in shape with anterior end gently rounded or truncate, surface moderately convex, length of the glabella nearly equal to its width. Three pairs of discontinuous lateral glabellar furrows, of which the first (countng from anterior) is short, almost straight, less distinct, nearly obscure, the second glabellar furrow is slightly longer than the first, distinct, gently oblique, nearly horizontal, the third furrow very prominent, longest, strongly oblique backwards, stopping just short of occipital ring. Eye ridges distinct, nearly straight, starting from just near the second glabellar furrow, eye of small size situated at the glabellar mid-length between second and third glabellar furrow. Occipital ring nearly of uniform width almost straight, occipital furrow distinct, some specimens show a faint trace of an occipital node at the middle of the ring. Fixed cheek gently convex about two-third the width of glabella at eyes and about three-fourth its width at base. Facial suture with anterior branches cutting margins of cranidium at about two times the width of the glabella, curving back and outwards in a convex arc to eyes but scarcely bending in, posterior branches curving back simply to cut posterior border at about 45^0 angle, nearly two-third the way out to genal angle and not further out than anterior branches on anterior border. Free cheek elongate. Lateral border narrow and confluent with straight genal spine. Posterior border narrow and short, forming slightly obtuse inner spine angle, marginal furrow well impressed.

Thorax of 12-14 segments, broad, axis convex less than one-third the total width of thorax, gradually tapering backward, axial rings with faint lateral swellings. Pleurae horizontal outwards upto fulcrum beyond which they are gently curved back to end in a short, free, pointed, posteriorly directed spine, surface marked by a narrow, deep diagonal furrow.

Pygidium semicircular to subtriangular, nearly one-fourth length of thorax with simple narrow flattened border. Anterior width of the pygidium nearly two and half times more than its length. Axis slightly conical, less than one-third width of pygidium, obtusely pointed, nearly extending to the marginal furrow, composed of 4-6 rings, lateral lobes gently convex consist of 5 pairs of pleurae. Each pleura with fine median furrow and usually traceable across flattened border. Inter-pleural furrows strong.

Dimensions (in mm) :

Specimen numbers	KUF 621	KUF 622	KUF 623	KUF 624	KUF 625
Length of complete exoskeleton	–	–	10.5	–	13.0
Length of cranidium	3.0	6.5	3.5	2.5	5.0
Posterior cranidial width	6.0	11.0	7.0	6.0	9.5
Length of glabella	2.5	4.5	2.8	2.0	3.5
Width of glabella at base	2.3	4.3	2.5	2.0	3.0
Preglabellar field (length)	0.3	1.0	0.4	0.3	1.2
Sagittal width anterior border	0.2	0.8	0.3	0.2	0.8
Length of thorax	4.5	–	5.0	4.0	6.0
Length of pygidium	2.0	–	2.5	1.0	2.0
Anterior width of pygidium	3.5	–	4.5	3.0	4.0
Length of axis of pygidium	1.0	–	1-.8	0.5	1.0
Frontal width of pygidial axis	1.5	–	2.0	0.8	1.4

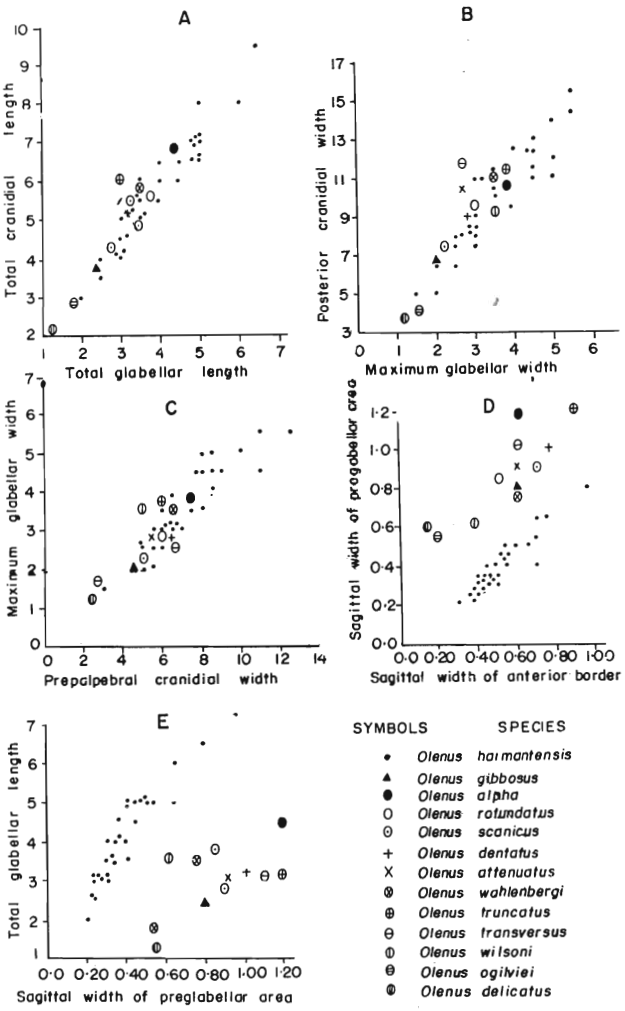

Fig. 2. Scatter diagrams of the dimensional parameters of species of *Olenus*

Remarks : The specimens comprise the topotypes of *Olenus haimantensis*. Reed (1910) had doubtfully assigned this form to genus *Olenus* taking into consideration the revised description of the genus *Olenus* by Lake (1908). He remarked that subquadrate shape of the glabella, the transverse shape of the cephalon, narrow fixed cheek, position of eye ridges, characters of thorax and number of segments in the pygidium recalls *O. attenuatus* Boeck (1827). But according to him, the eyes in the latter are further forward, smaller in size, anterior border is narrow and anterior branches of facial suture are subparallel, instead of bending outwards in a convex curve in front of the eyes. Reed (1910) also compared it with *Bathyuriscus stoliczkai* and found that the course of facial suture and shape of thoracic pleurae were sufficient to remove it from *B. stoliczkai*.

