UTAH GEOLOGICAL AND MINERALOGICAL SURVEY

AFFILIATED WITH

THE COLLEGE OF MINES AND MINERAL INDUSTRIES

UNIVERSITY OF UTAH

SALT LAKE CITY, UTAH

LOWER ORDOVICIAN TRILOBITES FROM WESTERN UTAH AND EASTERN NEVADA

BY

LEHI F. HINTZE

Bulletin 48

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UTAH GEOLOGICAL AND MINERALOGICAL SURVEY

The Utah Geological and Mineralogical Survey was authorized by act of the Utah State Legislature in 1931; however, no funds were made available for its establishment until 1941 when the State Government was reorganized and the Utah Geological and Mineralogical Survey was placed within the new State Department of Publicity and Industrial Development where the Survey functioned until July 1, 1949. Effective as of that date, the Survey was transferred by law to the College of Mines and Mineral Industries, University of Utah.

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The Utah Geological and Mineralogical Survey has published maps, circulars, and bulletins as well as articles in popular and scientific magazines. For a partial list of such publications see the inside back cover of this publication and the preceding pages. For other information concerning the geological and mineralogical resources of Utah address:

ARTHUR L. CRAWFORD, *Director*

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CONTENTS

FOREWORD

Occasionally research flowers and brings forth fruit of unhoped-for excellence. The monograph designated Bulletin 48 of the Utah Geological and Mineralogical Survey is such a prize.

In a sense it is a by-product of the stratigraphic study by the same author reported in Bulletin 39 of this series. But to those familiar with the technical requirements of this specialized field of study, it will be at once apparent that Dr. Hintze has gone far beyond the "call of duty" in preparing this masterful contribution to the science of paleontology. His enthusiasm for his subject and his pride in accomplishment are clearly evident in the wonderful plates here shown and in the scholarship intrinsic throughout his discussions.

The sustained tedium and meticulous care which must be endured and are necessary to prepare such a beautifully illustrated and scientifically accurate monograph as this cannot be purchased for cash. They are available only on the basis of a labor of love.

As Director of the Utah Geological and Mineralogical Survey, I am happy that this organization had some part in the sponsorship of the research which produced such a praiseworthy result. I am proud that it can be published as one of our bulletins, but sorry that our limited budget prevents us from printing the text in a more attractive form, commensurate with the excellence of the plates which Dr. Hintze has prepared for us.

Arthur L. Crawford, Director

Utah Geological and Mineralogical Survey

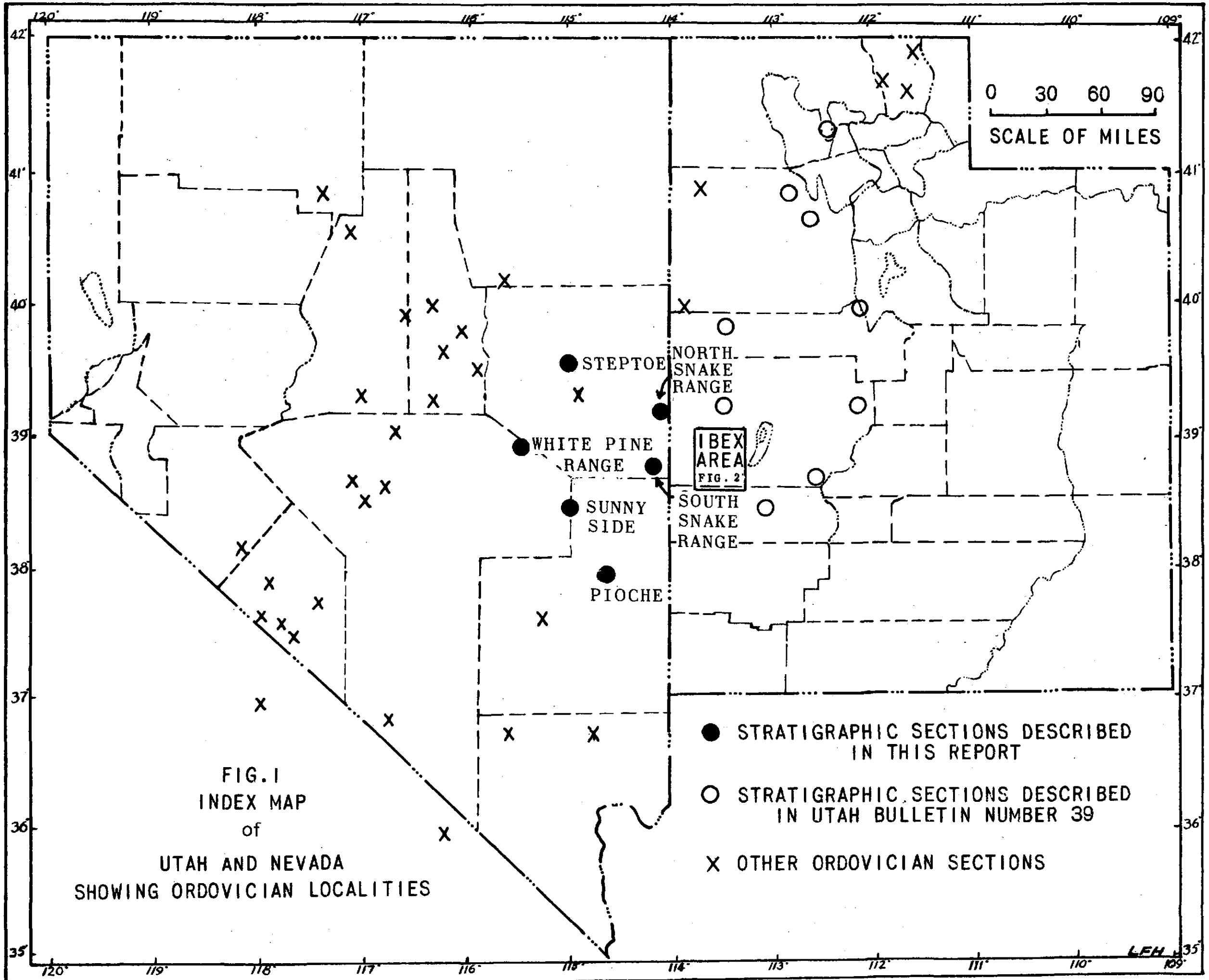

FIG. I
INDEX MAP
of
UTAH AND NEVADA
SHOWING ORDOVICIAN LOCALITIES

LOWER ORDOVICIAN TRILOBITES From WESTERN UTAH AND EASTERN NEVADA

By

Lehi F. Hintze[1]

ABSTRACT

Fifteen faunal zones are recognized in the Ordovician Pogonip group of west central Utah and eastern Nevada; the lower eleven zones are Canadian and the upper four are Chazyan. Zones are defined principally on the basis of trilobite assemblages although brachiopods and other forms are also listed. Faunal lists from western Utah and stratigraphic sections from six eastern Nevada localities are presented to evidence the zonation.

Fifty new species of trilobites are named; forty-two genera are represented on the plates, five of the genera (*Parabellefontia*, *Paranileus*, *Pseudonileus*, *Pseudoolenoides*, and *Trigonocercella*) being new.

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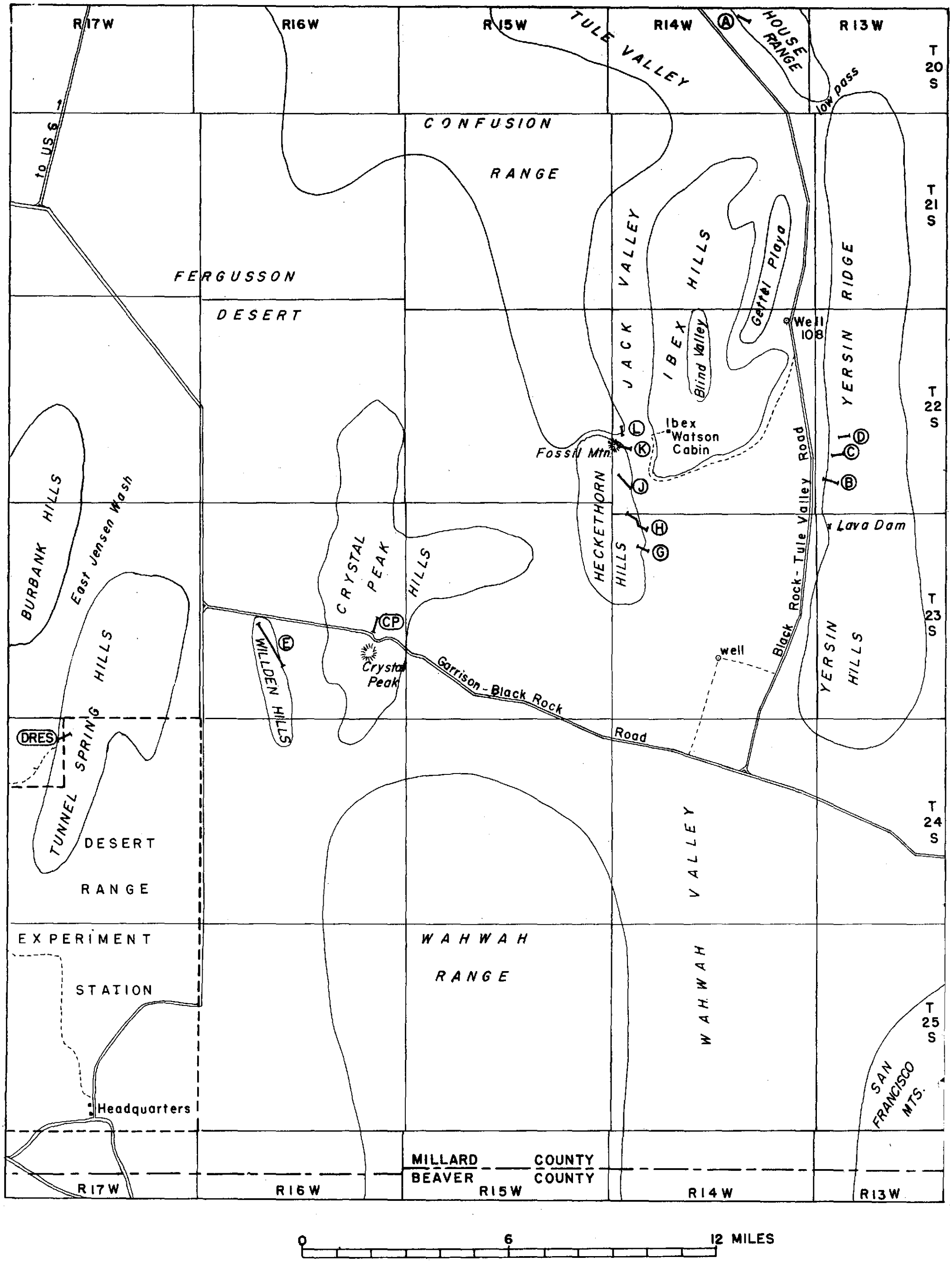

ORDOVICIAN STRATIGRAPHIC SECTIONS AND COLLECTING LOCALITIES: Ⓐ

FIG. 2. LOCALITY MAP OF IBEX AREA, MILLARD COUNTY, UTAH.

INTRODUCTION

This is the third in a series of closely related papers dealing with Ordovician stratigraphy and faunas in Utah and Nevada. The first two papers (Hintze, 1949, 1951) deal principally with stratigraphic sections in Utah; the present paper is principally concerned with the trilobite fauna but also presents six stratigraphic sections in eastern Nevada; a forthcoming paper will trace the Ordovician stratigraphy from central Utah and eastern Nevada into central Nevada (abstract, Hintze and Webb, 1950). The Ordovician rocks of central Nevada differ both in lithology and in faunas from those of eastern Nevada and Utah, and it was felt desirable to leave the discussion of correlations from Utah to central Nevada until the Utah sections and faunas had been adequately defined.

The field work began in the summer of 1947 in the Ibex area of west central Utah; the faunal collections were studied the following winter at Columbia University as the subject of the writer's Master's thesis (unpublished, June, 1948). Although cephalopods, gastropods, and brachiopods were found in the Pogonip group, the silicified trilobites were most diverse, and best suited for zoning purposes. Though many of the trilobites could be compared with described genera, specific comparisons were somewhat unsatisfactory; hence the fauna, for the most part, was undescribed up until that time. Field work continued during the summer months of 1948, 1949, and 1950; sections were examined throughout the Utah basin ranges from Salt Lake City southward, and westward to central Nevada. In the fall of 1948 the author was asked to summarize the Ordovician of Utah for the Utah Geological and Mineralogical Survey (Hintze, 1949); in the course of preparation of that manuscript, he learned that R. J. Ross, Jr., then a student at Yale University, was recognizing faunal zones similar to those in the Pogonip in his contemporaneous study of the Garden City formation of northeastern Utah. Ross' stratigraphic work and his trilobite descriptions have now been published (Ross, 1951), and a glance at the faunal lists of the Pogonip group will show that a great many of the species described by Ross from northeastern Utah are found in western Utah and eastern Nevada as well. In addition to figuring several of Ross' species identified in western Utah, the present paper describes 50 new species and subspecies, figures 42 genera, 5 of which are new.

ACKNOWLEDGMENTS

I am greatly indebted to Professor Marshall Kay of Columbia University for his constant interest and guidance. The writer has benefited immeasurably from a rather voluminous and enthusiastic correspondence with Dr. R. J. Ross Jr., which began in 1948 when it was discovered how many trilobites we shared in common. I am grateful to my wife, Ione, for assistance with the tedious task of preparing the trilobite plates for publication, to my friend and colleague in research, Mr. Robert C. Bright, for careful reading of the manuscript and final checking of the proof, and to Arthur L. Crawford for facilitating the work. It is a pleasure to acknowledge all of this aid but the writer alone assumes the responsibility for any shortcomings or mistakes. The study was made possible by financial support from the government under the veterans education program, by financial assistance from the Utah Geological and Mineralogical Survey, and by grants from the Kemp Memorial Fund of Columbia University, and from the General Research Fund of Oregon State College.

FAUNAL ZONES

The following zones are recognizable in the Pogonip group of western Utah and eastern Nevada:

O	_Eofletcheria_ zone
N	_Pseudoolenoides_ _acicaudus_ zone
M	_Pseudoolenoides_ _dilectus_ zone
L	_Orthis_ _subalata_ zone
K	_Hesperonomiella_ _minor_ zone
J	_Pseudocybele_ _nasuta_ zone
I	_Paranileus_ _ibexensis_ zone
H	_Trigonocerca_ _typica_ zone
G-2	_Protopliomerops_ _contracta_ zone
G-1	_Protopliomerops_ _celsaora_ zone
F	_Protopliomerops_ _superciliosa_ zone
E	_Tesselacauda_ zone
D	_Leiostegium_ - _Kainella_ zone
C	_Paraplethopeltis_ zone
B	_Symphysurina_ zone

The zones are defined by faunal assemblages rather than by the stratigraphic range of any species, and for convenience of reference have been assigned letter designations so as to correspond to those of Ross (1951, pp. 26-29) as nearly as possible. Ross'zone A was not recognized and is not used in the present report. Zones I and K of this report occupy similar positions in the zone sequence to corresponding zones of Ross, but inasmuch as the faunas listed for these zones are different from those listed by Ross it is not known that the Ross zones are the exact equivalents.

Zones B through K range from lowermost Ordovician to Upper Canadian; zones L to O are Chazyan. The uppermost zones, N and O, are younger than any reported from the Chazyan Swan Peak formation of northeastern Utah. Even younger Middle Ordovician faunas are known from central Nevada (Kirk, 1933, p. 33) but are not zoned in this report.

Upper Cambrian faunules have been obtained by the author in three localities in Utah and Nevada.

In southwestern Millard County, Utah, an uppermost Cambrian faunule from the Notch Peak limestone contained Euptychaspis, Eurekia, Stenopilus, Bowmania, and Monocheilus (Hintze, 1951, p.33). At Sunnyside, Nevada, Calvinella and Platycolpus were found in the Mendha limestone about 2000 feet below the Symphysurina zone. At Ninemile Canyon in the Antelope Range of central Nevada agnostid trilobites and Desmetia annectens (Walcott) were found about 900 feet below the Kainella zone. In each case the intervening beds were barren so that the Cambro-Ordovician boundry could be only tentatively placed at a convenient lithologic change. (See Frederickson, 1941, regarding this boundry.)

Symphysurina (B) zone.- (Table 1) This is one of the most persistent and easily recognized of the faunal zones. Symphysurina is characteristically very abundant but not restricted to this zone, occurring also in the next zone above according to Ross (1951, p.29). Bellefontia and Xenostegium, however, seem to be restricted to this lowest zone. The Symphysurina zone has been recognized by Ross at the base of the Garden City formation in northeastern Utah, and by Walcott (1924, p. 37) in the Mons formation of British Columbia where Symphysurina is reported to occur in the basal beds of Walcott's Kainella(Hungaia) zone and for about 1400 feet beneath. The assemblage resembles that of the Tribes Hill - Stonehenge of the East. Walcott (1884, pl. XII, figs. 4, 19) lists Symphysurina(Illaenurus) eurekensis as occurring with Apatokephalus finalis in the Eureka mining district of central Nevada. The Symphysurina zone is apparently of less vertical extent in central Nevada than in Utah, eastern Nevada and British Columbia. In the House limestone of western Utah the Symphysurina zone assemblage extends through over 300 feet.

It is probable that the Symphysurina zone could be subdivided on the basis of the range of certain trilobites. For example, Hystricurus lepidus and Symphysurina globocapitella seem to be restricted to the highest part of the zone, while Hystricurus

Table 1.- Symphysurina (B) zone faunules from the House limestone and equivalent beds.

	Plate No.	Localities* 1	2	3	4	5	6	7	8
<u>Bellefontia</u> <u>chamberlaini</u> Clark. .	IV	.	.	a	c	a	.	r	.
<u>Bellefontia</u> <u>ibexensis</u> Hintze. . .	IV	.	.	.	.	.	c	.	.
<u>Clelandia</u> <u>utahensis</u> Ross.	IV	.	.	c	.	c	.	.	.
<u>Geragnostus</u> sp.		.	.	.	.	.	.	.	c
<u>Hystricurus</u> <u>genalatus</u> Ross. . . .	VI	a	.	a	.	a	a	c	.
<u>H</u>. <u>lepidus</u> Hintze	VII	.	.	.	.	.	.	a	.
<u>H</u>. <u>millardensis</u> Hintze.	VI	.	c	.	.	.	.	.	.
<u>H</u>. <u>paragenalatus</u> Ross	VI	.	.	.	.	.	r	.	.
<u>H</u>. <u>politus</u> Ross	VI	r	.	.	.	a	a	.	.
<u>Parabellefontia</u> <u>concinna</u> Hintze .	III	.	.	c	.	.	.	.	.
<u>Pseudokainella</u> ? <u>armatus</u> Hintze .	V	.	.	.	.	.	.	r	.
<u>P</u>. ? sp. A Hintze	V	.	.	.	.	r	.	.	.
<u>P</u>. ? sp.		r	.	.	.	.	.	.	c
<u>Remopleuridiella</u> <u>caudalimbata</u> Ross	V	.	.	.	.	.	c	.	.
<u>Symphysurina</u> <u>brevispicata</u> Hintze.	III	.	a	.	.	.	.	.	.
<u>S</u>. <u>globocapitella</u> Hintze.	I	.	.	.	.	.	.	c	.
<u>S</u>. <u>uncaspicata</u> Hintze	II	.	.	.	c	.	.	.	.
<u>S</u>. cf. <u>S</u>. <u>cleora</u> (Walcott). . . .	II	r	a	.	.	.	.	.	a
<u>S</u>. cf. <u>S</u>. <u>spicata</u> Walcott		.	.	.	.	r	.	.	.
<u>S</u>. cf. <u>S</u>. <u>woosteri</u> Walcott. . . .		.	.	.	.	.	.	.	c
<u>Xenostegium</u> <u>franklinense</u> Ross . .	V	a	.	a	.	c	.	.	.
<u>Xenostegium</u> cf. <u>X</u>. <u>acuminferentis</u>	V	.	.	.	.	.	r	.	.
<u>Acrotreta</u> sp.		.	.	.	.	.	.	.	r
<u>Apheoorthis</u> cf. <u>A</u>. <u>melita</u>		.	c	.	.	.	.	.	.
<u>Lingulella</u> cf. <u>L</u>. <u>pogonipensis</u>. .		.	c	.	.	.	.	.	.
<u>Nanorthis</u> sp.		.	.	.	.	.	.	.	c
<u>Schizambon</u> sp.		.	.	.	.	.	.	.	c
<u>Ophileta</u> sp.		.	c	.	.	.	.	.	.

* a, abundant; c, common; r, rare. Localities: 1, Ibex, section A, locality A-7; 2, Ibex, section B, locality B-1; 3, locality B-12; 4, Ibex, section E, locality E-3A; 5, locality E-7; 6, locality E-10; 7, locality E-13; 8, White Pine Range, locality WP-1.

millardensis and Symphysurina brevispicata have been found only in the lower part of the zone. Further confirmation of these occurrences from other areas may make future subdivision of this zone useful.

Paraplethopeltis (C) zone.- (Table 2) In the Ibex area, Utah, the Paraplethopeltis zone is found near the top of the House limestone in a few thin layers of silty limestone which are crowded with the remains of unsilicified brachiopods of the genus Syntrophina and partially silicified trilobites tentatively assigned to the genus Paraplethopeltis.

Cloud and Barnes (1948, pp. 449, 454, pls. 38, 41) report the association of Paraplethopeltis with a Hystricurus species resembling H. lepidus within the upper 100 feet of the Staeneebach member of the Tanyard formation of Texas. They also report the occurrence of Syntrophina campbelli (Walcott) from within about 70 to 110 feet of the base of the overlying Gorman formation.

As noted under our discussion of the genus Paraplethopeltis below, the forms noted by Ross (1951) in the C zone of the Garden City formation are similar to the C zone forms from the Ibex area. In the author's study of Ordovician sections from central Utah to central Nevada, this zone was found only in the Ibex, Utah, area but may have been overlooked or concealed in other sections because of its thinness.

Table 2.- Paraplethopeltis (C) zone faunules from the House limestone.

	Plate No.	Loc.* 1	2	3
Hystricurus genalatus Ross	VI	c	.	.
Paraplethopeltis ? genacurvus Hintze . . .	VII	a	a	a
Paraplethopeltis ? genarectus Hintze . . .	VII	c	a	c
Syntrophina cf. S. campbelli (Walcott) . .		a	a	a

* a, abundant; c, common; r,rare. Localities: Ibex area, Utah, 1, loc. A-10; 2, loc. B-14; 3, loc. E-14.

Leiostegium - Kainella (D) zone.- (Table 3) The thickest sequence of Kainella-bearing beds known to the author occurs in the lower part of the Pogonip group in the Antelope Range of central Nevada, where Kainella ranges through over 500 feet of strata. Walcott (1924, p. 17) records the occurrence of Kainella through 168 feet of the Mons formation in British Columbia, but in eastern Nevada and in Utah the Kainella-bearing beds do not attain nearly such thicknesses, the fauna apparently being confined to less than 50 feet above the top of the Symphysurina-bearing beds. Recent collections from Ibex sections B and E, not included in the faunal lists below, have verified the presence of Kainella and Leiostegium manitouensis just above the Paraplethopeltis zone in western Utah. In addition to the Utah, Nevada, and British Columbia occurrences, Kainella has been noted from northern Argentina (Harrington, 1938, p. 258), from Colombia (Harrington and Kay, 1951, p. 656), and from boulders at Levis, Quebec (Rasetti, 1943, p. 101).

Table 3.- Leiostegium - Kainella (D) zone faunules

	Localities* 1	2
Apatokephalus finalis (Walcott)	.	r
Hystricurus sp.	r	.
Kainella sp.	.	a
Leiostegium manitouensis Walcott. . . .	c	r
Pseudoclelandia sp.	c	.
Apheoorthis ? sp.	c	.
Nanorthis cf. N. hamburgensis (Walcott)	.	c
Schizambon sp.	.	c
Syntrophina sp.	c	.

* a, abundant; c, common; r, rare. Localities: 1, White Pine Range, locality WP-2; 2, Sunnyside, Nevada section, locality Su-3.

Tesselacauda (E) _zone_.- (Table 4) This zone was first reported by Ross (1949,1951) from the Garden City formation of northeastern Utah. In the present study it has been found in the Fillmore limestone of western Utah, where it occurs in beds of intraformational conglomerate. During deposition of these beds the trilobite tests were subjected to much comminution resulting in unidentifiable trilobite hash, but a few beds yield identifiable remains. The _Tesselacauda_ zone of western Utah differs from Ross' zone E in relative abundance of certain forms (Ross, personal communication) and in the fact that _Hillyardina_, a genus noted by Ross only from zone F, is found here in the _Tesselacauda_ zone as well. In the Ibex, Utah, sections the _Tesselacauda_ zone extends through about 75 feet of beds.

Table 4.- _Tesselacauda_ (E) zone faunules from the Fillmore limestone.

	Plate No.	Localities* 1	2	3	4
Amblycranium variabile Ross.		.	.	r	.
Hillyardina sp.	VIII	c	c	.	.
Hystricurus sp. C Ross	VI	c	.	.	c
H. robustus Ross	VIII	.	.	c	.
_H._ cf. _H. oculilunatus_		r	.	.	.
Leiostegium formosa Hintze	VIII	.	c	.	.
Pseudoclelandia aff. _fluxafissura_.	IV	c	.	.	.
Pseudohystricurus sp.		.	.	.	r
Tesselacauda aff. _T. depressa_ Ross	XXI	r	c	.	r
Pilekia ? _trio_ Hintze.	XXI	.	.	c	.
Pilekia ? sp.		.	r	.	.
undet. pygidia pl. VIII, fig.12,13	VIII	.	r	.	r
Syntrophina ? sp.		.	c	.	.

* a, abundant; c, common; r, rare. Localities: 1, Ibex, section C loc. C-5; 2, C-6; 3, Ibex, section E, loc. E-17; 4, Ibex, section G, loc. G-3.

Protopliomerops superciliosa (F) zone.- (Table 5) More than one-third of the species listed by Ross (1951, pp. 28-29) for zone F in the Garden City formation of northeastern Utah have been found in the Fillmore limestone of western Utah where the fauna is found through about 80 feet of predominantly intraformational conglomerate in which most of the trilobite remains have been broken beyond recognition during deposition. A new species, Parahystricurus bispicatus, is recognized from this zone.

Table 5.- Protopliomerops superciliosa (F) zone faunules from the Pogonip group.

	Plate No.	Loc.* 1	2	3
Amblycranium cornutum Ross		.	.	r
Goniophrys prima Ross	XX	r	r	c
Hillyardina cf. H. semicylindrica .		.	c	c
Hillyardina sp. A Hintze.	VIII	r	r	.
Hyperbolochilus marginauctum Ross .		.	.	r
Hystricurus contractus Ross		.	r	.
Hystricurus oculilunatus Ross . . .		c	c	.
Licnocephala ? sp.	VIII	.	r	.
Parahystricurus aff. P. fraudator .	VIII	.	r	c
Parahystricurus bispicatus Hintze .	VIII	.	r	.
Parahystricurus sp.		r	.	.
Protopliomerops superciliosa Ross .		.	.	c
Protopliomerops sp. 5 Hintze. . . .	XXI	.	r	.
unassigned pygidium pl. VIII, 11. .	VIII	r	r	c

* a, abundant; c, common; r, rare. Localities: 1, Scipio, Utah, locality Sc-3 (Hintze, 1951, p. 79); 2, Ibex, section G, locality G-5; 3, Garden City formation, west side of Promontory Point, Great Salt Lake, Utah, 142 feet above base of exposed section (Hintze, 1951, p. 95)

Protopliomerops _celsaora_ (G-1) _zone_.- (Table 6) In the Fillmore limestone of western Utah the trilobite, _Asaphellus_ ? _quadrata_ is so abundant in some beds as to comprise matted trilobite hash. This same species was also found 170 miles to the north of Promontory Point (listed as "Megasaspidiella n. sp." in Hintze, 1951, p. 95), but it does not appear to be so abundant in northeastern Utah. On the other hand, _Menoparia_ _genalunata_ is much more abundant in the G zones in northeastern Utah than in western Utah. _Protopliomerops_ _celsaora_ seems most useful as an index to this zone for, although not as abundant as the asaphids are here, it appears to be of more universal distribution. The _Protopliomerops_ _celsaora_ zone is at least 240 feet thick in western Utah.

Table 6.- _Protopliomerops_ _celsaora_ (G-1) zone faunules from the Fillmore limestone.

	Plate No.	Localities* 1	2	3	4	5
Asaphellus ? _quadrata_ Hintze. .	XVI	a	a	a	a	.
Jeffersonia ? sp. B Hintze. . .	IX	.	.	.	r	.
Menoparia _genalunata_ Ross . . .		c	r	c	c	.
Parahystricurus sp.		.	r	.	.	.
Protopliomerops _celsaora_ Ross .	XXII	.	.	.	.	c
_P_. _firmimarginis_ Hintze	XXII	.	c	.	.	.
_P_. _aemula_ Hintze.	XXII	.	.	a	c	.
Psalikilus _spinosum_ Hintze. . .	IX	r	.	c	a	.
Psalikilus sp.		.	c	.	.	.
Undet. gen. and sp. A Hintze. .	XIII	.	.	.	r	c
unassigned pygidium	IX	.	.	.	.	r
unassigned pygidium	XX	.	.	.	r	.
Dictyonema sp.		r	.	.	.	.
Hormotoma-like gastropod. . . .		.	r	.	r	.

* a, abundant; c, common; r, rare. Localities: 1, Ibex, section C, locality C-11; 2, locality C-13; 3, Ibex, section D, locality D-3; 4, Ibex, section G, locality G-8; 6, locality G-9.

Protopliomerops contracta (G-2) *zone*.- (Table 7) As in the preceding zone a representative of the genus "*Asaphellus* ?" is the most abundant fossil in this zone in western Utah. Other trilobites are also of interest. *Protopliomerops* most commonly appears with five pairs of pleural spines on the pygidium. However, this zone apparently represents a period of experimentation for the genus, for pygidia have been found with from three pairs to seven pairs of spines. Unfortunately the association with cranidia is not yet definitely known so that we cannot yet tell whether these are each individual species or whether they are variations of the same species of *Protopliomerops*.

This zone marks the earliest appearance yet recorded for the genus *Kirkella*, a useful guide to this and succeeding zones H, I, and J. Another cosmopolitan trilobite of interest is *Carolinites*, which apparently derives from *Goniophyrs* of a lower zone. This genus, which ranges into the Chazyan *Pseudoolenoides dilectus* zone, is noted in the *Protopliomerops contracta* zone for the first time.

Ross (1951, p. 28) has subdivided his G-2 zone into five subzones, but such subdivisions are not recognizable in western Utah. However, on the basis of two species of *Psalikilus* it appears possible to recognize an upper (*P. paraspinosum*) G-2 zone and a lower (*P. typicum*) G-2 zone.

Although not shown in either table 6 or 7 because it is not known to which of the G zones it belongs, the genus *Bolbocephalus* deserves notice because it enables correlation with the Ozark section and with other areas. Also useful in this regard is the genus *Jeffersonia*. Ross (1951, p. 76) notes that his *J. peltabella* of zone G-2 is so close to *J. missouriensis* Cullison that a correlation with the Rich Fountain formation of the Ozarks is suggested.

The *Protopliomerops contracta* zone is at least 400 feet thick in the Fillmore limestone of the Ibex, Utah, area.

Table 7.- Protopliomerops contracta (G-2) zone faunules from the Fillmore limestone.

	Plate No.	Localities* 1	2	3	4	5	6	7	8
Asaphellus ? venta Hintze	XVI	a	.	.	.	a	.	c	.
Carolinites sp. A Hintze	XX	.	r	.	.	.	.	.	.
Hystricurus ? sp.	VI	.	.	.	.	.	.	.	r
Jeffersonia sp. A Hintze	X	.	.	.	a	.	.	.	.
Kirkella fillmorensis Hintze	XIV	.	.	r	.	.	.	c	.
Licnocephala bicornuta ? Ross		.	.	r	.	.	.	.	.
Licnocephala ? cavigladius Hintze	X	.	.	.	c	.	.	a	.
Menoparia genalunata Ross		.	.	.	.	c	.	.	.
Protopliomerops aff. contracta Ross	XXII	c	c	r	.	r	.	a	.
P. sp. 6 Hintze	XXII	.	.	.	.	r	.	.	.
P. sp. 4 Hintze	XXI	.	r	.	.	.	.	.	.
undet. pliomerid pygid. 3pr. spines.		.	.	.	.	.	r	.	.
undet. pliomerid pygid. 7pr. spines.		r	.	.	.	.	.	.	.
Protopliomerops ? quattuor Hintze	XXI	.	.	.	.	.	c	.	.
Psalikilus paraspinosum Hintze	IX	.	.	.	.	.	.	c	c
Psalikilus typicum Ross	IX	r	.	.	c	r	c	.	.
Pseudonileus willdeni Hintze	XV	.	.	.	.	.	.	r	.
undet. gen. and sp. B Hintze	XIII	.	.	.	c	r	c	.	.
undet. gen. and sp. C Hintze	IX	.	.	.	.	r	c	.	.
undet. gen. and sp. pl. XIX, fig. 11.	XIX	.	.	.	.	.	.	.	r
unassigned pygidium pl. XV, fig. 18.	XV	r	.	.	.	.	.	.	.
unassigned pygidium pl. XX, fig. 14.	XX	.	.	.	r	.	r	.	.
Nanorthis ? sp.		.	a	.	.	.	a	.	.
Syntrophina ? sp.		r	.	.	.	.	.	.	.
Endoceras sp.		r	.	.	r	.	.	.	.
Dictyonema sp.		.	.	.	r	.	.	.	.
Didymograptus ? sp.		.	.	.	r	.	.	.	.

* a, abundant; c, common; r, rare. Localities: 1, Ibex, section D, localities D-8 and D-9; 2, locality D-11; 3, locality D-12; 4, Ibex, section G, locality G-12; 5, locality G-13; 6, locality G-14; 7, locality G-17; 8, Ibex, section H, locality H-7.

Trigonocerca typica (H) *zone*.- (Table 8) This zone is named for its most abundant trilobite, prominent in almost every section examined in Utah and eastern Nevada. Because of its smooth and rugged construction the pygidium of *Trigonocerca* was able to withstand the rigors of burial in the Fillmore limestone intraformational conglomerates. Where accompanying trilobites are silicified a prolific fauna can be recovered from this zone. The *Trigonocerca typica* zone marks the earliest noted occurrence of the genera *Dimeropygiella*, *Pseudocybele*, and *Paranileus*, the last-named significant as the earliest known trilobite with the forked hypostome.

The *Trigonocerca typica* zone extends through at least 225 feet of beds in the type locality at Ibex section H, Utah.

Paranileus ibexensis (I) *zone*.- (Table 9) This zone is best developed in the upper Fillmore limestone in section H at Ibex, Utah. Several of the trilobite genera, namely *Carolinites*, *Isoteloides*, *Kirkella*, and *Paranileus*, show only slight modifications in form or proportion from other species of the same genera in the overlying or underlying zones. Ross'(1951, p. 28) faunal zone I and the *Paranileus ibexensis* zone of this report occupy the same position in the sequence of zones but have only *Hesperonomia* sp., *Diparelasma* sp., and *Goniotelus* sp. in common. Although this cannot be regarded as conclusive evidence that the two are equivalent zones, they are at least nearly so. In the type locality at Ibex, section H, the *Paranileus ibexensis* zone extends through at least 125 feet.

Pseudocybele nasuta (J) *zone*.- (Table 10) This is one of the most prolific and persistent of the faunal zones, extending throughout Utah and Nevada. It is probably the zone that Kirk (1934, pp. 454-56) referred to as the "*Taffia* zone", noting *Kirkella* ("*Asaphus curiosus*") as a guide to the zone. Inas-

Table 8.- Trigonocerca typica (H) zone faunules from the Pogonip group.

	Plate No.	Localities* 1	2	3	4
Carolinites genacinaca nevadensis. .	XX	.	.	c	a
Dimeropygiella blanda Hintze	XIX	r	a	.	.
Dimeropygiella ovata Hintze.	XIX	.	a	.	.
Isoteloides sp.		.	.	.	r
Goniotelus sp.		.	c	.	.
Jeffersonia ? sp.		.	c	.	.
Kirkella accliva Hintze.	XV,XIV	.	c	c	c
Paranileus elongatus Hintze.	XII	.	c	c	.
Paranileus cf. P. ibexensis Hintze .		.	.	.	r
Protopliomerops ? quattuor Hintze. .	XXI	.	r	.	.
Protopliomerops sp. 4 Hintze	XXI	.	r	r	.
Psalikilus pikum Hintze.	IX	r	.	.	.
Pseudocybele altinasuta Hintze . . .	XXIV	r	r	.	.
Pseudocybele lemurei Hintze.	XXIV	c	c	c	c
Trigonocerca typica Ross	XI	a	a	c	.
T. typica piochensis Hintze.	XI	.	.	.	a
undet. gen. and sp.	XIX	.	r	.	.
unassigned pygidia	IX,XXI	.	r	.	.
Diparalasma sp.		.	c	.	.
Trematorthis sp.		.	c	.	.
Bellerophon-like steinkerns.		.	c	.	.
Euomphalus ? sp.		.	c	.	.
Catoraphiceras sp.		.	r	.	.
Endoceras sp.		r	.	.	.
sponge ?		c	.	.	.

* a, abundant; c, common; r, rare. Localities: 1, Ibex, Utah, section H, localities H-18 and H-19; 2, locality H-20; 3, locality H-24; 4, locality YH-16A, near top of Yellow Hill, Ely Springs Range, near Pioche, Nevada.

much as _Kirkella_ occurs in three zones beneath the _Pseudocybele nasuta_ zone, the "_Taffia_ zone" of Kirk and the "_Asaphus curiosus_" zone of others cannot be regarded as exact equivalents of this zone except where other elements of the fauna would so indicate. The most common fossil in the _Pseudocybele nasuta_ zone in Utah is _Lachnostoma latucelsum_. Three trilobites, _Cybelopsis_, _Pseudomera_, and _Isoteloides_ are remarkably like species described by Poulsen from northern Greenland.

The _Pseudocybele nasuta_ zone extends through the lower 130 feet of the Wahwah limestone at Ibex, Utah, and is at least this thick at Sunnyside, Nevada.

Table 9.- _Paranileus ibexensis_ (I) zone faunules from the upper Fillmore limestone.

	Plate No.	Localities* 1	2	3
Bathyurellus ? sp.	X	.	r	.
Carolinites genacinaca Ross . . .	XX	c	c	r
Goniotelus ? sp.		.	r	r
Isoteloides flexus Hintze	XVII	c	c	.
Kirkella accliva Hintze	XIV,XV	r	.	.
Kirkella yersini Hintze	XIV	.	a	a
Paranileus ibexensis Hintze . . .	XII	c	a	c
Pseudocybele altinasuta Hintze. .	XXIV	.	.	r
Pseudocybele lemurei Hintze . . .	XXIV	a	a	c
Hesperonomia sp.		c	.	.
Syntrophina ? sp.		.	.	r
Bellerophon-like steinkerns . . .		.	.	r
Endoceras sp.		.	r	.
Phyllograptus sp.		.	r	.
sponge ?		a	.	.

* a, abundant; c, common; r, rare. Localities: 1, Ibex, Utah, section H, locality H-25; 2, locality H-28; 3, locality H-29.

Table 10.- *Pseudocybele nasuta* (J) zone faunules from the Pogonip group.

	Plate No.	1	2	3	4	5	6	7
"*Barrandia* ? sp." Walcott	XXVI			r				
Benthamaspis diminutiva Hintze	XIII			c				
Carolinites genacinaca Ross	XX		r	c		c		
Cybelopsis cf. *C. speciosa* Poulsen	XXV	c		c			r	c
Dimeropygiella caudanodosa Ross	XIX			a	a		c	c
Goniotelus brighti Hintze	XXVI			a				
G. brevus Hintze	XXVI			c				
G. wahwahensis Hintze	XXVI				c			
G. sp. D Hintze	XXVI				r			
Isoteloides polaris Poulsen	XVII		c	r				
Isoteloides ? *genalticurvatus* Hintze	XVII					c		
Kawina ? *sexapugia* Ross	XXI			r				
Kawina ? *webbi* Hintze	XXI					r		
Kirkella declivita Ross	XV			c		c		r
K. cf. *K. vigilans* (Whittington)	XV		a					
Lachnostoma latucelsum Ross	XVIII	c	a	a	c	a		c
Paranileus utahensis Hintze	XII		c					
Paranileus sp.	XIII			r		c		
Pseudomera cf. *P. insolita* (Poulsen)	XXIII	r		r			c	c
Pseudocybele nasuta Ross	XXIV		c	a	c		c	r
Trigonocercella acuta Hintze	XI		c					
unassigned pygidium pl. XV, fig. 19	XV					r		
Diparalasma sp.				r				
Hesperonomia cf. *H. dinorthoides*		c		c				c
Tritoechia sinuata Ulrich & Cooper				r				r
Bellerophon-like sp.				r				
Lesuerilla ? sp.							c	
Raphistomina sp.			r	c				
Campbelloceras ? sp.							r	
Catoraphiceras sp.				r				
Endoceras sp.								r
Zittelella cf. *Z. clarae* Howell						r		
bryozoa ?				c				
cystid plates							r	c

*a, abundant; c, common; r, rare. Localities:1, Scipio, Utah,locality Sc-7(Hintze, 1951, p. 78); 2, Ibex,Utah, section J,localities J-1 and J-2; 3, locality J-8; 4, locality J-12; 5, locality J-13; 6, localities J-14 and J-15; 7, Sunnyside, Nevada, locality S-17.

Hesperonomiella minor (K) *zone*.- In the upper Wahwah limestone, in the Ibex, Utah, area, a one-foot bed, crowded with the valves of *Hesperonomiella minor* (Walcott), serves as a useful marker horizon. The brachiopod valves are not silicified and are softer than the silty limestone matrix in which they occur, and good specimens are hard to find. The only other fossils common in this bed are gastropod steinkerns of *Lophospira* and *Lytospira*-like aspect. The *Hesperonomiella minor* zone occurs also in the Kanosh, Utah, section (Hintze, 1951, p. 81). This zone has yielded none of the forms noted by Ross (1951, p. 27) from his faunal zone K, but it occupies a similar stratigraphic position and is probably nearly equivalent.

Orthis subalata (L) *zone*.- The collection from Ibex, Utah, section J, locality J-17, typifies the sparse fauna of this zone in the Juab limestone:

Eleutherocentrus sp.
Parapilekia ? sp.
Pseudomera sp. indet.
Orthis aff. *O. subalata* Ulrich and Cooper

None of the fossils in the Juab limestone have been found silicified and preservation is so poor that specific identification of the trilobites was not possible. This zone bears the earliest noted occurrence of *Orthis* (s.s.) *Orthis subalata* specimens from the Ibex locality are similar in size and shape to the type material from northern Utah, figured by Ulrich and Cooper (1938), but differ in that the Ibex specimens have four or five less costae and the remaining costae are consequently spaced slightly wider. *Orthis subalata* is the most common fossil in the Juab limestone, but is nowhere as abundant as the orthid, *Orthambonites michaelis* (Clark), in the overlying M zone.

Orthis aff. *O. subalata* is the only fossil common to both western Utah and zone L of northern Utah as listed by Ross (1951, p. 27). Ross (p. 31) regards this zone as basal Chazyan.

Pseudoolenoides dilectus (M) zone.- (Table 11) The upper beds of the Pogonip group are so abundantly fossiliferous in comparison to the lower beds that most faunas listed in earlier reports are from the upper Pogonip. In the Kanosh shale of western Utah, Orthambonites michaelis (Clark), and less commonly Anomalorthis utahensis Ulrich and Cooper, are so abundant in some layers of rock as to comprise a shell-rock, as does also the ostracod, Macronotella. Two faunal zones are recognized in the Kanosh shales and the overlying Lehman formation. The lower, Pseudoolenoides dilectus, zone extends from the base of the Kanosh shale upward through about 300 feet of beds in the Ibex area. The upper, Pseudoolenoides acicaudus, zone occurs in the upper Kanosh shales and in the Lehman formation. The Pseudoolenoides dilectus zone is completely exposed at Ibex, section K, but a more readily accessible exposure of the upper beds of this zone is at the Crystal Peak section.

The Pseudoolenoides dilectus zone is characterized by two other trilobites in addition to the one which name it bears: namely, Bathyurellus pogonipensis n. sp. and Pseudomera kanoshensis n. sp.

This zone is correlated with Ross'(1951, p. 27) zone M, the uppermost faunal zone in the Swan Peak formation of northern Utah. Pseudoolenoides dilectus is listed by Ross as "Symphysurus ? goldfussi" Walcott.

