

NEW SPECIES OF *IRANOLEESIA* FROM THE CAMBRIAN ROCKS OF KASHMIR, INDIA

V. J. GUPTA* AND I. J. SUNEJA**

*DEPARTMENT OF GEOLOGY, PANJAB UNIVERSITY, CHANDIGARH, INDIA

**DEPARTMENT OF ANTHROPOLOGY, PANJAB UNIVERSITY, CHANDIGARH, INDIA

ABSTRACT

The paper describes four new species of *Iranoleesia* King from the upper Middle Cambrian beds of northwestern Kashmir.

INTRODUCTION

During the palaeontological and stratigraphical investigations of parts of Baramula District (Kashmir), the authors recorded a number of Cranidia, pygidia and some nearly complete specimens of *Iranoleesia* King along the streamlet and road cuttings around Zachaldor (34° 24' : 74° 11') and Pahldji (34° 27' : 74° 10') in the Hundwara basin. The *Iranoleesia* bearing beds conformably overlie the beds yielding fossils of *Anomocare*, *Tonkinella*, *Conocoryphe*, etc. The detailed study of various forms of *Iranoleesia* indicates the presence of four new species in the present collection.

Iranoleesia King had earlier been recorded from the Middle Cambrian rocks of Iran (King, 1937) and this genus is represented there by fragmentary material consisting of incomplete cranidia and a pygidium. out of the fragmentary Iranian material, King (*Op. cit.*) described two species of this genus, i.e., *I. pisiformis* King and *I. falconi* King. While describing this genus he suggested that some of the forms described under the genus *Anomocare* in China by the earlier workers may have to be grouped under the genus *Iranoleesia* on the basis of their morphological character.

While supporting authors' identifications of various forms of *Iranoleesia*, Prof. F. Rasetti of Italy (Personal communication) remarked, "...Your material of *Iranoleesia* gives a much more complete knowledge of that genus than was previously available and its description will be interesting... There are certainly more individuals of *Iranoleesia*..."

The *Iranoleesia* bearing beds of Kashmir consist of yellowish, greenish, reddish and bluish clays, loose to compact greenish shales, compact fine to medium grained sandstones, slates, etc. These rocks are highly jointed and the joints generally run oblique to the bedding thus making the extraction of fossils difficult.

The detailed Cambrian stratigraphy of the Hundwara basin and the Palaeogeographic significance of *Iranoleesia* King have already been discussed by the present authors (Gupta and Suneja, 1974) in a separate publication.

The specimens described in the present paper are catalogued in the collections of the Centre of Advanced Study in Geology, Panjab University, Chandigarh.

SYSTEMATIC DESCRIPTION

<i>Phylum</i>	Arthropoda Siebold & Stannius, 1845
<i>Class</i>	Trilobita Walch, 1771
<i>Order</i>	Ptychopariida Swinnerton, 1915
<i>Suborder</i>	Ptychopariina Richter, 1933
<i>Superfamily</i>	Asaphiscacca Raymond, 1924
<i>Family</i>	Asaphiscidae Raymond, 1924
<i>Subfamily</i>	Asaphiscinae Raymond, 1924
<i>Genus</i>	<i>Iranoleesia</i> King, 1955

Iranoleesia rasettii sp. nov.

(Plate I—7, 8)

Irania King, 1937, *Pal. Ind. Geol. Surv. Ind. N. S.*, Vol. 22, No. 5, Pl. 2, figs. 6a-6c, p. 12.

Iranoleesia King, 1955 (*Irania Pisiformis* King, 1937), vide *Treatise on invertebrate palaeontology* by R. C. Moore (ed.), p. 10, *Geol. Soc. Amer. & Univ. Kansas, Press*, p. 290.

Material : Two partly well preserved specimens.