Kobayashi (1967) stated that *Olenus haimantensis* from Spiti cannot be assigned to *Olenus* on the basis of revision of this genus by Henningsmoen (1957) and gave it a generic shift from *Olenus haimantensis* to *Hundwarella haimentensis*. He also suggested that *Bathyuriscus stoliczkai* and *Dicellocephalus interpres* from the same horizon and locality were the axially and laterally compressed forms of same species and therefore synonymous with *Hundwarella haimentensis*. *Olenus haimantensis*, however, is a distinctive form in having a subtrapezoidal glabella, raised anterior border, almost straight eye ridges, smaller eye, single posterior-most lateral glabellar furrow and thus cannot be grouped with *Hundwarella*. *Bathyuriscus ? stoliczkai and Dicellocephalus? interpres* are quite different from *O. haimantensis* but are, no doubt, axially and laterally compressed forms of single species congeneric with *Hundwarella* and are, therefore, referred to as *H. interpres* (Shah *et al.* 1988).

Assigning of this taxon to *Olenus* by Reed is undoubted both on the basis of qualitative and quantitative characters.

The difference between *O. haimantensis* and other species of *Olenus* is graphically exhibited in the scatter diagram (fig. 2) in which the measured dimensions of Spiti form has been plotted alongwith other known species of this genus. It is evident from the scatter diagram that in some dimensional characters many species are generally identical as is indicated in figs. A,B, and C. However, whenever the sagittal width of the preglabellar area is plotted against any other parameter, *O. haimantensis* stands apart from all other species as indicated in figs. D and E. The sagittal width of the preglabellar area, therefore, constitutes the most important basis of distinction of this species from other forms. In this respect the taxon showing closest affinities to *O. haimantensis* is the species *O. wilsoni*.

Qualitatively the difference between *O. haimantensis* and *O. wilsoni* is that the latter has small anteriorly placed eye lobes and oblique eye ridges.

From *O. gibbosus* (Wahlenberg, 1821), the genotype, *O. alpha* Henningsmoen (*1957*), *O. transversa* Westergaard (1922) and *O. truncetus* Brunnich (1781), the specimens differ in the presence of shorter preglabellar area and number of thoracic segments.

O. ogilviei Opik (1963) from Australia differs in possessing a larger preglabellar area, larger eye lobes

and a very small pygidium, which is as long as one segment of the thorax.

O. delicatus Opik (1963) is distinguished by a square glabella, granulose surface, four pairs of glabellar furrows and very wide interocular cheek which is as wide as half the glabella.

With *O. asiaticus* Kobayashi (1944) the resemblance is less close as is the case with *O. cataractes* and *O. micrurus* Salter (1849), *O. mundus* Lake (1908), and *O. rotundatus* Westergaard (*1922).*

Superfamily Anomocaracea POULSEN, 1927
Family Anomocaridae POULSEN, 1927
Genus *Haniwa* KOBAYASHI, 1933

Haniwa transversa n.sp.
(Plate II — o,u,i,m,q,r)

Etymology : The name is derived from the transverse nature of cranidium and glabella at front.

Material : Twenty six cranidia in a fair state of preservation in blocks of greenish shale.

Diagnosis : Cranidium flat, parallel sided, tapering forward, length slightly more than its posterior width, straight at the front. Glabella tapering to truncatotapering, length almost equal to its maximum width or slightly more, transverse anteriorly. Frontal area quadrate, wide, anterior border furrow lacking, preglabellar and axial furrow shallow and faint, nearly obsolete eye, ridges, medium size, eye lobes witth nearly semicircular eye, posterior limb straight and narrow. Occipital ring gently curved posteriorly at the centre.

Thorax and pygidium unknown.

Description : Cranidium subquadrate, straight at the front, tapering forward, flat, length slightly more than its posterior width. Globella tapering to truncato tapering downsloping forward, weakly convex to flat, length almost equal or slightly more than the maximum width of glabella, narrow and straight at the front, then widening down towards the posterior, glabella having maximum width at its posterior end and occupying about two-third cranidial length, axial furrows well impressed. Three pairs of faint lateral glabellar furrows. Frontal area depressed, with length about one-third that of cranidium. Preglabellar furrow faint, straight, preglabellar area wide, downsloping from the front of the glabella, anterior border furrow lacking so that preglabellar area and border cannot be differentiated. Eye ridges obsolete, eye of medium size, nearly semicircular, situated near the glabellar mid length. Occipital furrow shallow, faint. Occipital ring well developed, gently curved posteriorly at the centre, width more at the centre than at the sides.

From the front end of glabella fixed cheek gently downsloping, width at the palpebral lobe about one-half of the maximum width of glabella.

Posterior limb narrow, straight, length less than the maximum width of glabella, marginal furrow absent, facial suture divergent in front of eye lobes but turns sharply and extends in a broad curve inward after reaching the border and cuts anterior margin near axial line of cranidium. Posterior course of facial suture diverges widely behind eye lobes and continues in straight line till it reaches the posterior limb.

Dimensions (in mm.) :

Specimen numbers	KUF 626	KUF 615 c	KUF 615 d	KUF 615 e	KUF 627 e	KUF 628 a	KUF 628 b	KUF 615 f
Maximum cranidial length	12.0	10.0	8.5	8.6	10.5	10.4	8.7	10.2
Posterior cranidial width	11.5	9.2	7.8	8.0	9.3	9.6	7.8	8.8
Maximum glabellar length	8.5	7.0	6.0	6.2	7.5	6.5	6.2	6.0
Glabellar width at base	8.2	6.8	5.6	6.0	7.0	5.8	5.7	5.6
Frontal area	4.0	3.6	3.2	2.9	3.8	3.5	3.0	3.5
Width of cranidium at eye lobes	10.7	8.6	7.2	7.5	8.7	9.0	7.0	8.5

Remarks : The specimens correspond to *Haniwa* Kobayashi (1933), on the basis of a flat, parallel-sided cranidium, which is slightly more in length than its posterior width, truncato-tapering glabella, semicircular palpebral lobes, wide frontal area with its length about one-third the length of cranidium and facial suture slightly divergent anterior to the eyes.