Pseudoolenoides acicaudus (N) zone.- (Table 12) The best place to examine this zone is at the Crystal Peak, Utah, section (Hintze, 1951, p. 68) in the upper Kanosh shale and overlying Lehman formation. The most prolific fossil is the bean-sized ostracod Leperditia which, although common in earlier zones, is most abundant in zone N. The trilobites Illaenus utahensis n. sp., Kawina ? unicornica n. sp., and Nieszkowskia ? sp. give an aspect to this fauna younger than any from the Swan Peak formation in northeastern Utah, and, except for being somewhat smaller in size, are almost identical to forms from

Table 11.- *Pseudoolenoides dilectus* (M) zone faunules from the upper Pogonip group.

	Plate No.	Localities* 1	2	3	4	5	6	7	8
Bathyurellus pogonipensis Hintze .	X	.	a	a	c	a	c	c	c
Carolinites killaryensis utahensis	XX	.	.	.	.	c	.	.	.
Cybelopsis sp. (large)	XXV	.	.	.	.	.	r	.	.
Eleutherocentrus cf. *E. petersoni*.		.	.	.	.	.	c	.	.
Eleutherocentrus sp.		.	r	.	r	.	.	.	.
Goniotelus ? *ludificatus* Hintze. .	XXVII	c	.	.	.	c	.	.	.
Pseudomera kanoshensis Hintze. . .	XXIII	r	r	c	c	a	.	c	.
P. cf. *P. barrandei* (Billings) . .		.	.	.	r	.	.	.	.
Pseudoolenoides dilectus Hintze. .	XXVII	.	a	c	r	c	c	a	.
Leperditia sp.		.	c	a	.	.	c	.	.
Macronotella ? sp.		a	.	.	.	.	.	c	.
Acrotreta ? sp. (large).		.	.	c	.	.	.	.	.
Anomalorthis utahensis Ulrich & Cooper		r	.	.	r	.	.	.	.
Lingula sp.		.	.	.	r	.	.	.	.
Orthambonites michaelis (Clark). . . .		.	.	c	a	.	.	c	.
Bellerophon-like sp.		.	.	.	r	.	.	.	.
n. gen. near *Maclurites carinatus*. . .		.	.	r	r	.	.	.	.
Endoceras, large and small species . .		.	.	.	r	.	.	.	.
Receptaculites mammillaris Walcott . .		.	c	.	.	.	.	.	c
Receptaculites elongatus Walcott . . .		.	.	.	.	.	.	.	r
bryozoa, spherical and branching . . .		c	.	.	.	.	.	.	.
cystid plates and calcite balls. . . .		c	r	.	c	.	.	c	.

*a, abundant; c, common; r, rare. Localities: 1, Ibex, Utah, section J, locality J-18; 2, locality J-22; 3, locality J-23; 4, locality J-26; 5, Ibex, section K, locality K-1; 6, locality K-1A; 7, Crystal Peak, Utah, locality CP-5; 8, White Pine Range, Nevada, localities WP-6 and WP-7.

Table 12.- _Pseudoolenoides_ _acicaudus_ (N) zone

	Plate No.	Localities* 1	2	3	4	5
Barrandia ? sp.		c	r	r	c	.
Cybelopsis sp. (large)	XXV	.	r	.	c	r
Illaenus _utahensis_ Hintze. . .	XXVIII	.	a	c	.	.
Kawina ? _unicornica_ Hintze . .	XXVIII	.	c	.	.	.
Nieszkiwskia ? sp.	XXVIII	.	r	r	.	.
Pseudoolenoides _acicaudus_. . .	XXVII	.	c	r	.	c
Leperditia sp.		a	a	a	c	c
Anomalorthis sp.		.	c	.	c	.
Lingula sp.		.	r	.	.	.
Orthis ? sp.		.	c	c	.	c
Kirkina _millardensis_ Salmon.		.	.	.	.	c
Modiolopsis ? sp.		c	.	.	.	.
Hormotoma-like sp.		.	r	r	.	.
Lecanospira-like sp.		.	c	c	.	.
Maclurites sp.		.	c	.	.	.
Endoceras sp.		c	.	.	.	.
Trocholites ? sp.		c	r	.	.	.
bryozoans, spherical and branching .		.	r	r	c	.

* a, abundant; c, common; r, rare. Localities: 1, Ibex, Utah, section K, localities K-6 and K-7; 2, Crystal Peak, Utah, locality CP-1; 3, locality CP-40; 4, White Pine Range, Nevada, locality WP-9; 5, "Point of Rocks, Millard County, Utah" of E.S. Salmon, 1942, Jour. Paleo., vol. 16, p. 600. No such locality is now known among the residents of Millard County, and efforts of the present author to trace the exact collecting locality have not been successful. The collection, according to its label, was made by O. A. Kennedy in 1896, and it was subsequently acquired by A. W. Grabau for Columbia University.

the well known Ike's Canyon sponge locality, Toquima Range, central Nevada.

The "Symphysurus goldfussi" associated with Kirkina millardensis of Salmon(1942, p. 600) is definitely Pseudoolenoides acicaudus (see plate XXVII, and table 12, locality 5), and the "Pliomerops nevadensis" of Salmon is the large Cybelopsis sp. of this paper, based on reexamination of the Columbia University collection from "Point of Rocks, Millard County, Utah". Kirkina has been found elsewhere by the present author only in eastern Nevada at the South Snake Range section as described in the following pages.

Eofletcheria (O) zone.- This zone is found within the Dolomite member or just beneath in the upper Lehman formation from Ibex, Utah, to White Pine Range, Nevada. At Ibex, Eofletcheria was not found, but a fauna consisting largely of unidentifiable gastropod impressions in the Dolomite member (Hintze, 1951, p. 21) there is probably equivalent. Near Crystal Peak, a few miles southwestward from Ibex, a two-foot Eofletcheria biostrome is present in the Dolomite member; in the Desert Range Experiment Station section (Hintze, 1951, p. 74) the Eofletcheria reef is about three feet thick in the Dolomite member, and a brachiopod fauna was collected by G. W. Webb of Columbia University in the immediate vicinity of the reef.

In the South Snake Range section, Eofletcheria was found in float blocks in the upper part of the Lehman formation. Orthids and other brachiopods collected by Webb from the uppermost Lehman beds just beneath the Dolomite member at Sunnyside, Nevada, may be found to pertain to this zone. At the White Pine Range, Nevada, a one and one-half foot Eofletcheria biostrome near the top of the Lehman formation has associated orthid brachiopods and poorly preserved high-spired gastropods.

FAUNAL LISTS

The following faunal lists (Ibex, Utah, sections A,B,C,D,E,G,H,J, and K, and Crystal Peak, Utah, section) were originally published in Bulletin 39 (Hintze, 1951) wherein many of the then unpublished new species were given temporary designations such as "n. sp. a". Inasmuch as these particular faunal lists pertain to the localities from which came most of the figured specimens of the present paper it was felt desirable to recheck these faunules and list the forms using the new names of the present paper. The footage at which the collections were taken is shown in parentheses following the collection number; thus the interval between collections can easily be computed. Such footages are cumulative only for each individual section. Lithologies and correlations between sections are explained in Bulletin 39 to which the reader interested in such matters is referred.

Relative abundance of forms is indicated in the lists: (a), abundant; (c), common; (r), rare.

IBEX SECTION A FAUNULES:

A-10 (466') *Paraplethopeltis* ? *genacurvus* Hintze (a)
Paraplethopeltis ? *genarectus* Hintze (a)
Hystricurus genalatus Ross (c)
Syntrophina cf. *S. campbelli* Walcott (a)

A-9 (450') *Bellefontia ibexensis* Hintze (c)
Hystricurus genalatus Ross (a)
Hystricurus politus Ross (a)
Symphysurina globocapitella Hintze (r)

A-8 (400') *Bellefontia ibexensis* Hintze (a)
Hystricurus politus Ross (a)

A-7 (370') *Hystricurus genalatus* Ross (a)
Hystricurus politus Ross (r)
Pseudokainella ? sp. (r)
Symphysurina cf. *S. cleora* (Walcott) (r)
Xenostegium franklinense Ross (a)

A-6 (355') Hystricurus genalatus Ross (a)
Symphysurina cf. S. cleora (Walcott) (c)

A-5 (238') Schizambon ? sp. (r)

A-4 (160') Bellefontia sp. indet. (r)

A-3 (155') Symphysurina sp. indet. (r)

A-2 (123') Hystricurus millardensis Hintze (r)
Pseudokainella ? sp. indet. (r)
Symphysurina brevispicata Hintze (c)

A-1 (112') Symphysurina sp. indet. (r)

IBEX SECTION B FAUNULES:

B-14(328') Paraplethopeltis ? genacurvus Hintze (a)
Paraplethopeltis ? genarectus Hintze (a)
Syntrophina cf. S. campbelli Walcott (a)

B-13(318') Bellefontia chamberlaini Clark (c)
Hystricurus genalatus Ross (c)
Pseudokainella ? sp. (r)
Xenostegium sp. indet. (r)

B-12(254') Bellefontia chamberlaini Clark (a)
Clelandia utahensis Ross (c)
Hystricurus genalatus Ross (a)
Parabellefontia concinna Hintze (c)
Xenostegium franklinense Ross (a)

B-11(240') worm borings?

B-10(204') Hystricurus genalatus Ross (c)
Symphysurina sp. indet. (r)

B-8 (188') Hystricurus genalatus Ross (c)
Symphysurina sp. indet. (r)
Xenostegium sp. indet. (r)

B-7 (180') Clelandia utahensis Ross (c)
Hystricurus sp. indet. (c)
Symphysurina cf. S. spicata Walcott (c)

B-6 (160') *Clelandia utahensis* Ross (c)
Hystricurus sp. indet. (r)
Pseudokainella ? sp. (r)
Symphysurina cf. *S. spicata* Walcott (a)
Lingulella cf. *L. pogonipensis* Walcott(r)

B-5 (145') *Bellefontia* sp. indet. (r)
Hystricurus sp. indet. (c)

B-3 (110') *Bellefontia* sp. indet. (r)
Symphysurina uncaspicata Hintze (c)

B-2 (29') *Symphysurina* sp. indet. (r)

B-1 (7') *Hystricurus millardensis* Hintze (c)
Symphysurina brevispicata Hintze (a)
Symphysurina cf. *S. cleora* (Walcott) (a)
Apheoorthis cf. *A. melita* (Hall and Whitfield) (c)
Lingulella cf. *L. pogonipensis* Walcott(c)
Ophileta sp. indet. (c)

IBEX SECTION C FAUNULES:

C-13(595') *Asaphellus* ? *quadrata* Hintze (a)
Menoparia genalunata Ross (r)
Parahystricurus sp. (r)
Protopliomerops firmimarginis Hintze (c)
Psalikilus sp. (c)
Hormotoma-like gastropod impressions (r)

C-12(572') *Asaphellus* ? *quadrata* Hintze (a)
Menoparia genalunata Ross (c)

C-11(534') *Asaphellus* ? *quadrata* Hintze (a)
Menoparia genalunata Ross (c)
Psalikilus spinosum Hintze (r)
Dictyonema sp. (r)

C-10(530') *Asaphellus* ? *quadrata* Hintze (a)

C-9 (510') *Asaphellus* ? *quadrata* Hintze (a)
Endoceras sp. indet. (r)

C-8 (430') _Parahystricurus_ sp. (c)

C-7 (400') _Syntrophina_-like brachiopod

C-6 (390') _Hillyardina_ sp. (c)
Leiostegium formosa Hintze (c)
Pilekia ? sp. (r)
undet. pygidium pl. VIII, fig.13 (c)
Syntrophina ? sp. (c)
Tesselacauda aff. _T. depressa_ Ross (r)

C-5 (380') _Hillyardina_ sp. (c)
Hystricurus sp. C Ross (c)
Hystricurus cf. _H. oculilunatus_ Ross (r)
Pseudoclelandia aff. _P. fluxafissura_ (c)
Tesselacauda aff. _T. depressa_ Ross (r)

C-4 (366') _Hillyardina_ sp. (r)
Hystricurus sp. C Ross (c)
Leiostegium formosa Hintze (c)
Tesselacauda aff. _T. depressa_ Ross (r)
Syntrophina ? sp. (c)

C-3F(330') _Hystricurus_ sp. (r)

C-2 (286') _Endoceras_ sp. (r)
Syntrophina sp. (r)

C-1 (19') _Acrotreta_ sp. (a)

IBEX SECTION D FAUNULES:

D-13(969') _Asaphellus_ ? sp. (c)
Protopliomerops sp. (c)
Pseudonileus ? sp. (r)

D-12(924') _Kirkella fillmorensis_ Hintze (r)
Licnocephala bicornuta ? Ross (r)
Protopliomerops cf. _P. contracta_ Ross (r)
Pseudonileus ? sp. (r)

D-11(829') _Carolinites_ sp. A Hintze (r)
Protopliomerops aff. _P. contracta_ Ross(c)
Protopliomerops sp. 4 (r)

D-11(829') Cont'd unassigned pygid. cf. Ross,1951, pl. 30, figs. 20,21,24 (r)
<u>Nanorthis</u> ? sp. (a)

D-10(749') <u>Asaphellus</u> ? <u>venta</u> Hintze (a)
<u>Menoparia</u> <u>genalunata</u> Ross (r)
<u>Protopliomerops</u> aff. <u>P</u>. <u>contracta</u> (c)
<u>Psalikilus</u> <u>typicum</u> Ross (r)

D-9 (734') <u>Asaphellus</u> ? <u>venta</u> Hintze (a)
<u>Protopliomerops</u> aff. <u>P</u>. <u>contracta</u> (c)
<u>Psalikilus</u> <u>typicum</u> ? Ross (r)
unassigned pygidium pl. XV, fig. 18 (r)
<u>Syntrophina</u> ? sp. (r)
<u>Endoceras</u> ? sp. (r)

D-8 (719') <u>Asaphellus</u> ? <u>venta</u> Hintze (a)
Protopliomerops pygidium with 7 pairs of pleural spines (r)

D-7 (694') <u>Asaphellus</u> ? <u>venta</u> Hintze (a)
<u>Protopliomerops</u> cf. <u>P</u>. <u>celsaora</u> Ross (c)
unassigned pygidium cf. Ross 1951,pl.30, fig. 27 (r)

D-6 (684') <u>Asaphellus</u> ? <u>venta</u> Hintze (a)
<u>Protopliomerops</u> cf. <u>P</u>. <u>contracta</u> Ross(r)

D-5 (634') <u>Asaphellus</u> ? <u>quadrata</u> Hintze (c)

D-4 (604') <u>Asaphellus</u> ? <u>quadrata</u> Hintze (a)
<u>Protopliomerops</u> <u>aemula</u> Hintze (c)

D-3 (594') <u>Asaphellus</u> ? <u>quadrata</u> Hintze (a)
<u>Menoparia</u> <u>genalunata</u> Ross (c)
<u>Protopliomerops</u> <u>aemula</u> Hintze (a)
<u>Psalikilus</u> <u>spinosum</u> Hintze (c)

D-2 (580') <u>Asaphellus</u> ? <u>quadrata</u> Hintze (c)
<u>Protopliomerops</u> <u>firmimarginis</u> Hintze (c)

D-1 (394') <u>Leiostegium</u> <u>formosa</u> Hintze (c)

IBEX SECTION E FAUNULES:

E-17(588') *Amblycranium variabile* Ross (r)
Hystricurus robustus Ross (c)
Pilekia ? *trio* Hintze (c)

E-16(430') *Acrotreta* sp. (a)
Schizambon sp. (r)

E-15(415') *Paraplethopeltis* ? *genacurvus* Hintze (a)
Paraplethopeltis ? *genarectus* Hintze (c)
Syntrophina cf. *S. campbelli* Walcott (a)

E-14(413') Same fauna as E-15

E-13(405') *Bellefontia chamberlaini* Clark (r)
Hystricurus genalatus Ross (c)
Hystricurus lepidus Hintze (a)
Pseudokainella ? *armatus* Hintze (r)
Symphysurina globocapitella Hintze (c)

E-12(395') *Bellefontia* sp. indet. (r)
Hystricurus genalatus Ross (c)
Hystricurus politus Ross (c)
Remopleuridiella caudalimbata Ross (r)
Xenostegium sp. indet. (r)

E-11(385') *Bellefontia chamberlaini* Clark (c)
Hystricurus genalatus Ross (c)
H. paragenalatus Ross (r)
H. politus Ross (a)
Remopleuridiella caudalimbata Ross (c)
Xenostegium franklinense Ross (r)

E-10(370') *Bellefontia ibexensis* Hintze (c)
Hystricurus genalatus Ross (a)
H. paragenalatus (r)
H. politus Ross (a)
Remopleuridiella caudalimbata Ross (c)
Xenostegium cf. X. acuminferentis (Ross) (r)

E-9 (365') *Bellefontia ibexensis* Hintze (r)
Hystricurus genalatus Ross (c)
Hystricurus politus Ross (a)

E-8 (355') <u>Hystricurus politus</u> Ross (a)
<u>Remopleuridiella caudalimbata</u> Ross (r)
Xenostegium sp. indet. (r)

E-7 (315') <u>Bellefontia chamberlaini</u> Clark (a)
<u>Clelandia utahensis</u> Ross (c)
<u>Hystricurus genalatus</u> Ross (a)
<u>Hystricurus politus</u> Ross (a)
<u>Pseudokainella</u> ? sp. A Hintze (r)
<u>Symphysurina</u> cf. <u>S.</u> <u>spicata</u> Walcott (r)
<u>Xenostegium franklinense</u> Ross (c)

E-6 (290') <u>Bellefontia</u> sp. indet. (r)
<u>Clelandia utahensis</u> Ross (r)
<u>Hystricurus genalatus</u> Ross (a)

E-5 (285') <u>Hystricurus politus</u> Ross (c)

E-4 (260') <u>Bellefontia</u> sp. indet. (c)
<u>Hystricurus genalatus</u> Ross (a)

E-3A(235') <u>Bellefontia chamberlaini</u> Clark (c)
<u>Symphysurina uncaspicata</u> Hintze (c)

E-3 (200') <u>Clelandia utahensis</u> Ross (c)
<u>Symphysurina</u> cf. <u>S.</u> <u>spicata</u> Walcott (c)
<u>Xenostegium</u> cf. <u>X.</u> <u>franklinense</u> Ross (c)

E-2 (155') <u>Pseudokainella</u> ? sp. (r)

E-1 (120') float <u>Hystricurus genalatus</u> Ross (r)
<u>Symphysurina</u> sp. indet. (c)

IBEX SECTION G FAUNULES:

G-21(858') <u>Psalikilus paraspinosum</u> ? Hintze (c)

G-20(790') <u>Protopliomerops</u> sp. indet. (c)

G-19(758') <u>Kirkella fillmorensis</u> Hintze (c)
<u>Licnocephala</u> ? <u>cavigladius</u> Hintze (a)
<u>Menoparia genalunata</u> Ross (c)
<u>Protopliomerops</u> aff. <u>P.</u> <u>contracta</u> Ross(c)
<u>Pseudonileus willdeni</u> Hintze (r)

G-18(735') *Licnocephala* ? *cavigladius* Hintze (a)
Protopliomerops *contracta* Ross (c)

G-17(690') *Asaphellus* ? *venta* Hintze (c)
Kirkella *fillmorensis* Hintze (c)
Licnocephala ? *cavigladius* Hintze (a)
Protopliomerops *contracta* Ross (a)
Psalikilus *paraspinosum* Hintze (c)
Pseudonileus *willdeni* Hintze (r)

G-15(625') *Nanorthis* ? sp. (r)
undet. gen. and sp. B Hintze (r)

G-14(585') *Nanorthis* ? sp. (a)
Protopliomerops ? *quattuor* Hintze (c)
undet. pliomerid pygid.,3 pairs spines
Protopliomerops sp. indet., 5 pairs spines
undet. pygid., pl. XX, fig. 14 (r)
Psalikilus *typicum* Ross (c)
undet. gen. and sp. B Hintze (c)
undet. gen. and sp. C Hintze (c)

G-13(537') *Asaphellus* ? *venta* Hintze (a)
Menoparia *genalunata* Ross (c)
Protopliomerops sp. 6 Hintze (r)
Protopliomerops aff. *P.* *contracta* (r)
Psalikilus *typicum* Ross (r)
undet. gen. and sp. B Hintze (r)
undet. gen. and sp. C Hintze (r)

G-12(529') *Jeffersonia* sp. A Hintze (a)
Licnocephala cf. *L.* *cavigladius* (c)
Psalikilus *typicum* Ross (c)
undet. gen. and sp. B Hintze (c)
undet. pygidium cf. pl. XX, fig. 14
Endoceras ? sp. (r)
Dictyonema sp. (r)
Didymograptus ? sp. (r)

G-11(490') *Asaphellus* ? sp. indet. (r)

G-10A(462') *Asaphellus* ? sp. indet. (r)
float *Protopliomerops* aff. *P.* *celsaora* Ross (c)
Psalikilus *paraspinosum* Hintze (c)

G-10F(453') Bolbocephalus sp. (r)
Protopliomerops sp. indet. (c)
Psalikilus sp. indet. (r)

G-9 (407') Protopliomerops celsaora Ross (c)
undet. gen. and sp. A Hintze (c)
undet. pygidium pl. IX, fig. 9,10 (r)

G-8 (306') Asaphellus ? quadrata Hintze (a)
Jeffersonia ? sp. B Hintze (r)
Menoparia genalunata Ross (c)
Protopliomerops aemula Hintze (c)
Psalikilus spinosum Hintze (a)
undet. gen. and sp. A Hintze (r)
undet. pygidium pl. XX, fig. 16 (r)
Hormotoma-like gastropod impressions

G-7 (194') Asaphellus? sp. (see pl. XVI, fig. 12)(r)

G-6 (183') Asaphellus ? quadrata Hintze (c)

G-5 (140') Goniophrys prima Ross (r)
Hillyardina cf. H. semicylindrica Ross(c)
Hillyardina sp. A Hintze (r)
Hystricurus contractus Ross (r)
Hystricurus oculilunatus Ross (c)
Licnocephala ? sp. (r)
Parahystricurus aff. P. fraudator Ross(r)
Parahystricurus bispicatus Hintze (r)
Protopliomerops sp. 5 Hintze (r)
undet. pygidium pl. VIII, fig. 11 (r)

G-3 (90') Hystricurus sp. C Ross (c)
Pseudohystricurus sp. (r)
Tesselacauda sp. (r)
undet. pygidium pl. VIII, fig. 12 (r)

G-2 (66') Hystricurus sp. indet. (r)
Hyperbolochilus sp. (c)

G-1 (16') Amblycranium sp. (c)
unassigned pygid. Ross 1951 pl. 19, fig. 13 (r)

G-0 (0') Amblycranium ? sp. (r)

IBEX SECTION H FAUNULES:

H-32(745') Goniotelus brevus Hintze (r)
Lachnostoma latucelsum Ross (c)
Pseudocybele nasuta Ross (c)
Hesperonomia sp. (c)

H-31(731') Cybelopsis cf. C. speciosa Poulsen (c)
Pseudocybele nasuta Ross (c)

H-30(705') Kirkella cf. K. vigilans (Whittington)(a)
Isoteloides polaris Poulsen (c)
Pseudocybele nasuta Ross (c)
unassigned cranidium and hypostome

H-29(670') Carolinites genacinaca Ross (r)
Goniotelus ? sp. (r)
Kirkella yersini Hintze (a)
Paranileus ibexensis Hintze (c)
Pseudocybele altinasuta Hintze (r)
Pseudocybele lemurei Hintze (c)
Syntrophina ? sp. (r)
Bellerophon-like gastropod steinkerns (r)

H-28(630') Bathyurellus ? sp. (r)
Carolinites genacinaca Ross (c)
Goniotelus ? sp. (r)
Isoteloides flexus Hintze (c)
Kirkella yersini Hintze (a)
Paranileus ibexensis Hintze (a)
Pseudocybele lemurei Hintze (a)
Endoceras sp. (r)
Phyllograptus sp. (r)

H-27(610') Carolinites sp. indet. (r)
Dimeropygiella sp. indet. (r)
Kirkella sp. indet. (r)
Paranileus ibexensis Hintze (c)
Protopliomerops cf. P. quattuor Hintze(c)
Pseudocybele lemurei Hintze (a)

H-26(572') Paranileus sp. (c)
Pseudocybele lemurei Hintze (c)

H-25(545') *Carolinites genacinaca* Ross (c)
Isoteloides flexus Hintze (c)
Kirkella accliva Hintze (r)
Paranileus ibexensis Hintze (c)
Pseudocybele lemurei Hintze (a)
Hesperonomia ? sp. (c)
elongate sponge-like form cf. *Receptaculites elongatus* Walcott

H-24(525') *Carolinites genacinaca nevadensis* (c)
Dimeropygiella sp. (r)
Kirkella accliva Hintze (c)
Protopliomerops sp. 4 Hintze (r)
Paranileus elongatus Hintze (c)
Pseudocybele lemurei Hintze (c)
Trigonocerca typica Ross (c)

H-23(483') *Carolinites genacinaca nevadensis* (c)
Dimeropygiella sp. (r)
Kirkella accliva Hintze (r)
Protopliomerops sp. 4 Hintze (r)
Pseudocybele lemurei Hintze (c)
Trigonocerca typica Ross (a)

H-22(460') *Trigonocerca typica* Ross (a)

H-21(450') *Trigonocerca typica* Ross (a)
Diparalasma ? sp. (r)
Bellerophon-like gastropod steinkerns

H-20(434') *Dimeropygiella blanda* Hintze (a)
Dimeropygiella ovata Hintze (a)
Goniotelus ? 2 spp. pygidia (c)
Jeffersonia ? sp. (c)
Kirkella accliva Hintze (c)
Paranileus elongatus Hintze (c)
Protopliomerops ? *quattuor* Hintze (r)
Protopliomerops sp. 4 Hintze (r)
Pseudocybele altinasuta Hintze (r)
Pseudocybele lemurei Hintze (c)
Trigonocerca typica Hintze (a)
unassigned cranidia pl. XIX, figs. 12, 13, 16 (r)
undet. pygidia pl. XXI, figs. 6, 7 (r)
undet. pygidium pl. IX, fig. 16 (c)

H-20(434') Cont'd. *Diparalasma* sp. (c)
Trematorthis ? sp. (c)
Catoraphiceras sp. (r)
Euomphalus ? sp. (c)
Bellerophon-like steinkerns (c)

H-19(416') *Pseudocybele lemurei* Hintze (r)
Trigonocerca typica Ross (c)
Endoceras sp. (r)
sponge ? (c)

H-18(412') *Dimeropygiella blanda* Hintze (r)
Psalikilus pikum Hintze (r)
Pseudocybele altinasuta Hintze (r)
Pseudocybele lemurei Hintze (c)
Trigonocerca typica Ross (a)
unassigned pygidia

H-17(410') *Trigonocerca typica* Ross (c)

H-16(380') *Protopliomerops* sp. 4 Hintze (r)
Pseudocybele altinasuta Hintze (r)
Trigonocerca typica Ross (c)

H-15(357') *Dimeropygiella blanda* Hintze (r)
Trigonocerca sp. (c)

H-13(300') *Trigonocerca* sp. (r)
bryozoan ?

H-11(276') *Dimeropygiella* sp. (r)
Psalikilus paraspinosum ? Hintze (r)
Pseudonileus sp. (r)
Maclurites-like gastropod impression.

H-9F(250') *Protopliomerops contracta* Ross (c)

H-4 (205') *Protopliomerops* sp. (r)

H-7 (190') *Hystricurus* ? sp. (free cheek only)
Protopliomerops sp. (r)
Psalikilus paraspinosum Hintze (c)
Pseudonileus ? sp. (r)
undet. gen. and sp. pl. XIX, figs. 11, 14, 15 (r)

H-6 (186') _Protopliomerops contracta_ Ross (r)
Psalikilus paraspinosum ? Hintze (c)
undet. gen. and sp. C Hintze (r)

H-5 (177') undet. gen. and sp. B Hintze (r)

H-3 (160') _Protopliomerops contracta_ Ross (r)
Pseudonileus willdeni Hintze (c)

H-2 (104') _Kirkella fillmorensis_ Hintze (c)
Protopliomerops contracta Ross (c)
Pseudonileus sp. (r)

H-1 (82') _Licnocephala ? cavigladius_ Hintze (a)
Pseudonileus willdeni Hintze (c)

IBEX SECTION J FAUNULES:

J-31(591') _Bathyurellus pogonipensis_ Hintze (c)
Eleutherocentrus sp. (r)
Pseudoolenoides dilectus Hintze (c)
Leperditia sp. (c)

J-30(574') _Bathyurellus pogonipensis_ Hintze (a)
Pseudoolenoides dilectus Hintze (c)
Leperditia sp. (c)

J-29(502') same fauna as J-31

J-28(491') _Bathyurellus pogonipensis_ Hintze (c)
Pseudomera kanoshensis Hintze (c)
Anomalorthis utahensis Ulrich & Cooper(r)
Orthambonites michaelis (Clark) (c)
Endoceras sp. (c)
gastropod n. gen. (c)

J-27(485') _Pseudomera kanoshensis_ Hintze (c)
Pseudoolenoides dilectus Hintze (c)

J-26(479') _Bathyurellus pogonipensis_ Hintze (c)
Eleutherocentrus sp. (r)
Pseudomera cf. _P. barrandei_ (Billings)(r)
Pseudomera kanoshensis Hintze (c)
Pseudoolenoides dilectus Hintze (r)

J-26(479') Cont'd.	*Anomalorthis utahensis* Ulrich & Cooper (r) *Orthambonites michaelis* (Clark) (a) *Lingula* sp. (35 mm. long) (r) gastropod n. gen. (r) *Bellerophon*-like steinkerns (r) *Endoceras* sp. (c) cystid balls and plates (c)
J-25(468')	*Bathyurellus pogonipensis* Hintze (c) *Pseudomera kanoshensis* Hintze (c) *Pseudoolenoides dilectus* Hintze (c) *Endoceras* sp. (c) *Leperditia* sp. (c) *Macronotella* sp. (c)
J-24(457')	*Bathyurellus pogonipensis* Hintze (c) *Leperditia* sp. (a) *Macronotella* sp. (a)
J-23(441')	*Bathyurellus pogonipensis* Hintze (a) *Pseudomera kanoshensis* Hintze (c) *Pseudoolenoides dilectus* Hintze (c) *Orthambonites michaelis* (Clark) (c) large *Acrotreta* ? sp. (c) *Leperditia* sp. (a) gastropod n. gen. (r)
J-22(430')	*Bathyurellus pogonipensis* Hintze (a) *Eleutherocentrus* sp. (r) *Pseudomera kanoshensis* Hintze (r) *Pseudoolenoides dilectus* Hintze (a) *Receptaculites mammillaris* Walcott (c) *Leperditia* sp. (c) cystid plates (r)
J-21(397')	*Eleutherocentrus* sp. (c) *Pseudomera kanoshensis* Hintze (c)
J-20(391')	*Eleutherocentrus* sp. (r) *Pseudomera kanoshensis* Hintze (c) *Pseudoolenoides dilectus* Hintze (c) Macronotella sp. (a)
J-19(375')	*Eleutherocentrus* cf. *E. petersoni* (a) *Pseudomera kanoshensis* Hintze (c) *Macronotella* sp. (c), *Orthis* sp. (c)

J-18(336') _Pseudomera kanoshensis_ Hintze (r)
Goniotelus ? ludificatus Hintze (c)
Anomalorthis sp. (r)
Macronotella sp. (c)
bryozoa (c), cystid balls (c)

J-17(230') _Parapilekia_ ? sp. (r)
Pseudomera sp. indet. (r)
Orthis subalata Ulrich and Cooper (c)
Eleutherocentrus sp. (r)

J-16A(155') _Hesperonomiella minor_ (Walcott) (a)
Loxoplocus sp. (r)

J-16(127') _Goniotelus wahwahensis_ Hintze (c)
Pseudomera sp. (c)
Endoceras sp. (c)
Zittelella ? sp. (r)

J-15(118') _Cybelopsis_ cf. _C. speciosa_ Poulsen (r)
Goniotelus sp. (c)
Dimeropygiella caudanodosa Ross (c)
Pseudomera cf. _P. insolita_ (Poulsen)(c)
Pseudocybele nasuta Ross (c)
Lesuerilla ? sp. (c)

J-14(114') _Goniotelus_ sp. indet. (r)
Campbelloceras ? sp. (r)
cystid plates

J-13(80') _Carolinites genacinaca_ Ross (c)
Kawina ? webbi Hintze (r)
Kirkella declivita Ross (c)
Lachnostoma latucelsum Ross (a)
Isoteloides ? genalticurvatus Hintze(c)
Paranileus sp. (c)
unassigned pygidium pl. XV, fig. 19 (r)
Zittelella cf. _Z. clarae_ Howell(sponge)(r)

J-12(70') _Dimeropygiella caudanodosa_ Ross (a)
Goniotelus wahwahensis Hintze (c)
Goniotelus sp. D Hintze (r)
Lachnostoma latucelsum Ross (c)
Pseudocybele nasuta Ross (c)

J-11(66') *Cybelopsis* cf. *C. speciosa* Poulsen (r)
Goniotelus sp. (c)
Kirkella declivita Ross (c)
Lachnostoma latucelsum Ross (a)
Pseudomera cf. *P. insolita* (Poulsen)(c)

J-10(61') *Carolinites genacinaca* Ross (c)
Cybelopsis cf. *C. speciosa* Poulsen (c)
Dimeropygiella caudanodosa Ross (a)
Goniotelus brighti Hintze (c)
Kirkella declivita Ross (r)
Lachnostoma latucelsum Ross (a)
Pseudomera cf. *P. insolita* (Poulsen)
Catoraphiceras sp. (r)
Raphistomina sp. (c)

J-9 (51') *Benthamaspis diminutiva* Hintze (r)
Cybelopsis cf. *C. speciosa* Poulsen (r)
Dimeropygiella caudanodosa Ross (c)
Goniotelus brighti Hintze (c)
Lachnostoma latucelsum Ross (a)
Pseudomera cf. *P. insolita* (Poulsen)(c)

J-8 (38') "*Barrandia* ? sp." Walcott (r)
Benthamaspis diminutiva Hintze (c)
Carolinites genacinaca Ross (c)
Cybelopsis cf. *C. speciosa* Poulsen (c)
Dimeropygiella caudanodosa Ross (a)
Goniotelus brighti Hintze (a)
Goniotelus brevus Hintze (c)
Isoteloides polaris Poulsen (r)
Kawina ? *sexapugia* Ross (r)
Kirkella declivita Ross (c)
Lachnostoma latucelsum Ross (a)
Lachnostoma ? sp. hypostome (r)
Paranileus aff. *P. utahensis* Hintze (r)
Pseudocybele nasuta Ross (a)
Pseudomera cf. *P. insolita* (Poulsen)(r)
Diparalasma sp. (r)
Hesperonomia sp. (c)
Tritoechia sinuata Ulrich and Cooper(r)
Catoraphiceras sp. (r)
Raphistomina sp. (c)
Bellerophon-like steinkerns (r)
bryozoa ? (c)

J-7 (28') Kirkella sp. (c)

J-6 (26') Cybelopsis cf. C. speciosa Poulsen (c)
Goniotelus brighti Hintze (c)
Kirkella declivita Ross (c)
Lachnostoma latucelsum Ross (a)
Pseudocybele nasuta Ross (c)
Hesperonomia sp. (c)
Catoraphiceras sp. (r)

J-5 (21') Lachnostoma latucelsum Ross (c)
Pseudocybele nasuta Ross (c)

J-4 (20') Dimeropygiella caudanodosa Ross (r)
Lachnostoma latucelsum Ross (c)
Pseudocybele nasuta Ross (c)

J-2 (5') Carolinites genacinaca Ross (r)
Isoteloides polaris Poulsen (c)
Kirkella cf. K. vigilans(Whittington)(a)
Lachnostoma latucelsum Ross (a)
Pseudocybele nasuta Ross (c)
Trigonocercella acuta Hintze (c)

J-1 (0') Kirkella cf. K. vigilans(Whittington)(c)
Paranileus utahensis Hintze (c)
Pseudocybele nasuta Ross (c)
Trigonocercella acuta Hintze (c)
Raphistomina sp. (r)

IBEX SECTION K FAUNULES:

K-7 (590') Barrandia ? sp. (c)
Trocholites ? sp. (c)
Endoceras sp. (c)
Leperditia sp. (a)

K-6 (575') Modiolopsis ? sp. (c)

K-5 (490') Illaenus sp. (r), Orthis sp. (c)

K-4 (473') Cybelopsis sp. (r)
Orthis sp. (a)
cystid fragments (c)

K-3 (435') *Receptaculites* sp. indet. (r)
Orthis sp. (c)

K-2 (330') *Cybelopsis* sp. (pl. XXV fig. 3) (r)
Orthis sp. (c)
Endoceras sp. (r)

K-1A(137') *Bathyurellus pogonipensis* Hintze (c)
Eleutherocentrus cf. *petersoni* Clark(c)
Pseudoolenoides dilectus Hintze (c)
Leperditia sp. (c)
Cybelopsis sp. (large) (r)

K-1 (5') *Bathyurellus pogonipensis* Hintze (a)
Carolinites killaryensis utahensis (c)
Goniotelus ? *ludificatus* Hintze (c)
Pseudomera kanoshensis Hintze (a)
Pseudoolenoides dilectus Hintze (c)

CRYSTAL PEAK SECTION FAUNULES:

CP-77(426') *Cybelopsis* sp. (large)(c)
Leperditia sp. (c)

CP-74(404') *Barrandia* ? sp. (c)

CP-69(376') *Barrandia* ? sp. (c)
Leperditia sp. (a)

CP-55(300') *Cybelopsis* sp. (large)(c)
Barrandia ? sp. (c)

CP-54(294') *Barrandia* ? sp. (c)
Leperditia sp. (c)
raphistomid steinkerns (a)

CP-50(272') *Barrandia* ? sp. (c)
Cybelopsis sp. (large)(a)
Anomalorthis ? sp. (c)

CP-42(229') *Pseudoolenoides acicaudus* Hintze (r)
Orthis sp. (c)
Leperditia sp. (large)(a)

CP-40(218') <u>Barrandia</u> ? sp. (r)
<u>Illaenus utahensis</u> Hintze (c)
<u>Nieszkowskia</u> ? sp. (r)
<u>Pseudoolenoides acicaudus</u> Hintze (r)
<u>Orthis</u> ? sp. (c)
<u>Lecanospira</u>-like gastropod (c)
high spired gastropod (r)
fenestrellate bryozoan (r)
<u>Leperditia</u> sp. (a)

CP-3 (200') <u>Anomalorthis</u> sp. (c)
<u>Modiolopsis</u> ? sp. (a)
<u>Raphistoma</u> ? sp. (c)
high spired gastropod (c)

CP-2 (160') <u>Orthis</u> sp. (c)
<u>Leperditia</u> sp. (c)

CP-1 (150') <u>Barrandia</u> ? sp. (r)
<u>Cybelopsis</u> sp. (pl. XXV, fig. r) (r)
<u>Illaenus utahensis</u> Hintze (a)
<u>Kawina</u> ? <u>unicornica</u> Hintze (c)
<u>Nieszkowskia</u> ? sp. (pl. XXVIII) (r)
<u>Pseudoolenoides acicaudus</u> Hintze (c)
<u>Anomalorthis</u> sp. (c)
<u>Orthis</u> sp. (c)
<u>Lingula</u> sp. (r)
<u>Trocholites</u> sp. (r)
<u>Lecanospira</u>-like gastropod (c)
<u>Maclurites</u> sp. indet. (c)
high spired gastropod sp. indet. (r)
<u>Leperditia</u> sp. (a)
spherical bryozoan colony (r)

CP-13(71') <u>Anomalortnis utahensis</u> Ulrich & Cooper(a)
<u>Orthis</u> sp. (r)
cystid fragments (c)

CP-12(65') <u>Pseudomera</u> cf. <u>P</u>. <u>barrandei</u> (Billings)(r)
<u>Orthis</u> sp. (r)
<u>Macronotella</u> sp. (c)

CP-11(60') <u>Bathyurellus pogonipensis</u> Hintze (c)
<u>Pseudomera</u> sp. indet. (r)
<u>Anomalorthis utahensis</u> Ulrich & Cooper(c)

CP-8 (43') *Macronotella* sp. (a)
Orthis (*Orthambonites*) sp. (c)
Anomalorthis utahensis Ulrich & Cooper(c)
bryozoan colonies (c)

CP-5 (27') *Bathyurellus pogonipensis* Hintze (c)
Pseudomera kanoshensis Hintze (c)
Pseudoolenoides dilectus Hintze (a)
Orthambonites michaelis (Clark)(c)
Macronotella sp. (c)
cystid balls and plates (c)

NORTH SNAKE RANGE SECTION, NEVADA: From a point on old U. S. Route 6 (Cowboy Pass route), about seven miles south of Robinson Ranch, a light colored quartzite fault block may be seen forming a segment of the Snake Range foothills to the west. The outcrop is located in Nevada, not far from the State line, in T. 15 N., R. 70 E., about two miles west of the graded road. The section has been considerably disturbed by faulting, and the quartzite especially is much brecciated so that the thicknesses below can only be considered approximate.

Overlying beds: Dolomite, dark brownish-gray, Upper Ordovician?

Eureka Quartzite:		
Quartzite, white, vitreous, brecciated, forms massive cliff.	100'	270'
Quartzite, white, brittle, slope forming.	100	170
Quartzite, white, weathers rust brown on surface, cross-laminated in some beds, slope forming.	70	70
Dolomite Member:		
Dolomite, brownish gray, brecciated, largely float covered, contact with the quartzite not seen.	105	135
Interbedded brownish-gray dolomite and bluish-gray calcilutite, unfossiliferous.	30	30
Pogonip Group:		
Lehman Formation:		
Calcilutite, light bluish-gray weathering, medium-bedded, with interbeds of medium dark gray calcarenite up to 2 inches thick comprising about 10 percent of the rock, <u>Leperditia bivia</u> White, <u>Barrandia</u> ? sp., large <u>Pseudomera</u> sp. No quartzite interbeds.	145	745
Calcilutite, light bluish-gray, ledge forming.	60	600

	I	II
Kanosh Shale:		
Shales and limestones interbedded, brownish weathering, forms talus slopes, <u>Receptaculites</u> sp., <u>Orthis</u> sp., <u>Anomalorthis</u> sp., <u>Pseudomera</u> sp., cystid fragments. This corresponds to the lower part of the Kanosh Shale of Ibex in lithology.	120'	540'
Undivided Middle Pogonip:		
Calcilutite, medium light gray, ledge forming, white calcite filled fractures permeate the rock.	20	420
Calcarenite and calcisiltite, interbedded, medium gray, weathering light brownish-gray, thin-bedded, slope forming.	70	400
Calcisiltite, medium gray, weathering light rust-brown, quartz sandy.	85	330
Calcisiltite, medium gray, medium-bedded, forms low ledges.	10	245
Calcisiltite, medium light-gray, weathering light rust-brown, forms rubbly slopes.	105	235
Calcisiltite, as above, but with interbeds of 1 foot ledge forming more massive beds about every 8 feet.	15	130
Covered, calcisiltite talus.	18	115
Interbedded quartz silty, calcisiltite and intraformational conglomerate, medium dark gray, form low ledges and slopes.	42	97
Calcilutite, light bluish-gray, massive ledge forming, no fossils.	10	55
Calcisiltite, light medium-gray, fine quartz sandy, thin-bedded, weathers yellowish-gray, slope forming, unfossiliferous.	45	45

Lower beds covered by alluvium.

SOUTH SNAKE RANGE, BIG SPRING SECTION, NEVADA: On the east side of the Snake Range, about half way from the Big Spring ranch to Chokecherry Canyon, in T. 11 N., R. 69 E., the Eureka quartzite comprises the lower and lighter colored of two cliff forming formations which dip gently southward.