Type Nos. : Holotype CASG F759
Paratype CASG F760

Description : Cranidium subquadrate with a well preserved glabella, flat to weakly convex covering nearly three-fourths the total length of head shield with its length equal to or slightly more than its width at base, subcarinate, slowly tapering to subrounded anterior and with straight sides. As many as three pairs of lateral

glabellar furrows can be differentiated; third and second pairs (counting posterior to anterior) short, deep and weakly directed anteriorly whereas first pair directed posteriorly and bifurcated at the middle with the bifurcated branch also directed posteriorly and disappearing before reaching the occipital furrow which is shallow, straight and well marked in the present species. Neck ring simple band like with uniform thickness and without a mesial tubercle. Axial furrows of the head shield region shallow to moderately deep and convergent anteriorly. Preglabellar furrows quite shallow and not very prominent in the present specimens. Preglabellar field narrow, flat, gently to steeply sloping anteriorly. A shallow but wide border furrow separates it from the anterior border which is thin, slightly arched forward at its anterior part, weakly tapering and curving down laterally. Eye ridges thin but prominent, originate at fourth pair of lateral glabellar furrows and weakly curve back posteriorly. Fixigenae flat to slightly raised in the middle parts but a little below the level of glabellar surface.

Axis of the thorax convex, cylindrical, gradually tapering posteriorly and bearing +11 axial rings separated from one another by shallow transverse furrows with corresponding pleurae. Pleurae generally horizontal but may have weak fulcrum at about half the length, marked by shallow to moderately deep pleural furrows which taper distally separating the anterior and posterior pleural bands the distal ends of pleurae produced into spines. The axial furrows of the thoracic region shallow to moderately deep.

Pygidium unknown. Surface of the species ornamented with fine granules.

Dimensions (in mm.)	F 759	F 760
Length of cranidium	5.50	4.00 (Approx.)
Width of cranidium (at base)	—	8.25 (Approx.)
Length of glabella	4.00	3.00
Width of glabella (at base)	3.50	3.00
Width of glabella (at anterior side)	2.75	2.50
Width of fixigena (at palpebral part)	2.00	—
Midlength of anterior border	0.60	—
Midlength of preglabellar field	0.60	—
Length of thorax	+ 6.00	—

Remarks : The present form is closely comparable to *Iranoleesia orlovi* but can be well differentiated from the latter on the basis of the characters of glabella, preglabellar field, etc. In *I. orlovi*, glabella is quite convex with four pairs of lateral glabellar furrows, preglabellar field flat to slightly swollen unlike the specimen under description in which glabella is flat to weakly convex with three pairs of lateral glabellar furrows; preglabellar field flat and sloping gently to steeply anteriorly. There

is remarkable difference in the size of the two species also. *I. kobayashii* possesses four pairs of lateral glabellar furrows and also the glabella in the two considerably differs in the length-width ratio. In *I. kobayashii* glabella is quite longer than its width at base unlike the present species in which the two dimensions are either equal or have very slight difference. *I. pandei* is characterised by transverse nature of the posterior branches of the bifurcated first pair of lateral glabellar furrows. Although the Iranian forms, i.e., *Irania pisiformis* King and *I. falconi* King possess three pairs of lateral glabellar furrows each yet they differ from the Kashmir form in having differently shaped glabella, preglabellar field and anterior border.

Locality and Horizon : Section at the backside of Zachaldor Forest Rest House in the streamlet; upper Middle Cambrian.

Derivation of Name : The species has been named in honour of Prof. Franco Rasetti, Institute Fisico dell'Universita, Roma, Italy.

Iranoleesia kobayashii sp. nov.

(Pl. I—11)

Material : Four cranidia—one well preserved with part of thorax.

Type Nos. : Holotype CASG F 762

Paratypes CASG F 763-F 765

Description : Cranidium subquadrate in outline with length less than its width at base. Glabella strongly convex, convexity maximum in the middle and decreasing gradually anteriorly and posteriorly, shape of glabella subcylindrical, subcarinate with rounded anterior end, covering three-fourths the total length of cranidium with its length much more than its width at base; four pairs of well impressed lateral glabellar furrows present with fourth and third pairs (counting posterior to anterior side) oblique, directed anteriorly, second pair directed posteriorly and first pair nearly horizontal but bifurcated at the middle with bifurcated branch oblique posteriorly. Axial furrows prominently deep and nearly straight. Preglabellar furrows deep at the lateral sides, but quite shallow in the middle. Occipital furrows prominently deep and straight. Occipital ring with almost uniform thickness, bears a mesial tubercle in the middle. Fixigenae slightly raised at the palpebral parts and gently slope down at their anterior and posterior parts. Width of fixigena at the palpebral part less than the width of glabella at base. Preglabellar field narrow and slightly swollen in the middle. Narrow, flat and slightly arched forwardly anterior border tapering very little laterally and separated from the preglabellar field by shallow but well preserved anterior border furrow. Midlengths of anterior border and preglabellar field equal. Posterior