However, the Kashmir form does not match with any of the known species of the genus *Haniwa. H. sosanensis* Kobayashi (1933), the genotoype differs in having large eye lobes, two pairs of distinct lateral

glabellar furrows and an occipital ring which is nearly straight and of uniform width.

H. convexa Kobayashi (1935) differs in the shape of cranidium which is moderately convex, oblong glabella which is convex and elevated above the cheeks, lateral glabellar furrows being represented by three pairs of pits located inside the dorsal furrow, larger eye lobes, transverse occipital ring with strong occipital furrows.

H. conica Kobayashi (1935) shows some resemblance with the Kashmir form especially in the shape of glabella which is truncato-conical but *H. conica* has a concave preglabellar area, with narrow and poorly defined anterior border, large palpebral lobes close to glabella and in these characters it is distinguishable from Kashmir form.

H. oblongata Kobayashi (1935) matches in having an occipital lobe which is gently convex backward, obscure glabellar furrow, median palpebral lobe. But *H. oblongata* has a characteristic glabella which is roundly oblong, broadest in the middle, well defined by dorsal furrows, the palpebral lobe connected with glabella by a broad semi-elliptical eye band and hence is quite distinct from *H. transversa*.

H. transversa also shows some resemblance to genus *Aphelaspis* Resser (1935) in having a flat cranidium which is slightly more in length than its posterior width, forward tapering glabella, wide frontal area, wide preglabellar furrow, shallow dorsal furrow and medium-sized eye but in *Aphelaspis* the anterior border is easily differentiated from the preglabellar area by a shallow preglabellar furrow, the cranidium and glabella are strongly rounded anteriorly and in these characters it is easily distinguishable from the Kashmir form.

H. transversa shows some resemblance to *Shirakiella* Kobayashi (1935), especially in the truncato-conical shape of glabella, lack of glabellar furrows, transversely subquadrate frontal area without any demarcation of anterior border and medium-sized eye. But the latter is easily distinguishable by a trapezoidal cranidium, elevated glabella above the flat cheeks, convex frontal area, palpebral lobes being located close to glabella and facial suture nearly parallel in front of the eyes.

Superfamily Asaphiscacea RAYMOND, 1924
Family Asaphiscidae RAYMOND, 1924
Subfamily Asphicinae RAYMOND, 1924
Genus *Spitella* n. gen.

Etymology : The name is based on the occurrence of this typical form in Thango Section of Parahio Valley, Spiti.

Generic Diagnosis : Cranidium subtrapezoidal to subquadrate in outline, basal width more than the total cranidial length, anterior border gently raised with deep border furrow. Preglabellar area nearly twice as wide as the anterior border. Glabella conical with rounded anterior end, basal glabellar width about one and a half time more than the total glabellar length. Three pairs of lateral glabellar furrows, all being bifid, the bifurcating branches of all the furrows are obliterated in the middle. Eye ridges nearly straight, prominent, with small eyes situated at the glabellar mid length. Thorax and pygidium unknown.

Discussion : The form cannot be assigned to any existing genus because of the distinctive cranidial morphological features as described in the generic diagnosis. On the basis of these distinctive characters the specimens have been assigned to a new genus even though the material is scanty.

The genera with which it shows resemblance to a certain extent are *Apheloides* Ivshin (1962), *Palaedotes* Opik (1957) and *Perneraspis* Prantl (1947).

Apheloides shows some resemblance in having a cranidium which is subtrapezoidal in outline, elevated anterior border and a moderately convex glabella which converges conically towards its anterior end, three pairs of lateral glabellar furrows, prominent eye ridge with a small centrally located eye but differs in an arcuate anterior border which is more in width than the preglabellar area, length and width of glabella being nearly the same and only the posterior-most lateral glabellar furrow being bifid.

Palaedotes resembles in having a glabella which is converging at the front, three pairs of glabellar furrows of which the posterior most is bifid and small eyes which are present at the glabellar mid length. But *Palaeodotes* lacks preglabellar area, anterior border is represented by a very narrow shallow furrow, Ist lateral glabellar furrow being very forward, just behind the anterior end of the cranidium, glabellar length being more than its width and in these characters it

does not match with this form. Moreover, all the glabellar furrows are bifid in *Spitella*.

Perneraspis shows affinities in general outline of the cranidium, shape of the glabella which is wider at base and narrow at the front, straight eye ridges and small eye situated at the glabellar middle but differs in having only two lateral glabellar furrows which are very short and preglabellar area and anterior border being of nearly equal length.

Spitella barachuensis n. gen. & n. sp.
(Plate II — v,c)

Etymology : The species is named on Barachu the local name of river Parahio in Spiti.

Material : Eight cranidia in blocks of dark grey shale, in a fair state of preservation (Nos KUF 629-KUF 632).

Diagnosis : Same as for the genus.

Description : Cranidium moderately convex with subtrapezoidal to subquadrate outline, width of the cranidium at its base more than the total cranidial length. Anterior border narrow, gently raised, width slightly more in the centre than at the margins, nearly straight at the front, anterior border furrow deep, prominent. Preglabellar area narrow, of uniform width, nearly twice as wide as the anterior border, tapering forward, preglabellar furrow well developed, deep glabella, concial, rounded anteriorly, side of the glabella diverging towards the posterior end, basal glabellar width about one and a half time more than the total glabellar length. Three pairs of well developed lateral glabellar furrows, of these the first one (counting from anterior) short, less distinct, posteriorly directed and bifid, second glabellar furrow long, distinct, bifid, posteriorly directed, third lateral glabellar furrow prominent, posteriorly directed and bifid. All the three bifurcating branches are obliterated in the middle. Axial furrow well impressed, narrow. Occipital furrow deep, gently arched backwardly, occipital ring wider at the centre and strongly arched backwardly. Eye ridges prominent, straight, starting just near the anterior end of the glabella, eye of small size and situated at the mid glabellar length between second and third lateral, glabellar furrow. Fixed cheek wide, width nearly twice its length, gently convex, upsloping but not raised upto the level of anterior border.

