THE IRVINGELLA MAJOR ("PTYCHO-PLEURITES") FAUNIZONE OF THE UPPER CAMBRIAN

JAMES L. WILSON AND E. A. FREDERICKSON

ABSTRACT. The fauna of the "Ptychopleurites zone" is reviewed and a new genus erected for the trilobite Ptychopleurites amplooculata Frederickson. The geographic and vertical position of this assemblage in the standard faunal sequence of the North American Upper Cambrian is discussed. It is proposed that the name of the time-stratigraphic unit characterized by this fauna be changed from Ptychopleurites zone to Irvingella major faunizone.

FAUNAL ZONE TERMINOLOGY

The writers adopt the faunal zone terminology discussed by Arkell in 1933 and by Moore in 1945 (pp. 312-315). The term faunizone is employed to designate strata deposited during the life span of an assemblage of organisms. Strata deposited during the life span of a particular genus or species form a biozone. An epible includes beds formed only during the time of greatest abundance of a particular species or genus.

The faunal zones set up as a standard for the North American Cambrian sequence (Howell et al., 1944, p. 994) comprise trilobite faunizones of two orders of importance: (1) strata containing vertically well-delineated assemblages of genera, e.g. the Elvinia zone; (2) strata characterized by the association of only two or three genera any of which may range vertically outside the limits of the zone, e.g. the Plethopeltis or Saukiella "zones."

The Cambrian correlation chart extends the names of certain faunizones beyond the geographical limits of occurrence of the characteristic fossil whose name the zone bears, if one or more other genera are common to the strata of the type area and the area under consideration. This is a relatively sound procedure when the faunas are well-delineated assemblages of the first order (such as the Cedaria, Crepicephalus, Aphelaspis, Elvinia and Conaspis faunas) but may lead to incorrect correlation when using small, poorly delineated associations (faunizones of the second order). For example, the Trempealeauian "zones" of the standard Croixian section are not discernible in collections made by Wilson from the Conococheague limestone of the central Appalachians, the key gen-
era of these small assemblages being mainly absent and only certain long ranging forms quite common.

It is possible that the attempt to make certain of these Cambrian faunal zones continent-wide in extent is partially obscuring important facts of faunal migration and facies or geographical control of trilobite faunas. Some detailed work already definitely indicates this possibility. Lochman (1948, p. 452) has indicated the facies equivalence in time of the Middle Cambrian Albertella and Kochaspis liliana zones and the Zacanthoides-Anoria and Glossopleura-Kootenia zones. Bridge (1937, p. 236) has suggested that possible facies equivalents of the Dikelocephalus zones exist outside of the Croixan siltstone lithology. It also seems probable that the large faunal assemblage of the Elvinia zone of the standard section is almost completely replaced in the eastern part of the central Appalachian trough by another group of trilobite genera thus far undescribed.

Considering the above facts the writers believe that Cambrian biostratigraphy is reaching a point of such refinement that zonal terminology as used within a province as large as North America should always connote the possibility of areal restriction. We emphasize the geographic significance of a faunizon. The unit should be extended only so far as its characteristic assemblage occurs. Further, this assemblage should possess regional geographical continuity. Minor facies faunas (e.g. reef inhabitants) might be expected to occur locally within its province, and tend to obscure the regional picture. These should be excluded from the faunizon.

Though controlled vertically and geographically by ecologic factors, the widespread distribution and short vertical range of most Upper Cambrian faunizones make them all-important units for purposes of correlation. Essentially their use in Cambrian biostratigraphy of North America has been, in practice, that of time-stratigraphic units.

**DEFINITION AND PAST USAGE**

The term “Ptychopleurites zone” has been used by Cambrian paleontologists in recent years to identify a few feet of strata characterized by a small assemblage of trilobite genera. The strata lie within the Franconian stage of North America; beds below them possess an Elvinia fauna and those above a Conaspis
fauna. Although the assemblage includes a species assigned in
the past to Ptychopleurites Kobayashi 1936, it is better char-
acterized by numerous trilobites belonging to species of Irving-
ella. The assemblage was originally recognized by Twenhofel,
Raasch, and Thwaites (1935, pp. 1703-1704) in shaly micace-
ous sandstone of the Franconia formation. It was termed the
Irvingella major fauna and described as including several
species of brachiopods and three undescribed trilobite genera.