	I	II
Upper Ordovician Dolomite: Light gray weathering cherty dolomite, thickness not measured.		
Eureka Quartzite:		
Dolomitic sandstone.	3'	414'
Quartzite, gray to purplish-stained intermittant exposures.	15	411
Quartzite and sandstone, pink and gray at top becoming white below, incompetent, forms occasional ledges.	55	396
Quartzite, as above, but more resistant.	15	341
Quartzite, white, massive, silt-pocketed, lower 15 feet vitreous.	80	326
Quartzite, pink to white, massive, silt-pocketed and grainy-surfaced near the top, several vitreous and cross-laminated beds near the bottom.	205	246
Covered, quartzite float.	30	41
Quartzite, reddish, with quartzitic sandstones.	11	11
Lehman Formation: Note that this formation is expanded here to include the calcareous equivalents of the Swan Peak? quartzite at Ibex.		
Covered, quartzite float.	31	510
Calcilutite, gray, silty, partings weather in chickenwire pattern, forms ledge.	4	479
Sandstone, buff, ledge forming.	3	475
Covered, silty limestone and sandstone float.	32	472

Calcilutite, medium dark gray, weathering lighter gray, with silty partings, thin-bedded, ledge outcrop, *Eofletcheria* sp. in float.	35	440
Calcilutite, medium dark gray, weathering lighter, with yellowish-gray weathering silt partings, massive, forms continuous ledge visible from the valley below. Fossils in place at base of ledge are: *Kirkina millardensis* Salmon, *Hesperorthis* sp.	12	405
Calcilutite, medium dark gray, thin-bedded, low ledges.	23	393
Covered, calcilutite float.	26	370
Calcilutite, weathers dark bluish-gray, forms ledge.	4	344
Covered, calcilutite float.	26	340
Sandstone, buff, ledge forming.	4	324
Limestone, silty.	3	320
Sandstone, calcareous.	2	317
Covered.	34	315
Calcisiltite, dark bluish-gray, weathering lighter, forms ledge.	1	281
Covered.	94	280
Intraformational conglomerate, small subrounded calcilutite pebbles in a calcilutite matrix.	1	186
Covered, bluish-gray silty limestone float chips.	34	185
Limestone, weathering bluish gray, forms 6 inch ledge.	1	151
Covered, limestone float chips.	34	150
Calcisiltite, gray, forms ledge.	1	116
Covered, bluish-gray weathering, silty limestone float chips.	113	115
Calcilutite, silty, weathers bluish gray, ledge forming.	2	2

Kanosh Shale:		
Covered, mixed float from above, some shaly float.	340	365
Shales, olive gray, fissile, with interbedded, brown weathering, thin-bedded calcarenite with abundant fossils, <u>Orthis michaelis</u> Clark, <u>Macronotella</u> sp., <u>Pseudomera</u> sp. This is the lowest exposure of bedrock above the alluvium.	15	15

PIOCHE MINING DISTRICT, NEVADA: Three separate sections taken in the Ely Springs Range are described below, two of these being of the Tank Hill limestone and the other of the Yellow Hill limestone. Location of these sections can best be seen on the geologic map of the Pioche district, Plate 1, U. S. Geological Survey Professional Paper 171. It should be noted that the Ordovician rocks in the Ely Springs Range are much faulted and that there are numerous minor faults not shown on the geologic map which have so brecciated most of the area of exposure as to render it unsuitable for accurate stratigraphic measurement.

A complete typical Pogonip Ordovician section has not yet been found in the fault blocks of the Ely Springs Range. In addition to a hiatus of 200 to 500 feet of beds between the top of the Yellow Hill and the bottom of the Tank Hill (top of the Ordovician sequence), there is also a gap, probably of 500 feet or more, at the bottom of the Ordovician. The missing beds at the bottom would contain the <u>Symphysurina</u> faunas, but it is possible that these beds are currently being included with the Upper Cambrian Mendha Limestone. Inasmuch as both the upper and lower limits of the Yellow Hill limestone are fault bounded, as is the lower limit of the Tank Hill limestone, it is not considered advisable to attempt to carry these rather unnaturally bounded formations as stratigraphic units into other areas. However, several faunal zones and lithologic divisions from other areas can be correlated with those found within these formations, as noted in the sections described below.

Ely Springs Canyon Section: Measured from the lowest bedrock exposures a few hundred feet northeast of BM 5427 at Ely Springs in Sec. 34, T. 1 N., R. 65 E., northward to the top of the Eureka outcrop.

	I	II
Eureka Quartzite: The quartzite is much brecciated, as it is in all of the other exposures seen in this district, but the beds above and below are continuous and the brecciation probably does not affect the thickness greatly. The lower 19 feet of Ely Springs dolomite, resting on the quartzite, is here a calcareous quartz siltstone with worm borings.	490'	490'
Tank Hill Limestone: (This is equivalent to the beds from the Lehman formation to the base of the Eureka quartzite at Ibex, Utah.)		
Limestone, gray, weathering orange brown, silty, thin-bedded, forms slopes.	25.0	244.1
Limestone, medium gray, weathering yellow brown, shaly, thin-bedded, slope forming, <u>Orthis</u> sp. abundant.	22.0	219.1
Limestone, thin-bedded, shaly, silty, rubbly slopes, with three 8 inch to 10 inch ledges of fine calcarenite about evenly spaced, <u>Orthis</u> sp. abundant in some beds.	14.8	197.1
Calcilutite, light medium gray, silty, thin-bedded, forms ledges, <u>Columnaria</u> cf. <u>simplissima</u> Okulitch common.	11.0	182.3

Limestones, medium gray, silty, form low ledges.	8.0	171.3
Calcilutite, medium dark gray, silty partings, forms massive ledge.	4.0	163.3
Calcilutite, medium bluish-gray, silty, forms low ledges.	7.0	159.3
Covered.	7.5	152.3
Calcilutite, medium bluish-gray, silty, forms low ledges.	12.0	144.8
Calcisiltite, medium dark gray, siliceous.	1.0	132.8
Calcilutite, medium bluish-gray, forms low ledges.	26.5	131.8
Calcilutite, as above, but thick-bedded, ledge forming, silty.	24.0	105.3
Limestone, shaly, reentrant.	3.3	81.3
Calcilutite, medium bluish-gray, thick-bedded, silty, shaly, gnarly partings, ledge forming.	17.9	78.0
Covered, calcilutite float.	8.3	60.1
Calcilutite, bluish-gray, shaly, forms ledge.	4.0	51.8
Covered.	7.5	47.8
Calcilutite, bluish-gray, forms low ledges.	4.2	40.3
Covered.	6.1	36.1
Calcisiltite, medium dark gray, silty, thin-bedded, forms low ledges.	2.5	30.0
Covered.	11.5	27.5
Calcilutite, bluish-gray, silty, forms massive ledge, <u>Leperditia</u> sp. <u>Barrandia</u> ? sp., gastropod impressions abundant.	16.0	16.0

Lower Tank Hill beds bearing the <u>Receptaculites mammillaris</u> fauna occur in other fault blocks close by, on the western slopes of Battleship Mountain, (Howell, 1941, p. 36).

Tank Hill Section: Measured eastward from the lowest exposures near the cement tank on Tank Hill, Section 22 T. 1 N., R. 65 E.

Eureka Quartzite: Quartzite much brecciated and fractured. Estimated thickness 200 feet. Contact with underlying beds not well shown, relations uncertain but no obvious angular discordance.

Tank Hill Limestone:

Calcilutite, medium gray, weathering medium bluish-gray, thin- to medium-bedded, silty, with gnarly partings, Orthis sp.	50	408
Calcilutite, medium gray, weathering medium bluish-gray, thick-bedded to massive, forming the highest cliff within the Tank Hill, silty partings weather yellowish and pinkish-gray.	75	358
Calcilutite, as above, but thin-bedded, slope forming.	52	283
Calcilutite, as above, but thick-bedded, ledgy, with gastropod impressions common, and with white calcite stringers.	13	231
Calcilutite, medium gray, weathering medium bluish-gray, with thin and thick-bedded zones alternating, silty partings.	22	218
Calcisiltite, dark gray, thick-bedded, laminated, wavy bedding, unfossiliferous.	6	196
Calcilutite, alternating thin and medium-bedded, weathers medium bluish-gray, with yellowish and pinkish silty partings, Leperditia bivia White, Pseudomera cf. P. barrandei (Billings), Modiolopsis ? sp.	60	190
Calcilutite, forms ledge.	4	130
Calcilutite, medium dark gray, weathers light to medium bluish-gray, thin-bedded, silty, forms low ledges and slopes, Leperditia sp., Pseudomera sp., Barrandia sp., gastropod impressions. Base of section in the lowest bedrock outcrops about 50 feet above the Cement Tank.	126	126

Note that Westgate (1932) reports 450 feet of Tank Hill Limestone and includes the <u>Receptaculites</u> fauna in limestones near the base.

Yellow Hill Section: Measured from the south base of Yellow Hill, in Swiss Bob Canyon, northward to the highest beds exposed on Yellow Hill, Section 27, T. 1 N., R. 65 E. Trilobites occur silicified throughout this measured section.

Yellow Hill Limestone:

Chert, pinkish, weathering reddish and orange, caps top of Yellow Hill.	10.0	640.0
Calcisiltite, medium gray, thin-bedded, low ledges.	12.0	630.0
Calcisiltite, gray, thick-bedded, silty, with orange siliceous zone from 610 to 615.	18.0	618.0
Calcisiltite, gray, forms low ledges.	9.8	600.0
Calcisiltite, medium gray, with orange-gray weathering siliceous bands.	32.7	590.2
Calcisiltite, as above, minor fault displacement (YH-16) at 577': <u>Pseudocybele</u> sp.	5.7	557.5

Note: a float block(YH-16A), found down the hill slope at 400', yielded a fauna apparently from this horizon: <u>Pseudocybele</u> <u>lemurei</u> Hintze, <u>Paranileus</u> aff. <u>P</u>. <u>ibexensis</u> Hintze, <u>Kirkella</u> <u>accliva</u> Hintze, <u>Trigonocerca</u> <u>typica</u> <u>piochensis</u> Hintze, <u>Carolinites</u> <u>genacinacus</u> <u>nevadensis</u> Hintze, <u>Isoteloides</u> sp.

Calcisiltite, gray interbedded with yellowish siliceous calcisiltite, thin-bedded, form low ledges.	13.6	551.8
Calcisiltite, silty, siliceous, gray, stained orange, source of much of the orange-yellow talus that gives the hill its color.	7.9	538.2

Calcisiltite, medium gray, thin bedded, forms ledges.	22.1	530.3
Calcisiltite, medium gray, with yellowish weathering chert in large irregularly bedded lenses up to 1 1/2 feet thick. Rock chopped up by joints, but forms banded yellow and gray cliffs on the western face of Yellow Hill. Prominent chert bed at 503.5 to 505 feet.	78.2	508.2
Interbedded medium gray calcisiltite and orange weathering calcareous siltstone, thin-bedded, forms top ledges on southwest face of hill, pararipples with 35 inches between crests, trending N 42°W in one calcisiltite bed. (YH-15) at 430 feet: _Protopliomerops firmimarginis_ Hintze, _P. contracta_ Ross, _Asaphellus_ ? sp.	22.2	430.0
Calcisiltite, medium gray, weathers yellowish-gray, thin-bedded, but ledge forming, chert in 10 inches, bedded masses at 390 feet.	21.8	407.8
Calcisiltite, as above, but forming only low step ledges, chert at 381 feet.	9.7	386.0
Calcisiltite ledge, siliceous, with 12 inch layer of bedded-replacement chert.	3.7	376.3
Calcisiltite, medium gray, silty, thin-bedded, weathers to light yellowish-gray slopes.	18.9	372.6
Calcisiltite, medium gray, silty, cherty, forms massive ledge.	4.7	353.7
Calcisiltite, silty, forms rubbly slope.	7.0	349.0
Chert and siliceous calcisiltite, thin-bedded, ledge forming.	1.0	342.0
Calcisiltite, silty, reentrant.	1.0	341.0
Intraformational conglomerate, medium gray, forms massive ledge.	2.0	340.0
Calcisiltite, medium gray, silty, thin-bedded, low ledges and slopes	10.0	338.0
Calcisiltite ledge.	2.0	328.0

Intraformational conglomerate, ledgy, interbedded with reentrant forming silty calcisiltite.	8.0	326.0
Calcilutite, medium gray, forms ledge.	2.1	318.0
Calcilutite, thin-bedded, ledgy, interbedded with reentrant forming silty calcisiltite and ledge forming intraformational conglomerate.	18.3	315.9
Calcilutite, massive 2 foot ledge caps weaker thin-bedded calcitites, forms the base of the series of more massive ledges which cap the top of Yellow Hill. (YH-12F) at 290 feet: *Protopliomerops contracta* Ross, *Kirkella fillmorensis* Hintze, *Menoparia genalunata* Ross.	7.6	297.6
Intraformational conglomerate, medium gray, thin-bedded, resistant, interbedded with about equal amount of light yellowish-gray calcargillutite. (YH-11) at 250 feet: *Asaphellus* ? *venta* Hintze, *Protopliomerops contracta* Ross.	48.7	290.0
Calcargillutite, light yellowish-gray weathering, thin-bedded, with about one-third interbeds of more resistant thin-bedded intraformational conglomerate, (YH-10) at 225 feet: *Protopliomerops* sp.	62.2	241.3
Calcargillutite, as above, but with only about one-fifth interbeds of intraformational conglomerate. (YH-9) at 179': *Asaphellus* ? sp.	6.5	179.1
Calcisiltite, thin-bedded, slope forming with about one-fourth interbeds of intraformational conglomerate, capped by a massive 18 inch intraformational conglomerate ledge. (YH-8) at 172.6': Protopliomerops sp., *Asaphellus* ? sp.	21.0	172.6

Calcisiltite, light medium gray, silty, interbedded with 2 medium gray, more resistant intraformational conglomerate, thin-bedded, forms float covered slopes.	24.6	151.6
Calcisiltite, medium gray, weathering yellowish-gray, silty, forms slopes and low ledges, (YH-7) at 126 feet: Asaphellus ? sp., Menoparia genalunata Ross.	11.4	127.0
Calcisiltite and intraformational conglomerate, thin-bedded, platy.	20.0	115.6
Calcisiltite, medium gray, thin-bedded, forms resistant and continuous ledge capped by 6 inches of siliceous calcisiltite (YH-6) at 93 feet: Asaphellus ? sp.	3.0	95.6
Covered.	10.5	91.7
Intraformational conglomerate, medium dark gray, weathering brownish-gray, thin-bedded, forms low ledges and slopes. (YH-5F) at 81 feet: Asaphellus ? sp.	19.3	81.2
Intraformational conglomerate float capped by 15 inch heavy-bedded ledge of same.	11.9	61.9
Intraformational conglomerate, brownish-gray weathering, thin-bedded, slope forming.	14.0	50.0
Intraformational conglomerate and calcargillutite, weathering yellowish-gray. (YH-3) at 36': Linguellela sp., Kayseraspis ? sp. (pygidium only).	8.0	36.0
Intraformational conglomerate, medium gray, thin-bedded, forms low ledges.	2.0	28.0
Covered, silty limestone float.	14.5	26.0
Intraformational conglomerate, medium gray, silty, shaly, very thin-bedded, capped by 6 inch bed.	11.5	11.5

Note: a well preserved silicified faunule (YH-2) was obtained from the top of the ridge immediately south of Swiss Bob Canyon, about 100 feet stratigraphically above the massive-bedded cherty-limestone ledges near the contact of the Yellow Hill and Mendha formations: Protopliomerops contracta Ross, Psalikilus cf. P. paraspinosum Hintze, Macropyge gladiator Ross, Jeffersonia sp. A. Hintze.

STEPTOE, NEVADA: Low on the east face of the Egan Range, about 3 miles south of the ranch buildings at Steptoe, Nevada, the Eureka quartzite may be seen forming a prominent light-colored bluff which is more or less continuous for a few miles along the mountain front. The measured section was taken in Section 30, T. 19 N., R. 63 E., where the beds underlying the quartzite appeared to be best exposed. Beds dip 20°, N. 60°W.

	I	II
Upper Ordovician Dolomite:		
Dolomite, medium gray, weathering light olive-gray, medium-bedded, with about 5 percent black chert nodules. Total thickness not measured but in this dolomite 9 feet above the top of the Eureka quartzite beautifully preserved silicified brachiopods are found (Mc 6).		
Dalmanella sp. (Resserella?)		
Rhynchotrema cf. kentuckiense Fenton		
rugose rhychonellid probably near Rostricellula		
Valcourea sp. (Donorthis?), Platystrophia sp.		
Zygospira cf. recurvirostris		
This dolomite rests with no apparent angular discordance on the underlying quartzite.		

Eureka Quartzite:

Quartzite, white, surface stained pinkish, vitreous, forms massive bluffs.	253'	338'
Covered, quartzite talus.	85	85

Lehman Formation:

Calcilutite, medium dark gray, weathering medium bluish-gray, mottled with yellowish-gray, silty patches, thick-bedded, forms low ledges.	85	341
Covered, calcilutite and quartzite talus.	68	256
Calcilutite, medium dark gray, weathering medium bluish-gray, ledge.	4	188
Covered, calcilutite and quartzite talus, (Mc-5) <u>Barrandia</u> ? sp.	55	184
Quartzite, ledge forming.	2	129
Covered.	19	127
Calcilutite and calcisiltite, medium bluish-gray weathering, silty, thin- to thick-bedded, partings even to gnarly, thin brown siliceous bands in some beds show cross lamination, some thin intraformational conglomerate beds.	60	108
Calcilutite, medium bluish-gray weathering, silty, thin-bedded, gnarly, <u>Leperditia</u> sp. abundant lower few feet.	28	48
Covered.	18	20
Calcarenite, dark gray, weathering medium dark gray, silty, forms ledge, <u>Leperditia</u> sp., <u>Barrandia</u> ? sp., <u>Modiolopsis</u> sp., raphistomid gastropods, small orthid brachiopods.	2	2

Kanosh Shale:

Covered, blue-gray silty calcisiltite talus.	80	319
Covered, shaly, <u>Macronotella</u> in float.	14	239

Siltstone, gray, weathering dark yellowish-orange, exposed in bottom of small hillside wash, Orthis sp.,	2	225
Covered, bluish-gray weathering rubbly calcisiltite chips in soil.	223	223
Juab Limestone:		
Calcisiltite, medium gray, thin-bedded, crops out along the topographic terrace between the ledge forming calcisiltite below and the steeper talus covered slopes beneath the quartzite cliffs above.	15	135
Calcisiltite, medium gray, thick and thin-bedded, resistant, holds up the prominent bench about 600 feet below the Eureka bluffs, not silt parted, but with algal or sponge impressions toward the top, veined with small secondary white calcite stringers.	87	120
Covered, calcisiltite, float.	33	33
Wahwah Limestone:		
Calcisiltite, medium gray, thin-bedded, siliceous, silty, ledgy outcrops, blocky talus, partially silicified trilobites in beds at top, Eleutherocentrus sp., Hesperonomia sp. ? .	20'	341
Covered, calcisiltite float.	44	321
Calcisiltite, massive, ledge forming.	3	277
Covered, rubbly calcisiltite and calcarenite float, Pseudomera sp.	55	274
Calcarenite, bluish-gray, forms 8 inch ledge, and blocky float.	1	219
Covered.	61	218
Calcarenite, medium gray, weathering medium dark gray, thin-bedded, forms low ledges in creek bottom up to 2 feet high, but covered on hillside, silty, bedding moderately gnarly with silty partings.	22	157

Calcarenite, coarse, thin-bedded, forms about 30 percent of rock, shaly interbeds not exposed.	40	135
Calcarenite, fine, massive, ledge forming.	4	95
Covered.	11	91
Calcisiltite and calcarenite, silty thick-bedded, forms the highest ledge in creek bottom, a one foot brownish- to bluish-gray bedded replacement chert bed in the middle.	8	80
Calcarenite, coarse, thin-bedded, with cherty and siliceous beds.	20	72
Calcarenite, coarse, medium gray, thin-bedded, low ledges with shaly interbeds, sponge-like forms cf. *Receptaculites elongatus* Walcott, cystid stem segments, gastropod impressions.	36.5	52
Calcisiltite, medium gray, siliceous silt-parted, capped by a 2 foot bed of massive calcarenite.	10.5	15.5
Calcisiltite, medium gray, thin-bedded, very silty, siliceous to cherty, ledge forming, (Mc-1) *Kirkella* cf. *vigilans* Whittington *Isoteloides* sp. identified from silicified fragments. These are the lowest beds exposed on this hillside.	5	5

SUNNYSIDE SECTION NEVADA: This section is located in T. 7 N., R. 62 E., on the crest of the large spur which projects westward from the face of the Egan Range about six miles north of the ranch at Sunnyside. The spur is immediately south of the Cave Valley road and just north of Whipple Cave. Beds dip 38°, S. 50° E.

Upper Ordovician Dolomite: Not measured. Overlies Eureka quartzite apparently conformably, base somewhat siliceous.

Eureka Quartzite:		
Sandstone, weathers gray, contains nodular quartzite masses, grading into white quartzite below.	23'	513'
Quartzite, white, alternating smooth-surfaced and cross-laminated, grainy-surfaced.	352	490
Sandstone, white.	3	138
Quartzite, white, laminated and cross-laminated with silt and shale partings at the base, becoming more massive and grainy-surfaced toward top.	135	135
Dolomite Member:		
Dolomite, brownish-gray, thin-bedded silty, weathering to pale red-orange, forms low ledges to base of quartzite.	65	65
Lehman Formation:		
Calcilutite, medium gray, weathers bluish-gray, thin-bedded, forms low ledges, yellowish-gray on silty bedding partings. Fossiliferous with orthid brachiopods in upper third. (S-20) at 565 feet to 587 feet.	105	587
Calcilutite, as above, but thick-bedded, cliff forming. Grades laterally into dolomite. Unfossiliferous.	95	482

Calcilutite, medium gray, weathers medium bluish-gray, thin-bedded, silty partings, gastropod outlines abundant in some beds but not identifiable.	62	387
Calcilutite, dark gray, with white calcite stringers.	3	325
Calcilutite, medium gray, weathers bluish-gray, thin-bedded, forms low ledges and slopes, few coarser-textured beds, silty partings, wavy bedding planes, <u>Leperditia</u> abundant in few horizons. (S-19) at 112 feet.	235	322
Calcitite, gray, with pink-stained silty partings, somewhat-fractured and veined with white calcite, thick-bedded, ledge forming. These are the lowest ledges on the east side of the saddle below the Eureka quartzite.	87	87

Kanoshian:

Covered. In saddle bottom, float indicates thin-bedded siltstone and calcarenite. On slope below Lehman formation rubbly float indicates medium gray, gnarly-bedded calcisiltite.	256	613
Calcisiltite, medium gray, thin-bedded, <u>Receptaculites</u> <u>mammillaris</u> Walcott.	2	357
Siltstone, thin-bedded, yellow and pink.	16	355
Calcisiltite, abundant <u>Receptaculites</u> <u>mammillaris</u> and <u>R</u>. <u>elongatus</u>. These beds are at the crest of a small ridge in the middle of the innermost saddle below the Eureka.	4	339
Siltstone, thin-bedded, yellowish and pinkish-gray weathering	13	335
Calcisiltite, thin-bedded with shaly and silty interbeds, rubbly and unfossiliferous.	194	322

Calcisiltite, medium-gray beds up to one foot thick form about 20 percent of strata with interbeds of yellowish and pinkish-gray weathering silty shaly calcisiltite. The top of these beds is at the westernmost low on the inner broad saddle.	128	128
Juab Limestone:		
Calcisiltite, medium gray, thin- to thick-bedded, <u>Orthis</u> sp. indet. and <u>Pliomerops</u> sp. indet. common. (S-18) at 120 feet.	130	170
Calcisiltite, medium gray, medium-bedded, siliceous nodular masses abundant. The base of this unit is at the top of the first major crest west of the hillfront.	40	40
Wahwah Limestone:		
Calcisiltite, medium gray, mostly thick-bedded but with a few thin beds, silty, with thin siliceous nodular masses, very fossiliferous. (S-17) from 261 feet to 341 feet. Forms cliff at top of hogback.	80	341
Calcisiltite, and coarse calcarenite, thick-bedded, with interbeds of very thin-bedded yellowish-weathering shaly calcisiltite; fossiliferous; cliff forming. (S-16) at 212 feet.	49	261
Calcisiltite, medium gray, thin-bedded, silty, forming eastern slope of middle saddle; fossils abundant but poorly preserved (S-14) at 21 feet, (S-15) at 121 feet.	206	212
Calcisiltite, medium gray, thick-bedded, silty partings, weathers yellowish-gray; forms ledge in middle saddle.	6	6
Fillmore Limestone:		
Calcisiltite, medium gray, very thin-bedded, rubbly, slope	49	1151

forming, with brownish-weathering shaly material. (S-13) at 1151 feet.		
Calcisiltite, gray, thick-bedded, contains 5 percent chert in small bedding nodules; westernmost ledge in middle saddle.	5	1102
Calcarenite, coarse, with interbeds of intraformational conglomerate and very thin-bedded shaly calcisiltite. (S-12) at 1077 feet.	70	1097
Calcisiltite, gray, thin-bedded, siliceous, silty and cherty, most beds weather gray with silty partings, some weather yellowish and pinkish, chert more prominent toward base as nodules and bedding replacements; toward top are some beds of intraformational conglomerate. Forms backslope with dip changing from 38° at top of hogback (902 feet) to 30° at base of backslope (1027 feet). Gastropod impressions common. (S-11) at 1022 feet.	125	1027
Calcisiltite, gray, thick-bedded, with 20 percent pinkish-gray chert; (S-10) at 882 feet indet. From 742 feet to 902 feet forms the cliff face of the second hogback west of the Eureka cliffs.	55	902
Calcisiltite, thin-bedded, without chert, forms weak shelf zone in cliff.	35	847
Calcisiltite, gray, thick-bedded, with about 30 percent pinkish chert as irregular-bedded nodules. Forms resistant cliff.	50	812
Calcisiltite, thin-bedded, quartz silty to siliceous; (S-9) at 742 feet. This is the base of the second hogback cliff.	20	762
Calcisiltite, medium gray, thin-bedded, silty to siliceous, weathering medium brown with	30	742

silty material etching to "chicken-wire" pattern. Lingulid brachiopods.		
Covered, very thin-bedded shaly calcisiltite float.	70	712
Calcisiltite, medium gray, thick- to thin-bedded, laminated in some layers, with 5 percent chert as large light pinkish-gray nodules, silty to siliceous. (S-8F) at 562 to 642 feet.	80	642
Intraformational conglomerate, with interbeds of calcisiltite with 10 percent brown weathering replacement chert in beds up to 3 inches, and as large elongate nodules cutting bedding. (S-7F) at 472 feet.	110	562
Intraformational conglomerate, medium gray, thin-bedded, with yellowish-gray-weathering shaly interbeds; forms slopes.	244	452
Intraformational conglomerate, medium gray, thin-bedded, beds composed of fragmental trilobite material. Dip of beds steepens along bottom of saddle up to 76°, then flattens.	63	208
Intraformational conglomerate, thin and thick-bedded, medium gray, subangular pebbles up to 2 inches long in calcisiltite matrix, quartz silty. Occasional olive-gray shale interbeds. (S-6) at 142 feet.	145	145
House Limestone:		
Calcisiltite, medium gray, alternating thick and very thin-bedded, thin beds are quartz silty, weathering yellowish and pinkish-gray: thick beds are 5 percent cherty in large pinkish nodules and contain beds of intraformational conglomerate. Bottom of westernmost saddle is 528 feet.	158	528

Calcisiltite, medium gray, thin-bedded, chert in upper 2 feet in large irregular masses comprises 10 percent of beds; chert in lower 5 feet bedded, comprising 5 percent of rock. Ledge forming. (S-5) at 360 feet. "S-1" marked on ledge at 363 feet in yellow paint. This fossil locality is at base of dipslope.	7	370
Calcisiltite, medium gray, thin-bedded, slightly silty, platy talus, with 5 percent chert in large light brown-weathering bedded nodules. Even bedding, good exposures on dipslope. (Su-2) at 288 feet, (Su-3) at 316 feet.	158	363
Calcisiltite, medium light gray, thick-bedded, ledge forming, with 10 percent chert as light pinkish-bedded nodules and replacement layers up to 6 inches thick. The top of the westernmost large hogback is at 205 feet. (Su-1) at 180 feet.	160	205
Calcisiltite, medium gray, thin-bedded, with 5 percent chert as thin bedding plane nodules. Base of the House limestone taken at the top of the highest dolomite bed.	45	45

Upper Cambrian ? Dolomite:

Dolomite, medium gray, speckled and banded, mostly thick-bedded; with three calcilutite horizons each 15 to 20 feet thick, unfossiliferous.		590
Dolomite, mottled tiger-striped, dark to light medium gray, with 30 percent pinkish-gray chert in small elongate nodules in the cliff forming lower 100 feet. Upper beds contain brecciated zones suggesting that thickness of dolomite may be excessive due to faulting. Dolomite is unfossiliferous.		1200

Upper Cambrian:

Calcisiltite and calcarenite, weathers medium dark to medium light gray, forms ledges and cliffs. Fossiliferous layers bear Upper Cambrian trilobites and brachiopods, some calcisiltite beds show cross-lamination. (Su-4) at 750 feet, (S-3) at 700 feet, (S-2) at 620 feet, (S-1) at 450 feet. 760

SUNNYSIDE SECTION FAUNULES: (a) abundant; (c) common; (r) rare. S-1, S-2, S-3, Su-4 - all _Upper Cambrian_ faunas.

Su-1 _Symphysurina_ cf. _S_. _cleora_ (Walcott)(a), _Nanorthis_ sp. (c)

Su-2 _Hystricurus genalatus_ Ross (a) _Symphysurina_ cf. _S_. _globocapitella_ Hintze (r), _Pseudokainella_ ? sp. (r), _Schizambon_ sp. (r), _Nanorthis_ sp. (r).

Su-3 _Kainella_ n. sp. cf. _K_. _inexpectans_ (Walcott) (a), _Leiostegium manitouensis_ Walcott (r), _Apatokephalus finalis_ (Walcott) (r), _Schizambon_ sp. (c), _Nanorthis_ cf. _N_. _hamburgensis_ (Walcott) (c).

S-5 _Kainella_ sp. indet. (c), _Nanorthis_ sp. (a), _Symphysurina_ sp. (r).

S-6 _Kayseraspis_ cf. _K_. _asaphelloides_ Harrington (a).

S-7F _Licnocephala_ ? _cavigladius_ Hintze ? (r), _Asaphellus_ ? _venta_ Hintze (r), _Nanorthis_ ? sp. (c).

S-8 _Pseudonileus_ sp. (r), _Nanorthis_ ? sp. (r).

S-9 _Nanorthis_ ? sp. (c), _Schizambon_ ? sp. (r).

S-10 indet. fragments.

S-11 _Trigonocerca typica_ Ross (a).

S-12 *Trigonocerca typica* Ross (a). (Silicified fragments only).

S-13 elongate sponge ? cf. *Receptaculites elongatus* Walcott (a), *Hesperonomia* sp. (c).

S-14 Pseudocybele sp. indet. (r).

S-15 *Hesperonomia* sp. (c), cystid plates (c).

S-16 *Pseudocybele nasuta* Ross (r), *Pseudomera* cf. *P. insolita* (Poulsen) (c), *Cybelopsis* cf. *C. speciosa* Poulsen (c), *Lachnostoma latucelsum* Ross (c), *Hesperonomia* sp. (c), bryozoan ? indet. (r), cystid plates (c).

S-17 *Pseudocybele nasuta* Ross (r), *Pseudomera* cf. *P. insolita* (Poulsen) (c), *Cybelopsis* cf. *C. speciosa* Poulsen (c), *Lachnostoma latucelsum* Ross (c), *Dimeropygiella caudanodosa* Ross (c), *Kirkella declivita* Ross (r), *Hesperonomia dinorthoides* Ulrich and Cooper (c), *Tritoechia* sp. (r), *Endoceras* sp. (r), cystid plates. (c).

S-17A *Pseudomera* cf. *P. insolita* Poulsen (c), Cybelopsis cf. C. speciosa Poulsen (c), *Goniotelus brevus* Hintze (c), cystid plates (c).

S-17B *Lachnostoma latucelsum* Ross (c).

S-18 *Pseudomera* sp. indet., *Orthis* sp. indet.

S-19 *Leperditia* sp. (a), small finely costellate brachiopod - indet. (c).

S-20 *Orthis* sp. (a).

WHITE PINE RANGE SECTION, NEVADA: Looking eastward from the Green Springs Ranch - Duckwater road toward the northernmost mass of Duck-water Mountain in the White Pine Range one can see the prominent light pinkish colored Eureka quartzite about halfway up of the mountain face. Below the quartzite are exposed Cambrian and Ordovician limestones. The Black Rock Canyon road goes to within about a mile of the lowest Ordovician ourcrops which are readily reached by walking up canyon from the end of the road. I am indebted to Dr. F. L. Humphrey for informing me of the location of this excellent section. According to Dr. Humphrey who has made a restudy of the White Pine mining district a few miles north of here, the type Pogonip limestone in the mining district is much faulted, obscuring the exact stratigraphic thickness there. The section described below is in T. 13 N., R 58 E., and shows prominently on aerial photograph GS FE 2-205 (9-13-47). The beds dip 43°, N. 55°E.

	I	II
Eureka Quartzite:		
Quartzite, white, weathering pink, thick-bedded.	385'	465'
Sandstones and shales with thin quartzite intercalcations.	80	80
Dolomite Member:		
Dolomite, medium dark gray, weathers brownish-gray and yellowish-gray thick-bedded, ledge forming, cherty in upper few feet. Contact with quartzite obscured by talus.	27	27
Lehman Formation:		
Calcilutite, banded light and dark gray, silty, thick-bedded. Eofletcheria bed about 1 1/2 feet thick at 382 feet (WP-10). Poor impressions of high spired gastropods and orthid brachiopods abundant.	72	397

Calcilutite, medium dark gray, silty, weathers mottled, thick-bedded, forms ledges beneath quartzite cliffs. (WP-9B) at 275 feet, (WP-9A) at 264 feet.	63	325
Calcilutite, medium gray, weathers bluish-gray, silty, thin- to thick-bedded, step ledge and slope forming, *Leperditia* sp., *Pseudomera* sp.	94	262
Calcilutite, weathering bluish-gray, silty, forms continuous ourcrops on hillside but not ledges, (WP-9) at 84 feet.	168	168

Kanoshian:

Covered. (WP-8F) from 420 feet to 450 feet.	111	510
Calcilutite, bluish-gray, silty chert as bedding nodules, ledge forming.	75	399
Calcilutite, bluish-gray, silty, thick-bedded, step ledge forming, (WP-7) at 324 feet.	60	324
Calcisiltite, medium gray, weathers yellowish-orange, silty, thin-bedded, slope forming.	54	264
Calcisiltite, medium gray, weathers yellowish-orange, silty, calcarenitic in part, *Receptaculites elongatus* Walcott common.	54	210
Calcisiltite, gray, thick-bedded, silty, *Receptaculites mammillaris* Walcott and *R. elongatus* Walcott abundant in upper 5 feet, from 140 to 210 feet ledge forming, capping the first prominent hogback west of the Eureka quartzite cliff. (WP-6) at 153 feet.	16	156

Covered, traverse crosses bottom of side canyon at the east side of which is the <u>Receptaculites</u> ledge above. This zone is also covered on the opposite slope across the main canyon, probably denoting weak beds.	140	140
Juab Limestone?:		
Calcilutite, medium gray weathering reddish-gray, medium-bedded, ourcrops form ledgy dipslope along side canyon.	113	113
Wahwah Limestone:		
Calcilutite, pale red-purple, thick-bedded, ledge forming west slope of most prominent hogback of the Eureka quartzite cliffs.	65	383
Calcarenite, purplish-gray, massive, thick-bedded, forming lower part of resistant hogback.	48	318
Calcisiltite, rubbly float. (WP-5F).	40	270
Covered, float indicated thin-bedded shaly, silty limestones with occasional fossil fragments. <u>Pseudomera</u> sp.	218	230
Calcisiltite, medium gray, siliceous, thick-bedded, ledge forming, fossiliferous. (WP-5) at 8 feet.	12	12
Fillmore Limestone:		
Calcisiltite, medium gray, weathers yellowish-gray, with 10 percent bedded replacement chert, blocky talus, poor outcrops; 14 inch chert bed at 1230 feet.	77	1294

Calcisiltite, medium gray, weathers dark yellowish-orange, quartz silty, thin-bedded, platy talus, occasional 6 inch ledges outcrop, some showing poorly preserved gastropod impressions.	83	1217
Calcisiltite, medium gray, silty, with 30 percent chert as regularly bedded layers up to 2 inches spaced about 2 feet apart and in irregular bedding replacement masses. Lower 10 feet thin-bedded reentrant forming, upper beds cliff forming.	34	1134
Calcisiltite, medium dark gray, with 30 percent irregularly bedded chert nodules; thick-bedded, forms prominent ledge on both sides of canyon.	64	1100
Calcisiltite, medium dark gray, weathers yellowish and dark yellowish-orange, thin-bedded, slope forming.	28	1036
Calcisiltite, medium gray, weathers yellowish-gray, silty siliceous, "chicken-wire" weathering, very thick-bedded, forms ledge continuous on both sides of canyon.	17	1008
Limestones, mostly calcisiltite, weathering orange-brown; silty, very thin-bedded, slope forming, few outcrops; (WP-4) at 916 feet.	222	991
Calcisiltite, medium gray, weathers yellowish-gray, silty, cherty thick-bedded, forming lowest conspicuous ledge on both sides of canyon. Siliceous material is about one-third of rock as chert and siliceous partings; shaly silt-	112	769

stone beds up to 2 feet, form re-entrants under thick-bedded calcisiltite, some calcilutite, calcarenite, and intraformational conglomerate. (WP-3) at 657 feet.		
Covered, intraformational conglomerate float. This covered zone is occupied by a side stream.	237	657
Intraformational conglomerate, thin-bedded, with 25 percent interbeds of silty, platy calcisiltite, and 25 percent interbeds of more massive calcilutite.	80	420
Intraformational conglomerate and interbedded calcisiltite and calcarenite, thin-bedded, platy, light medium gray; (WP-2) at 320 feet.	92	340
Intraformational conglomerate, medium gray, thin-bedded, with 5 percent chert.	24	248
Chert, orangish-brown, irregular mass continuous along bedding forming ledge.	2	224
Calcisiltite and intraformational conglomerate, interbedded, medium gray, silty, with 10 percent chert as irregular bedding masses.	58	222
Intraformational conglomerate, medium gray, thick-bedded, ledge forming, with 5 percent chert.	5	164
Intraformational conglomerate, medium gray, silty calcisiltite pebbles in calcisiltite, slope forming, thin-bedded.	89	159
Calcilutite, medium gray, thick-bedded, with 10 percent yellowish-brown chert in bedding.	4	70
Covered, platy silty calcisiltite float, little chert.	64	66
Intraformational conglomerate, silty pebbles up to 1 1/2 inches long in calcisiltite matrix.	2	2

House Limestone:

Covered, cherty platy calcisiltite float.	98	266
Chert, yellowish-gray, irregular masses and large-bedded nodules.	2	168
Calcisiltite, medium gray, with 10 percent black chert nodules.	6	166
Covered, platy limestone float.	12	160
Calcisiltite, medium gray, thin-bedded, with 10 percent black bedded chert nodules, slope forming.	65	148
Calcisiltite, with chert as above but thick-bedded, ledge forming.	20	83
Covered, thin-bedded, platy, silty calcisiltite float.	58	63
Calcilutite, medium gray, massive ledge forming, with 5 percent black chert nodules. Thin layers bear trilobites. (WP-1).	5	5

Immediately underlying the above beds conformably are light gray unfossiliferous dolomites.

WHITE PINE RANGE SECTION FAUNULES: (a), abundant; (c), common; (r), rare.

WP-1 <u>Symphysurina</u> cf. <u>S</u>. <u>cleora</u> (Walcott) (a), <u>Symphysurina</u> cf. <u>S</u>. <u>woosteri</u> Walcott (c), <u>Hystricurus</u> sp. (r), <u>Geragnostus</u> sp. (c), <u>Pseudokainella</u> ? sp. (c), <u>Nanorthis</u> ? sp. (c), <u>Schizambon</u> ? sp. (c), <u>Acrotreta</u> sp. (r).

WP-2 <u>Leiostegium</u> <u>manitouensis</u> Walcott (c), <u>Hystricurus</u> sp. (r), <u>Pseudoclelandia</u> sp. (c), <u>Syntrophina</u> sp. (c), <u>Apheoorthis</u> ? sp. (c).

WP-3 <u>Asaphellus</u> ? <u>venta</u> Hintze (a).

WP-4 <u>Kirkella</u> cf. <u>K</u>. <u>accliva</u> Hintze (r).

WP-5 Kirkella sp. (c), Isoteloides sp. (r), Paranileus sp. (r), Hesperonomia sp. (c).

WP-5F Lachnostoma latucelsum Ross (c), Pseudomera sp. cf. P. insolita (Poulsen) (r), Goniotelus brevus Hintze (c), Hesperonomia sp. cf. H. dinorthoides Ulrich and Cooper (c).

WP-6 Receptaculites mammillaris Walcott (c), Receptaculites elongatus Walcott (r).

WP-7 Bathyurellus pogonipensis Hintze.

WP-8F Cybelopsis sp. (c), Illaenus sp. (c), Barrandia ? sp. (c), Anomalorthis sp. (c), Orthis sp. (c), Leperditia sp. (c), large branching bryozoa (c).

WP-9 Cybelopsis sp. (c), Anomalorthis sp. (c), Barrandia ? sp. (c), Leperditia sp. (c), branching bryozoa.

WP-9A Leperditia sp. (a), Anomalorthis sp. (c), Cybelopsis sp. (r).

WP-9B Coarsely costellate Orthis sp. (a).

WP-10 Eofletcheria sp.

PLATES I TO XXVIII*

All specimens, except those already dark, were blackened with dilute india ink; all were then whitened with ammonium chloride just before photographing them against a black background. Photographs were taken with a standard laboratory plate camera with ground glass focusing using a Tessar 1:3.5, 4.0 cm. lens for magnifications above three power and a Dagor 1:6.8, 12.5 cm. lens for those under three power. A balanced three-source lighting system was employed. Commercial Ortho film was used and most of the prints were made on F-1 Velox paper. No photographs have been retouched other than to black out the mounting pins or rock matrix.

All numbered type specimens have been deposited in the collections of Columbia University, New York. For ease of reference the trilobite genera have been listed alphabetically by genus in the text.

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*Note by the editor:

The plates, with their descriptions, have been inserted at this point rather than at the end of the book for three reasons:

1. They are the most valuable part of this monograph.
2. They will be more readily seen by the casual "browser" and hence more likely to be consulted if placed here than if they were placed at the end of the book in the more orthodox fashion.
3. It is believed that the plates will be better preserved if they are placed near the middle of the book rather than at the end.

It is hoped that the reader will not resent the possible inconvenience of the partial break in the sequence of treatment occasioned by this arrangement.

Arthur L. Crawford

PLATE I

1-9 *Symphysurina globocapitella* Hintze, n. sp. Loc. E-13. Zone B (high) (p.232).

1a,b,c, Holotype, cranidium, x4, front, dorsal, and side views, 26068.

2a,b, Paratype, free cheek, x5, dorsal and ventral views, 26070.

3a,b,c, Paratype, cranidium, x5, front, dorsal, and side views, 26069.

4a,b, Paratype, free cheek, x8, dorsal and ventral views, 26071.

5a,b, Paratype, cranidium, x6, ventral and dorsal views, 26072.

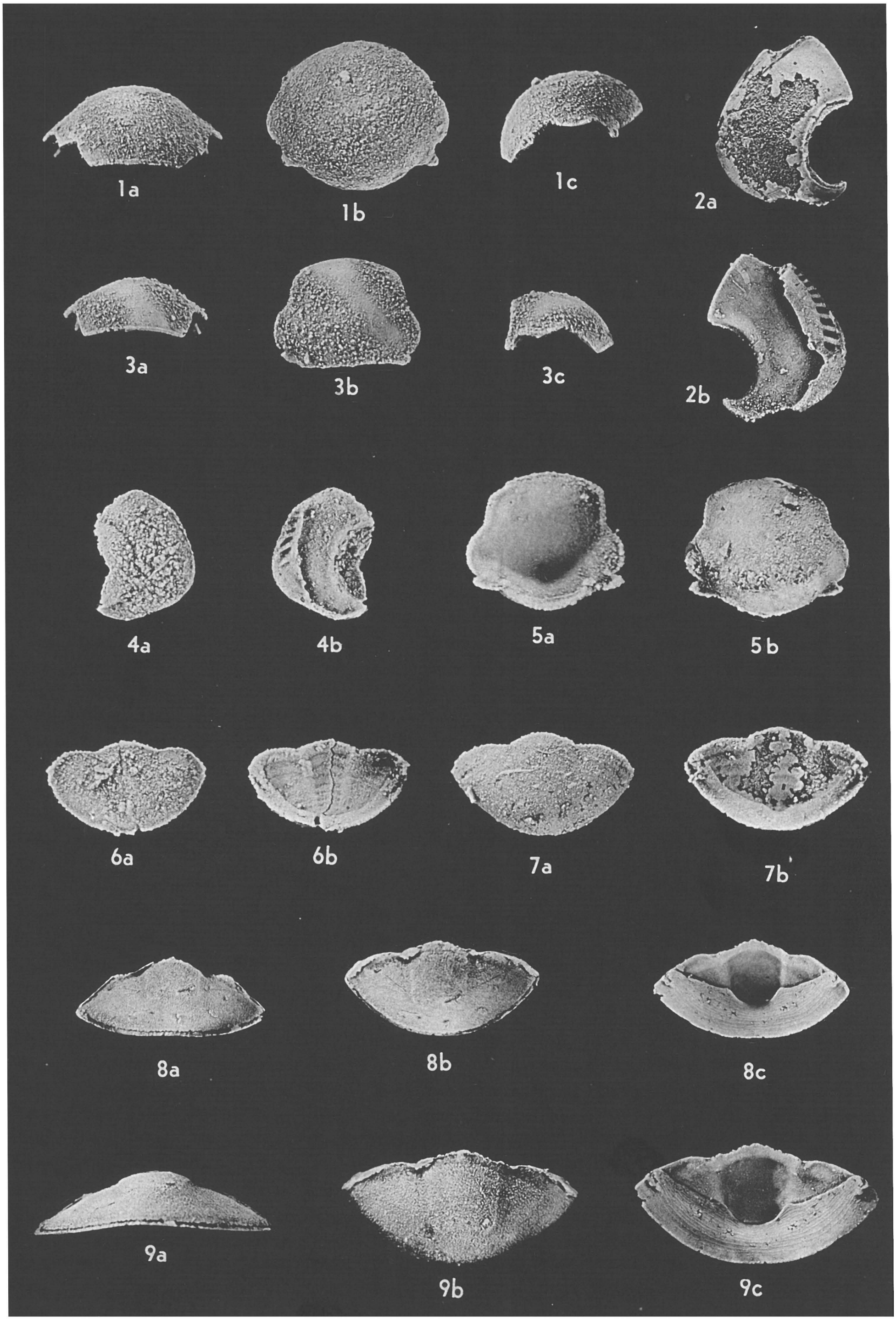
6a,b, Paratype, pygidium, x8, dorsal and ventral views, 26073.