Thorax and Pygidium unknown

Dimensions : (in mm) :

	KUF 629	KUF 630	KUF 631	KUF 632
Maximum cranidial length	2.9	4.5	6.5	5.6
Posterior cranidial width	5.5.8	9.2	12.5	10.5
Total glabellar length	1.5	3.0	4.5	4.0
Width of the glabella at base	2.5	4.0	5.0	5.4
Preglabellar area	0.8	1.0	1.0	0.9
Anterior border	0.3	0.5	0.8	0.6
Width of the cranidium at eye lobes	3.7	6.0	8.5	7.0

Subfamily Blountinae LOCHMAN, 1944
Genus *Blountia* WALCOTT, 1916

Blountia subangulata n. sp.
(Plate II— g,j,o,k)

Etymology : The name is derived from angular border and subangular fixed cheek.

Material : Twelve cranidia in a poor state of preservation in blocks of greenish shale.

Diagnosis : Cranidium sub-trapezoidal, length nearly equal to its posterior width, moderately arched transversely. Glabella prominent, as wide as long, gently rounded anteriorly, three pairs of very faint lateral glabellar furrows. Frontal area with distinct angular anterior border and preglabellar area, border nearly half the sagittal width of preglabellar area, border furrow angular. Eye ridges faint with medium size eye situated just ahead of glabellar mid-length and narrow fixed cheek, occipital ring narrow and of uniform width.

Thorax and pygidium unknown.

Description : Cranidium subtrapezoidal with length nearly equal to its posterior width, moderately arched transversely gently rounded anteriorly. Glabella prominent, as wide (at base) as long, tapering forward and gently rounded anteriorly. Axial furrows and preglabellar furrow well impressed at sides and front. Three pairs of very faint lateral glabellar furrows. Frontal area with distinct anterior border and preglabellar area, border furrow distinct almost straight, border angular, moderately arched upward gently rounded anteriorly and is nearly half the sagittal width of the preglabellar area, preglabellar area

moderate, gently convex. Eye ridges very faint to nearly obsolete, eye of medium size and situated just above glabellar middle length. Occipital furrow distinct, nearly of uniform width, occipital ring relatively short, rounded without occipital spine, occipital node absent. Posterior limbs nearly straight, its length almost equal to width of glabella at occipital furrows.

Anterior course of facial suture nearly straight up to the border and then turns inward to cut the margin, about midway between antero-lateral corners of cranidium and axial line, posterior course divergent behind the eye lobes. Fixigenae subangular, gently convex., width one half or less that of glabella.

Dimensions (in mm) :

Specimen numbers	KUF 632 (a)	KUF 632 (b)	KUF 632 (c)	KUF 633 (a)	KUF 633 (b)
Total cranidial length	3.5	4.6	3.8	3.6	3.2
Posterior cranidial width	4.2	5.3	4.5	4.2	3.8
Total glabellar length	2.5	3.0	2.8	2.6	2.0
Glabellar width at base	2.0	2.8	2.5	2.4	1.8
Sagittal width of anterior border	0.3	0.5	0.4	0.3	0.2
Sagittal width of the preglabellar area	0.6	0.8	0.6	0.5	0.4
Width of cranidium at eye lobes	4.0	4.8	4.2	3.8	3.5

Remarks : On the basis of characteristic features viz., anterior rounded cranidium, prominent rounded glabella with shallow glabellar furrows, distinctly narrow axial, preglabellar and anterior border furrows distinct border and small eyes situated anterior to preglabellar middle length, the specimens correspond to genus *Blountia*. However, these are easily distinguishable from all the known species of this genus.

The genus *Blountia* itself is divided into different subgenera viz., *Blontia (Blountia)* Walcott (1916), *B. (Homodictya)* Raymond (1937) and *B. (Mindycrusta)* Opik (1967), on the basis of abbreviated occipital furrow and shape of the thoracic pleural furrows. Opik (1967) suggested that all species whose thorax is unknown and are listed as belonging to *Blountia* are referable to that genus without any subgeneric designation.

In the absence of thorax, the Kashmir form, therefore, cannot be assigned to any subgenus. The Australian species of this genus show some resemblance especially in the shape of glabella and cranidium but all the species from Australia have been placed in subgenus *Mindycrusta* by Opik *(1967)*. These forms are characterised by an abbreviated occipital furrow, relatively long eye lobes and rounded tips of the postero-lateral limbs and thus are easily distinguishable from the Kashmir form.

The specimens also show some resemblance to *Modocia* Walcott (1924) in the shape of glabella which is rounded at front, three pairs of faint to obsolete glabellar furrows and small eye but *Modocia* has a straight anterior border furrow, distinct eye ridges, subtriangular and long posterior areas and in these characters it is easily distinguishable from the Kashmir form.

None of the forms reported from the same horizon in Kashmir are close enough to *Blountia subangulata,* to necessitate a comparison because the latter is characterised by a distinct anterior border, border furrow, and prominent glabella which is anteriorly rounded.

? Blountia sp.
(Plate II—d)

Material : Five cranidia in a poor state of preservation in blocks of dark green shale.

Description : Cranidium, subtrapezoidal to nearly semicircular with length slightly less than its posterior width, gently arched anteriorly. Glabella subquadrate with truncate front, gently convex, tapering forward, subrounded at the antero-lateral end, length of the glabella slightly more than its maximum width, glabella a little wider at the base than at the front. Axial and dorsal furrows well impressed. Three pairs of shallow lateral glabellar furrows. Frontal area narrow with distinct anterior border and preglabellar area. Anterior border furrow distinct, straight, border weakly convex, preglabellar area nearly of same width or slightly more than the anterior border. Eye ridges very prominent starting from the front of the glabella, gently directed posteriorly, eye of medium size, situated just ahead of the glabellar mid length. Occipital furrow distinct, straight, occipital ring very wide at the centre than at the sides, backwardly directed with

a prominent occipital node. Posterior limb straight of uniform width and its length nearly equal to the maximum width of the glabella. Fixigenae gently convex and almost parallel at side, with palpebral area same in width as glabella. Anterior course of facial suture nearly straight up to border then gently curving inward to cut the margin slightly away from the antero-lateral corners of cranidium, posterior course of facial suture nearly straight behind the eye lobes, weakly diverging near the posterior limbs.