border furrow horizontal and shallow separating weakly rounded posterior border. Eye ridges prominent, originate at the fourth pair of lateral glabellar furrows and curve back posteriorly. Palpebral lobes small, crescentic, present opposite the middle of glabella and are slightly raised. Trend of facial suture cannot be attempted accurately due to their broken and deformed nature in the present specimens.

Thorax of +1 axial ring with corresponding pair of horizontal pleurae bearing fairly deep pleural furrow which gradually narrows towards distal extremity and separates anterior and posterior pleural bands.

Pygidium unknown. Scattered fine granules ornament the surface of the species.

Dimensions (in mm.)	F762	F762	F764	F765
Length of cranium	8.00	8.00	10.10	10.00
Width of cranium (across palpebral lobes)	8.75	7.50 (approx)	12.00 (approx)	—
Length of glabella	5.25	5.50	7.00	7.25
Width of glabella (at base)	3.50	3.00	5.00	5.50
Width of glabella (at anterior side)	3.00	2.75	4.50	4.75
Width of fixigena (across eyes)	2.75	2.00	3.50 (approx)	—
Midlength of anterior border	0.75	1.00	1.00	1.00
Midlength of preglabellar field	0.75	1.00	1.00	1.00

Remarks : Species under study differ from *Irania pisiformis* King, *I. falconi* King and *Iranoleesia rasettii* in having four pairs of lateral glabellar furrows instead of three as is the case in the latter forms in addition to the difference in the shape of glabella. In *I. pisiformis* King glabella is quadrate and in *I. falconi* King it is conical in shape unlike the present species in which it is sub-cylindrical. *I. pisiformis* King further differs in having comparatively wide preglabellar field and conspicuously forwardly arched anterior border. Although there are four pairs of lateral glabellar furrows in *Iranoleesia orlovi* like the present form yet the two can be differentiated in the length-width ratio of the glabella in addition to other morphological differences. In the former, length of the glabella is nearly equal to its width at base whereas in the latter case, the length is more than its basal width. *I. pandei* differs from it in having transverse bifurcated branches of first pair of lateral glabellar furrows. *I. rasettii* differs in having a flat to weakly convex glabella and the preglabellar field sloping gently to steeply anteriorly.

Locality and Horizon : Section at the backside of Zachaldor Forest Rest House along the streamlet cutting ; upper Middle Cambrian.

Derivation of Name : The present species is named after Prof. Teiichi Kobayashi of Geological Institute, University of Tokyo, Tokyo (Hongo), Japan, who has

contributed a great deal towards the knowledge of Asian trilobites.

Iranoleesia pandei sp. nov.

(Pl. I—9)

Material : One partly well preserved cranium.

Type No. Holotype CASG F 766.

Description : Glabella strongly convex in the middle but the convexity decreasing slowly towards its anterior and posterior sides. Glabella covering slightly less than three-fourths the total length of cranium, subcarinate, tapering slowly anteriorly to subrounded anterior end, length nearly double the width at the base with straight sides and four pairs of lateral glabellar furrows ; fourth pair (counting posterior to anterior side) shallow, short, poorly defined and directed anteriorly, third pair also weakly directed anteriorly, second pair slightly oblique posteriorly and slightly longer than fourth and third pairs, first pair is the longest, nearly horizontal and bifurcated at the middle with bifurcated branches gradually shallowing at their inner ends and becoming transverse, thus separating a posterior band like lobe. Pre-glabellar furrow deep laterally but extremely shallow in the middle portion. Axial furrows deep, well defined and slightly convergent anteriorly. Occipital furrow moderately deep. Occipital ring rounded but not raised to the level of glabella, bearing a prominent mesial tubercle in the middle. Pre-glabellar field narrow, slightly swollen in the middle. Anterior border also, narrow, rounded, raised above the level of preglabellar field, slightly arched forward, very little tapering laterally and separated from pre-glabellar field by a deep and well defined anterior border furrow. Eye ridges prominent, thin, oblique posteriorly and originate at the fourth pair of lateral glabellar furrows. Fixigenae flat, partly preserved in the present specimen. Rest of the features of cranium cannot be attempted due to poor preservation.