7a,b, Paratype, pygidium, x8, dorsal and ventral views, 26074.

8a,b,c, Paratype, pygidium, x3, posterior, ventral, and dorsal views, 26075.

9a,b,c, Paratype, pygidium, x4, posterior, ventral, and dorsal views, 26075.

Note: (p.232) refers to the specific description in the text.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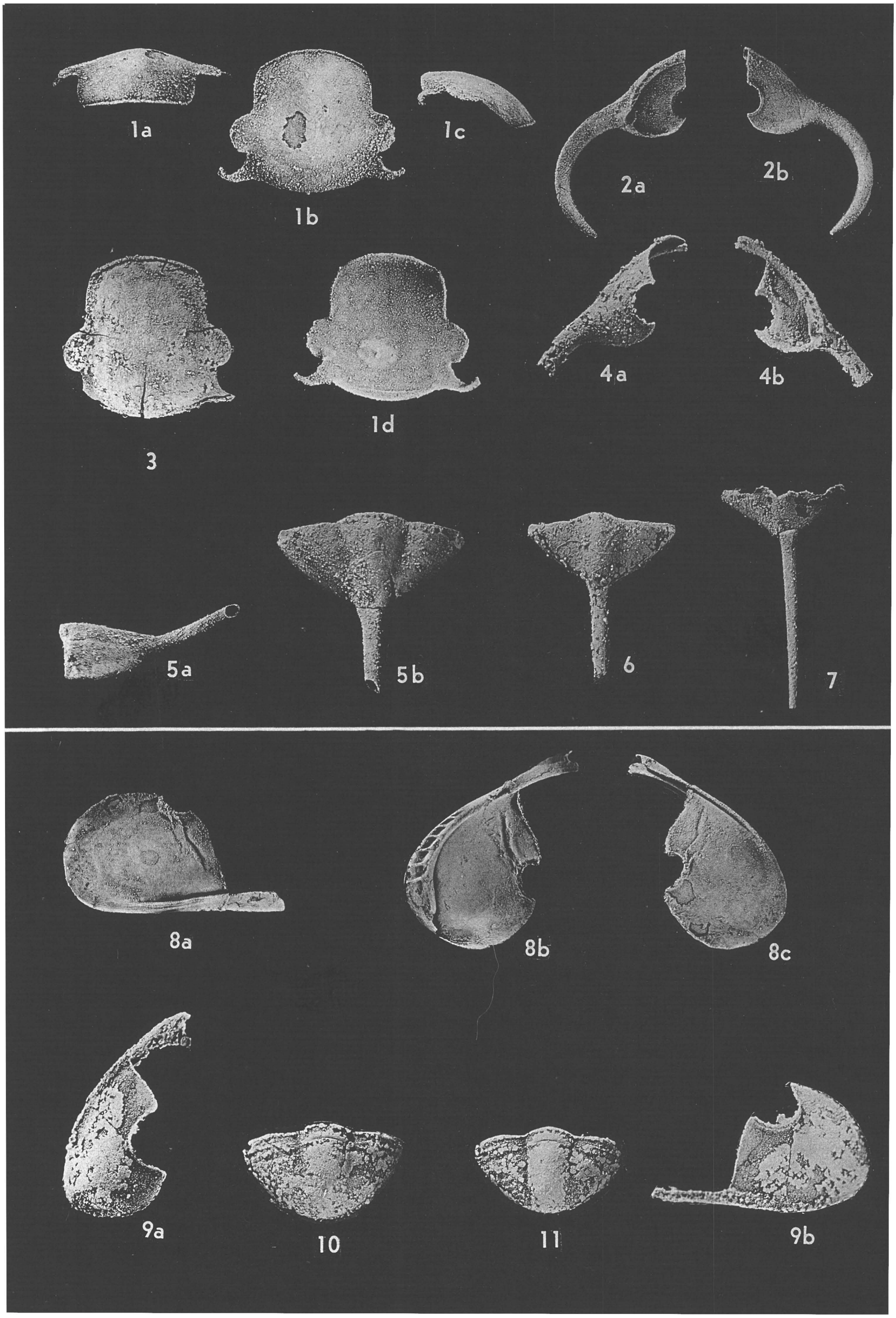
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PLATE II

<u>Symphysurina</u> <u>uncaspicata</u> Hintze, n. sp., Loc. E-3A. Zone B. (p.233).

1a,b,d, Holotype, cranidium, x 2 1/2, 1c, x2, front, dorsal, side and ventral views, 26076.

2a,b, Paratype, free cheek, x2, ventral and dorsal views, 26077.

3, Paratype, cranidium, x2, dorsal view, 26078.

4a,b, Paratype, free cheek, x4, dorsal and ventral views, 26080.

5a,b, Paratype, pygidium, x2, side and dorsal views, 26079.

6, Paratype, pygidium, x3, dorsal view, 26081.

7, Paratype, pygidium, x3, dorsal view, 26082.

<u>Symphysurina</u> cf. <u>S</u>. <u>cleora</u> (Walcott), Loc. B-1. Zone B. (p.234).

8a,b,c, Free cheek, x1, side, ventral, and dorsal views, 26083.

9a,b, Free cheek, x5, dorsal and side views, 26084.

10, Pygidium, x5, dorsal view, 26085.

11, Pygidium, x5, dorsal view, 26086.

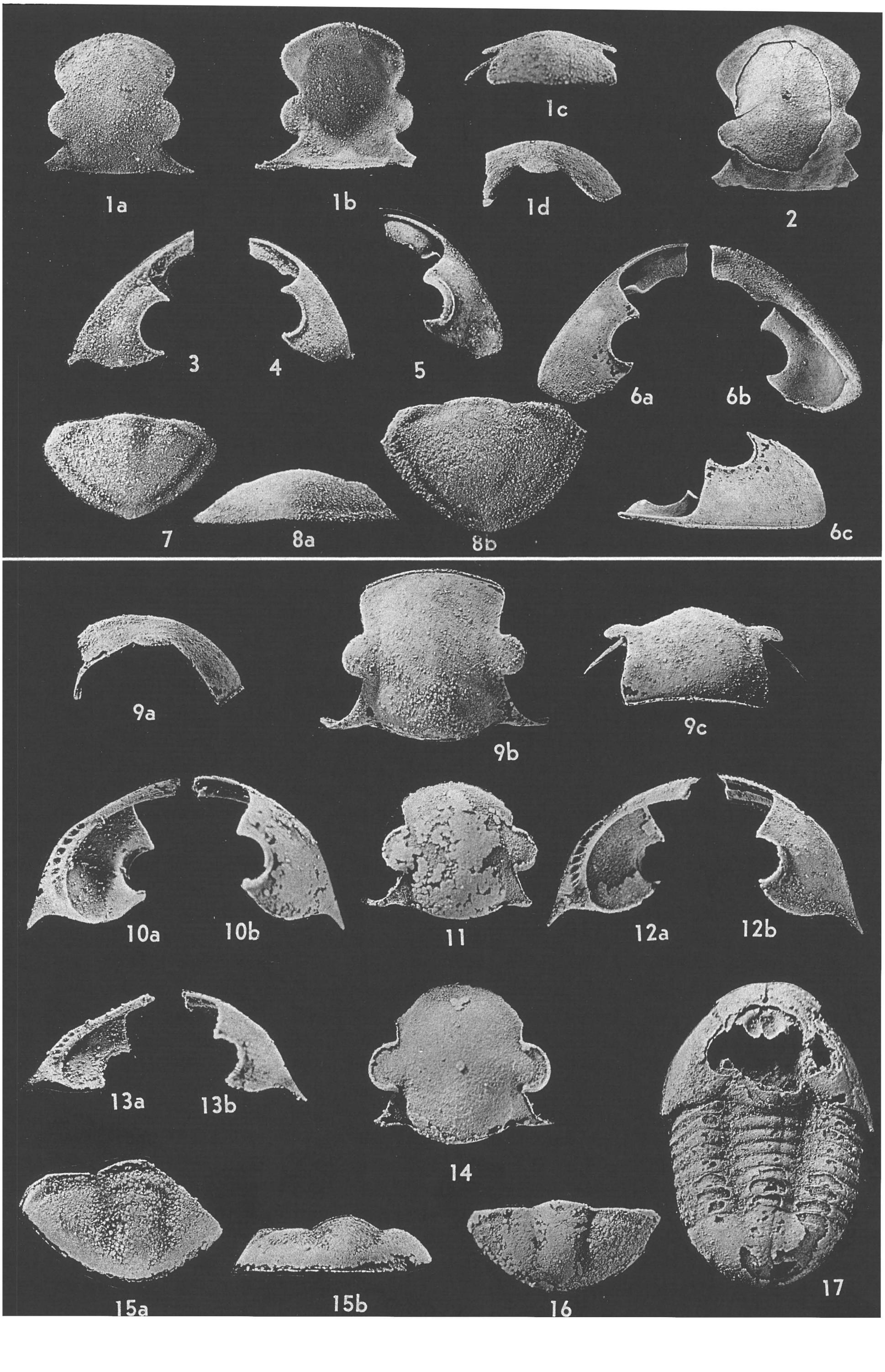
PLATE III

1-8 <u>Parabellefontia</u> <u>concinna</u> Hintze, n. gen., n. sp. Loc. B-12. Zone B. (p.194).

1a,b,c,d, Holotype, cranidium, x3, dorsal, ventral, front, and side views, 26087.
2, Paratype, cranidium, x1, dorsal view, 26088.
3, Paratype, free cheek, x4, dorsal view, 26089.
4, Paratype, free cheek, x3, dorsal view, 26090.
5, Paratype, free cheek, x2, dorsal view, 26093.
6a,b,c, Paratype, free cheek, x2, dorsal, ventral, and side views, 26092.
7, Paratype, pygidium, x4, dorsal view, 26091.
8a,b, Paratype, pygidium, x 2 1/2, posterior and dorsal views, 26094.

9-17 <u>Symphysurina</u> <u>brevispicata</u> Hintze, n. sp. Loc. B-1. Zone B. (low) (p.236).

9a,b,c, Paratype, cranidium, x2, side, dorsal, and front views, 26095.
10a,b, Paratype, free cheek, x4, ventral and, dorsal views, 26096.
11, Paratype, cranidium, x4, dorsal view, 26097.
12a,b, Paratype, free cheek, x3, ventral and dorsal views, 26100.
13a,b, Paratype, free cheek, x4, ventral and dorsal views, 26098.
14, Paratype, cranidium, x4, dorsal view, 26101.
15a,b, Paratype, pygidium, x 1 1/2, dorsal and posterior views, 26102.
16, Paratype, pygidium, x4, dorsal view, 26099.
17, Holotype, carapace, x 2.8, ventral view, 26400.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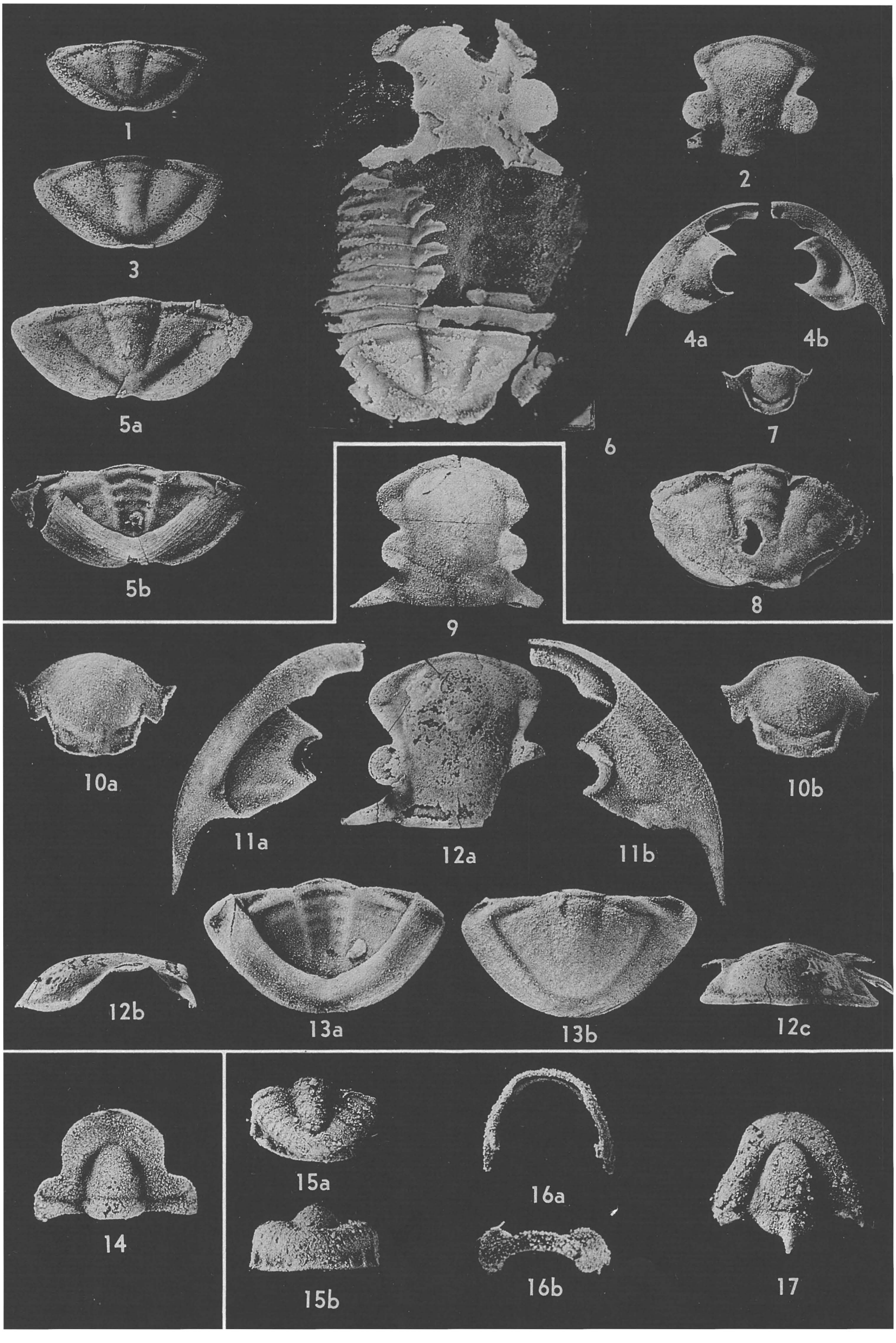

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PLATE IV

1-8 Bellefontia ibexensis Hintze, n. sp. All Loc. E-10 except 5, Loc. A-8, and 6, Loc. E-9. Zone B. (p.141).

1, Paratype, pygidium, x2, dorsal view, 26103.
2, Paratype, cranidium, x2, dorsal view, 26107.
3, Holotype, pygidium, x2, dorsal view, 26108.
4a,b, Paratype, free cheek, x2, dorsal and ventral views, 26105.
5a,b, Paratype, pygidium, x2, dorsal and ventral views, 26109.
6, Paratype, incomplete carapace, x3, dorsal view, 26110.
7, Paratype, hypostome, x2, dorsal view, 26104.
8, Paratype, pygidium, x 1 1/2, dorsal view, 26111.

9-13 Bellefontia chamberlaini Clark. Loc. E-11. Zone B. (p.142).

9, Cranidium, x2, dorsal view, 26112.
10a,b, Hypostome, x2, dorsal and ventral views, 26113.
11a,b, Free cheek, x2, ventral and dorsal views, 26114.
12a,b,c, Cranidium, x 1 1/2, dorsal, side, and front views, 26115.
13a,b, Pygidium, x2, ventral and dorsal views, 26116.

14 Pseudoclelandia aff. P. fluxafissura Ross. Loc. C-5. Zone E. Cranidium, x6, dorsal view, 26117. (p.214).

15-17 Clelandia utahensis Ross. Loc. E-7. Zone B. (p.147).

15a,b, Pygidium, x6, dorsal and posterior views, 26118.
16a,b, Free cheek unit, x6, dorsal and front views, 26119.
17, Cranidium, x6, dorsal view, 26120.

PLATE V

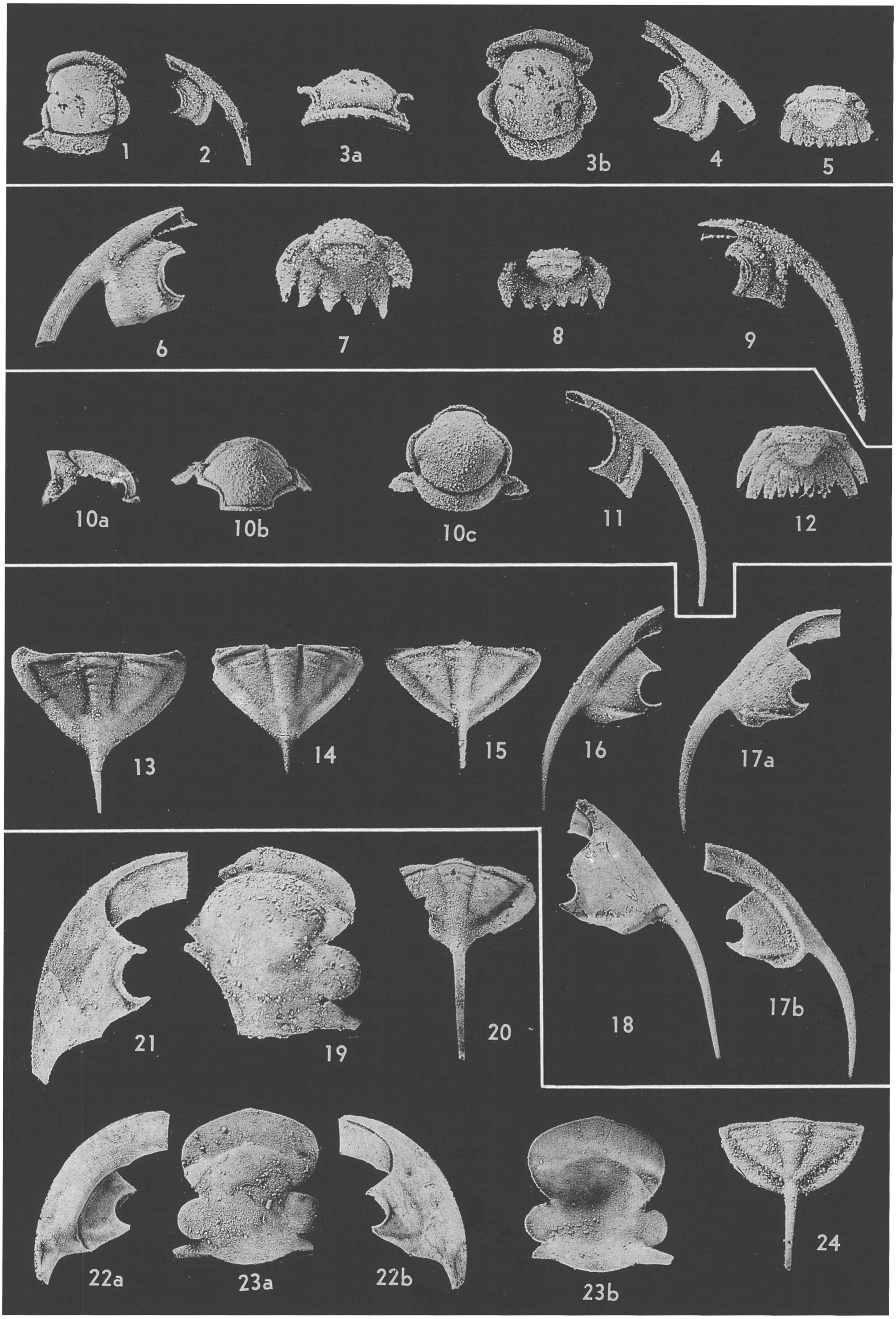
1-5 Pseudokainella ? armatus Hintze, n. sp. Loc. E-13. High in zone B. (p.218).
1, Paratype, cranidium, x3, dorsal view, 26122.
2, Paratype, free cheek, x4, dorsal view, 26123.
3a,b, Holotype, cranidium, x4, front and dorsal views, 26121.
4, Paratype, free cheek, x3, dorsal view, 26124.
5, Paratype, pygidium, x4, dorsal view, 26125.

6-9 Pseudokainella ? sp. A. All Loc. E-7 except 6, Loc. E-10. Zone B. (p.219).
6, Free cheek, x3, dorsal view, 26126.
7, Pygidium, x6, dorsal view, 26127.
8, Pygidium, x6, dorsal view, 26128.
9, Free cheek, x6, dorsal view, 26129.

10-12 Remopleuridiella caudalimbata Ross. All Loc. E-10 except 10, Loc. E-11. Zone B. (p. 229).
10a,b,c, Cranidium, x4, side, front and dorsal views, 26130.
11, Free cheek, x4, dorsal view, 26131.
12, Pygidium, x4, dorsal view, 26132.

13-18 Xenostegium franklinense Ross. All Loc. B-12 except 17, Loc. E-11. Zone B. (p. 240).
13, Pygidium, x2, dorsal view, 26133.
14, Pygidium, x2, dorsal view, 26134.
15, Pygidium, x3, dorsal view, 26135.
16, Free cheek, x3, dorsal view, 26136.
17a,b, Free cheek, x2, dorsal and ventral views, 26137.
18, Free cheek, x1, dorsal view, 26138.

19-24 Xenostegium cf. X. acuminferentis (Ross). Loc. E-10. Zone B. (p.241).
19, Cranidium, x 2 1/2, dorsal view, 26139.
20, Pygidium, x4, dorsal view, 26140.
21, Free cheek, x2, dorsal view, 26143.
22a,b, Free cheek, x2, ventral and dorsal views, 26144.
23a,b, Cranidium, x4, dorsal and ventral views, 26141.
24, Pygidium, x6, dorsal view, 26142.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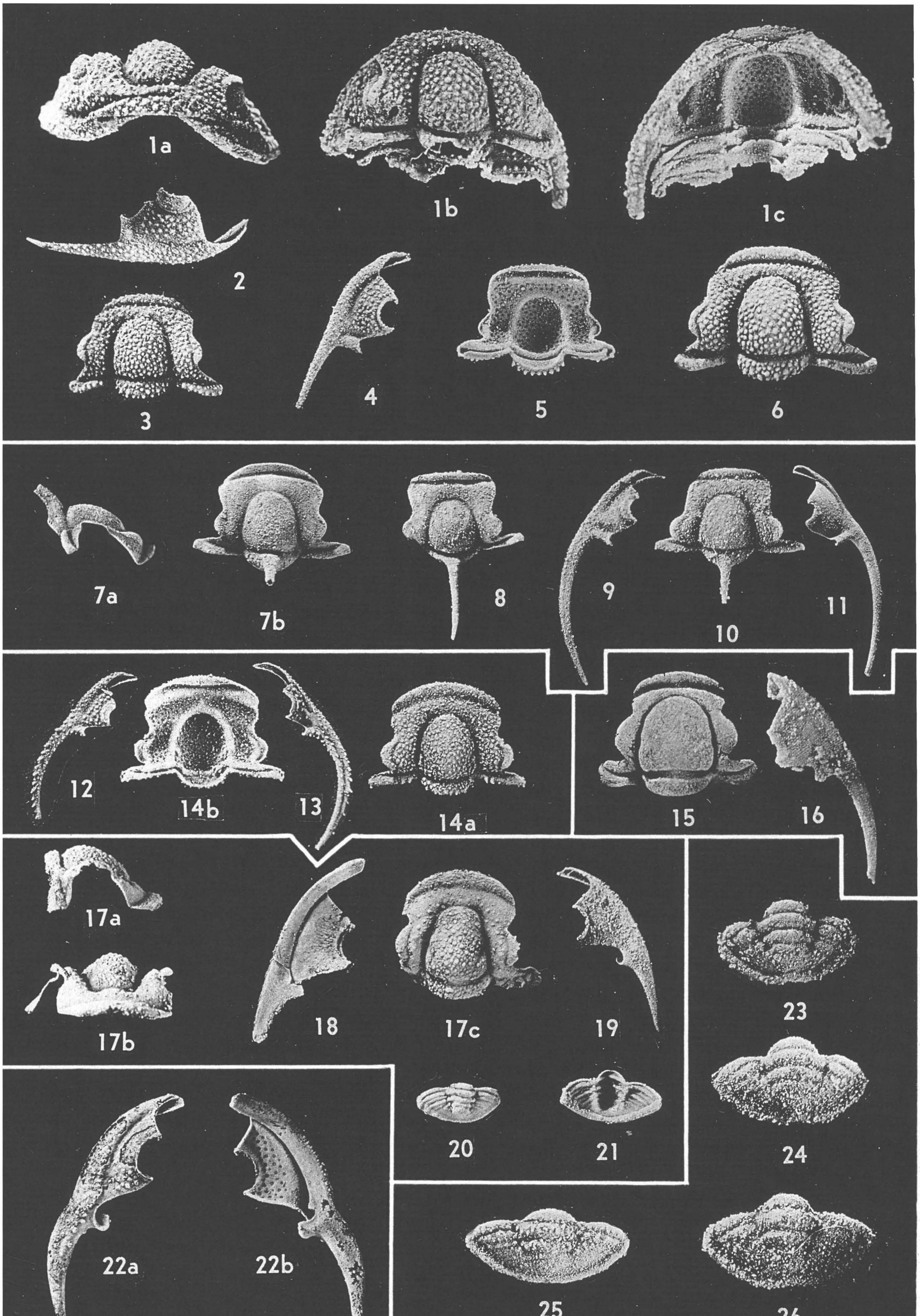
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1-6 <u>Hystricurus</u> <u>genalatus</u> Ross. All loc. E-10 except 1, loc. A-9. Zones B and C. (p.164).
1a,b,c, Cephalon, x4, front, dorsal, and ventral views, 26145. Note that the leading rim has been deformed, pushed partially beneath the brim.
2, Free cheek, x3, oblique view, 26146.
3, Cranidium, x3, dorsal view, 26147.
4, Free cheek, x3, dorsal view, 26148.
5, Cranidium, x3, ventral view, 26149.
6, Cranidium, x3, dorsal view, 26150.

7-11 <u>Hystricurus</u> <u>politus</u> Ross. All from Sec. A, float except 7, loc. A-7. Zone B. (p.165).
7a,b, Cranidium, x3, side and dorsal views, 26151
8, Cranidium, x2, dorsal view, 26152.
9, Free cheek, x3, dorsal view, 26153.
10, Cranidium, x3, dorsal view, 26154.
11, Free cheek, x3, dorsal view, 26155.

12-14 <u>Hystricurus</u> <u>paragenalatus</u> Ross. Loc. Sec. A. float. Zone B. (p.165).
12, Free cheek, x3, dorsal view, 26156.
13, Free cheek, x3, dorsal view, 26157.
14a,b, Cranidium, x3, dorsal and ventral views, 26158.

15-16 <u>Hystricurus</u> sp. C Ross. Zone E. (p.166).
15, Cranidium, x5, Loc. C-5, dorsal view, 26159.
16, Free cheek, x4, Loc. G-3, dorsal view, 26160.

17-21 <u>Hystricurus</u> <u>millardensis</u> Hintze, n. sp. Loc. B-1. Zone B. (low) (p.168).
17a,b,c, Holotype, cranidium, x 2 1/2, side, front, and dorsal views, 26161.
18, Paratype, free cheek, x3, ventral view, 26162.
19, Paratype, free cheek, x3, dorsal view, 26163.
20, Paratype, pygidium, x3, dorsal view, 26164.
21, Paratype, pygidium, x3, ventral view, 26165.

22 <u>Hystricurus</u> ? sp. Loc. H-7. Zone G-2. (p.169).
22a,b, Free cheek, x2, dorsal and ventral views, 26166.

23-26 <u>Hystricurus</u> sp. Loc. Sec. A, float. Zone B. (Not described).
23, Pygidium, x7, dorsal view, 26167.
24, Pygidium, x7, dorsal view, 26168.
25, Pygidium, x7, dorsal view, 26169.
26, Pygidium, x7, dorsal view, 26170.

PLATE VII

1-5 Paraplethopeltis ? genacurvus Hintze, n. sp. Loc. B-14. Zone C. (p.202).

1a,b,c, Paratype, cranidium, x2, front, dorsal, and ventral views, 26171.

2a,b,c, Holotype, free cheek, x2, ventral, dorsal, and side views, 26173.

3a,b,c, Paratype, cranidium, x3, side, dorsal, and front views, 26172.

4, Paratype, pygidium, x3, dorsal view, 26174.

5a,b, Paratype, pygidium, x2, dorsal and posterior views, 26175.

6-9 Paraplethopeltis ? generectus Hintze, n. sp. All loc. B-14 except 7a,b, loc. A-10. Zone C. (p.204).

6, Paratype, free cheek, x 1 1/2, dorsal view, 26176.

7a,b, Holotype, free cheek, x3, ventral and dorsal views, 26178.

8a,b,c, Paratype, cranidium, x3, dorsal, side, and front views, 26177.

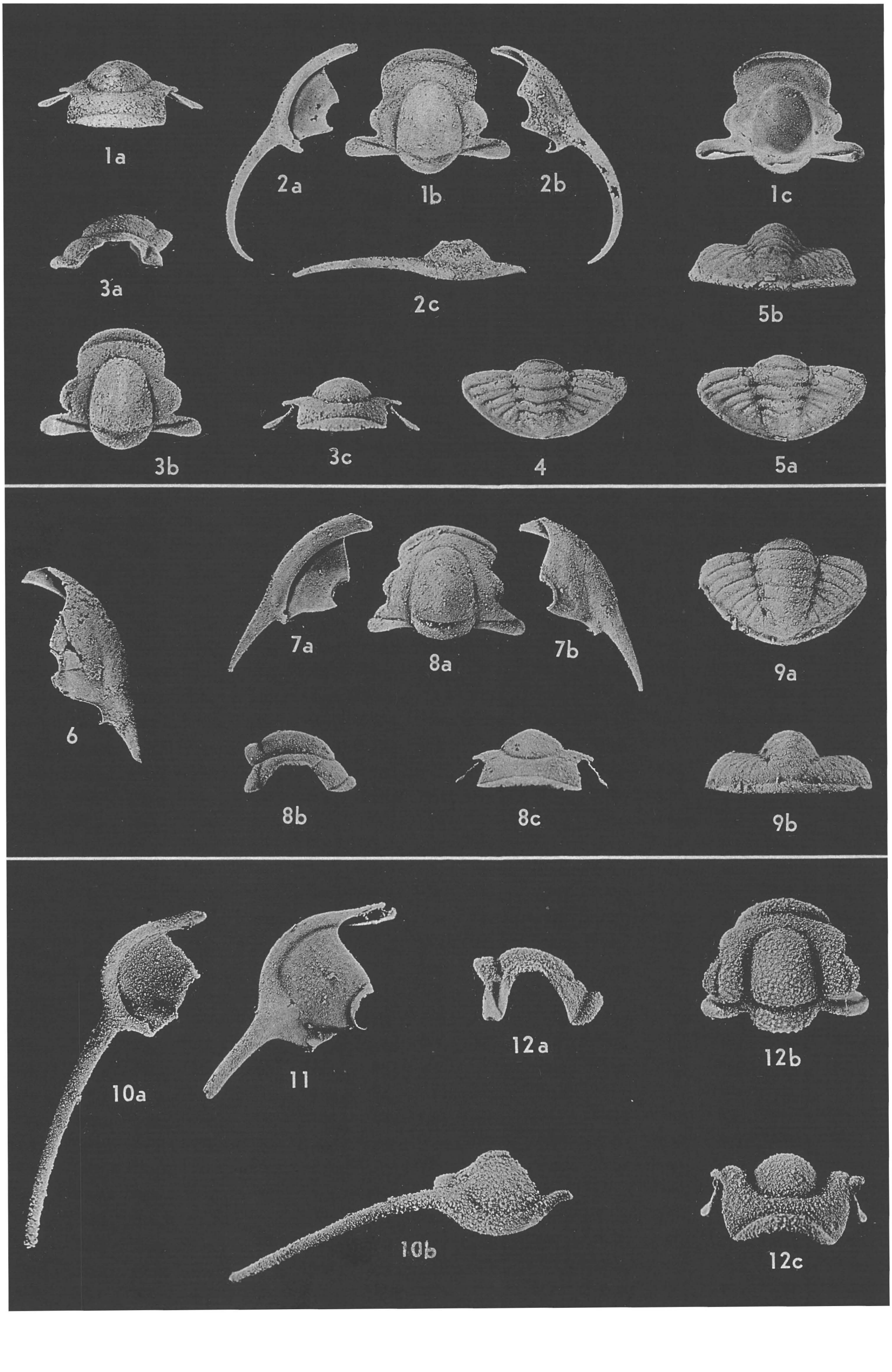
9a,b, Paratype, pygidium, x3, dorsal and posterior views, 26179.

10-12 Hystricurus lepidus Hintze, n.sp. All loc. E-13. High in zone B. (p.166).

10a,b, Paratype, free cheek, x4, ventral and side views, 26181.

11, Paratype, free cheek, x4, dorsal view, 26182.

12a,b,c, Holotype, cranidium, x4, side, dorsal, and front views, 26183.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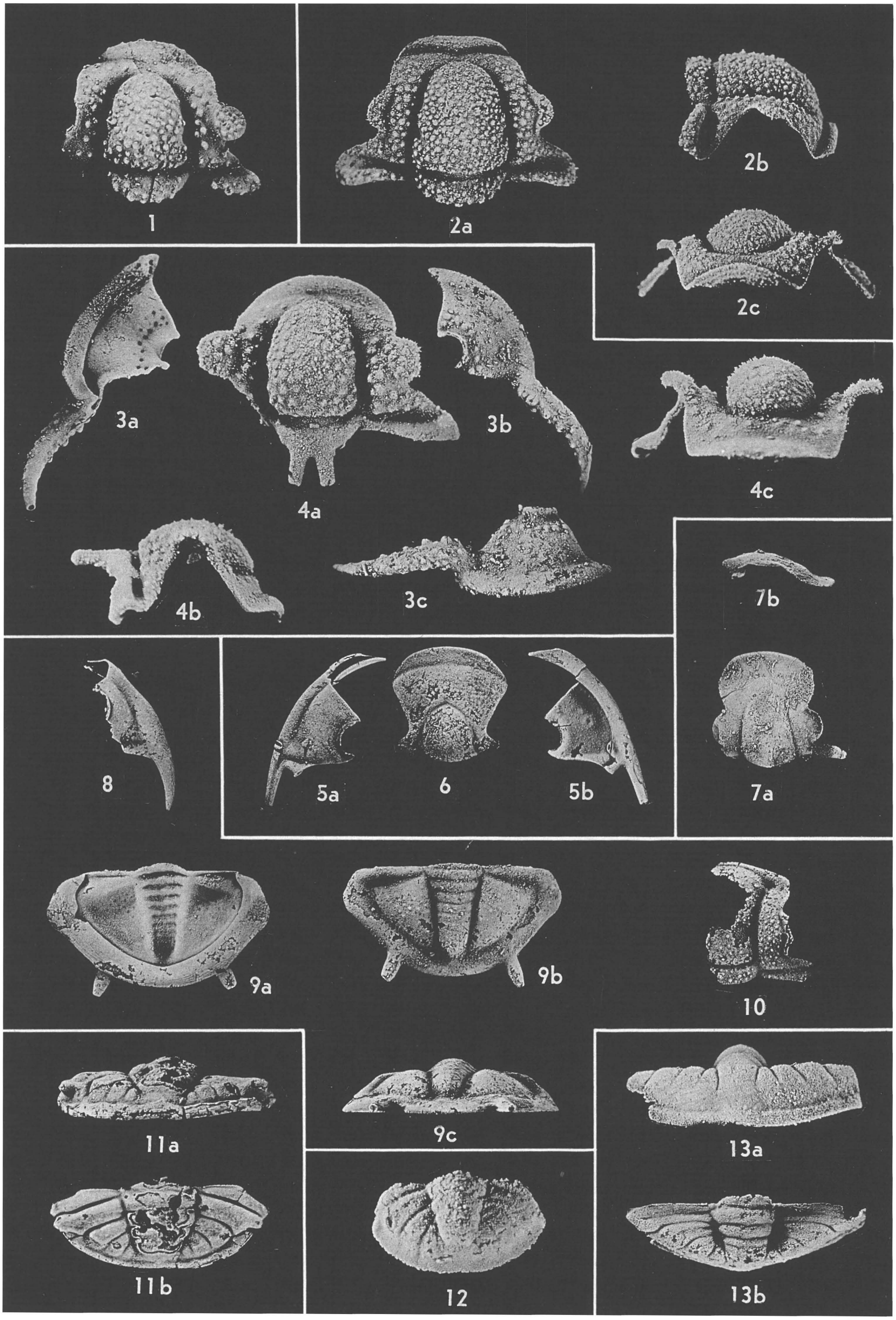
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PLATE VIII

1 *Parahystricurus* aff. *P. fraudator* Ross. Loc. G-5. Zone F. (p.195).
1, Cranidium, x5, dorsal view, 26184.

2 *Hystricurus robustus* Ross. Loc. E-17. Zone E. (p.166).
2a,b,c, Cranidium, x 4 1/2, dorsal, side, and front views, 26188.

3-4 *Parahystricurus bispicatus* Hintze, n. sp. Loc. G-5. Zone F. (p.195).
3a,b,c, Associated, free cheek, x4, ventral, dorsal, and side views, 26190.
4a,b,c, Holotype, cranidium, x 4 1/2, dorsal, side, and front views, 26189.

5-6 *Hillyardina* sp. A. Loc. G-5. Zone F. (p.162).
5a,b, Free cheek, x3, dorsal and ventral views, 26185. Note crater in center of cheek in 5b is probably a feature made during preservation.
6, Partial cranidium, x3, dorsal view, 26186.

7 *Licnocephala* ? sp. Loc. G-5. Zone F. (p.192).
7a,b, Cranidium, x3, dorsal and side views, 26187.

8-10 *Leiostegium formosa* Hintze, n. sp. All loc. C-4 except 10, loc. C-6. Zone E. (p.189).
8, Paratype, free cheek, x2, dorsal view, 26191.
9a,b,c, Holotype, pygidium, x2, ventral, dorsal, and posterior views, 26193.
10, Paratype, partial cranidium, x3, dorsal view, 26192.

11 Undetermined pygidium, Loc. G-5. Zone F. (Not described).
11a,b, Pygidium, x2, posterior and dorsal views, 26194.

12-13 Undetermined pygidia. Zone E. (Not described).
12, Pygidium, x4, loc. G-3, dorsal view, 26195.
13a,b, Pygidium, x4, loc. C-6, posterior and dorsal views, 26196.

PLATE IX

1 <u>Psalikilus</u> <u>pikum</u> Hintze, n. sp. Loc. H-18. Zone H. (p.214).
1a,b, Holotype, cranidium, x6, front and dorsal views, 26197.
1c, Paratype, cranidium, x6, side view, 26198.

2 <u>Psalikilus</u> <u>typicum</u> Ross. Loc. G-13. Zone G-2 (low) (p.213).
2a,b,c, Cranidium, x3, front, dorsal, and side views, 26199.

3,6,7 <u>Psalikilus</u> <u>spinosum</u> Hintze, n. sp. Zone G-1. (p.212).
3a,b,c, Holotype, cranidium, x5, dorsal, front, and side views, loc. G-8, 26200.
6, Paratype, free cheek, x5, loc. G-8, oblique view, 26203.
7, Associated pygidium, x5, loc. D-3, dorsal, ventral, and side views, Zone G-1, 26204.

4,5 <u>Psalikilus</u> <u>paraspinosum</u> Hintze, n. sp. Loc. G 10-A. Zone G-2 (high). (p.213).
4a,b,c, Paratype, cranidium, x4, side, dorsal, and front views, 26201.
5, Holotype, cranidium, x5, dorsal view, 26202.

8,11-12 <u>Jeffersonia</u> ? sp. B. Loc. G-8. Zone G-1. (p.175).
8, Pygidium, x6, dorsal view, 25205.
11, Cranidium, x4, dorsal view, 26206.
12, Free cheek, x4, dorsal view, 26207.

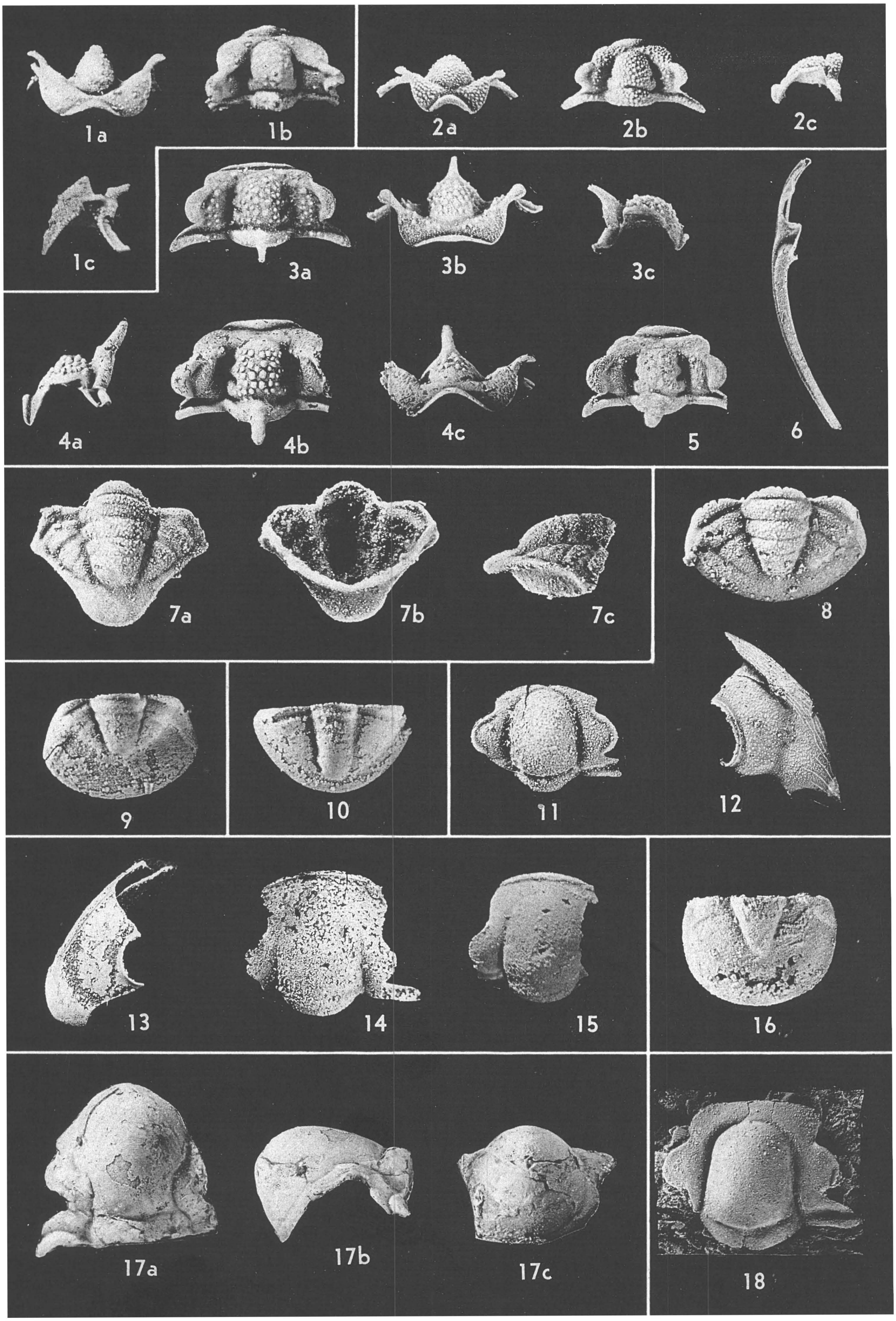
9-10 Undetermined pygidia. Loc. G-9. Zone G-1. (Not described).
9, Pygidium, x4, dorsal view, 26208.
10, Pygidium, x4, dorsal view, 26209.

13-15 Undetermined gen. and sp. C. Zone G-2. (p.243).
13, Free cheek, x3, loc. G-14, dorsal view, 26210.
14, Cranidium, x4, loc. G-14, dorsal view, 26211.
15, Cranidium, x3, loc. G-13, dorsal view, 26517.