Dimensions in mm :

Specimen numbers	KUF 634	KUF 635	KUF 636	KUF 637
Total cranidial length	7.0	7.5	9.0	8.0
Posterior cranidial width	8.4	8.6	12.2	10.6
Total glabellar length	4.2	5.6	6.8	6.2
Glabellar width at base	3.5	4.5	5.4	4.8
Sagittal width of anterior border	0.5	0.5	0.8	0.7
Sagittal width of preglabellar area	2.0	2.5	3.4	3.0
Width of cranidium at eye lobes	6 .0	7.0	11.3	10.2

Remarks : In having a subtrapezoidal cranidium which is gently arched at the front, subquadrate glabella with three pairs of shallow glabellar furrow, distinct border and preglabellar area and medium size eye situated just ahead of the glabellar mid length, the specimens can be referred to *Blountia*.

However, it does not match with any of the known species of this genus. It differs from *B. subangulata,* the species presently being described from the same stratigraphic harizon in Kashmir, in having a cranidium, with length slightly less than its posterior width, prominent eye ridges, an occipital ring very wide at the centre, with width at the centre being slightly more than double its width at side and a prominent occipital node.

This form from Kashmir has a very peculiar occipital ring and a prominent occipital node which clearly differentiates it from American and Australian species of this genus. It is possible that this could represent a different genus but in the absence of better preserved material it is tentatively referred to *Blountia.*

The specimens also show some resemblance to *Pedinocephalus kashmirensis* from Kashmir, in the general outline of the cranidium, weakly convex galbella which is tapering forward, three pairs of faint lateral galbellar furrows and a distinct eye ridge but *P. kashmirensis* is characterized by a glabella whose width at the front is nearly two-third its width at the base, an anterior border which is less than one half the width of the preglabellar areas, absence of occipital node, crescent shaped eyes, fixigenae with palpebral areas nearly half the width of glabella and in this respect it differs from *Blountia* sp.

Superfamily Damescellacea KOBAYASHI, 1935
Family Damesellidae KOBAYASHI, 1935
Subfamily Drepanurinae HUPE, 1953
Genus *Parablackwelderia* KOBAYASHI, 1942

? Parablackwelderia sp.
(Plate II—w,x)

Material : Two pygidia in a poor state of preservation in blocks of greenish shale.

Description : Pygidium semicircular, anterior width slightly more than double its maximum length, pygidial axis tapering posteriorly, bearing three axial rings and terminal, pleural field moderately convex, equal to axis in width with 5 pleurae, 5 pairs of pleural furrows, border furrow nearly obsolete, narrow flat border with seven pairs of pygidial spines, Ist pair of pygidial spines (counting from anterior to posterior) much longer than others and all other pairs of spines smaller.

Dimensions in mm :

Specimen numbers	KUF 638	KUF 639
Length of pygidium	6.5	7.4
Anterior width of pygidium	11.8	12.4
Length of the axis	3	3.8
Frontal width of the axis	3.5	4.5

Remarks : The specimen corresponds to *Parablackwelderia* in most of its pygidial morphological characters especially in having a semicircular shape, width greater than length, three axial rings and pattern of the marginal spines. However, the form does not match with the only known species, *P. spectabilis* because the pygidium of *P. spectabilis* is characterized by a very long Ist and 5th pair of pygidial spine. The specimen differs from *Blackwelderia monkei* from the same stratigraphic horizon of Kashmir, as the latter has subtriangular outline, in the length-width ratio and pattern of the pygidial spines. It is not possible, however, to assign these specimens to a new species, because of poor state of preservation and also due to lack of any associated cranidia.

Suborder *Asaphina* SALTER, 1864
Superfamily *Asaphacea* BURMEISTER, 1840
Family *Tsinaniidae* KOBAYASHI, 1933
Genus *Tsinania* WALCOTT, 1914

Tsinania sp.
(Plate II—f,s,t)

Material : Six cranidia in a tolerable state of preservation, in dark grey shale. (Nos. KUF 644 to KUF 646).

Description : Cranidium elongated, subquadrate in outline, moderately convex, tapering anteriorly, sligtly more in length than the posterior cranidial width. Anterior border narrow, moderately flat, of uniform width, gently arched at the front. Preglabellar area narrow, of uniform width, slightly more in width than the anterior border. Glabella rounded anteriorly, parallel sided, gently convex, glabella occupies about seventy per cent of the total cranidial length. Length of the glabella about one and half time more than its width at the base. Three pairs of faint lateral glabellar furrows, of which the posterior one is relatively more distinct, axial furrow narrow, occipital furrow shallow, straight, occipital ring wider at the centre and moderately arched backward. Eye ridges faint, gently oblique starting at the first lateral glabellar furrow, eye of small size and situated between second and third lateral glabellar furrow, nearly at the glabellar mid length. Fixed cheek narrow, elongated, its width slightly less than the total cranidial length, gently convex, upsloping but not raised upto the level of glabella.

Dimensions in mm :

Specimen numbers	KUF 644	KUF 645	KUF 646
Total cranidial length	5.1	5.0	6.5
Posterior cranidial width	4.8	4.9	6.0
Total glabellar length	3.7	3.5	4.8
Width of the glabellar at base	2.0	1.9	2.5
Sagittal width of preglabellar area	0.7	0.6	1.0
Sagittal width of anterior border	0.5	0.5	0.5
Width of the cranidium at eye lobes	4.2	4.5	5.5

Remarks : In having a subquadrate, moderately convex, anteriorly tapering cranidium, glabella outlined with narrow and shallow dorsal furrows on both sides, shallow lateral glabellar furrows, small eyes situated at the glabellar middle length and an occipital ring which is wide at the centre and moderately arched backwards, the specimens can easily be referred to *Tsinania*.