Surface of the species ornamented with scattered fine granules.

Dimensions (in mm.)—	F 766
Length of cranium	7.00
Length of glabella	4.50
Width of glabella (at base)	3.25
Width of glabella (at anterior side)	2.75
Midlength of preglabellar field	0.75
Midlength of anterior border	0.50

Remarks : The species under description can only be compared with *I. orlovi* in most of its characters but the transverse nature of the bifurcated parts of first pair of lateral glabellar furrows in the former sufficiently separates

it not only from the latter but from all the so-far known *Iranoleesia* spp. In all other *Iranoleesia* species, the bifurcated first pair has the bifurcated branches directed posteriorly in an oblique manner. It can be further differentiated from *I. orlovi* in having length of the glabella nearly double the width at the base unlike the later form.

Locality and Horizon : Section at the backside of Zachaldor Forest Rest House along the streamlet cutting ; upper Middle Cambrian.

Derivation of Name : The species has been named in honour of Dr. I. C. Pande, Prof. & Head, Centre of Advanced Study in Geology, Panjab University, Chandigarh, India.

Iranoleesia orlovi sp. nov.
(Pl. I—1-6, 10, 12)

Material : Twenty specimens including casts of cranidia, parts of thorax, pygidia and a mold of nearly complete specimen (excluding librigenae).

Type Nos. : Holotype CASG F 767
Paratypes CASG F 768-F 786.

Description : Head shield transversely semielliptical, generally more than twice as wide as long with well preserved convex glabella, subcarinate having subtruncated to subrounded anterior end, covering nearly three-fourths the total length of the head shield with its length either equal to or a little more than its width at base, tapering very slowly anteriorly with nearly straight sides ; four pairs of well impressed lateral glabellar furrows can be seen, fourth pair (counting posterior to anterior) short and slightly directed anteriorly, third pair as long as second and first pairs and either directed anteriorly or horizontal, second pair slightly directed posteriorly and first pair horizontal, bifurcated at the middle with the bifurcated branches oblique posteriorly without touching the occipital furrow which is well preserved in all the specimens and is characteristically shallow in the middle but deep at the lateral sides. Occipital ring with low convexity, widest in the middle portion with or without a mesial tubercle. Axial furrows prominently deep and weakly convergent anteriorly. Preglabellar furrow generally shallow in the middle as compared to its lateral sides. Preglabellar field quite narrow, flat to slightly swollen. Cephalon border subrounded to rounded, weakly arched forward at its anterior part and prominently curve down at lateral portions without tapering significantly and is separated from the preglabellar field by a moderately deep border furrow. Eye ridges prominent, originate at the fourth pair of lateral glabellar furrows and are either oblique or generally curving backwards to the anterior end of palpebral lobes. Palpebral lobe well marked, slightly raised above the level of fixigenae.

Eyes small with their position slightly posterior to the middle of glabella. Fixigenae nearly flat and sloping down gently at their anterior and posterior parts. Posterior branches of facial sutures make a low angle with the posterior border, curve round the palpebral lobe with their anterior branches diverging out gently.

Axis of the thorax convex, very gradually tapering posteriorly with 12 prominent axial rings and corresponding pleurae in the pleural region. Axial furrows well marked in the thoracic region. Pleurae spinose with moderately deep pleural furrows, narrowing on the distal side and separating anterior and posterior pleural bands. Pleurae straight but sometimes with very weak fulcrum at about half their length.