16 Undetermined pygidium, x4, loc. H-20, zone H, dorsal view, 26291. (Not described).

17 <u>Bolbocephalus</u> sp. Loc. G-10F. Zone G. (p. 143).
17a,b,c, Cranidium, x 1 1/2, dorsal, side, and front views, 26212.

18 Undetermined gen. and sp. B. Zone G-2. (p.242).
18, Cranidium, x3, loc. G-13, dorsal view, 26518.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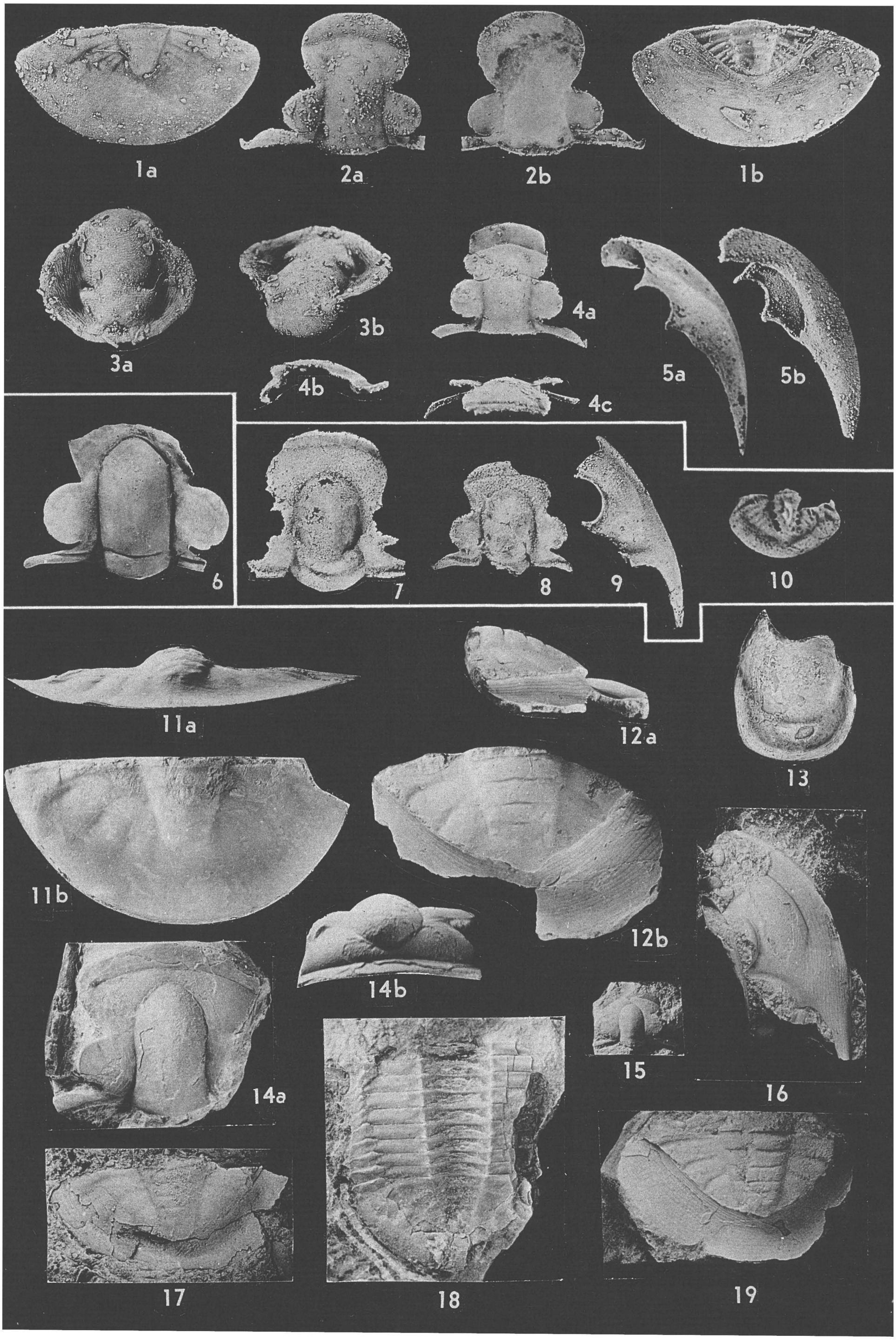
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PLATE X

1-5 Licnocephala ? cavigladius Hintze, n. sp. All loc. G-17 except 2, Loc. G-19. Zone G-2. (p.190).

1a,b, Paratype, pygidium, x4, dorsal and ventral views, 26213.
2a,b, Holotype, cranidium, x2, dorsal and ventral views, 25214.
3a,b, Paratype, hypostome, x4, dorsal and oblique views, 26216.
4a,b,c, Paratype, cranidium, x2, dorsal, side, front views, 26215.
5a,b, Paratype, free cheek, x3, dorsal and ventral views, 26217.

6 Bathyurellus ? sp. Loc. H-28. Zone I. (p.140).

6, Cranidium, x2, dorsal views, 26218.

7-10 Jeffersonia sp. A. Loc. G-12. Zone G-2. (p.174).

7, Cranidium, x2, dorsal view, 26219.
8, Cranidium, x2, dorsal view, 26220.
9, Free cheek, x2, dorsal view, 26221.
10, Pygidium, x2, dorsal view, 26222.

1-19 Bathyurellus pogonipensis Hintze, n. sp. Zone M. (p.138).

11a,b, Holotype, pygidium, x1, loc. DRES 106, posterior and dorsal views, 26519. (see Hintze, 1951, pp. 74-76 for locality description).
12a,b, Paratype, weathered pygidium, x1, loc. sec. K-float, side and dorsal views, 26520.
13, Paratype, hypostome, x2, loc. J-22, dorsal view, 26223.
14a,b, Paratype, cranidium, x1, loc. (K-1A), dorsal and front views, 26521.
15, Paratype, cranidium, x1, loc. (K-1A), dorsal view, 26406.
16, Paratype, free cheek, x1, loc. (K-1A), dorsal view, 26407/
17, Paratype, pygidium, x1, loc. sec. K-float, dorsal view, 26408.
18, Paratype, thorax and pygidium, x1, loc. sec. K-float, ventral view, 26409.
19, Paratype, weathered pygidium, x1, loc. sec. K-float, dorsal view, 26410.

PLATE XI

1-5 Trigonocercella acuta Hintze, n. gen., n. sp. Loc. J-1. Low Zone J. (p.239).

1a,b,c,d, Holotype, cranidium, x2, dorsal, ventral, side, front views, 26224.

2a,b, Paratype, pygidium, x2, dorsal and ventral views, 26225.

3, Paratype, free cheek, x3, dorsal view, 26226.

4, Paratype, free cheek, x2, latero-ventral view, 26227.

5, Paratype, hypostome, x4, dorsal view, 26228.

6-11 Trigonocerca typica Ross. All loc. H-20. Zone H. (p.238).

6a,b, Pygidium, x 1 1/2, ventral and dorsal views, 26229.

7a,b, Free cheek, x 1 1/2, dorsal and side views, 26230.

8a,b, Cranidium, x3, dorsal and ventral views, 26231.

9, Pygidium, x3, dorsal view, 26232.

10, Pygidium, x8, dorsal view, 26233.

11a,b,c, Cranidium, x3, dorsal, front, and side views, 26234.

12-18 Trigonocerca typica piochensis Hintze, n. var. Loc. YH-16A, Yellow Hill formation, near top of Yellow Hill, Pioche, Nevada. Zone H. (p.238).

12, Paratype, hypostome, x2, dorsal view, 26235.

13, Paratype, free cheek, x2, ventral view, 26236.

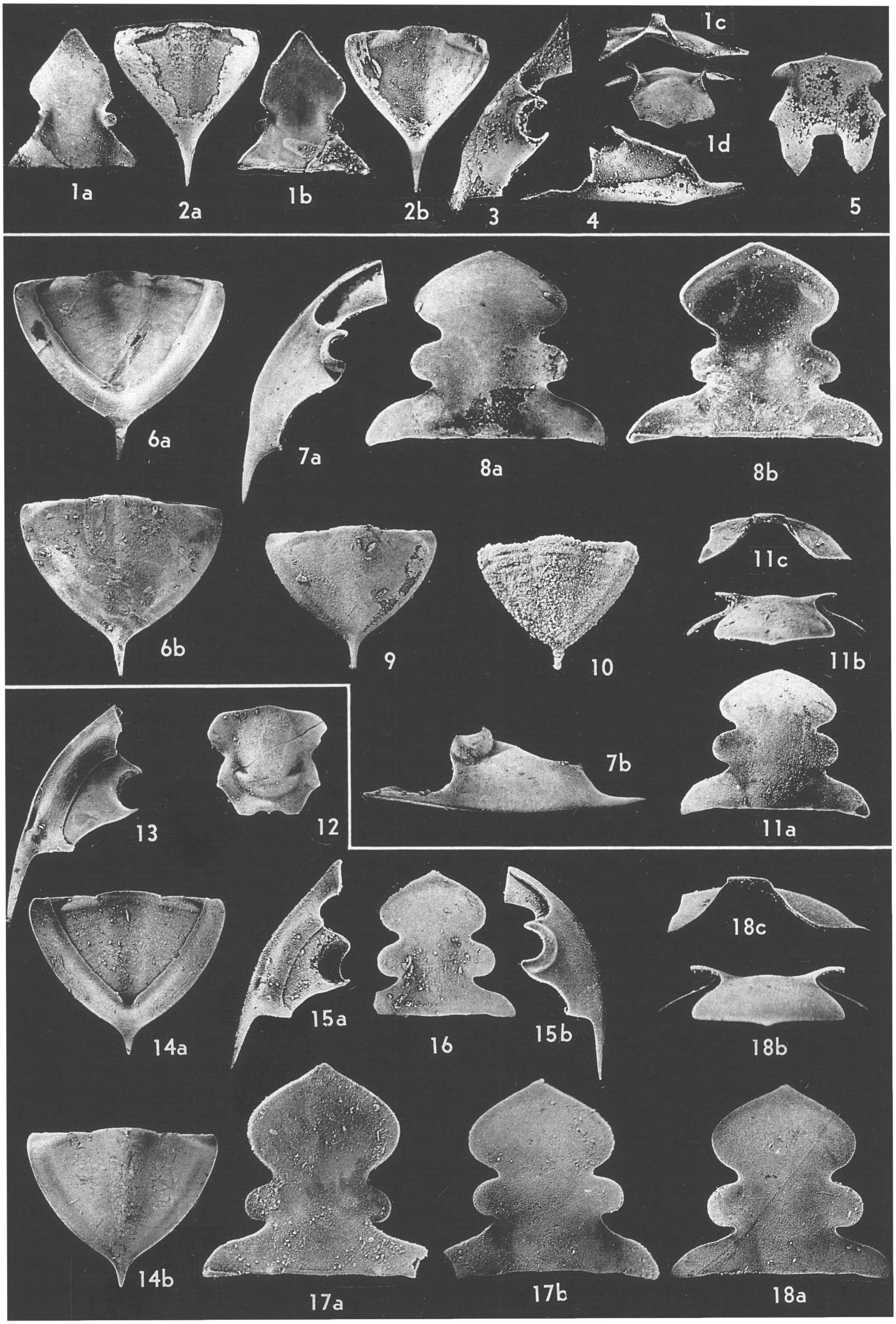
14a,b, Paratype, pygidium, x2, ventral and dorsal views, 26237.

15a,b, Paratype, free cheek, x4, ventral and dorsal views, 26238.

16, Paratype, cranidium, x3, dorsal view, 26239.

17a,b, Paratype, cranidium, x3, ventral and dorsal views, 26240.

18a,b,c, Holotype, cranidium, x4, dorsal, front, and side views, 26241.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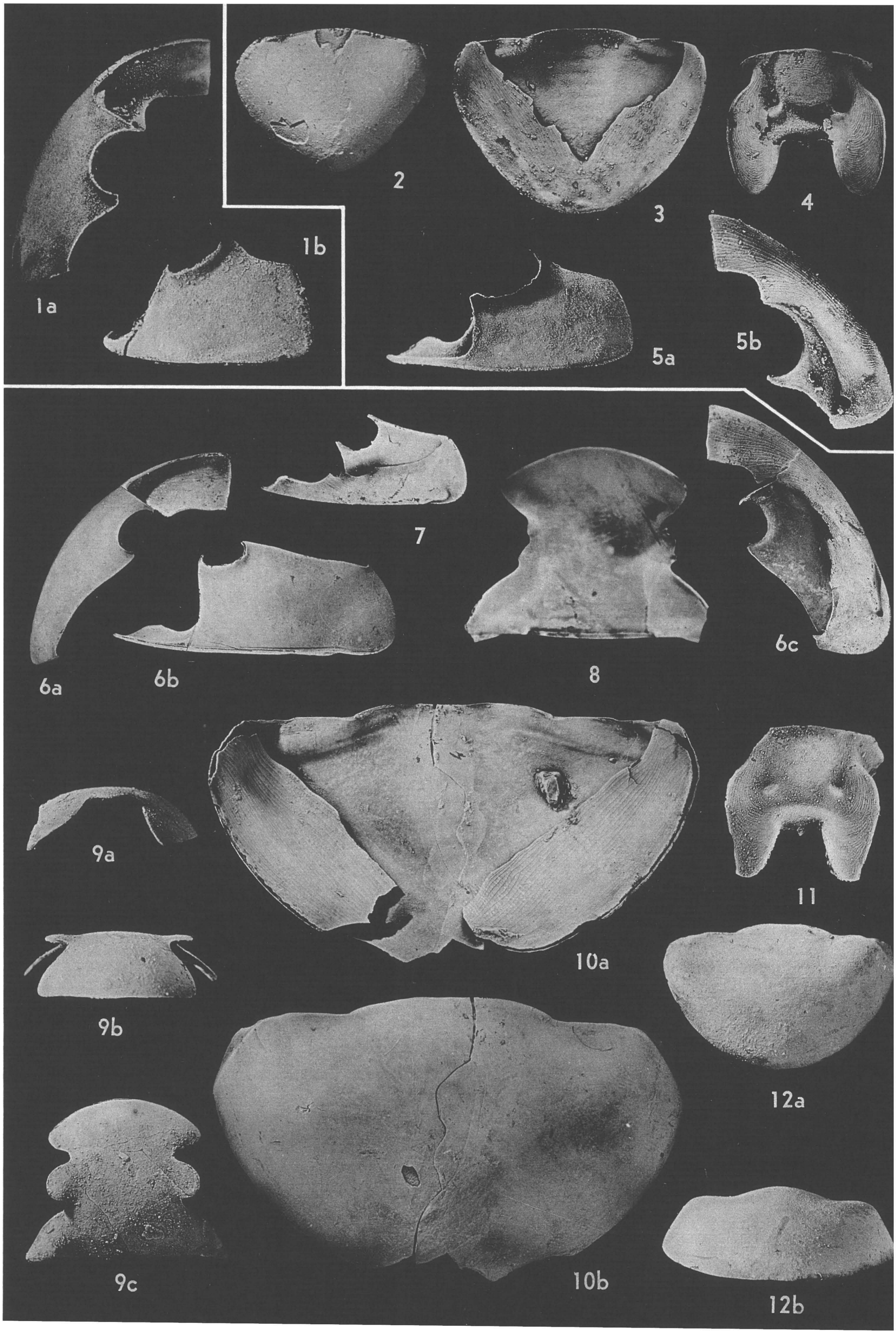
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PLATE XII

1 *Paranileus* aff. *P.* *utahensis* Hintze, Loc. J-8. Zone J. (p.201).
1a,b, Free cheek, x2, dorsal and side views, 26242.

2-5 *Paranileus elongatus* Hintze, n. sp. Loc. H-20. Zone H. (p.199).
2, Paratype, pygidium, x2, dorsal view, 26411.
3, Holotype, pygidium, x 1 1/2, ventral view, 26243.
4, Paratype, hypostome, x2, dorsal view, 26244.
5a,b, Paratype, free cheek, x4, side and ventral views, 26245.

6-12 *Paranileus ibexensis* Hintze, n. gen., n. sp. Loc. H-28. Zone I. (p.199).
6a,b,c, Paratype, free cheek, x1, dorsal, side, and ventral views, 26246.
7, Paratype, free cheek, x2, oblique ventral view, 26247.
8, Paratype, cranidium, x 1 1/2, ventral view, 26248.
9a,b,c, Holotype, cranidium, x3, side, front, and dorsal views, 26249.
10a,b, Paratype, pygidium, x1, ventral and dorsal views, 26250.
11, Paratype, hypostome, x4, dorsal view, 26251.
12a,b, Paratype, pygidium, x2, dorsal and posterior views, 26252.

PLATE XIII

1-4 <u>Paranileus utahensis</u> Hintze, n. sp. Loc. J-1. Zone J. (p.200).

1a,b, Paratype, free cheek, x3, side and dorsal views, 26253.

2a,b,c,d, Holotype, cranidium, x3, ventral, dorsal, front, and side views, 26254.

3a,b,c,d, Paratype, pygidium, x3, side, posterior, ventral, and dorsal views, 26255.

4a,b, Paratype, hypostome,x3, ventral and dorsal views, 26256.

5-8 Undetermined gen. and sp. A. Zone G-1. (p.241).

5a,b, Incomplete cranidium, x3, loc. G-8, dorsal and side views, 26257.

6, Pygidium, x5, loc. G-9, dorsal view, 26259.

7a,b, Pygidium, x4, loc. G-8, ventral and dorsal views, 26258.

8a,b,c, Cranidium, x5, loc. G-9, side, dorsal, and front views, 26260.

9-12 <u>Benthamaspis diminutiva</u> Hintze, n. sp. Loc. J-8. zone J. (p.142).

9a,b, Holotype, cranidium, x4, dorsal and front views, 26262.

10a,b,c, Paratype, cranidium, x4, dorsal, side, and front views, 26261. (Note: Doublure folded back under cranidium on this specimen)

11a,b, Paratype, pygidium, x5, ventral and dorsal views, 26263.

12, Paratype, pygidium, x5, dorsal view, 26264.

13-17 Undetermined gen. and sp. B. All loc. G-14 except 7, loc. G-15. Zone G-2. (p.242.)

13a,b, Pygidium, x3, posterior and dorsal views, 26265.

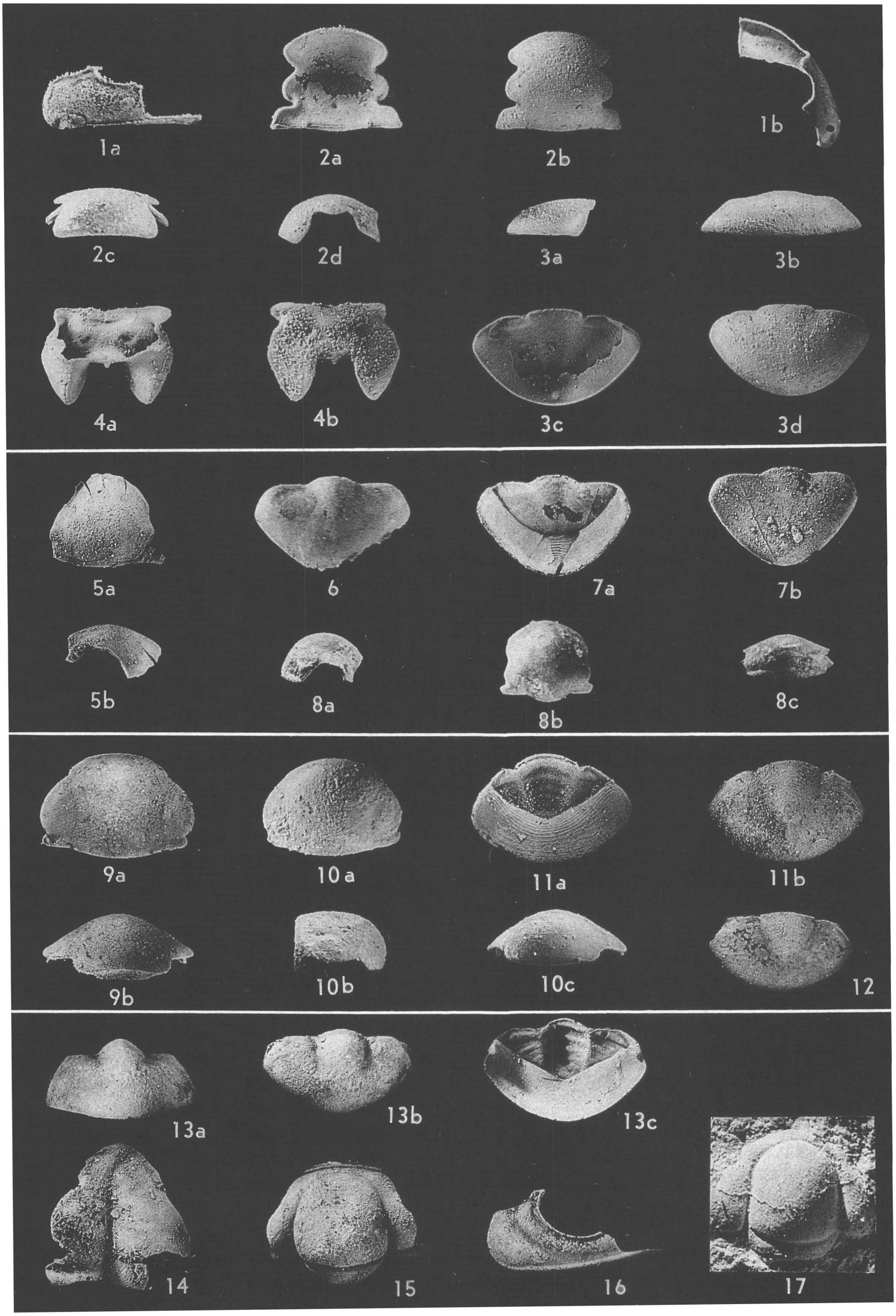
13c, Pygidium, x3, ventral view, 26266.

14, Fragmentary cranidium, x3, dorsal view, 26267.

15, Cranidium, x4, dorsal view, 26268.

16, Free cheek, x3, dorsal view, 26269.

17, Cranidium, rubber cast, x3, dorsal view, 26412.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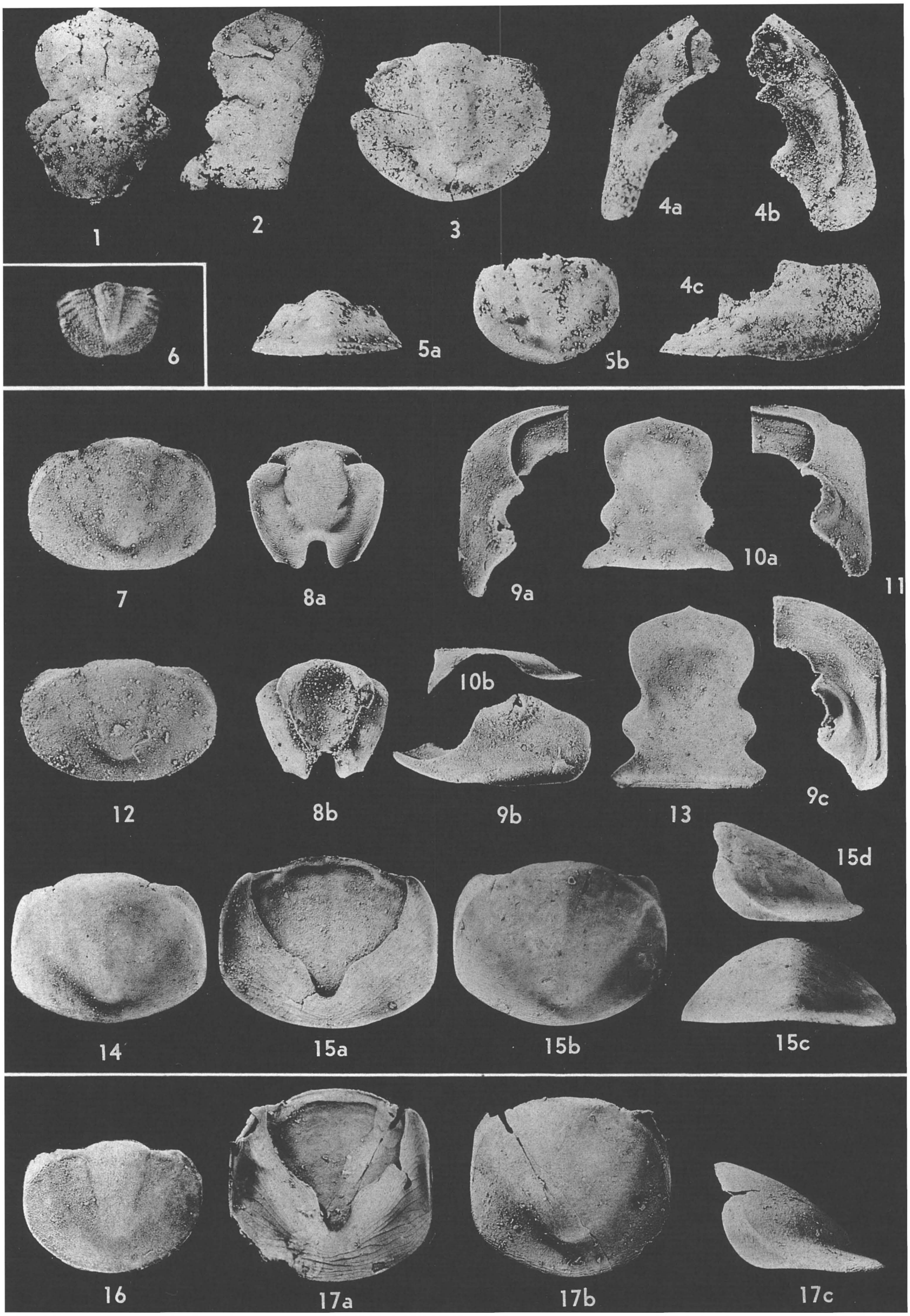
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PLATE XIV

1-5 Kirkella fillmorensis Hintze, n. sp. Loc. G-17. Zone G-2 (p.186).

1, Paratype, cranidium, x4, dorsal view, 26270.
2, Holotype, cranidium, x4, dorsal view, 26271.
3, Paratype, pygidium, x2, dorsal view, 26274.
4a,b,c, Paratype, free cheek, x3, dorsal, ventral, and side views, 26272.
5a,b, Paratype, pygidium, x3, posterior and dorsal views, 26273.

6 Kirkella accliva Hintze, n. sp. Loc. H-20. Zone H. (p.185).

6, Paratype, immature pygidium, x6, dorsal view, 26275.

7-15 Kirkella yersini Hintze, n. sp. Loc. H-28. Zone I. (p.184).

7, Paratype, pygidium, x4, dorsal view, 26276.
8a, Paratype, hypostome, x3, dorsal view, 26277.
8b, Paratype, hypostome, x4, ventral view, 26278.
9a,b,c, Paratype, free cheek, x3, dorsal, side, and ventral views, 26279.
10a,b, Holotype, cranidium, x3, dorsal and side views, 26281.
11, Paratype, free cheek, x3, dorsal view, 26280.
12, Paratype, pygidium, x5, dorsal view, 26282.
13, Paratype, cranidium, x3, ventral view. 26283.
14, Paratype, pygidium, x3, dorsal view, 26284.
15a,b,c,d, Paratype, pygidium, x2, ventral, dorsal, posterior, and side views, 26285.

16-17 Kirkella accliva Hintze, n. sp. Loc. H-20. Zone H. (p.185).

16, Paratype, pygidium, x5, dorsal view, 26287.
17a,b,c, Paratype, pygidium, x2, ventral, dorsal, and side views, 26286.

PLATE XV

1-2 *Kirkella accliva* Hintze, n. sp. Zone H. (p.185).
- 1, Paratype, free cheek, x 2 1/2, loc. H-20, dorsal view, 26288.
- 2a,b, Holotype, cranidium, x2, loc. H-24, dorsal and ventral views, 26289.

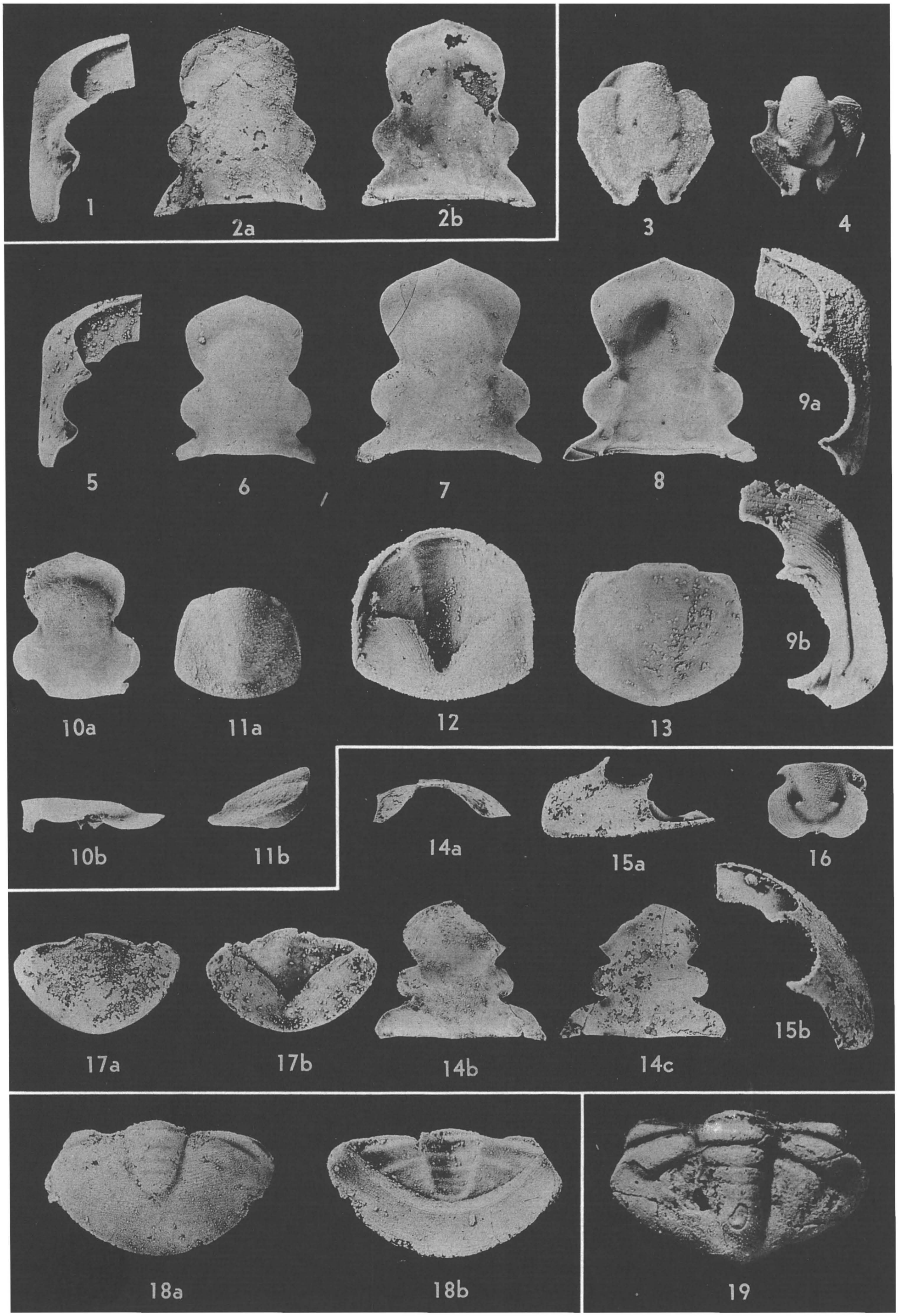
3,4, 9-12 *Kirkella declivita* Ross. Zone J.(middle). (p.183).
- 3, Hypostome, x3, loc. J-8, dorsal view, 26290.
- 4, Hypostome, x3, loc. J-8, dorsal view, 26413.
- 9a,b, Free cheeks, x3, loc. J-8, dorsal and oblique ventral views, 26294, 26295.
- 10a,b, Cranidium, x3, loc. J-8, dorsal and side views, 26296.
- 11a,b, Pygidium, x3, loc. J-8, dorsal and side views, 26297.
- 12, Pygidium, x3, loc. J-8, ventral view, 26299.

5-8, 13 *Kirkella* cf. *K. vigilans* (Whittington). Low in zone J. (p.184).
- 5, Free cheek, x3, loc. H-30 dorsal view, 26292.
- 6, Cranidium, x3, loc. H-30, dorsal view, 26293.
- 7, Cranidium, x2, loc. H-30, dorsal view, 26296.
- 8, Cranidium, x2, loc. H-30, ventral view,26296.
- 13, Pygidium, x3, loc. H-30, dorsal view, 26298.

14-17 *Pseudonileus willdeni* Hintze, n. gen., n. sp. Loc. G-19 except 14, loc. H-3. Zone G-2 (p.224).
- 14a,b,c, Holotype, cranidium, x1, side, ventral, and dorsal views, 26300.
- 15a,b, Paratype, free cheek, x3, side and dorsal views, 26301.
- 16, Paratype, hypostome, x2, dorsal view, 26302.
- 17a,b, Paratype, pygidium, x4, dorsal and ventral views, 26303.

18 Unassigned pygid. (See Ross, 1951, plate 30, figs. 12, 13, 16) Loc. D-9. Zone G-2. (Not described).
- 18a,b, Pygidium, x4, dorsal and ventral views, 26304.

19 Unassigned pygidium, Loc. J-13, Zone J. (Not described).
- 19, Pygidium, x2, dorsal view, 26414.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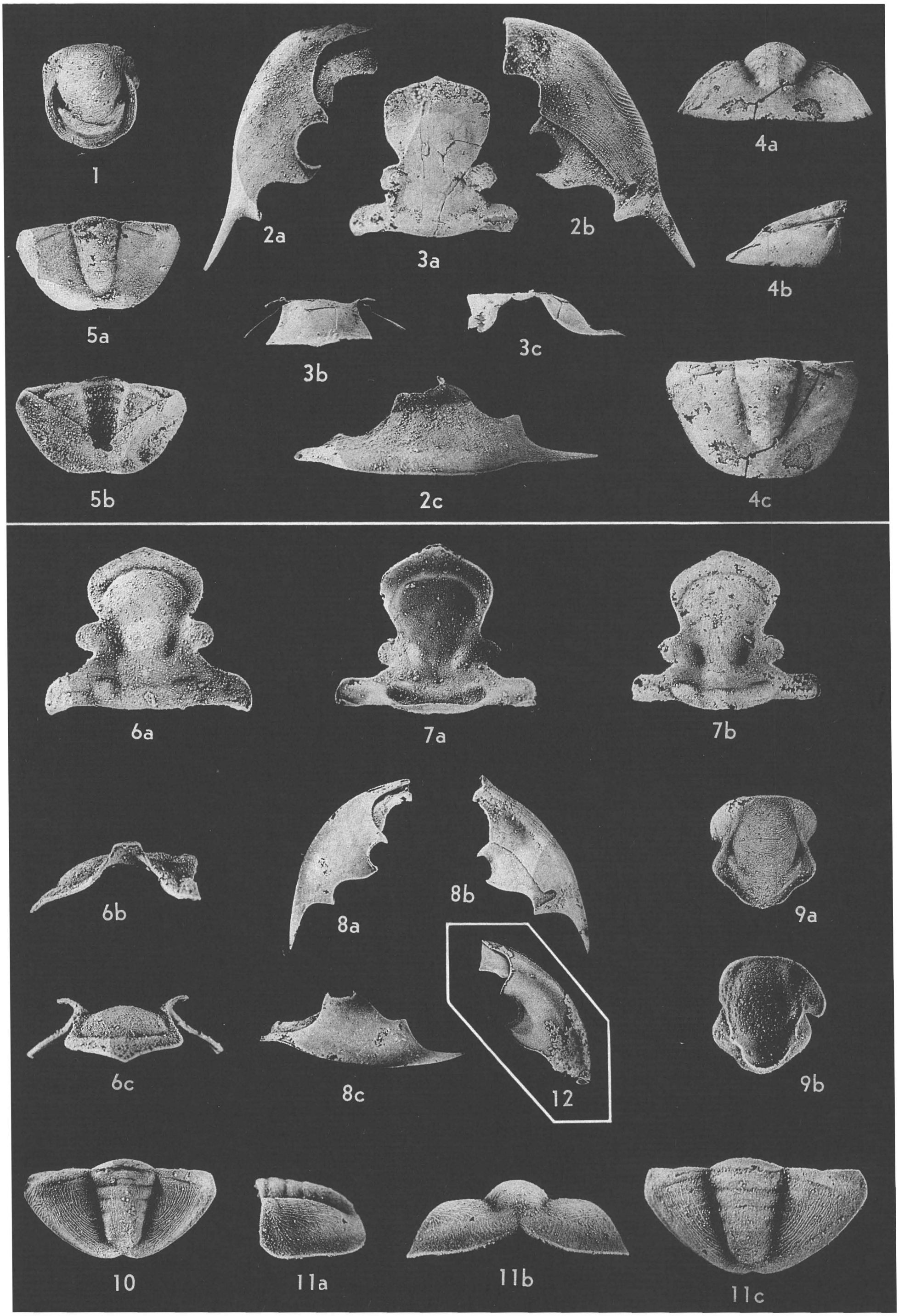
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PLATE XVI

1-5 <u>Asaphellus</u> ? <u>quadrata</u> Hintze, n. sp. Loc. D-3. Zone G-1. (p.133).

1, Paratype, hypostome, x3, dorsal view, 26305.

2a,b,c, Paratype, free cheek, x3, dorsal, ventral and side views, 26306.

3a,b,c, Holotype, cranidium, x2, dorsal, front, and side views, 26308.

4a,b,c, Paratype, pygidium, x2, posterior, side, and dorsal views, 26309.

5a,b, Paratype, pygidium, x4, dorsal and ventral views, 26307.

6-11 <u>Asaphellus</u> ? <u>venta</u> Hintze, n. sp. Loc. D-9. Zone G-2. (p.134).

6a,b,c, Holotype, cranidium, x4, dorsal, side, and front views, 26310.

7a,b, Paratype, cranidium, x3, ventral, dorsal views, 26311.

8a,b,c, Paratype, free cheek, x2, dorsal, ventral, and side views, 26312.

9a,b, Paratype, hypostome, x4, dorsal and ventral views, 26313.

10, Paratype, pygidium, x4, dorsal view, 26314.

11a,b,c, Paratype, pygidium, x3, side, posterior and dorsal views, 26315.

12 <u>Asaphellus</u> ? sp. Loc. G-7. Zone G-2. (p.137).

12, Free cheek, x2, dorsal view, 26316.

PLATE XVII

1,2a, 2b — <u>Isoteloides</u> ? <u>genalticurvatus</u> Hintze, n. sp. Loc. J-13. Zone J. (p.173).

1a,b,c, Paratype, free cheek, x 1 1/2, dorsal, side, and ventral views, 26317.

2a,b, Holotype, cranidium, x2, dorsal and ventral views, 26318.

2c, 3-8 — <u>Isoteloides</u> <u>flexus</u> Hintze, n. sp. Loc. H-25. Zone I. (p.172).

3, Paratype, free cheek, x3, dorsal view, 26319.

2c,4, Holotype, cranidium, x3, side and dorsal views, 26322.

5, Paratype, free cheek, x2, dorsal view, 26321.

6, Paratype, hypostome, x2, dorsal view, 26323.

7a,b, Paratype, pygidium, x2, dorsal and posterior views, 26324.

8, Paratype, pygidium, x5, dorsal view, 26320.

9-15 — <u>Isoteloides</u> <u>polaris</u> Poulsen. Zone J. (p.171).

9a,b, Cranidium, x3, loc. J-8, side and dorsal views, 26325.

10, Hypostome, x3, loc. H-30, dorsal view, 26326.

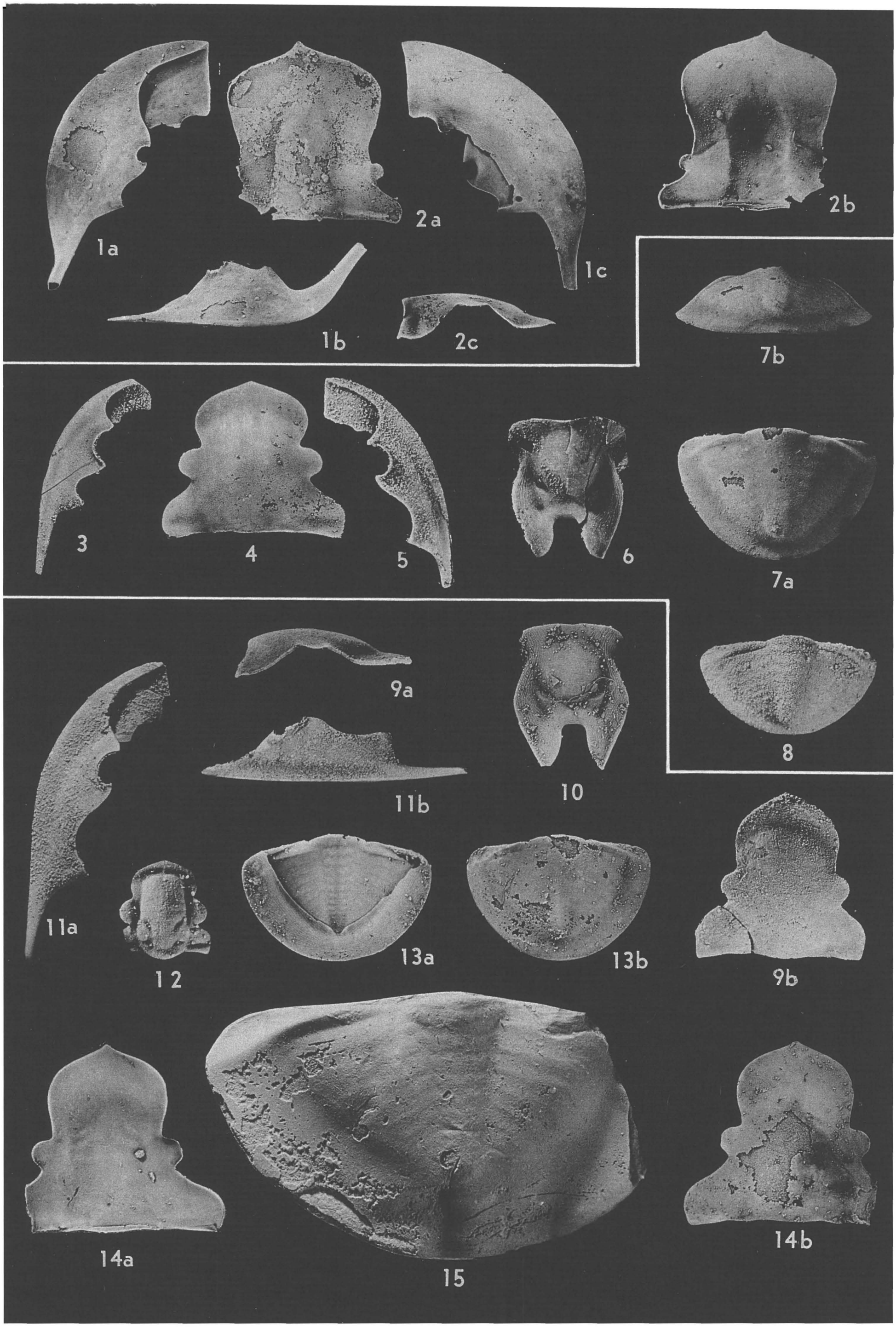
11a,b, Free cheek, x2, loc. J-8, dorsal and side views, 26328.

12, Immature cranidium, x6, loc. J-8, dorsal view, 26327.

13a,b, Pygidium, x2, loc. H-30, ventral and dorsal views, 26329.

14a,b, Cranidium, x2, loc. H-30, ventral and dorsal views, 26330.