However, this form does not match with any of the known species of this genus. *T. canens* Walcott (1914) the genotype differs in having very shallow to nearly obsolete border furrow, glabella being almost straight at the front and slightly diverging posteriorly towards the occipital furrow, fixed cheek in front of the palpebral lobe being rather narrow, postero-lateral limb being short and narrow.

T. ceres Walcott (1914), *T. peipingense* and *T. tinqtaohenqi* Sun (1935) are based on pygidia only and no comparison can be made with the Spiti form in the absence of any associated pygidium.

On the basis of elongated nature of cranidium, the Spiti form is more close to *Tsinania acuta* Sun (1935) but *T. acuta* has a strongly convex cranidium, frontal border is acutely rounded, the elongate palpebral lobe is situated slightly below the glabellar mid length and has a very characteristic outline of the facial suture and in these respects this form does not match with Spiti form.

The specimens also show some resemblance to *Manchuriella* Kobayashi (1935) especially in having small preglabellar field, shallow lateral furrow and short palpebral lobes but *Manchuriella* has a broad glabella which is straight at the front, border furrow very prominent, distinct eye ridges and in these characters it differs from the Spiti form.

STRATIGRAPHIC SIGNIFICANCE OF THE FAUNA

It was generally believed that Late Cambrian did not occur in Himalaya as is evident from several reviews (e.g. Wolfart, 1983, p. 59). This view was further supported when some of the Late Cambrian forms reported by Reed (1934) proved to be Middle Cambrian ptychoparids. The report of *Olenus* from Spiti was also disputed (Kobayashi, 1967). The description of the present fauna and the earlier reports (Shah, 1982, Shah and Sudan, 1983, 1984, 1987, Jell, 1986) indicates without any doubt that early Late Cambrian fauna is known in both Kashmir and Spiti though in the latter it would be at a slightly younger level. The beds bearing this fauna in Kashmir could be correlated to Lower part of Dresbachian stage of America, Lower part of Maentworgian stage of Wales, and Mindyallan stage of Australia, whereas those of

Spiti could be comparable to the Upper part of Dresbachian and Maentworgian of America and Wales respectively and Idamena of Australia. No Cambrian fauna younger than these is known anywhere in Himalaya. While in Spiti, there is a distinct angular unconformity above these beds which accounts for the remaining part of Late Cambrian and Early Ordovician sequence, in Kashmir there appears to be a paraconformity since the next fossiliferous beds in Trahagan section bear Middle Ordovician fauna.

In Magam and Trahagam sections of Kashmir, the Late Cambrian fauna was earlier grouped into two Assemblage Zones (Shah, 1982), but as these Zones were found to be overlapping for a considerable thickness they were combined in a single Zone viz. *Damesella* Zone (Shah and Sudan, 1984). This Zone overlies the *Bolaspidella* Zone of Middle Cambrian.

While disputing the identification of *Bolaspidella*, Jell (1986) has opined that it can be referred to some early Middle Cambrian inyonids. However, not only is the record of *Bolaspidella* beyond dispute (Shah *et al.*, 1985) but its stratigraphic position is nowhere near early Middle Cambrian. The topmost part of *Bolaspidella* Zone contains *Diplagnostus* a characteristic genus which is reported from *Lejopyge laevigata* Zone in several parts of the world. The *L. laevigata* is used as a marker to delineate the Middle and Upper Cambrian boundary (Daily and Jago, 1975). Though in Kashmir *L. laevigata* is absent, a characteristic genus associated with *L. laevigata* everywhere in the world, viz. *Diplagnostus* is found and *Damesella* Zone overlies the latter.

The faunal elements of the *Damesella* Zone are all characteristic of early Late Cambrian forms. The presence of *Damesella* in this Zone is very significant. This genus is a characteristic faunal element of the Australo-Asian super-region and has been reported besides Kashmir, from China, Iran, Australia and Kazakhistan. However, the stratigraphic position of *Damesella* in Kashmir is somewhat different from its level of occurrence in some other areas. In China *Damesella* occurs in the topmost Zone of *Changhia* Stage of Late Middle Cambrian. This is overlain by the *Blackwelderia* Zone of Kushan stage which is early Late Cambrian (Chang, 1980). In Australia *Damesella* occus in *Damesella torosa- Ascionepea janitrix* Zone which has been referred to as Zone of passage by Opik (1967) and is a part of Mindyallan (considered to be partly Middle and partly Late Cambrian). So *Damesella* in Australia occurs at a slightly higher stratigraphic level than that of China and its reported occurrence from Iran is also at the same level at which it occurs in Australia. Ivshin (1962) has reported the occurrence of *Damesella* from *Agnostus pisiformis* Zone of early Late Cambrian from Altai-Sayan region of the Siberian platform. Accordingly, the *Damesella* Zone of Kashmir can be correlated with the *Agnostus pisiformis* Zone of Europe, Mindyallan stage of Australia, *Blackwelderia* Zone of Kushanian stage of China and Cedaria Zone of North America.