Raasch (1939, pp. 91, 92, 115) describes the fauna as the
Ptychopleura or uppermost subdivision of the “Camaraspis
zone.” (The Wisconsin Camaraspis fauna is synonymous with
the Elvinia fauna of present usage. Ptychopleura, Kobayashi’s
original name, was a synonym and was replaced with Ptycho-
pleurites by Kobayashi in 1936.)

Dorf and Lochman (1940, pp. 545, 547) recognized the
“Irvingella major zone” in the columnar limestone of the Snowy
Range formation in southern Montana. Howell et al. (1944)
in the Cambrian correlation chart list the genera Ptycho-
pleurites, Irvingella, Berkeia, and Deadwoodia as constituents
of the “Ptychopleurites zone” and indicate its development in
numerous sections of the Rocky Mountains and mid-continent
areas of North America. Lochman and Duncan (1944, pp. 2,
13) use “Ptychopleurites zone” in the same sense, stating that
it is always present in the columnar limestone lithology of the
Snowy Range formation of Montana.

Wilson in 1948 added the genus Sulcocephalus to the faunal
assemblage and in 1949 (p. 30) lists this form with ‘Ptycho-
pleurites” and Irvingella from the middle Morgan Creek mem-
ber of the Wilberns limestone of Texas as constituents of his
“Irvingella subzone of the Elvinia zone.”

Frederickson (1948, p. 803) described the new species Pty-
chopleurites amplooculata and in 1949 (p. 356) added the genus
Kiowaia to the “Ptychopleurites zone.” Neither Frederickson
nor Wilson found the genera Berkeia and Deadwoodia in the
numerous exposures of this horizon in Oklahoma and Texas
although these are listed by Howell et al. (1944, p. 994) as
characteristics of the zone.

The present paper furnishes current information on genera
of the Irvingella major fauna and discusses the unit as a
time-stratigraphic division of the Upper Cambrian sequence
(table 1).
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Table 1

Relation of the Irvingella major faunizone to the Elvinia and Conaspis faunizones. The linear sequence of X’s mark the range of Irvingella and Eoorthis. Where the biozone and epibole correspond, small X’s are used.
Major Faunizone of the Upper Cambrian

The genus Ptychopleurites Kobayashi 1936.—Dr. W. A. Bell of the National Museum of Canada, Ottawa, Ontario, kindly furnished the writers with plaster casts of Kobayashi’s original material upon which Ptychopleurites brevisrjrons, the genotype, was founded. These show that Kobayashi’s illustrations of the species have been retouched to some extent. The material upon which the genus is founded is extremely poor. The holotype lacks palpebral lobes, the posterior limbs are incomplete and the paratype cannot be matched certainly with its illustration (Kobayashi, 1936, plate 21, fig. 8). The specimens were collected from a locality on the Alaskan-Yukon boundary in a section of dubious position in the Upper Cambrian faunal sequence. Kobayashi considered the genus to be as young as the Briscoia fauna and lists the new species Parabolinella ? punctolineata and Agnostus subobesus as associates. The genus Parabolinella may range from middle Franconian to high Trempealeauian (Lake 1906-1946, p. 63 reports Parabolinella with Dikelocephalus in Upper Lingula flags) but has never been found as low as the Elvinia fauna. Kobayashi’s agnostid species is stated to belong unquestionably to the Agnostus pisiformis var. obesus group. Westergard (1947, p. 4) states that this form ranges through most of the Olenus zone. This Atlantic province zone is generally considered middle Franconian in age (Howell and Lochman, 1939, p. 116). Thus while Kobayashi’s fauna may be as old as the Conaspis assemblage of North America, it also may be considerably younger. In either case, this fauna is definitely younger than the Irvingella major fauna.

The inclusion of Ptychopleurites in the Irvingella major fauna was based upon the generic assignment of what is now known as Ptychopleurites amplooculatus Frederickson. A comparison of actual specimens of this Franconian species with the genotype casts indicates some similarities but also differences which may be considered of generic importance (see discussion of Comanchia below).