15, Pygidium, x1, loc. Sec. J float, dorsal view, 26415.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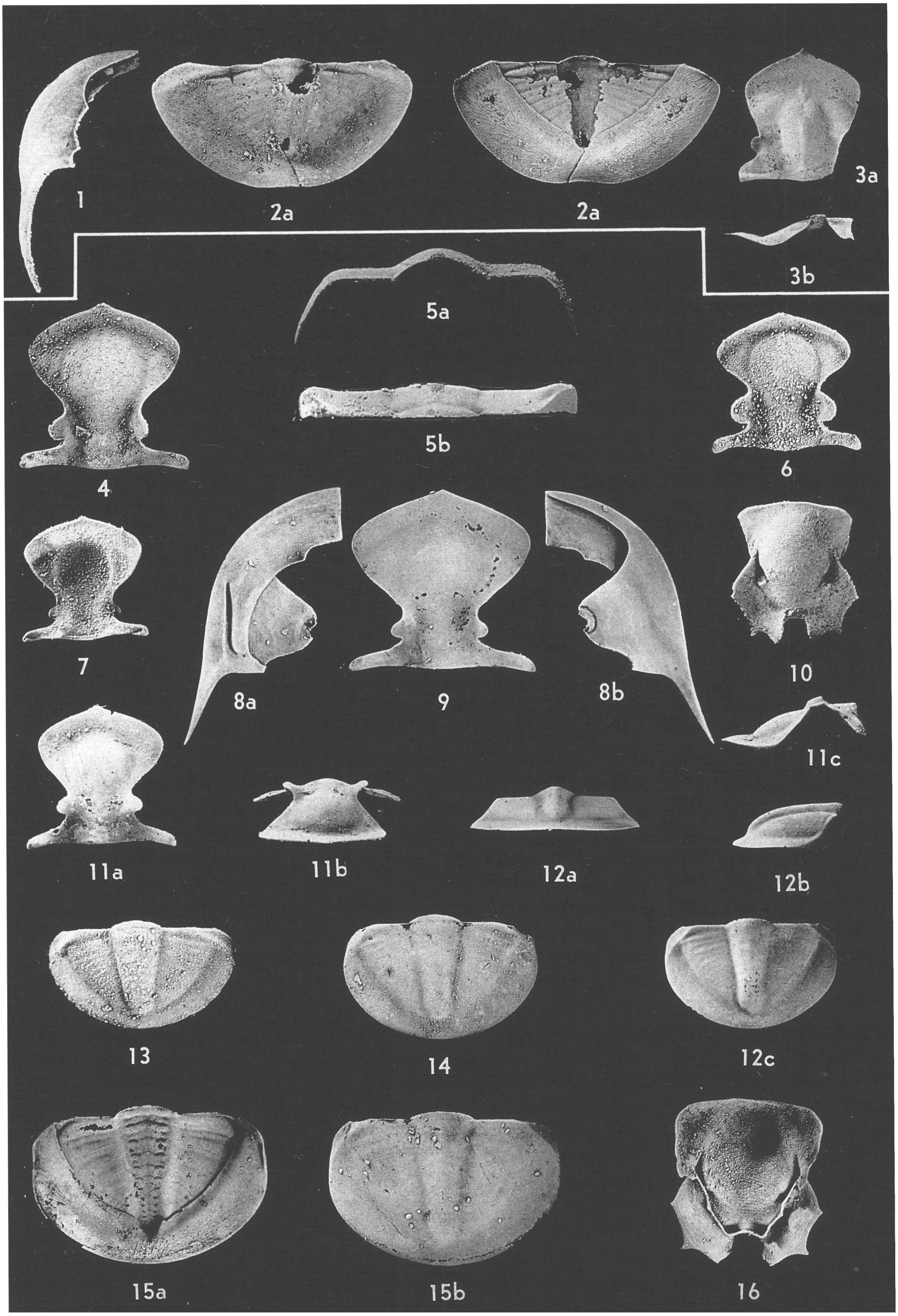
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PLATE XVIII

1-3 *Isoteloides* ? *genalticurvatus* Hintze, n. sp. Loc. J-13. Zone J. (p.173).

1, Paratype, free cheek, x4, dorsal view, 26331.

2, Paratype, pygidium, x3, dorsal and ventral views, 26332.

3, Paratype, cranidium, x2, dorsal and side views, 26333.

4-16 *Lachnostoma latucelsum* Ross. Zone J. (p.187).

4, Cranidium, x 3 1/2, loc. J-13, dorsal view, 26334.

5a,b, Segment of thorax, x2, loc. J-8, front and dorsal (inverted) views, 26335.

6, Small cranidium, x5, loc. J-13, dorsal view, 26336.

7, Cranidium, x3, loc. J-8, ventral view, 26338.

8a,b, Free cheek, x 1 1/2, loc. J-13, ventral and dorsal views, 26339.

9, Cranidium, x2, loc. J-13, dorsal view, 26340.

10, Hypostome, x2, loc. J-2, dorsal view, 26341.

11a,b,c, Cranidium, x2, loc. J-8, dorsal, front, and side views, 26343.

12a,b,c, Pygidium, x2, loc. J-8, posterior, side, and dorsal views, 26344.

13, Pygidium, x5, loc. J-13, dorsal view, 26337.

14, Pygidium, x3, loc. J-13, dorsal view, 26345.

15a,b, Pygidium, x 1 1/2, loc. J-13, ventral and dorsal views, 26346.

16, Hypostome, x 2 1/2, loc. J-13, ventral view, 26342.

PLATE XIX

1-4 <u>Dimeropygiella</u> <u>ovata</u> Hintze, n. sp. Loc. H-2(
Zone H. (p.155).
1a,b,c, Holotype, cranidium, x3, dorsal, front and side views, 26347.
2, Paratype, cranidium, x4, dorsal view, 26348
3, Paratype, free cheek, x5, dorsal view, 26349 (Note: Small piece of siliceous matte: obscures genal spine).
4a,b, Paratype, pygidium, x5, dorsal view posterior view, 26350.

5,10 <u>Dimeropygiella</u> <u>caudanodosa</u> Ross. Loc. J-8. Zon J. (p.154).
5, Cranidium, x4, dorsal view, 26354.
10, Pygidium, x4, dorsal view, 26355.

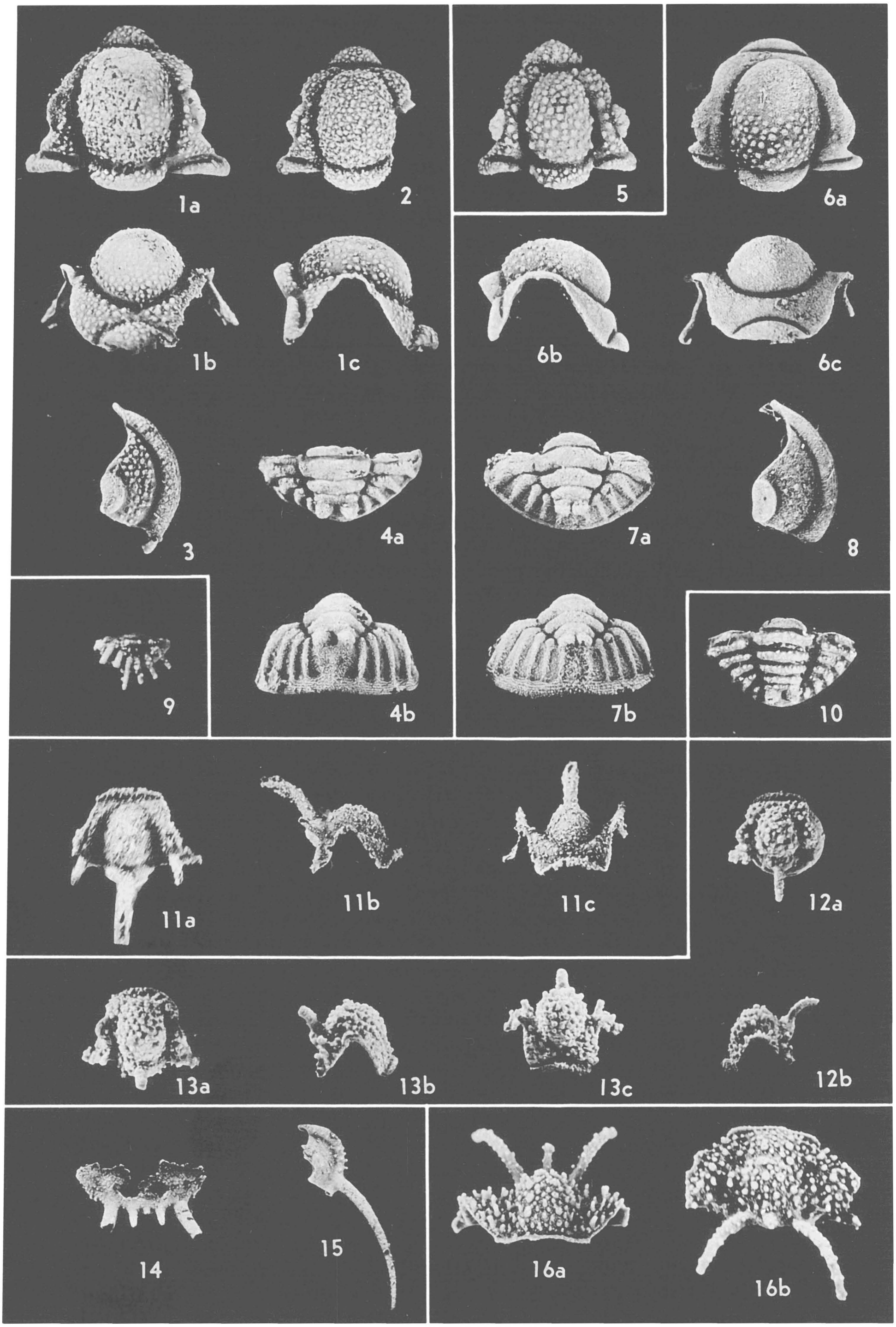
6-8 <u>Dimeropygiella</u> <u>blanda</u> Hintze, n. sp. Loc. H-20 Zone H. (p.155).
6a,b,c, Holotype, cranidium, x4, dorsal, side and front views, 26353.
7a,b, Paratype, pygidium, x5, dorsal and posterior views, 26351.
8, Paratype, free cheek, x5, dorsal view, 26352

9 <u>Dimeropygiella</u> ? immature pygidium. Loc. H-20. Zone H.
9, Pygidium, x6, dorsal view, 26356.

11,14, 15 Undetermined gen. and sp. Loc. H-7. Zone G-2 (Not described).
11, Cranidium, x6, dorsal, side, and front views, 26359.
14, Pygidium, x8, dorsal view, 26357.
15, Free cheek, x6, dorsal view, 26358.

12-13 Undetermined gen. and sp. Loc. H-20. Zone H. (Not described).
12a,b, Cranidium, x6, dorsal and side views, 26360.
13a,b,c, Cranidium, x4, dorsal, side, and front views, 26361.

16 Undetermined gen. and sp. Loc. H-20. Zone H. (See <u>Dicantaspis</u>, Whittington, Jour. Paleo. 1941) (Not described).
16,Cranidium, x8, front and dorsal views, 26362.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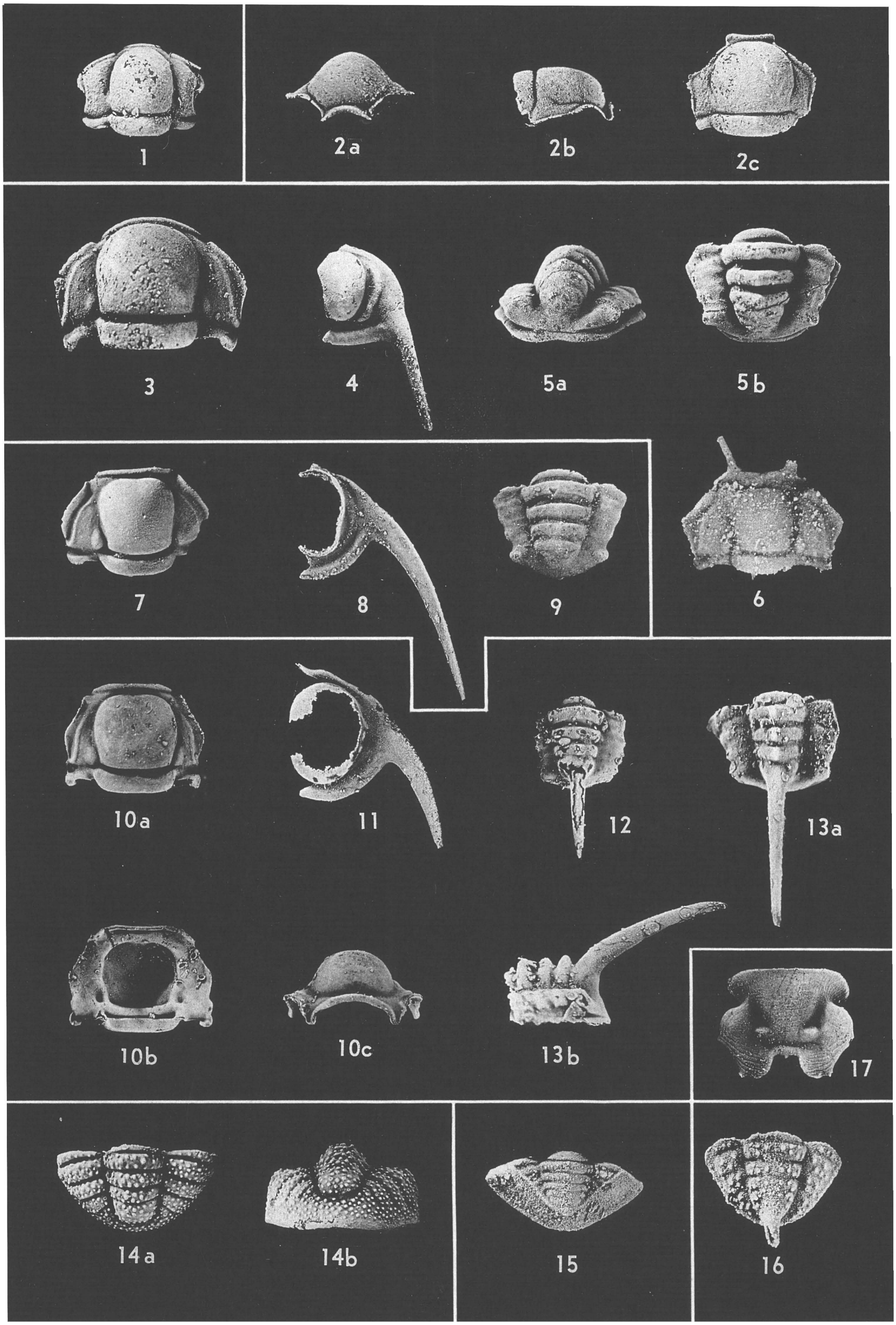
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PLATE XX

1 *Goniophrys prima* Ross. Loc. G-5. Zone F. (p.156).
1, Cranidium, x5, dorsal view, 26363.

2 *Carolinites* sp. A. Loc. D-11. Zone G-2 (p.146).
2a,b,c, Cranidium, x4, front, side and dorsal views, 26368.

3-6 *Carolinites genacinaca nevadensis* Hintze, n. subsp. Zone H. All from loc. YH-16A, top of Yellow Hill near Pioche, Nevada, except 6, loc. H-28. (p.146).
3, Holotype, cranidium, x3, dorsal view, 26364.
4, Paratype, free cheek, x3, dorsal view, 26365.
5a,b, Paratype, pygidium, x3, posterior and dorsal views, 26366.
6, Immature cranidium, x8, dorsal view, 26367.

7-9 *Carolinites genacinaca* Ross. Loc. J-8. Zone J. (p.145).
7, Cranidium, x3, dorsal view, 26369.
8, Free cheek, x3, dorsal view, 26370.
9, Pygidium, x3, dorsal view, 26371.

10-13 *Carolinites killaryensis utahensis* Hintze, n. subsp. Loc. K-1. Zone M. (p.145).
10a,b,c, Holotype, cranidium, x3, dorsal, ventral, and front views, 26372.
11, Paratype, free cheek, x4, dorsal view, 26373.
12, Paratype, pygidium, x3, dorsal view, 26374.
13a,b, Paratype, pygidium, x6, dorsal and side views, 26375.

14 Undetermined pygidium, loc. G-14. Zone G-2. (Not described).
14a,b, Pygidium, x2, dorsal and posterior views, 26376.

15 *Psalikilus typicum* Ross, pygidium, x5, loc. G-14, Zone G-2, dorsal view, 26377. (p.213).

16 Undetermined pygidium, x6, loc. G-8, zone G-1, dorsal view, 26378. (Not described).

17 *Lachnostoma* ? sp., hypostome, Loc. J-8, Zone J, dorsal view, x2, 26379. (p.187).

PLATE XXI

1 *Pilekia* ? *trio* Hintze, n. sp. Loc. E-17. Zone E. (p.205).
1a,b,c, Holotype, cranidium, x3, side, front, and dorsal views, 26380.

2-3 *Tesselacauda* aff. *T. depressa* Ross. Loc. C-6. Zone E. (p.237).
2, Fragmentary cranidium, x4 dorsal view, 26381.
3, Hypostome, x4, dorsal view, 26382.

4,8 *Protopliomerops* sp. 4. Zones H, G-2. (p.210)
4, Pygidium, x6, loc. H-23, dorsal view, 26383.
8, Pygidium, x6, loc. D-11, dorsal view, 26384.

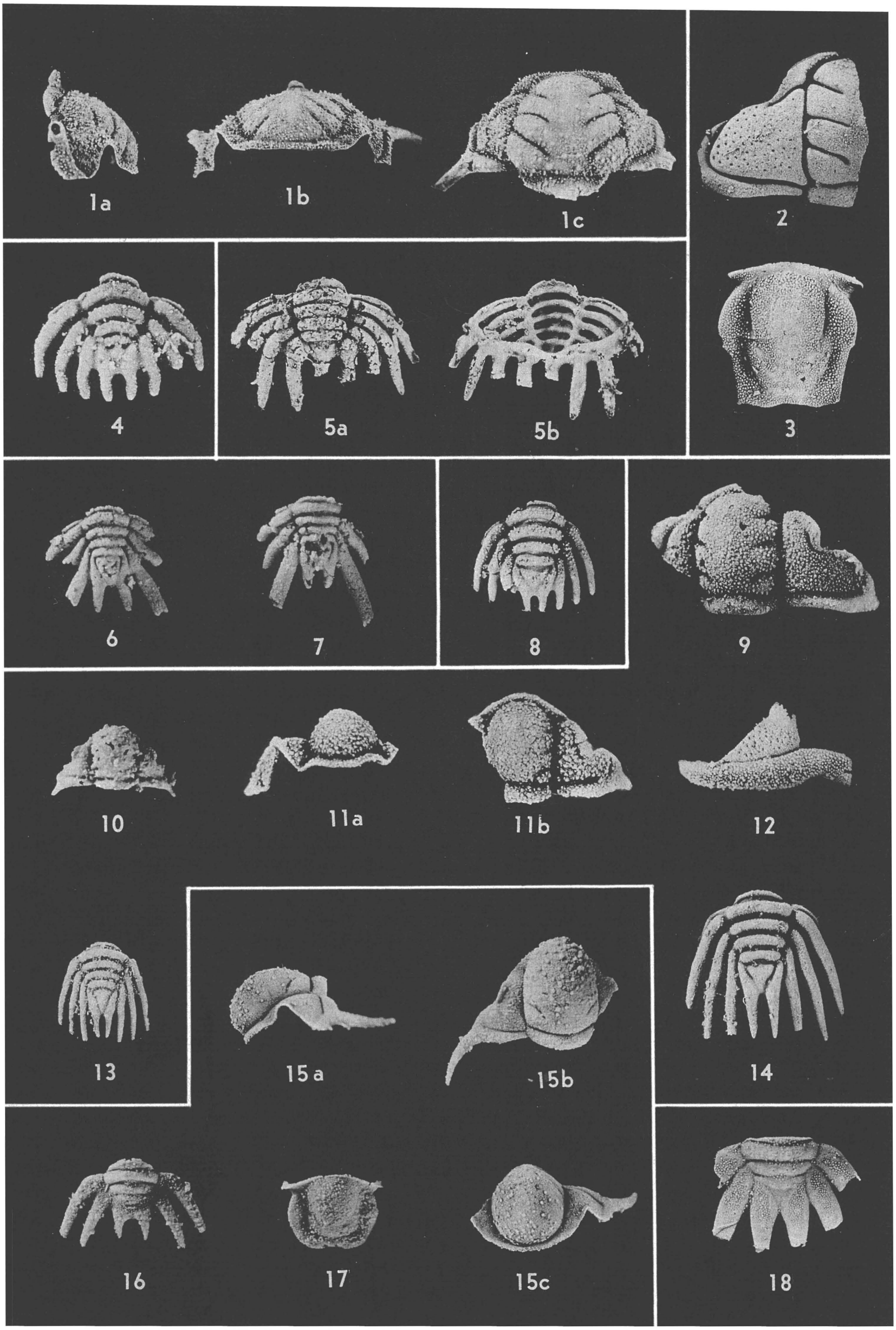
5 *Protopliomerops* sp. 5. Loc. G-5. Zone F. (p.210)
5a,b, Pygidium, x3, dorsal and ventral views, 26387.

6-7 Undetermined gen. and sp. Loc. H-20. Zone H. (Not described).
6, Pygidium, x5, dorsal view, 26385.
7, Pygidium, x5, dorsal view, 26386.

9-14 *Protopliomerops* ? *quattuor* Hintze, n. sp. Loc. G-14 except 10 and 11, loc. H-20. Zones G-2 and H. (p.209).
9, Holotype, cranidium, x5, dorsal view, 26390.
10, Paratype, cranidium, x6, dorsal view, 26388.
11a,b, Paratype, cranidium, x6, front and dorsal views, 26389.
12, Paratype, free cheek, x5, side view, 26391.
13, Paratype, pygidium, x5, dorsal view, 26392.
14, Paratype, pygidium, x4, dorsal view, 26393.

15-17 *Kawina* ? *webbi* Hintze, n. sp. Loc. J-13. Zone J. (p.178).
15a,b,c, Holotype, cranidium, x5, side, dorsal and front views, 26394.
16, Paratype, pygidium, x5, dorsal view, 26395.
17, Paratype, hypostome, x5, dorsal view, 26396.

18 *Kawina* ? *sexapugia* Ross. Loc. J-8. Zone J. (p.178).
18, Pygidium, x5, dorsal view, 26397.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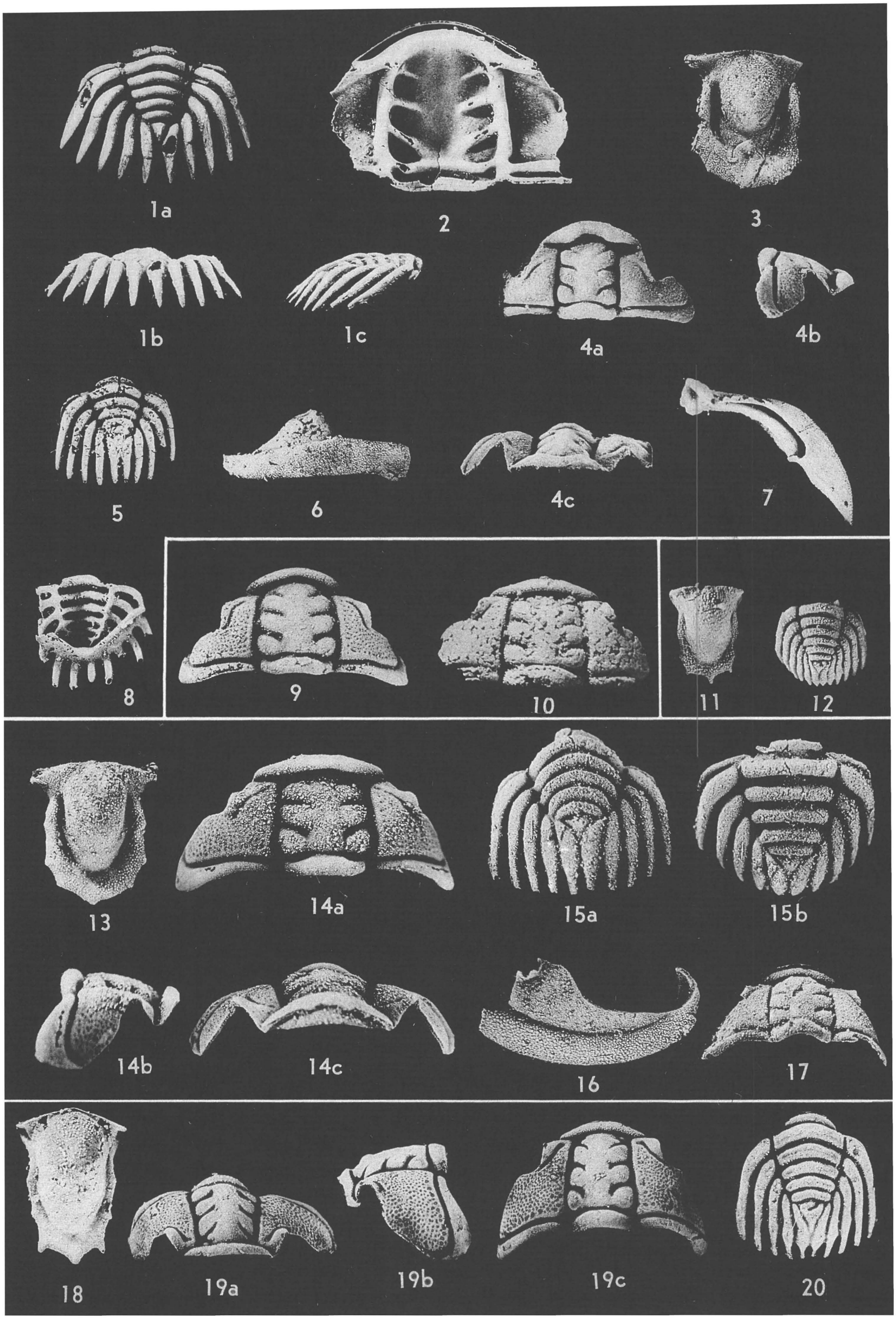
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PLATE XXII

1-8 Protopliomerops firmimarginis Hintze, n. sp. Loc. C-13 except 1 and 4, loc. D-2. Zone G-1. (p.208).

1a,b,c, Paratype, pygidium, x2, dorsal, posterior, and side views, 26422.
2,Paratype, cranidium, x3, ventral view, 26424.
3, Paratype, hypostome, x3, dorsal view, 26425.
4a,b,c, Holotype, cranidium, x2, dorsal, side, and front views, 26423.
5, Paratype, pygidium, x3, dorsal view, 26426.
6, Paratype, free cheek, x3, side view, 26427.
7, Paratype, segment of thorax, x3, ventral view, 26428.
8, Paratype, pygidium, x3, ventral view, 26429.

10 Protopliomerops aff. P. celsaora Ross. Zone G-2. (p.207).

10, Cranidium, x4, loc. G-10A, dorsal view, 26431.

12 Protopliomerops sp. 6. Loc. G-13. Zone G-2.

12, Pygidium, x4, dorsal view, 26433 (p.209).

9,13-17 Protopliomerops aemula Hintze, n. sp. Loc. D-3 except 9, G-8. Zone G-1. (p.206).

9, Paratype, cranidium, x4, dorsal view, 26430.
13,Paratype, hypostome, x5, dorsal view, 26435.
14a,b,c, Holotype, cranidium, x4, dorsal, side, and front views, 26434.
15a,b, Paratype, pygidium, x5, posterior and dorsal views, 26436.
16, Paratype, free cheek, x5, side view, 26437.
17,Paratype, cranidium, x6, dorsal view, 26438.

11-18-20 Protopliomerops aff. P. contracta Ross. Zone G-2. (p.207).

11, Hypostome, x4, loc. G-13, dorsal view, 26432.
18, Hypostome, x5, loc. G-19, dorsal view, 26440.
19a,b,c, Cranidium, x3, loc. G-13, front, side and dorsal views, 26439.
20,Pygidium, x5, loc. G-19, dorsal view, 26441.

PLATE XXIII

1-4 Pseudomera kanoshensis Hintze, n. sp. Loc. K-1. Zone M. (p.223).

1, Paratype, hypostome, x4, dorsal view, 26443.

2a,b,c, Holotype, cranidium, x4, side, front and dorsal views, 26442.

3, Paratype, pygidium, x5, dorsal view, 26444.

4a,b,c, Paratype, pygidium, x3, posterior, front, and dorsal views, 26445.

5-13 Pseudomera cf. P. insolita (Poulsen). Loc. J-8. Zone J. (p.222).

5, Hypostome, x3, dorsal view, 26446.

6a,b,c, Free cheek, x2, side, ventral and dorsal views, 26447.

7, Hypostome, x3, dorsal view, 26448.

8, Posterior limb, x2, side view, 26449.

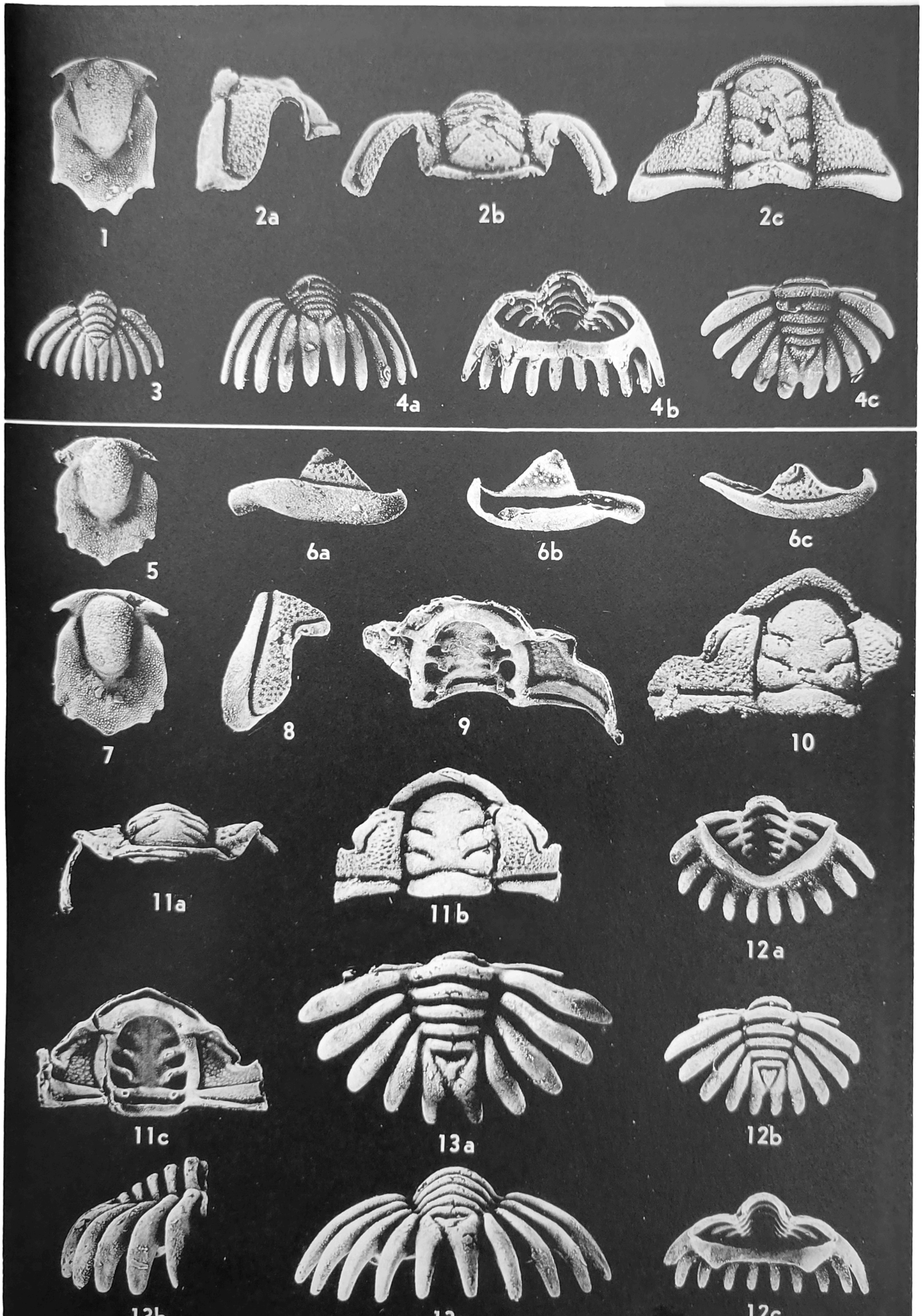
9, Cranidium, x2, anterio-ventral view, 26451.

10, Cranidium, x2, dorsal view, 26452.

11a,b,c, Cranidium, x2, front, dorsal, and ventral views, 26453.

12a,b,c, Pygidium, x3, ventral, dorsal, and front views, 26450.

13a,b,c, Pygidium, x2, dorsal, side, and posterior views. 26454.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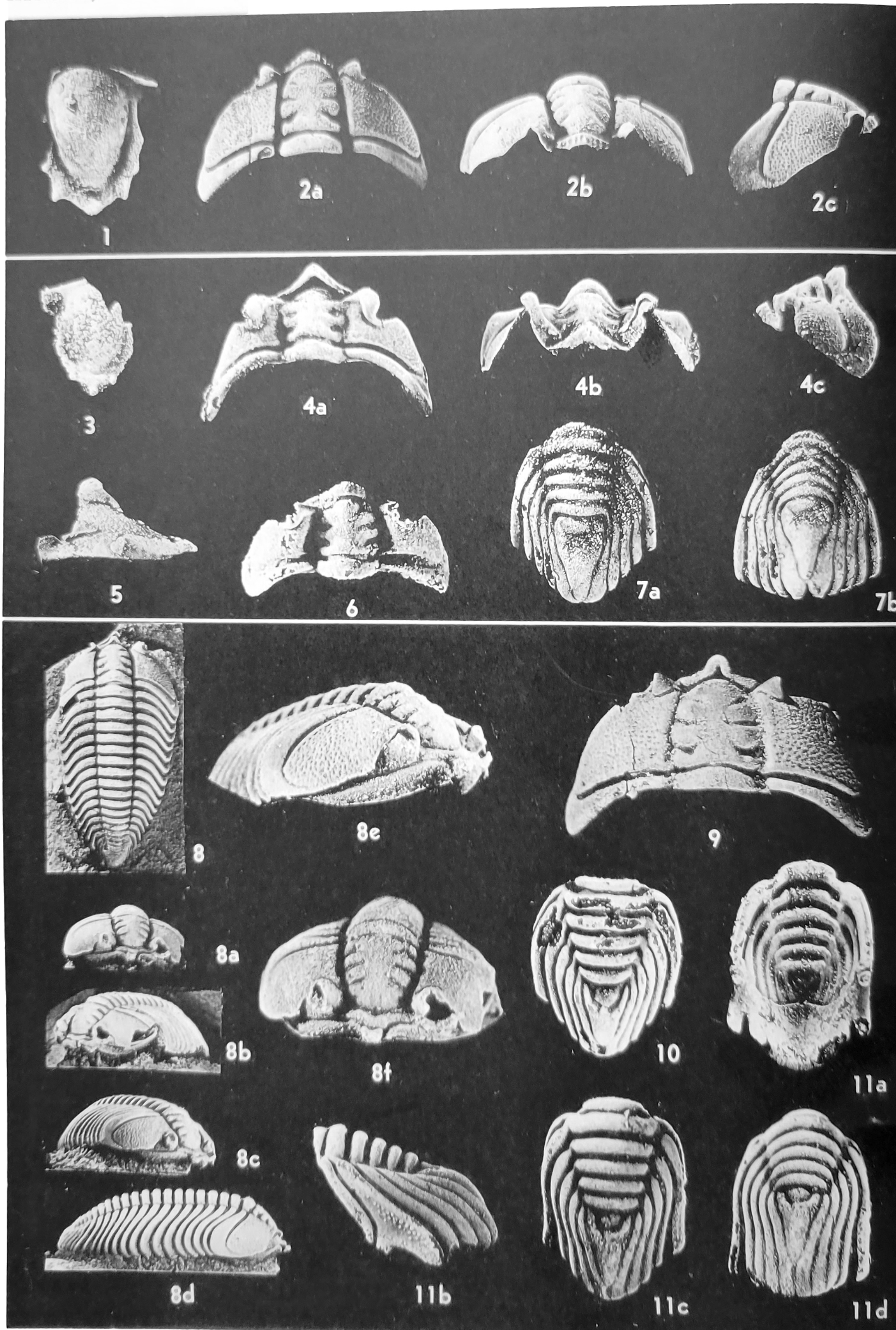
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PLATE XXIV

1-2 Pseudocybele altinasuta Hintze, n. sp. Loc. H-20. Zones H,I. (p.216).

1, Paratype, hypostome, x4, dorsal view, 26455.

2a,b,c, Holotype, cranidium, x2, dorsal, front, and side views, 26456.

3-7 Pseudocybele lemurei Hintze, n. sp. Loc. H-25. Zones H,I. (p.217).

3, Paratype, hypostome, x4, dorsal view, 26457.

4a,b,c, Holotype, cranidium, x3, dorsal, front, and side views, 26461.

5, Paratype, free cheek, x3, side view, 26458.

6, Paratype, cranidium, x4, dorsal view, 26459.

7a,b, Paratype, pygidium, x3, dorsal and posterior views, 26460.

8-11 Pseudocybele nasuta Ross. Zone J. (p.215).

8,8a,b,c,d, Carapace, x2, Sec. J float near J-2, dorsal, front, oblique and side views, 8e and f, x3, oblique and front views, 26462.

9, Cranidium, x2, loc. J-8, dorsal view, 26463.

10,Pygidium, x3, loc. J-2, dorsal view, 26464 .

11a,b,c,d, Pygidium, x4, loc. J-2, ventral, side, dorsal and posterior views, 26465.

PLATE XXV

1-4 *Cybelopsis* sp. Zone M-N. (p.153).

1, Pygidium, and associated cranidium, x1, loc. DRES-float, dorsal view, 26416. (see Hintze, 1951, pp. 74-76 for DRES locality descriptions).

2, Pygidium, x1, loc. DRES-133, dorsal view, 26417.

3, Pygidium, x1, loc. K-2, dorsal view, 26398.

4, Cranidium, x1, loc. CP-1, ventral view, 26399.

5,6, 8-12 *Cybelopsis* cf. *C. speciosa* Poulsen. Loc. J-8. Zone J. (p.152).

5a,b,c,d, Cranidium, x2, front, side, ventral and dorsal views, 26466.

6a,b, Free cheek, x2, ventral and side views, 26467.

8, Pygidium, x4, dorsal view, 26468.

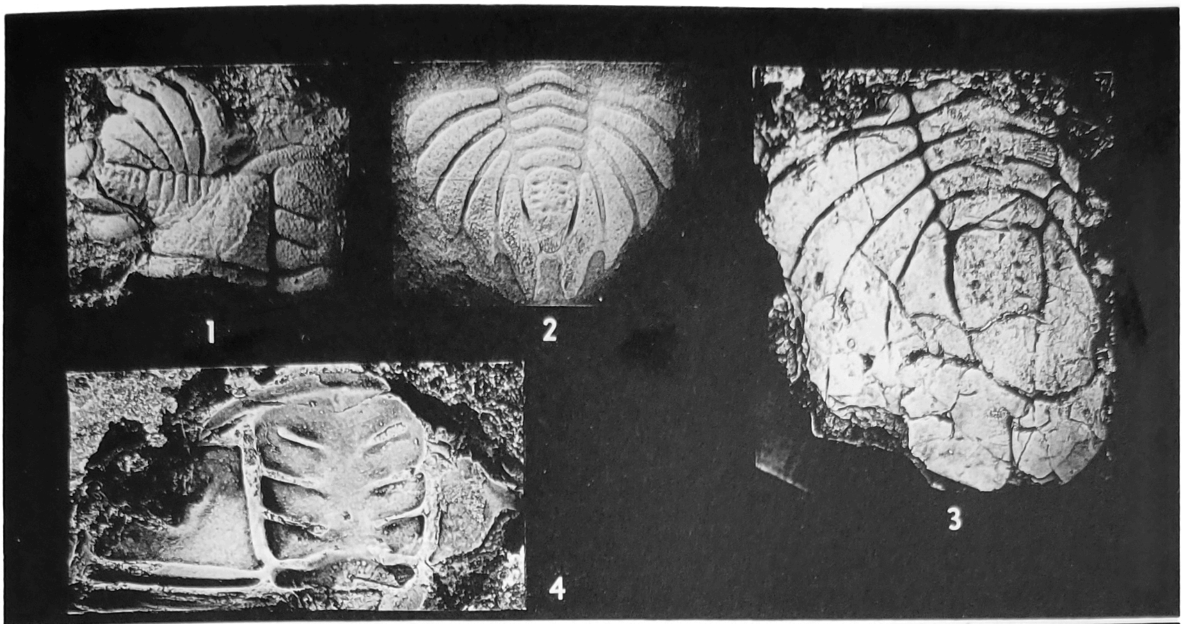
9, Pygidium, x5, dorsal view, 26469.

10, Pygidium, x5, dorsal view, 26470.

11, Hypostome, x3, dorsal view, 26471.

12a,b,c,d, Pygidium, x2, posterior, dorsal, ventral, and side views, 26472.

7 *Goniotelus* ? sp. Rostrum, x5, ventral view, 26473, loc. J-8, Zone J. (pp. 158-9).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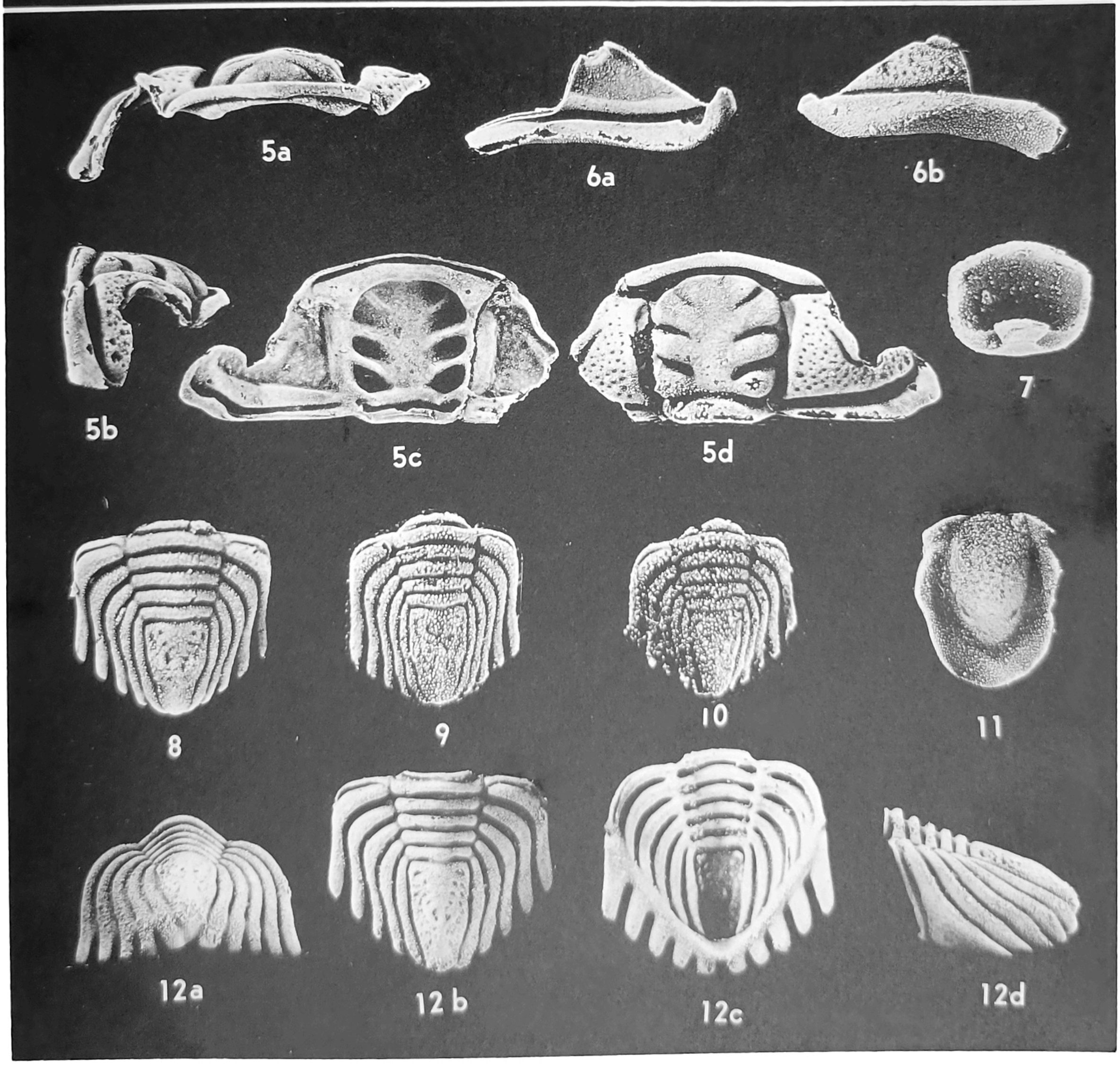
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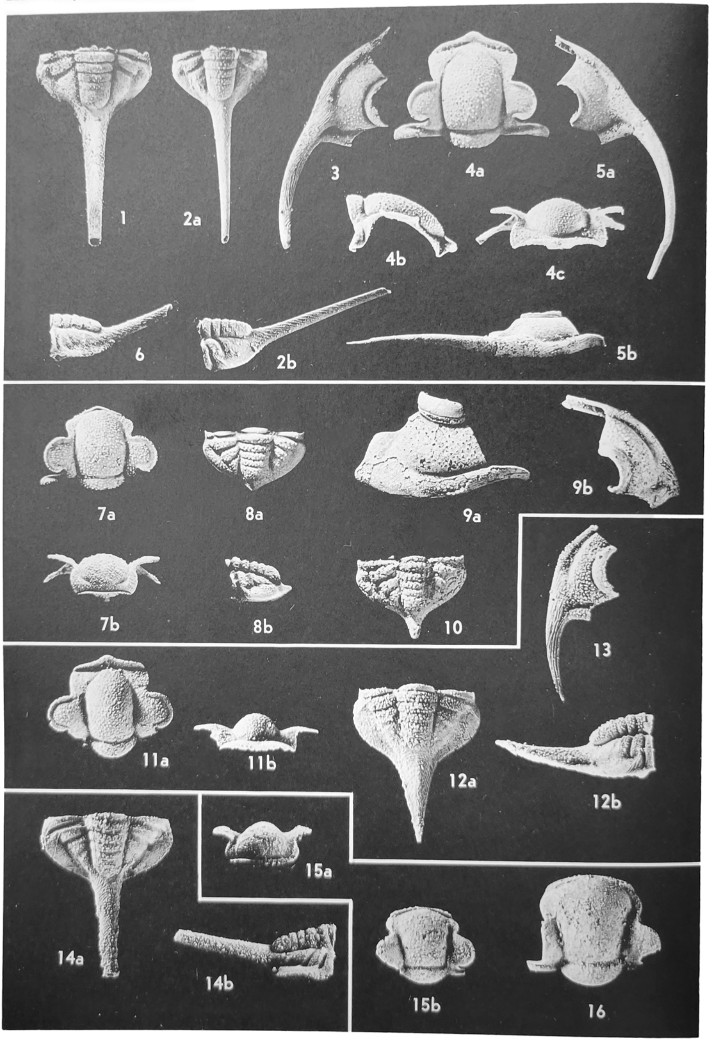
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PLATE XXVI

1-6 <u>Goniotelus</u> <u>brighti</u> Hintze, n. sp. Loc. J-8. Zone J. (p.158).