The other associated fauna of the *Damesella* Zone of Kashmir bears the elements of *Agnostus pisiformis* Zone, *Cedaria* Zone and the younger *Crepicehalus-Aphelaspsis* Zone (= *Glyptoagnostus stolidotus* Zone of Australia). *Blountia* is reported from *G. stolidotus* Zone of Australia (Opik, 1967) and *Crepicephalus* Zone of Kazakhistan (Ivshin, 1962) and it ranges from Middle *Cedaria* Zone to lower *Aphelaspis* Zone in North America (Lochman- Blak, 1977). The genera *Blackwelderoides* and *Parablackwelderia* occur in the *Blackwelderia* Zone of China (Chang, 1980) Korea and Vietnam (Kobayashi 1967), Afghanistan and Iran (Wolfart, 1981). *Crepicephalus* and *Paracoosia*, the typical North American elements of *Crepicephalus* Zone, have been reported from *Blackwelderia* Zone of Iran and Afghanistan (Wolfart and Kursten, 1974). *Pedinocephalus* occurs in the *Crepicephalus* Zone of Kazakhistan (Ivshin, 1962). *Blandicephalus* which is very similar to new genus *Amrticephalus* from Kashmir occurs in the lower part of *Aphelaspis* Zone of North America (Palmer, 1954).

In Spiti while *Olenus* represents the early Late Cambrian, it cannot be correlated with the *Damesella* Zone of Kashmir because except for *Hundwarella*, there is no other form common in both the Zones even at generic level. This can be explained by the fact that the *Olenus* Zone of Spiti occurs at slightly higher stratigraphic level than the *Damesella* Zone of Kashmir. This is also evident from the species of *Hundwarella* from the *Olenus* Zone which shows a higher level of evolution than *Hundwarella kingi* which occurs just below the *Damesella* Zone of Kashmir. This has been discussed by Shah *et al.* (1988) and Shah and Raina (in press). Secondly, the *Olenus* Zone in Scandinavia (Henningsmoen, 1957, Martinsson, 1974) overlies the *Agnostus pisiformis* Zone as is the case in Wales and England (Rushton, 1974). *Olenus* Zone of Europe is considered equivalent of *Aphelaspis* Zone of North America.

While *Damesella* Zone of Kashmir seems to range from *Cedaria* Zone (= *Agnostus pisiformis* and *Blackwelderia* Zone) to *Crepicephalus* Zone, the *Olenus* Zone of Spiti can be correlated to *Aphelaspis* Zone. This difference in the stratigraphic levels accounts for the absence of any comparable faunal elements in the two localities.

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EXPLANATION OF PLATES

PLATE I

Pedinocephalus kashmirensis n. sp.

(a)	Cranidium	x 6.3
(d)	Cranidium	x 4.8
(g)	Cranidium (Holotype)	x 5.7
(k)	Cranidium	x 5.6
(p)	Cranidium	x 3.2

Amurticephalus elongatus n. gen. & n. sp.

(b)	Cranidium (Holotype)	x 5.2
(e)	Cranidium	x 4.0
(h)	Cranidium	x 4.8
(l)	Cranidium	x 4.8
(m)	Cranidium	x 4.4

Cyclolorenzella sp.

(c)	Cranidium	x 5.2
(f)	Cranidium	x 5.0
(i)	Cranidium	x 4.3

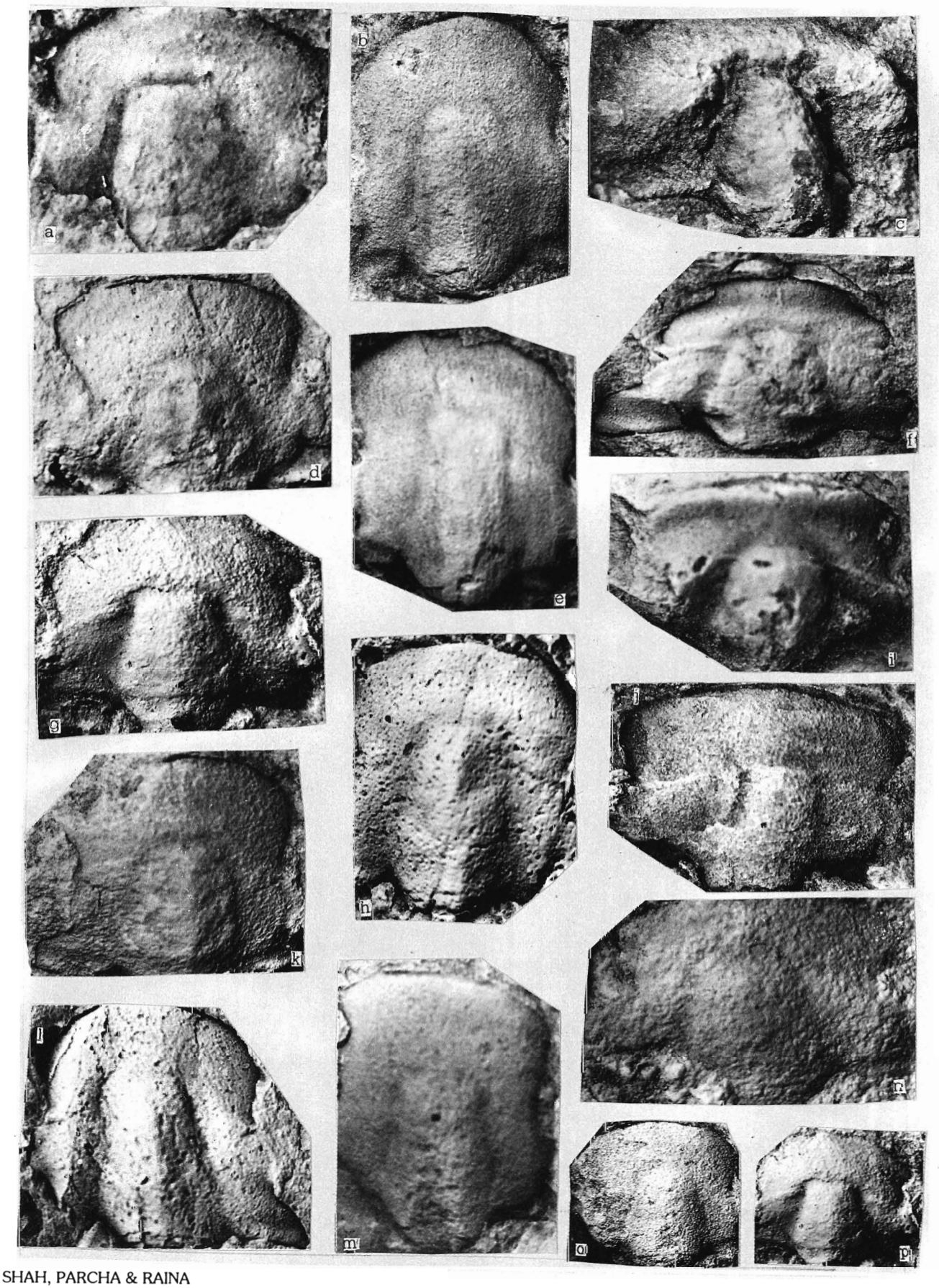
Walcottaspis sp.