Discussion of Genera of the Irvingella Major Fauna

As now constituted the Irvingella major fauna in the mid-continent region includes only the associated genera Irvingella, Sulcocephalus, Kiowaic and Comanchia (erected here for Ptychopleurites amplooculatus Frederickson).
Irvingella Walcott 1924 is by far the most common genus in the fauna and thus gives its name to the bio-stratigraphic unit characterized by this fauna. Although Resser described numerous species of Irvingella (1942, pp. 13-25), the writers consider most of these to be synonyms of Irvingella major based in large part on growth stages. The genus first appears with the typical Elvinia fauna but is much more common above it in association with Comanchia. It has been stated by Twenhofel et al. (1935, p. 1704), by Raasch (1939, p. 95), and by Howell et al. (1944, p. 994) that the genus Irvingella recurs above the Ptychaspis-Proasukia fauna of the Croixan area, but in the writers' experience this is not so; probably species of Chariocephalus or Drumaspis have been mistaken for those of Irvingella. In the U. S. National Museum collections in Washington, D. C. a slab is present from the Croixan region which contains Irvingella and certain conaspid species showing that unless specimens of the former genus have been reworked from the Ironton member, it may range up into the basal Conaspis fauna.

Sulcocephalus Wilson 1948. This genus is a persistent member of the assemblage. *S. candidus* (Resser) is known in the Irvingella coquina with Comanchia from six sections in the Llano Uplift of Texas (Baldy Mountain, Backbone Ridge, Threadgill Creek, Marble Falls-Burnet highway, Camp San Saba, and Sponge Mountain-Cold Creek (U.S.N.M. loc. 14b)). *Sulcocephalus benesulcatus* Wilson is known only from the Threadgill Creek section in a collection made by Dr. Virgil Barnes of the Texas Bureau of Economic Geology. It is as-

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**Explanation of Plate 1**


Figs. 4-5. *Sulcocephalus candidus* (Resser). Hypotype, dorsal and profile views of cranidium, X3, Morgan Creek member, Wilbern limestone, Baldy Mt., Llano Uplift, Texas.

Figs. 6-7. *Comanchia empiooculata* (Fredericksen). Holotype, dorsal and profile views of cranidium, X10, Honey Creek formation, Oklahoma.


Fig. 10. *Ptychopleurites bretifrons* (Kobayashi). Reproduction of Kobayashi's original illustration of the holotype of *P. bretifrons*, X10 (2½ x original illustration).
sociated with *Eoorthis* and *Irvingella* in a bed of glauconitic limestone. The Honey Creek limestone of Oklahoma has yielded a species of *Sulcocephalus*, originally described as "Berkeia" *sculptilis* by Resser in 1942 (p. 93, plate 16, figs. 1-4), but herein assigned to the genus *Sulcocephalus*. The genus is also present in the collections from Wisconsin in the Milwaukee Public Museum (M.P.M. no. 976) from 6 miles south of Grand Marsh, Wisconsin. It is associated with cranidia and pygidia of *Irvingella* and with *Comanchia*. *Sulcocephalus* is quite similar to the genus *Berkeia*, differing from this genus of the *Elvinia* fauna in possession of narrower fixed cheeks and a central posterior extension of the border. Quite probably this occasions the reference of *Berkeia* to the *Irvingella major* fauna in the Cambrian correlation chart (Howell et al., 1944).

*Kiowaia* Frederickson 1949 (p. 356). *Kiowaia timberensis* Frederickson, from the Honey Creek limestone of Oklahoma, is the only published species of this genus, but Gilbert O. Raasch (personal communication, dated December 9, 1949) has indicated its possible occurrence in the *Irvingella major* fauna of Wisconsin.

*Comanchia* Frederickson, n. gen. This monotypic genus was erected to include the species *Ptychopleurites amplooculata* Frederickson. This species has been described from the *Irvingella major* horizon in Texas and Oklahoma and has been reported as being present in the zone in Wisconsin (Raasch, 1939, p. 91). The genus as now known is confined to the *Irvingella major* faunizone.

**Geographic Distribution of the Irvingella Major Faunizone**

This assemblage is commonly found in the middle of the Morgan Creek limestone member of the Wilberns formation of the Llano Uplift in Texas and in the middle of the Honey Creek limestone of the Arbuckle and Wichita mountains of Oklahoma. Detailed information about local occurrences of the fauna in the southwest may be obtained from papers by the writers (1948 and 1949).