1, Paratype, pygidium, x3, dorsal view, 26474.

2a,b, Holotype, pygidium, x3, dorsal and side views, 26476.

3,Paratype, free cheek, x3, dorsal view, 26475.

4a,b,c, Paratype, cranidium, x3, dorsal, side, and front views, 26477.

5a,b, Paratype, free cheek, x2, dorsal and side views, 26478.

6, Paratype, pygidium, x2, side view, 26479.

7-10 <u>Goniotelus</u> <u>brevus</u> Hintze, n. sp. Loc. J-8. Zone J. (p.159).

7a,b, Paratype, cranidium, x2, dorsal and front views, 26480.

8a,b, Holotype, pygidium, x2, dorsal, side views, 26481.

9a,b, Paratypes, free cheeks, x2, side and dorsal views, 26482, 26483.

10, Paratype, pygidium, x3, dorsal view, 26418.

11-13 <u>Goniotelus</u> <u>wahwahensis</u> Hintze, n. sp. Loc. J-12. Zone J. (p.160).

11a,b, Paratype, cranidium, x4, dorsal and front views, 26484.

12a,b, Holotype, pygidium, x3, dorsal and side views, 26485.

13, Paratype, free cheek, x3, dorsal view, 26486.

14 <u>Goniotelus</u> sp. D. Loc. J-12. Zone J. (p.161).

14a,b, Pygidium, x4, dorsal and side views, 26487.

15-16 "<u>Barrandia</u> ? sp." Walcott. Loc. J-8. Zone J. (p.137).

15a,b, Cranidium, x4, front and dorsal views, 26488.

16, Cranidium, x4, dorsal view, 26489.

PLATE XXVII

1-6 <u>Pseudoolenoides</u> <u>dilectus</u> Hintze, n. gen., n. sp. Loc. K-1 except 2, loc. J-22. Zone M. (p.228).

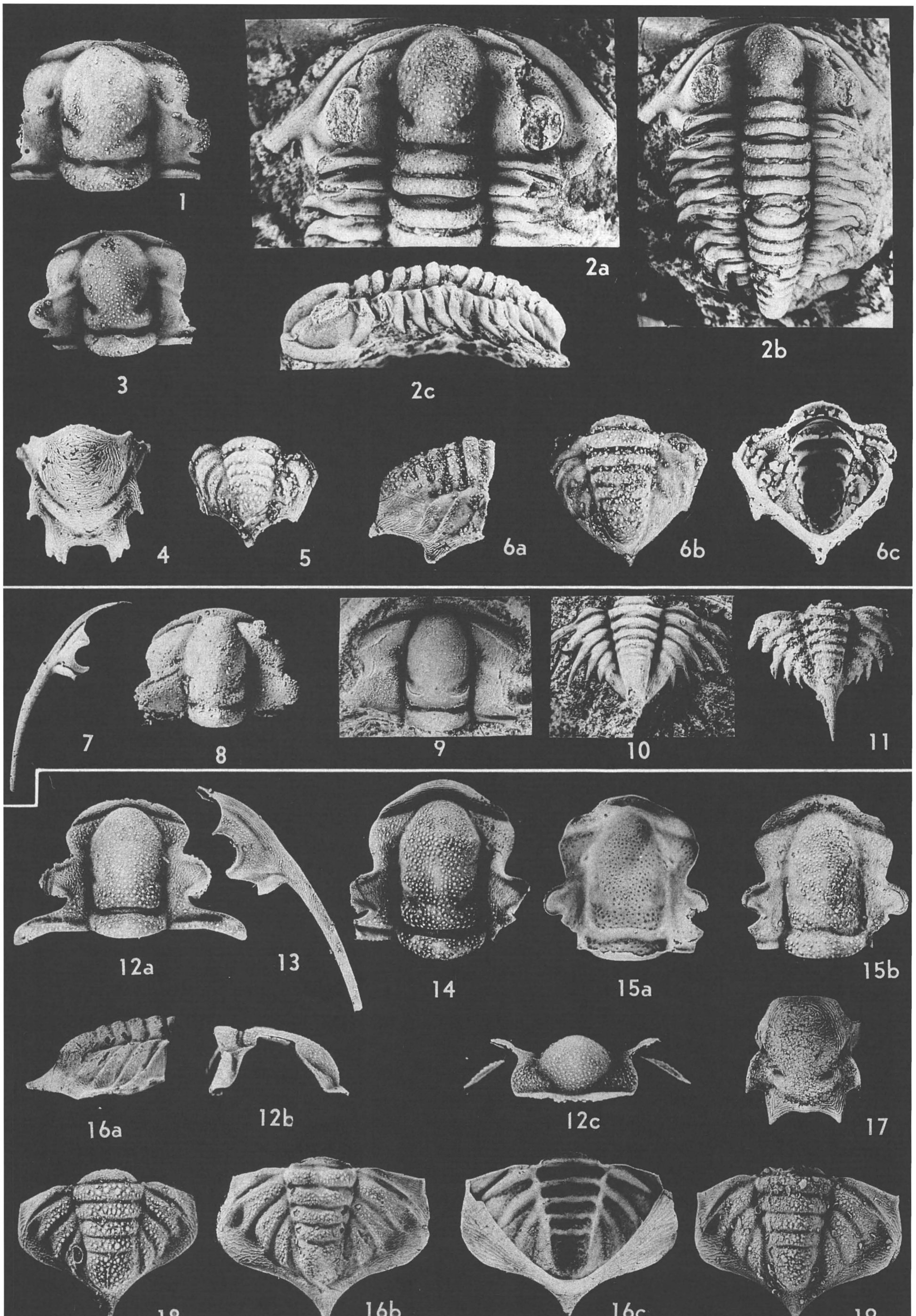
1, Paratype, cranidium, x3, dorsal view, 26490.
2a,b,c, Holotype, carapace, a, x4, dorsal view, b and c, x3, dorsal and side views, 26492.
3, Paratype, cranidium, x3, dorsal view, 26491.
4, Paratype, hypostome, x4, dorsal view, 26493.
5, Paratype, pygidium, x6, dorsal view, 26494.
6a,b,c, Paratype, pygidium, x4, side, dorsal, and ventral views, 26495.

7-11 <u>Pseudoolenoides</u> <u>acicaudus</u> Hintze, n. sp. Loc. "Point of Rocks," Utah except 9 and 10, loc. CP-1. Zone N. (p.229).

7, Paratype, free cheek, x3, dorsal view, 26419.
8, Paratype, cranidium, x3, dorsal view, 26420.
9, Paratype, cranidium, x3, dorsal view, 26496 .
10, Holotype, pygidium, x3, dorsal view, 26497.
11, Paratype, pygidium, x3, dorsal view, 26421.

.2-19 <u>Goniotelus</u> ? <u>ludificatus</u> Hintze, n. sp. Loc. K-1. Zone M. (p.161).

12a,b,c, Holotype, cranidium, x4, dorsal, side, and front views, 26498.
13, Paratype, free cheek, x3, dorsal view, 26499.
14, Paratype, cranidium, x3, dorsal view, 26502.
15a,b, Paratype, cranidium, x2, ventral and dorsal views, 26503.
16a,b,c, Paratype, pygidium, x2, side, dorsal, and ventral views, 26504.
17, Paratype, hypostome, x3, dorsal view, 26500.
18, Paratype, pygidium, x6, dorsal view, 26501.
19, Paratype, pygidium, x3, dorsal view, 26505.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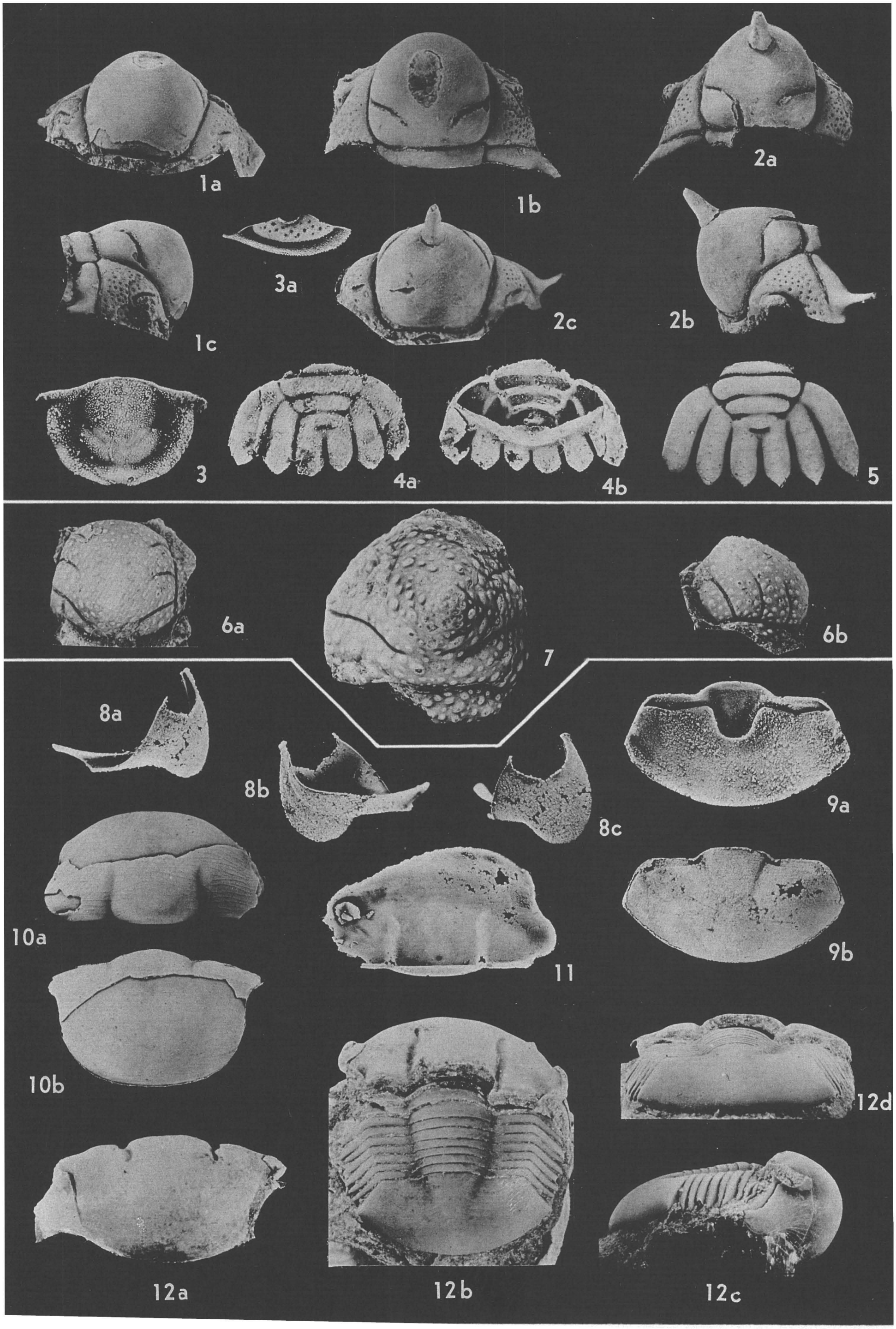
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PLATE XXVIII

1-5 Kawina ? unicornica Hintze, n. sp. Loc. CP-1. Zone N. (p.179).
- 1a,b,c, Paratype, cranidium, x2, front, dorsal and side views, 26506.
- 2a,b,c, Holotype, cranidium, x2, dorsal, side, and front views, 26507.
- 3, Paratype, hypostome, x4, dorsal view, 26508.
- 3a, Paratype, free cheek, x2, dorsal view, 26509.
- 4a,b, Paratype, pygidium, x3, dorsal and ventral views, 26510.
- 5, Paratype, pygidium, x4, dorsal view, 26511.

6-7 Nieszkowskia ? sp. Loc. CP-1. Zone N. (p.193).
- 6a,b, Partial cranidium, x3, dorsal and side views, 26512.
- 7, Partial cranidium, x2, dorsal view, 26513.

8-12 Illaenus utahensis Hintze, n. sp. Loc. CP-1 Zone N. (p.169).
- 8a,b,c, Paratype, free cheek, x3, front, ventral and side views, 26514.
- 9a,b, Paratype, pygidium, x2, ventral and dorsal views, 26522.
- 10a,b, Paratype, cranidium, x2, dorsal and front views, 26523.
- 11, Paratype, cranidium, x3, ventral view, 26515.
- 12a,b,c,d, Holotype, carapace, x2, front, dorsal, side, and posterior views, 26516.

DESCRIPTION OF TRILOBITE SPECIES

For convenience of reference the trilobite genera are listed alphabetically. Terminology used is that of Howell and others (1947) and Ross (1948). The numbered specimens are deposited at Columbia University.

Genus ASAPHELLUS Calloway, 1877

Asaphellus ? quadrata Hintze n. sp.
Plate XVI, figs. 1-5

Cephalon and pygidium subtrapezoidal in outline. Cranidium elongate, with low glabella extending about three-fourths of midlength and expanding slightly in front of the eyes. Glabella unfurrowed except by traces of occipital furrow at rear. Rim slightly concave at midline on both cephalon and pygidium, but fills out into steeply sloping slightly convex surface laterally. Facial suture Isoteliform. Fixed cheeks comprised almost entirely of flat, slightly elevated palpebral lobes. Free cheeks smooth, with short slender genal spine. Doublure extremely broad, notched in front for reception of hypostome and notched near postero-lateral corner presumably for the same reason that some other trilobites have a Panderian opening there.

Hypostome ovoid; well defined rim borders middle body laterally and posteriorly. Middle furrow comprised of two notches directed posteriorly and proximally. Anterior wings short, narrow. Thorax unknown.

Pygidium subtrapezoidal; axis tapering posteriorly and extending about two-thirds the midlength. Segmentation only faintly discernable on dorsal side but ventral view shows seven axial segments. Wide doublure partially conceals segmentation of pleural platforms. Smaller specimens are faintly notched in rear (see fig. 5, pl. XVI) giving a bilobed appearance.

Asaphellus ? quadrata is probably the most abundant single species in the G-1 zone in west-central Utah. Generic assignment has proved troublesome because other asaphid genera appear to have much in common with this species. For example, *Kayseraspis* Harrington (1938, p. 228) differs principally in having a short pygidial spine. The definition of *Asaphellus* and its relation to other asaphid genera has been discussed by Reed (1930; 1931, p. 456) and Kobayashi (1937, p. 498; 1940, p. 73). In view of their discussions, it seems advisable to only tentatively assign this species to the genus *Asaphellus*.

Holotype: 26308; paratypes, 26305-26307, 26309.

Occurrence: zone G-1.

Asaphellus ? venta Hintze n. sp.
Plate XVI, figs. 6-11

This is the most abundant species in the G-2 zone of the Pogonip group in west central Utah. The cranidium is remarkably similar to those of a number of other asaphid genera such as *Asaphus*, *Ptychopyge*, *Pseudasaphus*, *Basilicus*, *Macropyge* and *Onchometopus* and the species would gladly have been assigned to one of these genera had it not been for its unforked hypostome. The resemblance of the cranidium to some species of these genera with the forked hypostome, for example *Ptychopyge plautini* Schmidt (1907, pl. 3, fig.15), is remarkably close.

The unforked hypostome of *A. ? venta* resembles that found on *Megalaspis* (see *M. lamanskii* Schmidt, 1907, fig. 8, p. 29 and *M. acuticanda* Ang. Schmidt, 1907, pl. 5, figs. 6, 7), on *Kayseraspis* (see *K. asaphelloides* Harrington, 1938, pl. 10, fig. 2, 15), and on *Megalaspidella* (see *M. orthometopa* Harrington, 1938, pl. 12, figs. 6, 7) but configuration of either the head or tail precludes assignment of *A. ? venta* to these genera.

Reed (1931, p. 456) has discussed the assignment of the hypostome to the genotype of Asaphellus. If we consider the hypostomes of the genotype and A. ? venta to be close enough to be congeneric, even so A. ? venta can be only tentatively assigned to Asaphellus because of the convexity, rather than concavity of its cephalic and pygidial rim.

Ross has encountered the same problem in the classification of this type of asaphid trilobite from the G zone of the Garden City formation and has made assignments to several genera such as Basilicus, "Xenostegium", Macropyge, and Asaphellus. It is improbable that "Xenostegium taurus" of Ross (1951, p. 103, pl. 27, figs. 6,7,11) is the same species or even the same genus as Walcott's original X. taurus which was recently named the genotype for Kobayashia Harrington 1938. Ross himself noted the lack of substantiating pygidia for his material. It is not surprising that Ross' species and Walcott's are different for they come from quite different zones in the lower Ordovician. Ross' Utah "Xenostegium taurus" is from zone G-1 while Walcott's Kobayashia taurus is from an equivalent of zone D, judging from the associated fauna listed by Walcott (1928, p. 359) from loc. (61q), Chushina formation, Robson Peak district, British Columbia.

When Harrington (1938, p. 224) erected Kobayashia he assigned Xenostegium ? sulcatum Walcott and X. ? eudocia Walcott to the genus. This assignment does not appear feasible to this author because of the differences in the cranidia, particularly the marginal furrow. Furthermore, according to Ross (1951, p. 107), both X. ? sulcatum and X. ? eudocia are the same species and are from zone G-1, stratigraphically well above the fauna equivalent to that in which Kobayashia taurus was found by Walcott. We think it preferable to reserve the use of the name Kobayashia to those trilobites like K. taurus (Walcott) of zone D until such time as it can conclusively be shown that Kobayashia extends into earlier or later zones.

Asaphellus ? *eudocia* (Walcott) and "*Xenostegium taurus*" Ross (see Ross, 1951, pl. 27) are both somewhat similar to *A*. ? *venta* of the G-2 zone, but come from the G-1 zone; one or the other may be the direct ancestor of *A*. ? *venta*. The cranidium which Ross (1951, pl. 27) has tentatively assigned to *Macropyge gladiator* (the holotype of which is a pygidium with a huge telson) is virtually identical to that of *A*. ? *venta* and is from the same faunal zone.

It is possible that these asaphids from the G zone in the lower Ordovician of Utah should be assigned to a new genus. But rather than further confuse an already confused classification by the erection of a new genus for *A*. ? *venta* it was felt desirable to give a tentative assignment to an already established genus at this time, and to await the further clarification of asaphid genera by study of their genotypes.

A. ? *venta* is distinctive among the asaphids of the G zone in Utah for its convex rim on the pygidium and cephalon. The doublure on the free cheeks is wide like that of *A*. ? *quadrata* Hintze n. sp., is notched deeply in the front for the reception of the hypostome, and has the "Panderian notch" near the postero-lateral corner. The pygidial rim is readily distinguished by its posterior elevation at midline; hence the specific name. The pygidial doublure is not as broad as in *A*. ? *quadrata*, extending up the inner side of the pygidium only about half the way to the top of the pleural platform. The pygidial doublure is also notched at midline becoming extremely narrow there. Thorax not known.

Holotype: 26310; paratypes, 26311-26315

Occurrence: zone G-2.

Asaphellus ? sp.
Plate XVI, fig. 12

The free cheek of an asaphid of infrequent occurrence in zone G-2 of the Pogonip formation is figured for comparative purposes. It differs from A. ? venta of the same zone in having a concave rim and in the course of the posterior facial suture (compare figs. 12 and 8, pl. XVI). This free cheek compares quite closely with that of Asaphellus ? sp. B. Ross (1951, pl. 28) from the same zone in the Garden City formation.

Figured specimen: 26316

Occurrence: zone G-2.

Genus BARRANDIA McCoy, 1849

"Barrandia ? sp." Walcott
Plate XXVI, figs. 15-16

Walcott's (1884, pp. 96-97, pl. XII, fig. 6) description of the single fragmentary cranidium from the upper Pogonip group in central Nevada is as follows:

"Glabella subclavate, the width of the base being about four-fifths of that of the anterior portion; front broadly rounded; general surface gently convex, curving down somewhat abruptly in front to the narrow, rim-like margin; occipital furrow shallow, but quite distinct; dorsal furrows clearly defined.

"There are but slight traces of the fixed cheeks attached to the glabella. The species is characterized by the peculiarly shaped glabella."

"Formation and locality.---Pogonip Group, on the west slope of McCoy's Ridge, Eureka District, Nevada."

The two small cranidia from the Pogonip group in central Utah are more complete than Walcott's figured specimen and show the palpebral lobes to be large, semicircular, horizontal, and situated well back of the cranidial midlength. "Barrandia ? sp." is uncommon in zone J, but a somewhat larger similar form is more common in zone N. Unfortunately, this later form has not been found silicified and its preservation is generally so poor that it has been neither figured nor described. Because of the poor preservation of Walcott's specimen it has not been possible to decide whether it compares better with the zone N or zone J "Barrandia ? sp." from Utah.

Figured specimens: 26488, 26489

Occurrence: zone J.

Genus BATHYURELLUS Billings, 1865

Bathyurellus pogonipensis Hintze n. sp.
Plate X, figs. 11-19

Cephalon semicircular in outline, excluding genal spines; width up to 60 mm., midlength up to 30 mm., and length including genal spines up to 65 mm. Glabella entirely smooth except for faint indication of occipital furrow on each side; glabella expands slightly anteriorly and is bluntly pointed in front, set off from rest of cranidium by well marked dorsal furrow. Brim slightly shorter than rim along midlength; collectively the anterior limb is about one-third of the length of glabella along midlength. Brim more convex than rim; they meet along arcuate sharp line, the marginal furrow. Palpebral lobes large, semicircular, horizontal, being about two-fifths of the length of the glabella; no ocular ridge or palpebral furrows. Anteriorly the facial suture diverges about 30 degrees from axial line, cutting almost entirely across rim before curving sharply inward to continue on dorsal surface along front edge of cephalon. Posteriorly the suture parallels rear edge of cranidium to base of genal spine where it cuts backwards terminating the slender featureless posterior limb. Free cheeks with large sloping ocular platform; marginal furrow continues from cranidium as a well-marked line to the angle where it becomes obsolete after curving proximally at the base of the genal spine. Free cheeks covered with Bertillion lines; doublure not observed.

Only one incomplete hypostome (fig. 13, plate X) has been found associated. An incomplete thorax (fig. 18, plate X) shows at least nine thoracic segments, the number cited as typical for the genus by Billings (1865, p. 263). Axis of thorax is highly convex; and of almost constant width from front to rear; pleural platform almost horizontal.

Pygidium semicircular, not pustulose; width up to 55 mm., length up 'o 25 mm. Axis convex, triangular, about one-fifth the width and one-half the length of the pygidium, tapering posteriorly and divided by five shallow axial furrows, the posteriormost of which is almost obsolete. Pleural platform marked by four pairs of shallow, posteriorly curving furrows which fade away upon reaching the broad rim. Well defined, fairly large facets at the antero-lateral corners. Rim broad, smooth, faintly concave. Doublure broad, shows commonly on weathered specimens where the rim has peeled off (figs. 12, 19, plate X). In this regard it seems probable to me that _B_. _validus_ Billings (1865, p. 268) is a synonym of _B_. _fraternus_ Billings (1865, p. 267), the difference in the pygidia of the two being explained by this same "peeling" phenomena exposing the broad doublure.

_B_. _pogonipensis_ differs from most other species of the genus in that the neck furrow is virtually obsolete and the palpebral lobes are somewhat larger proportionally. The pygidium of *B. pogonipensis* is almost identical to that figured by Holliday (1942, plate 74, fig. 7) for his *Niobe* ? *feitleri* from the Pogonip formation at Beatty, southwestern Nevada. Inasmuch as Holliday's assignment of this pygidium to *Niobe* was only tentative, based on a poorly preserved associated glabella, it seems very likely that *feitleri* is really a species of *Bathyurellus*.

Holotype: 26519 (pygidium); paratypes, 26520, 26521, 26406-26410, 26223.

Occurrence: zone M.

Bathyurellus ? sp.
Plate X, fig. 6

The figured specimen is the only one found and is mentioned because of its possible biostratigraphic significance. Inasmuch as the rim is not preserved we cannot definitely assign this specimen but the features that are shown indicate a possible if not probable assignment to the genus *Bathyurellus*. If this is correct it indicates that *Bathyurellus* ranges from zone I (upper Canadian) to zone M (Chazyan) in Utah. "*Bathyurellus* ? sp." differs from the later *B. pogonipensis* in presence of a well-marked occipital furrow. In that regard it is like most of Billings' species from eastern Canada.

Figured specimen: 26218

Occurrence: zone I.

Genus BELLEFONTIA Ulrich, 1924

Bellefontia Ulrich, in Walcott, 1924, Smithsonian Misc. Coll., vol. 75, no. 2, p. 54; 1925, Smithsonian Misc. Coll., vol. 75, no. 3, pp. 69-71.

No mention is made of the number of thoracic segments in Ulrich's original or Ross' (1951, p. 97) subsequent discussion of this genus. Based on an incomplete carapace of the new species B. ibexensis (fig. 6, plate IV) we can add to the generic description that the number of thoracic segments in the adult appears to be eight.

Bellefontia ibexensis Hintze n. sp.
Plate IV, figs. 1-8

Cranidium differs from that of B. collieana, the genotype, B. nonius Walcott, and B. chamberlaini Clark principally in that B. ibexensis has slightly larger palpebral lobes than any of the others. The pygidium, however, is the really distinctive part, as this species is the only one yet described for the genus which has a median notch in the pygidial rim. This notch gives a bilobed appearance to the mature pygidia but is absent from specimens under 5 mm. in width. Pygidia of this species vary individually somewhat in convexity, width of rim, and prominence of the posterior notch, but as these variations appear among specimens leached from a single sample of rock it is unlikely that there is any taxonomic significance in this variation. The free cheek is distinctive in that the posterior edge and the genal spine meet at more nearly a 90 degree angle than in other species. Hypostome and hypostomal articulation like that described for genus by Ross (1951, p. 98); thorax with eight segments, width of axis decreasing from front to rear.

Holotype: 26108 (pygidium); paratypes, 26103-26107, 26109-26112.

Occurrence: high in zone B. This species was mentioned by Ross (1951, p. 97) as occurring in same zone in the Garden City formation but was not figured or described.

Bellefontia chamberlaini Clark
Plate IV, figs. 9-13

This species in central Utah appears to be conspecific with the type material from northeastern Utah as described by Clark (1935, p. 245) and Ross (1951, p. 98). It should be noted that the smaller pygidia are relatively wider and shorter (see Ross, 1951, plate 25, figs. 10-15) than the larger specimens (see Clark 1935, plate 24, fig. 11).

Figured specimens: 26112-26116.

Occurrence: high in zone B.

Genus BENTHAMASPIS Poulsen, 1946

Benthamaspis diminutiva Hintze n. sp.
Plate XIII, figs. 9-12

Surface smooth or with fine lines. Cranidium convex, globose; glabella outlined by faint dorsal furrows which extend to front corner of eye; marginal furrow in front of glabella more pronounced than on posterior limbs. Fixed cheek narrow, merges imperceptibly into long palpebral lobe which is margined by slightly thickened rim and faint furrow. Posterior facial suture defines stubby posterior limb. Anterior facial suture cuts directly forward to rim, curves sharply inward and cuts diagonally across rim and doublure. A rostrum of considerable size probably separates the right and left free cheeks.

Free cheeks, rostrum, hypostome and thorax unknown.

Pygidium semicircular, not so highly convex as cranidium. Subtriangular convex axis rises above more gently convex pygidial platform. Broad pygidial doublure of even width encircles ventral outer third of pygidial radius.

The genotype, B. problematica Poulsen (1946, pp. 325-6, pl. 22, figs. 14-16) was obtained from "Nunatami formation ? (possibly the ostracod horizon); Cape Steven, Ellesmere Land". Other trilobites previously described by Poulsen (1927) from the ostracod horizon of the Nunatami formation in Greenland show the equivalence of the ostracod horizon to the J zone of Utah. It is therefore significant that this new species of Benthamaspis comes from the J zone thus affirming Poulsen's tentative assignment of the stratigraphic horizon of the genotype.

B. diminutiva differs from B. problematica principally in depth of dorsal furrow and length of posterior limb.

Holotype: 26262; paratypes, 26261, 26263, 26264.

Occurrence: zone J.

Genus BOLBOCEPHALUS Whitfield, 1890

Bolbocephalus sp.
Plate IX, fig. 17

A single incomplete cranidium assignable to this genus was obtained from a piece of limestone talus. Other fossils obtained by leaching a part of the talus block were several small Protopliomerops pygidia and a fragmentary Psalikilus cranidium. This does not permit us to make a closer assignment than that the material is definitely zone G, whether G-1 or G-2 is not known.

Cranidium dominated by bulbous glabella which expands anteriorly and is somewhat higher and overhangs the rim more than in the genotype, B. seelyi. In this respect it more resembles Rananasus Cullison (1944). In Rananasus, however, the dorsal furrow is said to be coincident with the facial suture for a short distance in front of the eye. This is not the case with the specimen at hand. Anteriorly the dorsal suture parallels the facial suture defining a rim of medium width. Fixed cheeks narrow; long narrow palpebral lobes margined by thickened rim and furrow. Well marked occipital and marginal furrow on posterior limb.

No other parts of the carapace are known.

Figured specimen: 26212.

Occurrence: zone G.

Genus CAROLINITES Kobayashi, 1940

Carolinites Kobayashi, 1940, Papers and Proc. Roy. Soc. Tasmania (1939), p. 70.
Dimastocephalus Stubblefield, 1950, Ann. Mag. Nat. Hist. (12), vol. 3, no. 28, p. 341.
Carolinites Kobayashi. Stubblefield, 1950, Ann. Mag. Nat. Hist. (12), vol. 3, no. 29, p. 451.

Ross (1951, p. 82-84) expressed the view that the "pre-occipital lobes" which characterize this genus are not glabellar lobes, but rather "some other structures independently developed, and that after development on the fixed cheeks they may have migrated inward to impress the sides of the glabella and dislocate the straight course of the dorsal furrows." Ross based his conclusion principally on the assumption that the earlier occurring genus Goniophrys Ross, which is similar in aspect but lacks the "pre-occipital lobes", was an ancestral form from which the lobed forms developed and that the "lobes" then represent a new development rather than a modification of pre-existing glabella furrows, as was held by Stubblefield (1950, p. 344).

The finding of a form intermediate between the Goniophrys of zone F and Carolinites genacinaca Ross of zone J has shed some light on this problem. "Carolinites sp. A.", described below from zone G-2, is strikingly like Goniophrys of zone F except that "pre-occipital lobes" are found only on the former, thus supporting Ross' view that the lobed Carolinites developed from the unlobed

Goniophrys. This apparently occurred somewhere in the G-1 interval. Beginning with *Goniophrys* we can demonstrate a sequence of these related forms in the Pogonip group:

zone M - *Carolinites killaryensis utahensis* Hintze n. subsp.
zoneI,J- *Carolinites genacinaca* Ross
zone H - *Carolinites genacinaca nevadensis* Hintze n. subsp.
zone G-2-*Carolinites* sp. A Hintze
zone F - *Goniophrys prima* Ross

From the faunal list of forms associated with *Carolinites killaryensis* (Stubblefield, 1950, p. 342) at Derrynaclough Hill in western Ireland it appears that his *C. killaryensis* is found in a zone comparable to our zone N or even slightly younger.

Carolinites killaryensis utahensis Hintze
n. subsp.
Plate XX, figs. 10-13

This subspecies differs only in a few minor respects from the well described *C. killaryensis* (Stubblefield): the fixed cheek of the Utah species is narrower, and distally is more deflexed downward; the genal spine and telson are apparently slightly shorter and less graceful than those of the Irish species. As noted above it is thought that the Utah subspecies may be slightly older than Stubblefield's species.

Holotype: 26372; paratype, 26373-26375

Occurrence: zone M.

Carolinites genacinaca Ross
Plate XX, figs. 7-9

Specimens from central Utah do not appear to differ appreciably from Ross' (1951, p. 84) type material from northeastern Utah and are here figured only for comparative purposes.

Figured specimens: 26369-26371

Occurrence: zones I, J

Carolinites genacinaca nevadensis Hintze n. subsp.
Plate XX, figs. 3-6

This subspecies differs from the later occurring C. genacinaca Ross (1951, p. 84) only in minor details: the "pre-occipital lobes" are proportionally slightly smaller; the genal spine is not quite as far forward on the free cheek, and is less arcuate in curvature; the marginal furrow on the pygidium is more deeply impressed.

An immature meraspid cranidium (fig. 6, plate XX) shows the "pre-occipital lobes", although Ross (1951, p. 83) has noted that for C. genacinaca these lobes are not present in cranidia less than 1.3 mm. in length. This stage also shows "anterior horns" similar to those noted by Ross (1951b, plate 81, figs. 12-13) for another Ordovician trilobite. This small cranidium lacks the convexity of adult forms.

Holotype: 26364; paratypes, 26365-26367

Occurrence: zone H.

Carolinites sp. A.
Plate XX, fig. 2

This species differs from all other known species in two respects: first, the rim is not as wide transversely as the glabella in other species, in fact it is only about three-fifths the glabellar width; second, the "pre-occipital lobe" is defined by the bifurcation of the dorsal furrow only for about half the length of the "lobe", the posterior half of the "lobe" being essentially a a sloping ramp from the glabella to the fixed cheek. In the bifurcation of the dorsal furrow the distally trending fork is extremely short while the proximally trending fork curves upwards and inwards about half the length of the lobe.

<u>Carolinites</u> sp. A. seems to be intermediate between typical <u>Carolinites</u> species and the earlier occurring <u>Goniophrys prima</u> Ross, but differs from the last named in that in <u>C</u>. sp. A. the dorsal and marginal furrows are confluent along the front of the glabella; also, the fixed cheek of <u>Goniophrys</u> is larger and the eyes further forward. In our figured specimen of <u>Goniophrys</u> (fig. 1, plate XX) there is a suggestion of the beginnings of the "pre-occipital lobe" in that the posterior part of the dorsal furrow is not so deeply impressed as the rest of the furrow through approximately the same distance as the length of the "lobe" on <u>Carolinites</u>. This is discussed further under <u>Goniophrys prima</u>. It further confirms the relationship between <u>Carolinites</u> and <u>Goniophrys</u>.

Figured specimen: 26[illegible]68

Occurrence: zone G-2.

Genus CLELANDIA Cossman, 1902

Clelandia utahensis Ross
Plate IV, figs. 15-17

This species, as found in west central Utah, agrees in all respects with the type material described by Ross (1951, p. 117) from northeastern Utah and is figured here for comparative purposes only. Fig. 16 shows a complete free cheek "yoke" of <u>C</u>. <u>utahensis</u>. The "yoke" is a generic characteristic mentioned by Cleland (1900, p. 255 (127)) in his original description.

Figured specimens: 26118-26120.

Occurrence: zone B.

Genus CYBELOPSIS Poulsen, 1927

Cybelopsis Poulsen, 1927, Meddelelser om Gronland, vol. 70, p. 305.

Poulsen's generic diagnosis follows in its entirety:

"Cybelopsis is erected by E. O. Ulrich to include certain trilobites belonging to the Cybele group, but differing from Cybele in having three instead of four glabellar lobes. The shape of the cranidium and the thorax indicates relationship to Pliomera Raymond, but the pygidium is almost perfectly cybeloid."

"A few species are found in the Black River of Illinois and Wisconsin."

Following this brief diagnosis Poulsen described one species, Cybelopsis speciosa, from the Nunatami formation at Nunatami on the south coast of Washington land. This procedure has made C. speciosa Poulsen the genotype of Cybelopsis by monotypy and established the genus as based on that species. Ulrich's manuscript which was indirectly referred to by Poulsen has never been published and as Ulrich was not quoted directly by Poulsen the genus Cybelopsis must be henceforth credited to Poulsen rather than Ulrich. The impracticability of perpetuating courtesy references has been discussed by Knight (1941, p. 21).

Fortunately, C. speciosa was well represented in Poulsen's collections being known from "an almost complete dorsal shield, a fragmentary cranidium, a couple of free cheeks and a great number of pygidia". Poulsen's (1927, pp. 305-306) description of the genotype is therefore quite complete except for lack of mention of an hypostome. An associated hypostome from our western Utah collections may serve to supplement the original description of the genus. This hypostome (fig. 11, pl. XXV), is oval in outline with an ovoid middle body; middle furrow consists of a small pair of inward and posteriorly directed furrows which do not extend across the central portion of the body; anterior wings short and stout; rim broad and continuous around sides and rear of middle body but lacking from anterior edge.

Except for Poulsen's comment, apparently taken from Ulrich, that "a few species are found in the Black River" all of the known species of Cybelopsis are Upper Canadian or Chazyan in age. The Nunatami formation from which the genotype was taken was classified by Poulsen as Upper Canadian. "C. cf. speciosa" occurs in the Wahwah limestone of western Utah in the J zone, also classified as Upper Canadian. In Utah, at least one and perhaps two as yet unnamed "Cybelopsis sp." of large size are found in zones M and N (both Chazyan), the upper part of the Pogonip group. As yet, no species of Cybelopsis has been described from beds of Black River age. Ross (1951, p. 138) has suggested that his genus Pseudocybele may be ancestral to the Middle Ordovician Cybelidae; an alternative proposal is that Cybelopsis may be the ancestral form as Pseudocybele has, as yet, not been found above zone J, whereas Cybelopsis occurs from zone J into zone N.

Except for the presence of pits on the postaxial boss, the pygidium of Cybelopsis is strikingly similar to that of Pseudocybele and Pliomerops, and the three could be confused in poorly preserved material. Furthermore, even though the cranidium of Pseudocybele is distinctive enough, that of Pliomerops could be confused with that of Cybelopsis. Pliomerops, as represented by its genotype P. canadensis (Billings) is best figured and described by Raymond (1905, Ann. Carn. Mus., vol. 3, pp. 363-5, pl. 14, fig. 10-13; 1910, 7th Rept. Vermont State Geol., pp. 238-9, pl. 36, fig. 10-13, pl. 38, fig. 14; 1910, Ann. Carn. Mus. vol. 7, pp. 75-76, text figure 4, 6, pl. 18, fig. 14). Perhaps the most obvious cranidial difference between Cybelopsis and Pliomerops is in the course of the glabellar furrows. The posterior two pairs of Pliomerops extend almost straight laterally (at right angles to the axial line), whereas those of Cybelopsis trend antero-laterally. _Pliomerops_ is characterized by a large number of thoracic segments, nineteen, according to Raymond, whereas Poulsen reports only thirteen segments for a _Cybelopsis_ specimen of comparable size. In addition, the hypostomes of the two genera, though somewhat similar, differ in that the broad rim is not continuous as far forward in _Pliomerops_ as in _Cybelopsis_.

Cybelopsis appears to have developed from _Protopliomerops_ at about the same time as did _Pseudocybele_ and _Pseudomera_ (see Table 13) and it is found in the J zone together with the last named two genera. As noted above, _Pseudocybele_ has not been reported higher than the J zone but _Pseudomera_ and _Cybelopsis_ continue upwards together in the Pogonip group virtually to the base of the Eureka quartzite. The large "Cybelopsis sp." of zones M and N is paralleled by equally large species of _Pseudomera_. These large _Pseudomera_ species from zone M and N in Utah are probably the same as those Holliday (1942, plate 73, fig. 5-7, 11-14, 16) called "_P. nevadensis_" and "_P. barrandei_" from Ike's Canyon in central Nevada. The parallelism of the development of _Cybelopsis_ and _Pseudomera_ in the upper Pogonip has lead us to speculate upon the possibility that, instead of two different genera being represented, as in our present classification, actually _Pseudomera_ and _Cybelopsis_ might be merely the two sexes of one genus. The paired occurrence of trilobite species is a common thing in other Pogonip group faunules, as well as elsewhere in the geologic record, and it is unfortunate that speculation on the significance of this pairing seems doomed to remain in realm of mere speculation because the matter does not lend itself to proof. Nonetheless it is conceivable that the pits on the post-axial base of _Cybelopsis_, instead of indicating rudimentary segmentation as suggested by Poulsen (1927, p. 306) may be instead sex indications of an opposite character to the pitless boss found on _Pseudomera_.

Zone	PSEUDOCYBELE	CYBELOPSIS	PSEUDOMERA	KAWINA ?
N		Cybelopsis sp. (large)	Pseudomera cf. P. barrandei	Kawina ? unicornica
M		Cybelopsis sp. (large)	Pseudomera kanoshensis	
J	Pseudocybele nasuta	Cybelopsis cf. C. speciosa	Pseudomera cf. P. insolita	Kawina ? webbi Kawina ? sexapugia
H-I	Pseudocybele altinasuta	Pseudocybele lemurei		
G-2	Protopliomerops contracta			Protopliomerops ? quattuor
G-1	Protopliomerops celsaora	Protopliomerops aemula	Protopliomerops firmimarginis	
F	Protopliomerops superciliosa			
E	Tesselacauda depressa			

Table 13.- Pliomerid development in the Pogonip group of western Utah.

Cybelopsis cf. C. speciosa Poulsen
Plate XXV, figs. 5,6,8-12

As far as can be ascertained from Poulsen's photographs and written description, our Utah specimens are virtually identical with the genotype, C. speciosa Poulsen (1927, pp. 305-306, text figures 6, plate 20, fig. 9, 38-43) with the exception that the pattern of the pits on the post-axial boss may be more complex on the Utah specimens than it is on Poulsen's type material. Poulsen's text figure 6 indicates sixteen pits in two double rows extending about half the length of the post-axial boss. At the posterior end of the rows of pits Poulsen indicates a faintly marked backward curving line crossing the axis. On the Utah specimens, however, no such line appears to be indicated. The sixteen major pits are commonly slightly modified from the pattern noted by Poulsen; the anterior double pair on large specimens has usually coalesced to form a single large pair of pits (see fig. 12b, pl. XXV) and an additional large pair of pits is developed at about the center of the post-axial boss. In addition to the major pits two rows of lesser pits occur beneath and posterior to the major pits in arcs which curve backwards across the post-axial boss joining in the center. This may be the feature referred to as a "line" by Poulsen. The lesser pits are ill-defined on small specimens. Even the major pits are sometimes obscured by the small pustules which cover much of the pygidium.

The doublure of the pygidium is rather unique, forming a reinforcing arc around the base of the pleural spines. The tips of the spines extend to the rear of the doublure, but very little beneath it in elevation.

The doublure of the free cheek extends under the front of the cranidium but does not reach the midline; a small roughly rectangular plate must have fitted between the two cheeks but none has been found so far. The hypostome is oval in outline with an ovoid middle body which is cut by two small furrows towards the rear (see fig. 11, pl. XXV). A broad rim is continuous around sides and rear of middle body but terminates at the anterior wings.

Figured specimens: 26466-26472

Occurrence: zone J.

Cybelopsis sp.
Plate XXV, figs. 1-4

In the uppermost part of the Pogonip group the most common trilobites are Pseudomera and Cybelopsis species of large size. Unfortunately none of these have yet been found silicified and the composition of the shaly limestone in which they occur is such that they are almost impossible to prepare. Fragments of weathered specimens indicate that these may be two species of each genus (pl. XXV, figs. 1 and 2 vs. figs. 3 and 4 for Cybelopsis; "P. barrandei" and "P. nevadensis" for Pseudomera as discussed by Holliday, 1942). On the other hand these may later be found to be only size variants of the same species for each of these genera. At any rate they differ markedly in appearance from their ancestral forms of the J zone. In addition to the larger size, these higher occurring forms have much broader pygidial pleurae; the generic characteristic pits on the post-axial boss on "Cybelopsis sp." have been reduced one-half in number by the coalescing of the pairs of pits found in the older C. speciosa; the cranidium lacks the convexity of the older forms.

Figured specimens: 26416, 26417, 26398, 26399.

Occurrence: zones M-N.

Genus DIMEROPYGIELLA Ross, 1951

Dimeropygiella Ross, 1942, Peabody Mus. Nat. Hist., Yale Univ., Bull. 6, p. 123.