(j)	Cranidium	x 6.0

(n)	Cranidium	6.3
	Haniwa transversa	
(o)	Cranidium	x 3.3

PLATE II

	Olenus haimantensis Reed	
(a)	Complete exoskeleton	x 7.2
(b)	Complete exoskeleton	x 5.8
(c)	Complete exoskeleton without free cheek	x 2.8
(h)	Exoskeleton partially broken without free cheek	x 6.7
(p)	Complete exoskeleton	x 6.0
	Haniwa transversa n. sp.	
(i)	Cranidium (Holotype)	x 5.2
(m)	Cranidium	x 5.8
(q)	Cranidium	x 4.6
(r)	Partially broken cranidium	x 4.8
(u)	Cranidium	x 5.4
	Spitella barachucensis n. gen & n. sp.	
(c)	Cranidium (Holotype)	x 6.7
(v)	Partially broken cranidium	x 6.0
	Blountia subangulata n. sp.	
(g)	Cranidium	x 5.8
(j)	Cranidium (Holotype)	x 6.3
(k)	Partially broken Cranidium	x 6.3
(o)	Cranidium	x 6.1
	? *Blountia* sp.	
(d)	Cranidium	x 6.0
	Tsinania sp.	
(f)	Cranidium	x 2.8
(s)	Cranidium	x 4.8
(t)	Cranidium	x 4.3
	Parablackwelderia sp.	
(w)	Pygidium	x 4.8
(x)	Pygidium (Cast)	x 5.6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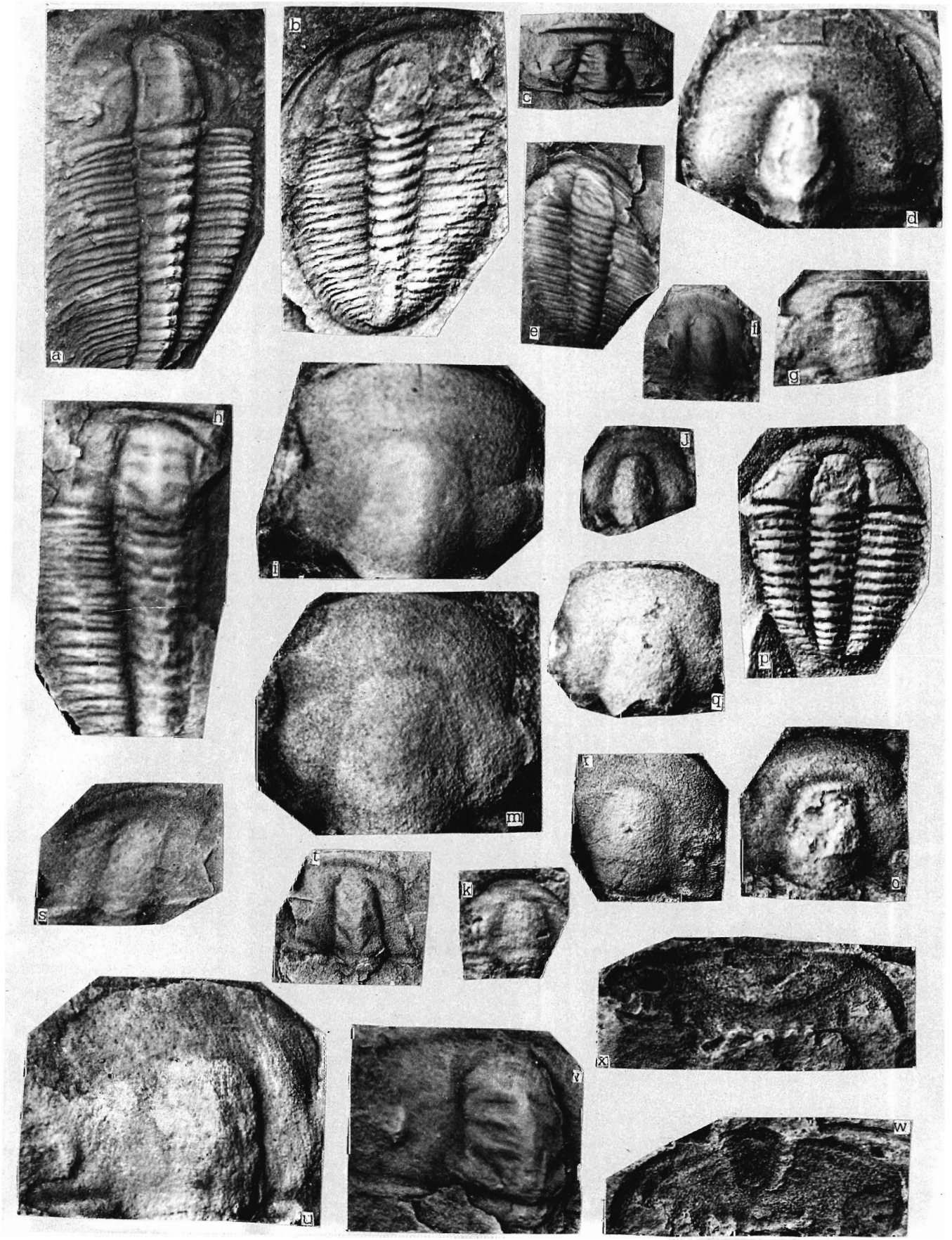
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