Dr. Gilbert O. Raasch of the Illinois Geological Survey has kindly furnished the writers with details of the areal distribution of the fauna in the Croixan region:

"... the fauna occurs only in a rather restricted area in central Wisconsin, including the counties of Adams, Juneau,
and northeastern Sauk. The faunal unit thins westward until it is less than an inch thick at a locality three miles north of Reedsburg, Sauk County. It has thinned to disappearance by the time the Goodenough Hill is reached, but specimens have been found in residual float on the high mound west of Point Bluff, north of Mauston, Juneau County.

"North of the Baraboo ranges in Sauk County, the zone seems to be continuous but only a few feet thick in Dellona Township (Section 10, 11, 23, 26) and in the northeast corner of Reedsburg Township (Sec. 1). It is not present by the time the city of Reedsburg is reached.

"In Adams County, east of the Wisconsin River, the unit thickens to exceed six feet in thickness at the shalepit in SE\(\frac{1}{4}\) of NW\(\frac{1}{4}\). Section 11, T 17N, R 7 E, near Pilot Knob, Adams County. Other localities in Adams County are Section 25; NE\(\frac{1}{4}\) of Section 11; SE\(\frac{1}{4}\) of Section 2, all in T 12 N, R 6 E; SE\(\frac{1}{4}\) of Section 25, T 16 N, R 6 E; and Friendship Mound at Adams Station."

According to Twnhofel, Raasch, and Thwaites (1935, p. 1699) the *Irvingella major* faunal assemblage occurs in fine-grained, micaceous sandstone and siltstones which, "overlie the Ironton with its typical fauna and lithology. The fossils indicate a closer relationship to the Ironton than to the overlying Goodenough, but the lithology is that of the basal Goodenough."

In general the *Irvingella major* faunizone is typically present in the Franconian stage of the mid-continent region. Collections from the Davis formation of Missouri do not show it, but no detailed stratigraphic paleontology has yet been done in the Upper Cambrian of this area.

Genera of the *Irvingella major* faunizone in the Rocky Mountain Cambrian sections are reported by Lochman and Duncan (1944, pp. 2, 3, 13) as always associated with the columnar limestone of the Snowy Range formation. However, numerous trilobites of the *Elvinia* fauna including *Kyphoecephalus*, *Deadwoodia*, *Burnetia*, *Cheilocephalus*, and *Dellea* were collected by Wilson from the columnar limestone in four sections of the Snowy Range formation of southern Montana and northern Wyoming (Mill Creek, Grove Creek, Shoshone Canyon, and Boysen in Wind River Canyon). No genera of the *Irvingella major* faunizone were found except *Irvingella* which
occurs through a thickness of 10 feet of strata above the Colenia major reefs (columnar limestone). Miller (1936, p. 31) states that Irvingella occurs about 15 feet above the Elvina fauna in the Wind River and Teton Mountains. It may be that the faunizone is represented immediately above the columnar limestone but as yet there is no positive evidence that the typical mid-continent assemblage of genera is present in the Rocky Mountains.

A study by Wilson on Franconian strata of the Central Appalachians failed to discover the Irvingella major faunizone. In the western Appalachian geosyncline of central Pennsylvania, the Ore Hill member of the Gatesburg formation generally contains about 40 feet of unfossiliferous dolomite in the stratigraphic position of the Irvingella major faunizone between the typical Elvina fauna in the basal strata and the Conaspis fauna in the upper beds. None of the genera of the Irvingella major assemblage were found in the Ore Hill except Irvingella which was present in the underlying Elvina fauna.

Considering the facts now at hand, therefore, it seems best to restrict the Irvingella major faunizone to the mid-continent region.

Vertical relations of the faunizone.—The wide geographic distribution of the Irvingella major faunizone in the mid-continent area is remarkable in view of its extreme thinness. In Oklahoma and Texas where it has been best studied to date, it occurs in less than 5 feet of beds. Thicknesses in the Croixian region have already been noted; the unit in central Wisconsin varies from 6 feet to a few inches in a westerly direction.