Pygidium semielliptical in shape with its width at the anterior side nearly two times the length. It consists of a convex axis, raised above the pleural region, tapering posteriorly to the pointed end which does not reach the posterior extremity. This posterior part curves down gently. Five axial rings can be counted of which the three anterior ones are well defined. The lateral part of the pygidium consists of an inner and an outer part. The inner part consists of three differentiable pleural segments and it occupies a triangular area which reaches the axis before its extremity. The outer part constitutes a flat flange border and surrounds the inner portion and is equal in width on the anterior margin to the ribbed part and then gradually narrows posteriorly. Species is micropygous.

Remarks : The present species can be differentiated from the Iranian forms, i.e. *Irania pisiformis* King and *I. falconi* King and from *Iranoleesia rasettii* of the area under study in having four pairs of lateral glabellar furrows instead of three. In the Iranian forms, the anterior border is considerably arched forward unlike the species under description. In addition, glabella is of quadrate shape and a wide preglabellar field is present in *I. pisiformis* King. Conical glabella characterises the *I. falconi* King although its narrow preglabellar field, shape and characters of pygidium are comparable with the form under description. *I. kobayashii* is comparable with the present form in having four pairs of lateral glabellar furrows. But the two clearly differ in the length-width ratio of the glabella. In *I. kobayashii* glabella is much more longer than its width at the base unlike the specimen under description in which the glabella is either with the same length as the width at base or there is slight difference in the two dimensions. *I. pandai* is characterised by the transverse nature of the posterior branches of the bifurcated first pair of lateral glabellar furrows, which is in contrast to the remaining forms.

Localities and Horizon : Around Pahldji village and at the backside of Zachaldor Forest Rest House along the streamlet cutting ; upper Middle Cambrian.

Dimensions (in mm.)	F 767	F 768	F 769	F 770	F 771	F 772	F 773	F 774	F 775
Length of cranidium	10.00	10.25	7.25	7.50	11.00	..	6.50	6.75	..
Width of cranidium (at palpebral loes)	..	..	7.00	9.25	12.25	..	9.00	8.50	..
							(approx)	(approx)	
Width of cranidium (at base) ..	19.00	..	9.50	..	18.00	..	..	..	..
Width of cranidium (at anterior side) ..	..	12.00	8.00	10.00	16.75	..	9.25	..	..
		(approx)		(approx)			(approx)		
Length of glabella	7.25	6.50	5.00	5.50	8.25	..	4.50	4.75	..
Width of glabella (at base) ..	7.00	5.75	4.00	5.00	7.50	..	4.50	4.25	..
Width of glabella (at anterior side) ..	..	4.25	3.00	3.75	5.25	..	3.50	3.50	..
Midlength of preglabellar field ..	0.75	1.00	0.75	0.75	0.75	..	0.50	0.50	..
Midlength of anterior border ..	0.75	1.00	0.75	0.50	0.75	..	0.50	0.50	..
Length of thorax	13.50	..	..	..	15.50	13.00	..	..	..
Length of pygidium	6.75	..	..	..	..	..	..	..	..
Width of pygidium (at anterior side) ..	14.00	..	..	..	..	11.00	..	..	12.00
						(approx)			

Derivation of Name : The species is named after late Prof. J. Orlov of USSR in whose honour the present volume is being published.

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EXPLANATION OF PLATE

PLATE I

1. *Iranoleesia orlovi* n. sp. Cranidium $\times 2$
2. *Iranoleesia orlovi* n. sp. Nearly complete specimen $\times 1.6$
3. *Iranoleesia orlovi* n. sp. Cranidium $\times 3.3$
4. *Iranoleesia orlovi* n. sp. Pygidium $\times 2$
5. *Iranoleesia orlovi* n. sp. Pygidium $\times 2$
6. *Iranoleesia orlovi* n. sp. Cranidium $\times 2$
7. *Iranoleesia rasettii* n. sp. Cranidium attached with part of thorax $\times 3$
8. *Iranoleesia rasettii* n. sp. Cranidium attached with part of thorax $\times 2$
9. *Iranoleesia pandei* n. sp. Cranidium $\times 3.6$
10. *Iranoleesia orlovi* n. sp. Cranidium $\times 3.6$
11. *Iranoleesia kobayashii* n. sp. Cranidium $\times 2.7$
12. *Iranoleesia orlovi* n. sp. Part of thorax $\times 3.4$