It is believed that over the mid-continent area the biozones of Comanchia, Sulcocephalus, and probably also Kiowaia always fall between the stratigraphic ranges of the Elvina and Conaspis trilobite faunas. The biozones of these genera coincide with the epibole of Irvingella.

Though in the writers' experience no proof exists of the mixing of trilobite faunas of the Irvingella major and Conaspis faunizones, Raasch (1939, p. 94 and in a personal communication) implies that such occurs through a few inches of beds in some Croixan sections. There is no evidence of mixing of the Irvingella major and Elvina faunas with the exception of Irvingella. These statements do not apply, however, to the brachiopod genera Eoorthis and Billingsella which span the
boundary between the faunizones discussed above, reaching their acme with the Conaspis fauna. In Wilson (1949, pp. 27-28) faunal lists containing misidentifications of two trilobites indicate a mixing of Irvingella major and Elvinia zone faunas which recollecting and inch-by-inch remeasurement of the Baldy Mountain, Backbone Ridge, Morgan Creek, and Camp San Saba sections of Texas have failed to substantiate.

The Irvingella major fauna shows a closer relation to the underlying Elvinia assemblage than to the overlying conaspid trilobites. This fact was recognized by Twenhofel, Raasch, and Thwaites (1935, pp. 1703-1704). Not only does the genus Irvingella, a typical member of the Elvinia fauna, reach its zenith in the beds containing the higher assemblage, but there is also a close relation between the older genus Berkeia and its possible descendant Sulcocephalus. Undescribed material from the Ore Hill limestone member of the Gatesburg formation in Pennsylvania indicates even closer kinship than does a comparison of the genotypes.

Genus Comanchia Frederickson, n. gen.

Cranidium with elongate appearance because of narrow posterior limbs. Glabella convex, quadrate, rounded anteriorly; three pairs of weak, oblique glabellar furrows; occipital furrow straight across center, bent forward and more deeply impressed at sides. Brim narrow, flat; border flatly convex, tapering slightly laterally, more than twice width of brim. Fixed cheeks narrow but expanded at palpebral lobes which are elevated and elongate, extending from position between first and second pair of glabellar furrows almost to occipital furrow; width of palpebral lobes equal to one-third glabellar width at midpoint; wide convex palpebral band separated from inner cheek by narrow furrow; faint ocular ridges present. Posterior limbs narrow, elongate, strap-like with narrow, deep marginal furrows. Free cheek not known.

Facial suture cutting anterior margin at center, curving out around border, then converging to palpebral lobe around which it curves gently; thence sharply outward at nearly right angles to axial line and around posterior limb to posterior margin.

Average cranidium very small, 31/2 mm. long, 5 mm. wide across posterior limbs. Surface of test minutely granular.
Genotype: Comanchia amplexoculata (Frederickson).

Remarks.—The genotype was originally assigned to the genus Ptychopleurites Kobayashi (Frederickson, 1948, p. 803), but at that time attention was called to the wider posterior limbs and small palpebral lobes of Kobayashi’s genotype. However, an examination of a plaster cast of Kobayashi’s original specimens shows that the palpebral lobes are not preserved at all, and that the posterior limbs are very poorly preserved, but apparently even wider than Kobayashi figured them.

Certain general similarities in the cranidium are apparent in comparing the two genera but the following generic differences exist:

1. Judging from the width of the posterior limbs, the palpebral lobes are apparently smaller and differently shaped in Ptychopleurites than in Comanchia.

2. The glabella of Ptychopleurites is much more convex, the dorsal furrow more deeply impressed, and the occipital lobe is narrower and more convex.

3. The posterior limb of Ptychopleurites, though poorly preserved, indicates a triangular shape, quite different than the strap-like limbs of Comanchia.

4. The border is narrower, very convex, and much more depressed laterally in Ptychopleurites.

Comanchia amplexoculata (Frederickson)

Plate 1, figures 6, 7


Remarks.—Both of the above descriptions are extensive and include several photographs of specimens of the species from Texas and Oklahoma.

References


Bridge, Josiah, 1937, The correlation of the Upper Cambrian sections of Missouri and Texas with the sections in the Upper Mississippi Valley; U. S. Geol. Survey Prof. Paper 186-J.
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