Ross notes that the genotype, _D. caudanodosa_, from the Lower Ordovician, differs from species of the somewhat similar Middle Ordovician genus _Dimeropyge_ in that "Its cranidial brim is split into two halves, since the marginal and dorsal furrows are tangent in front of the glabella; in _Dimeropyge_ the brim is fully developed." Further, "Although the pygidia of the two genera are similar in outline, that of the new genus possesses five distinct axial and pleural segments, two more than are present in Opik's "(Dimeropyge). The lower Ordovician H zone of the Fillmore limestone of western Utah has yielded two new species which are clearly directly ancestral to _Dimeropygiella caudanodosa_ but which in the features of the cranidial brim and pygidial axis are like the supposedly much later occurring _Dimeropyge_. These H zone species, if left in _Dimeropygiella_ will require some modification of the generic diagnosis of that genus; but if placed in _Dimeropyge_ will require considerable extension in time range of _Dimeropyge_, bracketing in time the occurrence of _Dimeropygiella_.

Stratigraphically the three species occur as follows in western Utah:

zone J - _D. caudanodosa_ Ross
zone H - D. ovata Hintze n. sp. and _D. blanda_ Hintze n. sp.

Dimeropygiella caudanodosa Ross
Plate XIX, figs. 5,10

This species, as found in west central Utah, is similar in all respects to topotype material from northeastern Utah and is figured here for comparative purposes only.

Figured specimens: 26354-26355.

Occurrence: zone J.

Dimeropygiella ovata Hintze n. sp.
Plate XIX, figs. 1-4

This species is more finely pustulose, has an even more inflated glabella, and specimens average somewhat larger in size than the well described genotype, _D_. _caudanodosa_ Ross. In addition, the marginal and dorsal furrows are not quite tangent being separated by a narrow strip of the brim. This narrow strip of the brim lacks pustules thus giving the appearance that the marginal and dorsal furrows approach tangency closer than they do.

Free cheek is as described for genotype except that pustules are not so large and Bertillion lines may be seen on rim. Genal spine is very short, blunt, located immediately distal to facial sutures. Hypostome and thorax unknown.

Pygidium with three axial segments; at the posterior of axis a pair of strong nodes. Four pairs of pleural segments taper distally but extend to and join with rim. The only pustules on the pygidium are one or two on the horizontal portion of each pleural segment.

Holotype: 26347; paratypes, 26348-26350.

Occurrence: zone H.

Dimeropygiella blanda Hintze n. sp.
Plate XIX, figs. 6-8

Glabella pustulose, fixed cheeks and free cheeks faintly pustulose. Palpebral lobe longer and less elevated than in _D_. _caudanodosa_ or _D_. _ovata_. Brim as wide as rim at midline. Specimens average about the same size as _D_. _ovata_ and somewhat larger than _D_. _caudanodosa_.

Free cheek like that of genotype except for pustulosity and virtual lack of genal spine which in this species is almost obsolete (see fig. 8, pl. XIX). Hypostome and thorax unknown.

Pygidium with three distinct axial segments and the suggestion of a fourth at the base of the pair of closely spaced nodes at the posterior of the axis. Five pairs of pleural segments, not pustulose, taper distally but extend to and join with rim.

D. blanda and D. ovata were obtained abundantly and in about equal numbers from the leaching of single rock samples from locality H-20. This again leads to the speculation that perhaps instead of specific differences actually the two "species" are opposite sexes.

Holotype: 26353; paratypes, 26351-26352

Occurrence: zone H.

Genus GONIOPHRYS Ross, 1951

Goniophrys prima Ross
Plate XX, fig. 1

Perhaps the single cranidium from west central Utah illustrated by us should have been given a "cf." designation, for it shows a feature neither mentioned by Ross nor shown in any of his photographs in the original description of the species (Ross, 1951, p. 81-82). This feature is the "shallowing" of the dorsal furrow in its posterior part at about the same position as occupied by the peculiar "pre-occipital lobes" in the genus Carolinites. This "shallowing" is important as it shows the transition between the earlier "lobeless" and later "lobed" forms of Komaspid trilobites.

The reader, in comparing Ross' (1951, plate 18, fig. 17) photograph of the holotype cranidium of Goniophrys prima with our photograph of the specimen from west central Utah, may conclude that there is a difference in the anterior limbs of the two because the brim does not show on our figure 1, plate XX. However, this has resulted from the orientation of the specimen during photographing; it having been tilted forward more than Ross' figured specimens. Actually, just as in the holotype, the dorsal furrow on our specimen does not quite touch the anterior marginal furrow at midline, and except for the "shallowing" feature mentioned above, and perhaps a slightly greater convexity of the whole cranidium, is the same as the type material from northeastern Utah.

Specimens obtained by us from the Garden City formation on the west side of Promontory Point in northern Utah (for exact place in measured section, see Hintze, 1951, p. 95) also show the "shallowing" of the dorsal furrow but not as markedly as the figured specimen. In fact, the shallowing on the same Promontory Point specimens can be observed only on the ventral side where the "dorsal ridge" becomes less sharp. Although both Ross' and our specimens come from zone F there is the possibility that our west central Utah material is actually slightly younger than that of Ross, as inferred from the further development of the "shallowing" feature in the specimen from west central Utah as discussed above.

Figured specimen: 26363

Occurrence: zone F.

Genus GONIOTELUS Ulrich, 1927

Goniurus Raymond, 1913, Canada Geol. Surv., Victoria Mem. Mus., Bull. I, p. 65.
Goniotelus Ulrich, 1927, Okla. Geol. Surv., Bull. 45, p. 14 (Goniurus preoccupied).

Ross (1951, pp. 68-71) discusses the morphologic similarities of the genera Eleuthrocentrus and Goniotelus and describes a new species of the former, E. williamsi, from the uppermost Canadian J zone in northeastern Utah. The same zone in west central Utah has yielded four species here assigned to the genus *Goniotelus*. Thus *Eleutherocentrus* and *Goniotelus*, if really two distinct genera, appear to occupy a similar stratigraphic position. *Goniotelus* is most readily distinguished from *Eleutherocentrus* by the fact that the terminal spine in *Goniotelus* is an extension of the pleural platform and rim, not of the axis as in *Eleutherocentrus*. Whether or not this is a characteristic of generic value is open to question.

Goniotelus brighti Hintze n. sp.
Plate XXVI, figs. 1-6

Cranidium and ocular platform of free cheeks pustulose; cephalon surrounded by a tubular rim which is extended into long arcuate genal spines; cephalon nasute; free cheeks do not meet at mid-line but are separated by a rostrum probably like that shown in fig. 7, plate XXV. Glabella bullet-shaped, defined by distinct, continuous dorsal furrow. A suggestion of traces of ocular ridges crosses the dorsal furrow at its antero-lateral corners. This feature can be seen faintly on the right hand side of fig. 4a, plate XXVI. Marginal furrow distinct in front but becomes obsolete towards the base of the genal spine. Palpebral lobes large, subcircular, and bordered by a thickened palpebral rim and furrow.

Free cheeks with large globose eyes, convex ocular platform and rim dominated by genal spine. Hypostome and thorax unknown.

Pygidial axis with five segments, only the anteriormost continuing as a well defined pleuron. Pleural platform shows shadow of another faint furrow indicating possibly three pairs of pleura totally. Posterior edge of rim and doublure produced into long slender marginal spine at least three times as long as the axis and probably longer. The principal point of difference between this species and *Eleutherocentrus williamsi* Ross

(1951, pl. 14, figs. 16, 17) is that in _E_. _williamsi_ the spine is apparently an extension of the axis rather than of the rim and doublure.

It should be noted that _G_. _brighti_ and _G_. _brevus_ occur in about equal numbers in the same horizon in the Wahwah limestone and that neither has ever been found whole. Consequently the association of pygidia and cephala as reported here was determined largely by inferring that the cheeks with a long genal spine would belong to the form with the tail bearing the long telson.

Holotype: 26476 (pygidium); paratypes, 26474-26475, 26477-26479.

Occurrence: low in zone J.

Goniotelus brevus Hintze, n. sp.
Plate XXVI, figs. 7-10

The most conspicuous difference between the species and its contemporary _G_. _brighti_ is the contrast in length of genal spines and telsons between the two species. In _G_. _brevus_ these features are a mere token as compared with those of _G_. _brighti_. In most other respects there is a good deal of similarity between the two species. The cranidia differ slightly in proportion; that of _G_. _brevus_ is more pustulose and more convex and the palpebral lobes are relatively slightly larger. The dorsal furrow becomes obsolete at the front but there is a definite area that could properly be called brim. No indication of ocular ridges, or glabellar furrows.

Except for the stubby genal spine the free cheek is like that of _G_. _brighti_. It is not known to which of these two species the rostrum illustrated in fig. 7, plate XXV belongs, but it is likely one or the other. Hypostome and thorax not known.

Pygidium pustulose, semicircular, excluding short marginal spine. Length of spine varies somewhat on individual specimens from "long" ones as shown in fig. 10, plate XXVI to the more common short spine as in fig. 8, plate XXVI. Well defined axis with five segments: three pairs pleura terminate at marginal furrow; broad sloping rim of same width as doublure on ventral side. Marginal spine produced posteriorly from rim and doublure.

G. crassicornis (Poulsen, 1927, pl. XX, fig. 22-25) from the Nunatami formation of Greenland appears to be something like G. brevus. It is of the same age.

Holotype: 26481; paratypes, 26480-26483,26418.

Occurrence: low in zone J.

Goniotelus wahwahensis Hintze n. sp.
Plate XXVI, figs. 11-13

Cephalon and pygidium pustulose, except for rim. Cranidium nasute; glabella bullet-shaped; a faint suggestion of an ocular ridge crosses from the anterior corner of the eye to the dorsal furrow. Two pair of glabellar furrows are faintly indicated by slight depressions in the dorsal furrow opposite the front half of the palpebral lobes, and a third pair is suggested by a very faint shadow on the glabella itself trending backwards from the dorsal furrow opposite the rear of the eye. Dorsal furrow continuous around front of glabella where it touches the marginal furrow.

Free cheek with large eye; tubular rim extends to sharp pointed genal spine of moderate length. Hypostome and thorax unknown.

Pygidium with broad rim which, combined with the doublure, is produced into a dagger-like spine. Flat doublure is as broad on ventral surface as rim is on dorsal. Axis with five segments; three pairs of pleura on pleural platform fade into rim; no distinct marginal furrow.

Holotype: 26485; paratypes, 26484, 26486.

Occurrence: high in zone J.

Goniotelus sp. D.
Plate XXVI, fig. 14

This pygidium somewhat resembles that of G. brighti but has a wider rim and better defined pleural furrows. It occurs with G. wahwahensis somewhat higher in the Wahwah limestone than G. brighti and G. brevus.

Figured specimen: 26487.

Occurrence: high in zone J.

Goniotelus ? ludificatus Hintze n. sp.
Plate XXVII, figs. 12-19

Surface pustulose except rim and furrows. Glabella bullet-shaped, parallel sided with bluntly pointed front end, entirely defined by dorsal furrow. Dorsal and marginal furrows coalesce in front of glabella. Occipital furrow deep. Two nonpustulose areas on side of glabella opposite eyes occupy position of glabellar furrows. semicircular palpebral lobes slope upwards from fixed cheeks; lobes bordered by thickened palpebral rim and furrow.

Free cheek with convex ocular platform, flat rim and doublure. Front ends of doublure of right and left cheek do not meet but are separated by a rostrum of unknown proportions. Marginal furrow on cheek fades at base of genal spine. Spine is flattened tubular at base becoming circular in cross section away from cheek.

Hypostome with ovoid middle body indented near posterior with a pair of short deep furrows.

Rim of hypostome with two pairs of large posteriorly directed spines, one pair at postero-lateral corners and the other pair on the side of the posterior third of the hypostome. Anterior wings directed dorsal.

Thorax not known.

Pygidium convex, sub-pentagonal in outline. Well-defined axis with four ring-like segments and bulbous terminal segment. Three pairs unfurrowed pleura on convex pleural platform fade into concave rim. Doublure flat, slightly wider than rim. Rim and doublure produced into short marginal spine. Triangular facets on antero-lateral corners of pygidium exceptionally well developed.

G.? ludificatus differs from the lower occurring G. brighti, G. brevus, and G. wahwahensis in the following respects: First, the rim on the cephalon is not nasute; second, the rim is flattened tubular rather than circular in cross section; third, the eyes must have been taller for the palpebral lobes slope upwards from the fixed cheek rather than extending horizontally.

Holotype: 26498; paratypes, 26499-26505.

Occurrence: zone M.

Genus HILLYARDINA Ross, 1951

Hillyardina sp. A.
Plate VIII, figs. 5, 6

Ross (1951, p. 71, 77) has described two new monotypic genera, Hyperbolochilus and Hillyardina from the F zone of northeastern Utah and notes that they are differentiated chiefly by the presence of a raised boss on the postero-lateral corner of the ocular platform on Hillyardina and by the anteriorly expanding brim on Hyperbolochilus. The F zone of the Pogonip of western Utah has yielded a form, _Hillyardina_ sp. A., with both an anteriorly expanding brim and a boss on the corner of the ocular platform. This would suggest that the differences which Ross has pointed out between _Hillyardina_ and _Hyperbolochilus_ are perhaps of specific rather than generic value.

Hillyardina sp. A. is represented among our collections by four free cheeks like that in fig. 5 plate VIII and half a dozen incompletely preserved cranidia. Occurring with these at locality G-5 are several other free cheeks, not figured here, but as far as can be determined identical with that of _Hillyardina semicylindrica_ figured by Ross (1951, pl. 16, fig. 2, 8). Thus, if the boss on the postero-lateral corner of the free cheek is indicative of _Hillyardina_ there are at least two species of that genus in our G-5 locality collections. No cranidia, however, have been found which are like those of _H. semicylindrica_ Ross.

The free cheek of _Hillyardina_ sp. A. differs from that of _H. semicylindrica_ Ross in the course of the facial suture both anteriorly and posteriorly from the eye. Anteriorly the suture trends about 30 degrees from midline almost entirely crossing the rim before cutting sharply inward, then revolving ventrally and posteriorly across the doublure. Posteriorly the suture crosses the rim about two-thirds of the distance from dorsal furrow to genal angle truncating the limbs rather than beveling them as in _H. semicylindrica_. The marginal furrow is more sharply defined and the rim slightly narrower than in _H. semicylindrica_.

Cranidium not pustulose; brim expands anteriorly; marginal and dorsal furrows distinct. Small specimens, not figured, show distinct occipital furrow. Hypostome, thorax and pygidium not known.

Figured specimens: 26185, 26186.

Occurrence: zone F.

Genus HYSTRICURUS Raymond, 1913

<u>Hystricurus</u> Raymond, 1913, Canada Geol. Surv., Victoria Mem. Mus., Bull. I, p. 60.

Ross (1951, pp. 39-40) has thoroughly discussed this genus. However, recovery of a silicified cranidium of <u>H</u>. <u>genalatus</u> with free cheeks and rostrum still attached (see fig. 1, pl. VI) gives us an opportunity to note the form of the hitherto unobserved rostrum in this rather typical species of <u>Hystricurus</u> as described below.

Hystricurus genalatus Ross
Plate VI, figs. 1-6

Ross (1951, p. 41) noted that for this species, "Free cheeks in front clearly separated by approximately one-third width of anterior limb". Ross was apparently referring to the width of that portion of the doublure on the cranidium which lies within the facial sutures and which, excluding the beveled edges, is about the same width as the front of the glabella or "approximately one-third width of anterior limb" (see ventral view of cranidium fig. 5, pl. VI). A uniquely preserved complete cephalon (fig. 1, pl. VI) shows, however, that the anterior tips of the free cheeks extend beyond the beveled edges of the cranidial doublure and come close to touching, and that in between the tip ends of the cheeks and the cranidial doublure there lies a small trapezoidal rostrum.

Ross (1951, p. 41) further deduced, "It is almost certain that the anterior margin (of the hypostome) is connected directly to the posterior edge of the cranidial doublure between the free cheeks". It can be seen at once that with the rostrum in place and the free cheeks overlapping the cranidial doublure it is impossible for the hypostome to fit in the manner suggested by Ross. Furthermore no processes or grooves for hypostomal attachment have yet been observed on the obvious place for such attachment, the rear edge of the free cheek doublure, nor have any hypostomes been found. Positive evidence on the mode of hypostomal attachment, if any, must await the finding and study of complete specimens.

Figured specimens: 26145-26150.

Occurrence: zones B and C.

Hystricurus paragenalatus Ross
Plate VI, figs. 12-14

In the lower Pogonip group of west central Utah _H. paragenalatus_ is found together with _H. genalatus_, an association noted by Ross (1951, p. 53) also, in the Garden City formation of northeastern Utah. Morphologically the specimens from west central Utah are identical with the type from northeastern Utah and are figured here only for comparison.

Figured specimens: 26156-26158.

Occurrence: zone B.

Hystricurus politus Ross
Plate VI, figs. 7-11

We agree with Ross (1951, p. 45) in suspecting that all of the zone B smooth _Hystricurus_ specimens with an occipital spine may not belong to one species. Unfortunately our collections are not adequate to permit splitting the species at this time so the name _H. politus_ has been applied by us to any hystricurid with an occipital spine and without conspicuous pustules. The figures show the range of specimens to which the designation has been applied. Fig. 7, pl. VI might more properly have been compared with _Hystricurus_ ? sp. F. Ross (1951, pl. 15).

Figured specimens: 26151-26155.

Occurrence: zone B.

Hystricurus robustus Ross
Plate VIII, fig. 2

A specimen from west central Utah is figured as a matter of record for comparison to the type material from northeastern Utah.

Figured specimen: 26188.

Occurrence: zone E.

Hystricurus sp. C. Ross
Plate VI, figs. 15-16

Ross (1951, pl. 10) figured an immature cranidium of rare occurrence from the E zone of the Garden City formation. A few cranidia, slightly larger and more mature have been obtained from the E zone in the Pogonip group of west central Utah and are figured here for purposes of comparison. The main point of differences between our specimens and those of Ross is that the two glabellar furrows and the palpebral furrow are not as prominent on our larger specimens as on Ross' figured specimens. An associated free cheek bears the long genal spine typical of the genus Hystricurus.

Figured specimens: 26159-26160.

Occurrence: zone E.

Hystricurus lepidus Hintze n. sp.
Plate VII, figs. 10-12

This species differs from all others yet assigned to the genus by its greater convexity and rotundness. The cranidium is most nearly like that of *H. genalatus* Ross from which it differs by having a more highly up-arched rim in front view, a less deeply incised marginal furrow, and finer overall pustulosity. The free cheek is most like that of *H. politus* Ross but has an even broader ocular platform and a spine which curves ventrally as it curves posteriorly.

Cranidium pustulose; glabella depressed into cranidial surface by deep dorsal furrow; two pairs of glabellar furrows are indicated opposite the palpebral lobes by faint depressions in the dorsal furrow and small nonpustulose area on the adjacent side of glabella. Due to convexity, anterior limb narrowest at marginal furrow; rim subtubular, set off from brim by change in slope rather than by a deep marginal furrow. Posterior limbs short, stubby, flexed downward. Palpebral lobes with the thickened rims set off by distinct palpebral furrow.

Free cheeks with short (sag.) and broad (or high) ocular platform; rim subtubular and extended posteriorly and ventrally into long slender genal spine. Marginal furrow becomes obsolete around the genal angle at the base of the spine. Hypostome and thorax unknown.

Pygidium, inadvertantly not figured, is typically hystricurid, though more nearly semicircular than most species; paratype specimen 26180 measures 2.0 mm. long and 3.7 mm. wide; axis convex, with four axial segments; pleural platform divided into definitely three and possibly four pleura each with a medial pleural groove; pleura fade into tubular rim.

Holotype: 26183; paratypes, 26180 (pygidium, not figured), 26181-26182.

Occurrence: high in zone B.

Hystricurus millardensis, Hintze n. sp.
Plate VI, figs. 17-21

Glabella densely pustulose; brim and fixed cheek sparingly pustulose. Glabella depressed, widest at occipital ring, tapering toward front, subtrapezoidal in outline. Two pairs of glabellar furrows represented by nonpustulose patches on the sides of the glabella. Anterior limb two-sevenths the length of the cranidium; brim and rim about equal in length at midline. Center of eyes about even with midpoint of glabella; lobes horizontal, with thickened lunate rims set off by distinct palpebral furrows.

Free cheeks not pustulose; ocular platform with surface markings radiating outwards from eyes (see fig. 18, pl. VI) as in H. armatus (see Poulsen, 1937, pl. 2, fig. 6). Marginal furrow shallow. Genal spines strong, slightly curved, a little shorter than cranidium at midline. Hypostome and thorax unknown.

Associated pygidia small, sub-semicircular; highly convex axis with four segments; three pairs pleura separated by intrapleural grooves and marked with pleural furrows. Furrows and pleura fade into narrow rim.

Although this species bears a superficial similarity to H. crotalifrons (Dwight), 1884 and H. ravni Poulsen, 1927 it is readily distinguished fron these species by the pattern of pustulosity and by the continuous frontward taper of the glabella. In several respects it is very similar to H. armatus Poulsen but obviously lacks the occipital spine of that species.

Holotype: 26161; paratypes, 26162-26165.

Occurrence: zone B. (low)

Hystricurus ? sp.
Plate VI, fig. 22

A single hystricurid free cheek has been found in a G-2 zone assemblage at locality H-7 and is notable as the highest stratigraphic occurrence of a hystricurid trilobite yet reported from Utah. It is figured as a matter of record.

Figured specimen: 26166.

Occurrence: zone G-2.

Genus ILLAENUS Dalman, 1826

Illaenus utahensis Hintze n. sp.
Plate XXVIII, figs. 8-12

Cranidium and genal corner of free cheeks marked with minute punctae. Cranidium very convex, almost semicircular in side view; length of cranidium (measured on curved surface) is slightly over two-thirds width at eyes. Palpebral lobes large, semicircular, the rear edge almost even with the rear edge of the cranidium. Posterior limb narrow, short, virtually obsolete. Glabella slightly over one-third width of cranidium, well defined at rear but undefined in front as dorsal furrow curves outwards and becomes obsolete. Small glabellar node is centered near rear edge of glabella about even with rear edge of eyes. (This node can be seen on fig. 11, pl. XXVIII and more faintly on the holotype fig. 12b, pl. XXVIII). Sinclair (1947) has called attention to muscle scars on the glabella of other species of <u>Illaenus</u>. On <u>I</u>. <u>utahensis</u> these places of muscle attachment appear as two very faintly elevated rows of scars which parallel the dorsal furrows, are about the same width as the dorsal furrows, and are spaced so as to divide the glabella into three longitudinal columns. (This can be seen in fig. 11, pl. XXVIII. The slightly lighter part down the center of the glabella is flanked by the longitudinal rows of scars.)

Between the two longitudinal rows of scars and the dorsal furrows there are four pairs of additional scars, again showing as faintly elevated areas, in a position analogous to glabellar furrows on other trilobites. These four pairs of scars radiate, the anterior pair pointing antero-laterally and situated about even with the front end of the dorsal furrows, the two middle pairs directed laterally, and the posterior pair directed postero-laterally and situated a little in front of a line even with the glabellar node.

Free cheeks subtriangular, with large eye and roundly pointed genal angle. Doublure extends further towards midline on its trailing rather than leading edge, but free cheeks do not meet at midline. Rostrum, though not found, must be a broad plate, almost as wide in front as the front edge of the cranidium, but narrowing somewhat posteriorly to conform to the oblique trend of the suture between the rostrum and the free cheek doublure. Posterior edge of rostrum parallels leading edge. Hypostome and hypostomal attachment not known.

Thorax with ten segments. In our only complete specimen, the holotype, the head has been shoved backwards partially concealing the first segment so that it does not show up in the photographs, fig. 12, pl. XXVIII, but the rear edge of this segment can be seen on the specimen itself. Axis comparatively narrow for Illaenus, and tapers posteriorly.

Pygidium about twice as wide as long; axis narrow in front, dorsal furrows converge posteriorly but become obsolete around the rear end of the axis. Pygidial doublure extremely broad, extending under entire pygidium except axis and articulating surface on leading edge. A pair of small projections on the doublure near the postero-lateral corners may act as "doorstops" during enrollment. In comparing I. utahensis to previously described species it was found to be most similar to I. consimilis Billings (1865,

p. 277, 331) and _I. fraternus_ Billings (1865, p. 276) both from L, Point Rich, M and N, Table Head, Newfoundland. _I. consimilis_ is, however, larger than the Utah species and with a cranidium which is less convex and wider in front. _I. fraternus_ has smaller eyes, a rounded genal angle and a more semicircular pygidium. Comparison with other described species with more obvious differences is not considered necessary.

Holotype: 26516; paratypes, 26514-26515, 26522-26523.

Occurrence: zone N.

Genus ISOTELOIDES Raymond, 1910

Isoteloides polaris Poulsen
Plate XVII, figs. 9-15

The excellent preservation of the silicified material from Utah enables us to supplement Poulsen's (1927, p. 295) original description of this species. Concerning the glabella, Poulsen says, "The limits of the glabella are practically impossible to settle, as the dorsal furrow is extremely shallow; the glabella, however, seems to be wider at both ends than in the middle". The glabella is best seen in ventral view (see fig. 14a, pl. XVII) where Poulsen's observations are confirmed. In addition, faint traces of four pairs of furrows (ridges on the ventral side) radiate into the narrow part of the glabella from an apparent center at the eyes. A small glabellar node is situated about one-seventh of the mid-length from the rear of the cranidium. Size of the palpebral lobes varies with size of individual, being proportionately larger on smaller specimens. An immature cranidium, tentatively assigned to this species, (fig. 12, pl. XVII) shows marginal, dorsal, and glabellar furrows much more distinctly than mature specimens, nor is the glabella on this immature specimen constricted in width near the eye as on larger individuals.

Free cheek with broad doublure, notched on rear edge to receive the hypostome. Pygidium smooth on dorsal side of medium-sized specimens but large specimen (fig. 15, pl. XVII) shows traces of six pleura. Ventral view of silicified specimen (fig. 13a, pl. XVII) shows axis with traces of twelve or thirteen segments and pleural platform with six and possibly a seventh pair of pleura.

Poulsen questionably referred polaris to the genus Isoteloides because its poorly defined glabella and wide thoracic axis differed from the genotype. In these respects polaris is more like the Upper Ordovician genus Homotelus Raymond, 1920, which has recently been refigured, redescribed and discussed by Whittington (1950, pp. 550-552, pl. 73, figs. 3, 5, 6, 9, 10; text figure 5).

Figured specimens: 26325-26330, 26415.

Occurrence: zone J. Ross (personal communication, 19 June, 1951) also notes the occurrence of I. polaris in this same zone in the Garden City formation of northeastern Utah.

Isoteloides flexus Hintze n. sp.
Plate XVII, figs. 2c, 3-8

Only in proportions of its features does this earlier occurring species differ from I. polaris. The palpebral lobes are proportionately larger for specimens of the same size than in I. polaris; cranidium in front of eyes is wider; interior angle at base of genal spine is less rounded; the pygidium is very slightly wider, proportionately, in I. flexus.

Had not a number of specimens of each of the two species been recovered in stratigraphic succession from the same measured section, it is doubtful that these minor points of difference would have been ascribed to other than individual variation. Undoubtedly there are transitional forms between the two which may be discovered in the future.

Holotype: 26322; paratypes, 26319-26321, 26323.

Occurrence: zone I.

Isoteloides ? genalticurvatus Hintze n. sp.
Plate XVII, figs. 1, 2a, 2b (not 2c),
Plate XVIII, figs. 1-3

Cephalon semicircular, excluding upswept genal spines; median part of cephalon is gently convex, the lateral and anterior parts sloping more steeply down to broad almost flat border. Glabella definitely outlined by break in slope, except directly in front where it appears to extend further forward as a low double prong. A low ridge extends two-thirds of the length of the glabella at midline (see fig. 3a, pl. XVIII) and is flanked by four pairs of lower ridges which radiate toward the central ridge from the dorsal furrow and are directed from an apparent common center near the position of the eyes. These ridges are, presumably, scars of muscle attachment and give rise to inter-ridge "glabellar furrows" or shallow depressions. Marginal furrow moderately impressed on posterior limb. Palpebral lobes small, elevated. Ocular ridge extends from front edge of eyes proximally and anteriorly to the edge of the glabella.

Free cheek with broad rim which merges imperceptibly with ocular platform; doublure extremely broad, extending under almost the entire area of the free cheek. Free cheeks meet at midline; posterior edge of doublure is notched for hypostomal attachment. Genal spine subtriangular in cross section, curves gently upwards, backwards, then inwards.

Hypostome and thorax unknown.

Pygidium semicircular. Width of axis is about one-fifth pygidial width at anterior margin, and it tapers back to prominent termination at inner edge of broad pygidial rim. Axis and pleural platform faintly segmented. Pygidium bordered by broad almost horizontal rim which is slightly upturned at posterior midline. Doublure slightly broader than rim.

This asaphid species cannot be given an unquestioned generic assignment until the hypostome has been identified. Although it is unique in several respects it nonetheless seems to show relationship to Isoteloides in which genus it is placed for the time being. It occurs somewhat higher in the J zone than I. polaris, and may have evolved from some such form during I or J zone time.

Holotype: 26318; paratypes, 26317, 26331-26333.

Occurrence: high in zone J.

Genus JEFFERSONIA Cullison, 1944

Jeffersonia sp. A.
Plate X, figs. 7-10

Cephalon semicircular, excluding genal spine. Glabella smooth, moderately convex, evenly rounded in front, and cut only by prominent occipital furrow; no glabellar furrows. Large, semicircular palpebral lobes rise above elevation of fixed cheek and bear faint narrow-thickened rim and furrow. Anterior limb comprises about one-fourth of the midlength. Slightly convex brim slopes down to almost horizontal rim. Brim and rim separated by abrupt change in slope rather than by deeply impressed furrow. Facial suture cuts slightly outward in front of eye to rim, cuts across rim in gentle curve then turns sharply inward and downward cutting just along front edge of doublure. Posterior limb slender; suture curves evenly postero-laterally cutting marginal furrow about halfway from dorsal furrow to edge of cephalon. Free cheek with convex ocular platform, large eye. Rim and doublure produced into substantial, slightly curved, tubular genal spine. Marginal furrow splits beneath eye, one part trending along edge of cheek to become obsolete at the base of the spine, the other part shallowing but curving around the genal angle to join the occipital furrow.

Nature of frontal doublure on free cheek, hypostome, and thorax unknown.

Pygidium semicircular; axis and pleural platforms with five segments which are less strongly marked posteriorly. Axis highly convex, terminating posteriorly at rim. Rim broad, very slightly convex. Doublure slightly wider than rim and reinforced with a ridge on its inner edge.

This species is very much like J. missouriensis Cullison,(1944, p. 71, pl. 34, figs. 10-16). In side view cranidia of J. sp. A. are almost identical to Cullison's fig. 12. Perhaps the major point of difference between the Utah species and J. missouriensis is in the pygidium. A new pygidium has been assigned J. missouriensis by Ross (1951, p. 76, pl. 15, fig. 15) and it differs from J. sp. A. especially in width of rim. Unfortunately all of our specimens of J. sp. A. are rather poorly preserved, and it was not felt advisable to erect a new species until better material was secured and the species more completely known.

Figured specimens: 26219-26222.

Occurrence: zone G-2.

Jeffersonia ? sp. B.
Plate IX, figs. 8, 11, 12

Unfortunately, the rim of the cranidium of this species is not known, hence it can only questionably be assigned. In most respects, the cephalon, as now known, agrees quite closely with that of _J. peltabella_ Ross (1951, p. 76, pl. 17, figs. 7, 8, 12, 13, 16-22). The cranidium appears to be somewhat relatively shorter, but the similarity of the free cheeks is striking. The pygidium, however, is different in that the rim of _J. peltabella_ is so much wider.

Although several free cheeks of _J_. ? sp. B. are present in our collections the associated pygidium is less common, and the cranidium is known only from the single figured specimen. The association of the parts is, therefore, only tentative and it was not felt desirable to assign a specific name at this time.

Figured specimens: 26205-26207.

Occurrence: zone G-1.

Genus KAWINA Barton, 1915

Kawina Barton, 1915, Washington University Studies (St. Louis), ser. 4, vol. 3, part I, no. 1, pp. 117-118

Three species, two new, are tentatively assigned to this genus from the Ordovician of central Utah; _K_. ? _sexapugia_ Ross and _K_. ? _webbi_ Hintze n. sp., from the uppermost Canadian Wahwah limestone, and _K_. ? _unicornica_ Hintze n. sp. from the Chazyan Kanosh shale. Both new species possess genal spines as does _K_. ? _sexapugia_ Ross. This author confirms Ross (1951, p. 127) in the positive association of the Utah "_Kawina_ ?" cranidia with the pygidia with three pairs of pleura and the characteristic subcircular hypostoma as described by Ross for _K_. ? _sexapugia_.

The reason for the questioned assignment of the three Utah species is that these species all show cranidial features most like the genus _Pseudosphaerexochus_ Schmidt, 1881, as exemplified by the genotype _P_. _hemicranium_ Kutorga, but have pygidia like Kawina rather than like Pseudosphaerexochus.

The genus Kawina was erected by Barton to include Cheirurids with "Cephalon strongly convex; glabella large and composing one-half of the cephalon, not quite as wide as long, strongly swollen, and with a tendency for a faint hump at the posterior; the three pairs of glabellar furrows about equally distinct; cheeks drooping; facial suture running roughly parallel to the sides of the glabella and cutting the margin at the genal angles or even slightly in towards the axis; genal angles without spines". Inasmuch as the published figures of the genotype, K. vulcanus Billings (1865, p. 284, fig. 271), represent either objective drawings in which the posterior limb is obscured, or subjective reconstructions of the posterior limb and free cheeks, it is not entirely impossible that a re-examination of the genotype material would reveal a course for the facial suture different than that indicated by Billings, Raymond, and Barton; however, in view of the point which Raymond (1905) and Barton have made of the course of the suture such a possibility seems unlikely. Nonetheless, if the course of the posterior branch of the facial suture were actually found to be similar to that of the present species there would be no doubt as to the congenerity of the Utah species and the Canadian genotype. Then Ross' (1951, p. 126-7) emended description of the genus would certainly apply.

Granulate and punctate surfaces, as shown on the Utah species, seem to be common to the genera Pseudosphaerexochus and Nieszkowskia as well as Kawina. Kawina is the only one of these three genera which has been said to lack genal spines. As mentioned above, Kawina has been said to be peculiar in the course of the posterior branch of the facial suture. Furthermore, the three pairs of glabellar furrows are said, by Barton, to be equally distinct in Kawina whereas in Pseudosphaerexochus the posterior pair is distinctly stronger. In this regard, also, the Utah species are more like _Pseudosphaerexochus_ than _Kawina_. Pygidia of the three genera have different numbers of pleura: _Nieszkowskia_, two pairs; _Kawina_, three pairs; and _Pseudosphaerexochus_, four pairs.

Until such time as the type material of _Kawina_ can be re-examined, it seems inadvisable to consider erecting a new genus for the Utah species, which appear to have the cephalic features of _Pseudosphaerexochus_ combined with a _Kawina_ pygidium. For the present, it seems most expedient to let the Utah species remain under the genus _Kawina_ as assigned by Ross and to note that the assignment is made with some reservation.

Kawina ? sexapugia Ross
Plate XXI, fig. 18

Comparison of the pygidium from central Utah with the figured topotype pygidium from northeastern Utah (Ross, 1951, plate 35, fig. 13) shows remarkable similarity in form and size between the two specimens. Also, the surface is granulose and punctate as is Ross' figured specimen. There is little doubt that the pygidium from central Utah is conspecific with the type material from northeastern Utah. _K_. ? _sexapugia_ occurs about 40 feet below _K_. ? _webbi_ in the Wahwah limestone.

Figured specimen: 26397.

Occurrence: zone J.

Kawina ? webbi Hintze n. sp.
Plate XXI, figs. 15-17

This species has so many features in common with the well-described species _K_. _sexapugia_ Ross (1951, p. 127-129) that a comparative description seems advisable. The figured specimens of both species are of approximately the same size. Both species are similar in general outline and have granulose surfaces. Genal spines are longer in _K_. _webbi_; the glabella is more inflated and the glabellar furrows, particularly the anterior and middle pair, are more lightly impressed than in _K_. _sexapugia_. The anterior and middle glabellar furrows of _K_. _webbi_ are only faintly discernible on the photographs and show best in fig. 15a. They have the same position and trend as those of _K_. _sexapugia_ as shown on Ross, (1951) plate 35, fig. 12.

In _K_. _webbi_, the marginal furrow is very definite on the posterior limb but becomes almost obsolete at the angle. Anteriorly, its position shows again in the form on a minute anterior pit at its intersection with the dorsal furrow. The hypostome of _K_. _webbi_ is similar to that of _K_. _sexapugia_ but the pygidia of the two species are quite different. Whereas the pygidial pleura of _K_. _sexapugia_ are broad and dagger-shaped, those of _K_. _webbi_ are narrower and spike-shaped with the posterior pair being markedly shorter than the others. Both _K_. _webbi_ and _K_. _sexapugia_ seem to be rather rare in the Ordovician of central Utah and have been found only in the "J" section at Ibex where _K_. _webbi_ occurs about 40 feet, stratigraphically, above _K_. _sexapugia_.

Holotype: 26394 (cranidium); paratypes, 26395, 26396.

Occurrence: zone J.

Kawina ? unicornica Hintze n. sp.
Plate XXVIII, fig. 1-5

Surface of carapace granulose; fixed cheek and free cheek proximally from marginal furrow pitted. Cephalon strongly convex; glabella inflated, barely overhanging the anterior rim in lateral profile but not swollen immediately anterior to the occipital furrow as _K_. _vulcanus_ or _K_. _billingsi_. Three pairs glabellar furrows, the posterior pair being deeply impressed and the two anterior pairs but faintly impressed. Distally, none of the glabellar furrows extend quite to the dorsal furrow, the distal end of the anterior pair heading in a faint pit which can be discerned in figs. 1a and 1c, plate XXVIII. Proximally, the two anterior furrows fade out about one-third of the way toward the glabellar midline. In lateral view, the anterior glabellar furrows slant forward about 45 degrees; the middle pair slants forward slightly, then curves upwards almost vertically; and the posterior pair curves backwards in an open "S" so that the proximal ends are directed parallel to the midline, just the reverse of the "S" curvature in _K. sexapugia_. The posterior furrow is the only one which appears as a ridge on the ventral side of the glabella. Dorsal furrow intersects the marginal furrow forming the anterior pit slightly anterior to the anterior glabellar furrow. Convex palpebral lobes, about one-fifth as long as glabella, are approximately at glabellar midlength, and are bounded proximally by the furrow. No ocular ridge. Posterior limb of facial suture cuts lateral portion of marginal furrow about halfway between eyes and angles. Genal spine well inside of angle. Anterior to eyes, sutures cross marginal furrow then turn sharply inward as epistomal or rostral suture. Doublures of cheeks are not long enough to meet at midline; consequently, an epistomal plate is necessary for _K. unicornica_ similar to that visualized by Ross (1951, p. 128) for _K. sexapugia_.

Hypostome more granulose than other parts of test. Differs from hypostome of _K. webbi_ and _K. sexapugia_ in being broader at anterior end and semicircular in outline rather than subrectangular.

Pygidium without much convexity as contrasted with cranidium; axis with three rings; three pairs of flattened tubular pleura with pointed ends.

The unusual feature of _K. unicornica_ is the spine which protrudes forward and upward from the central glabellar region. In the possession of this type of glabellar spine, _K. unicornica_ is like _Cheirurus perforator_ Billings (1865, p. 287), _C._

glaucus Billings (1865, p. 323), and C. satyrus Billings (1865, p. 324). Billings' three species were reassigned to the genus Nieskowskia by Barton (1915, p. 116-117). Inasmuch as all of Billings' species appear to be known only from partial cranidia, future collecting and study of the Canadian species will be necessary to enable better comparison and positive classification. However, of the Canadian species, C. perforator seems the closest in appearance to K. unicornica.

Holotype: 26507 (cranidium); paratypes, 26506, 26508-26511.

Occurrence: zone N.

Genus KIRKELLA Kobayashi, 1942

Kirkella Kobayashi, 1942, Geol. Soc. Japan, Jour., vol. 49, pp. 118-121.

This distinctive genus ("Asaphus curiosus" of authors, "Billingsura" of Ulrich, "Ptyocephalus" of Whittington) has been said to be restricted in age to Black Rock and equivalents. Kirk (1934, pp. 454-456) felt that "Asaphus curiosus" could be used as a guide to his "Taffia zone". Stratigraphic collecting from the Pogonip group in west central Utah shows, however, that Kirkella ranges through at least four middle and upper Canadian zones as listed below. Although Kirkella has not yet been reported from above the upper Canadian J zone in Utah or Nevada it may range into the Chazyan elsewhere. The genotype, Asaphus ? curiosus, was described by Billings (1865, p. 318) from "Stanbridge, range 6, lot 20; Quebec group". Other genera such as Bathyurellus, Harpes, Illaenus, Ectenonotus (Amphion westoni), and Nieszkowskia (Cheirurus) listed from the same locality by Billings (1865, pp. 318-328) have a decidedly Chazyan aspect. However, this apparent association with Chazyan fossils may not have any stratigraphic significance for Billings' specimens came from boulders in the Mystic conglomerate.

New species described below show an evolution of the genus from K. fillmorensis, a form with more conventional sub-semicircular head and tail shields, to the unique parallel-sided forms typical of the genus in succeeding zones. The stratigraphic succession of species occurring in west central Utah is as follows:

Middle zone J	-	K. declevita Ross
Lower zone J	-	K. cf. K. vigilans (Whittington)
zone I	-	K. yersini Hintze n. sp.
zone H,I	-	K. accliva Hintze n. sp.
zone G-2	-	K. fillmorensis Hintze n. sp.

In addition to the progressive "squaring off" of the antero- and postero-lateral corners, certain other trends can be noted in the development of this genus. The posterior limbs, massive affairs almost as long as broad in the older species K. fillmorensis and K. accliva, become progressively more delicate in later species. The eyes, on the other hand, become progressively larger. On the pygidium, the relative distance from the termination of the axis to the edge of the pygidium becomes progressively less. Late appearing features, the thickened hypostomal rim and the elongate pygidium described by Ross (1951, p. 92), do not appear until the middle of the J zone with the advent of K. declevita. It must be realized that the species here described are but glimpses of the progressive change of this genus through time. No doubt forms intermediate to those described will be found, and it is hoped that the trends noted above may be proved useful in the systemization of other finds.

A generic feature not noted previously in the detailed discussions of this genus by Whittington (1948) and Ross (1951) is the presence of a small glabellar node, situated on midline about even with the rear of the eyes. It is seen only on the ventral surface.

Kirkella declivata Ross
Plate XV, figs. 3, 4, 9-12

The material from west central Utah shows the features which were cited by Ross (1951, pp. 91-93) as distinguishing this species, namely the unique hypostomal rim (see figs. 3 and 4, pl. XV) and the elongate pygidium with subangular postero-lateral corners. Ross took some pains to describe the differences between _K_. _declevita_ from northeastern Utah and _K_. _vigilans_ from central Nevada and concluded that _K_. _vigilans_ represented a form ancestral to _K_. _declevita_. We now can confirm Ross' deduction with field evidence from west central Utah. There the J zone of the Wahwah formation has yielded two species; the lowest Wahwah limestone beds contain _Kirkella_ cf. _K_. _vigilans_, while less than forty feet stratigraphically higher in the Wahwah formation _K_. _declevita_ is obtained.

_K_. _declevita_ is not as well preserved among our silicified specimens as the earlier species. While this may be due to conditions of burial, it is thought that perhaps there is a more basic cause. The test itself does not seem to have been quite so thick-walled and rugged as the tests of its predecessors. Certainly the posterior limb of the cranidium was more fragile for none have been found entire for this species. _K_. _declevita_ is the stratigraphically highest species to be found in the Pogonip group and the signs of structural weakness which are suggested in the test of _K_. _declevita_ may be indicative of the causes of its disappearance from the late Canadian fossil record in Utah.

Figured specimens: 26290, 26413, 26294-26297, 26299.

Occurrence: middle part of zone J.

Kirkella cf. *K. vigilans* (Whittington)
Plate XV, figs. 5-8, 13

Silicified specimens from the lowest part of the Wahwah limestone in west central Utah seem to have the attributes of Whittington's (1948) species from Nevada. However, certain minute differences, possibly the result of different modes of preservation, have caused the use of a "cf." designation. Whittington noted that the surface of *K. vigilans* is pitted. Our specimens do not seem to be. The pygidium of the holotype appears to expand in width posteriorly; ours do not. The hypostome associated with the Utah specimens is similar to that figured by Whittington (1948, pl. 83, fig. 8).

Ventral view of the cranidium (fig. 8, p. XV) shows the glabellar node (pit in ventral view) a feature seen also in *K. accliva* and *K. yersini* and presumably present in the other species as well. Holding a silicified cranidium up to the light shows the glabellar area to be thinner than the surrounding area. Slightly thickened ridges on the glabella are presumed sites of muscle attachment, which show on the ventral side of the cranidium (see fig. 8, pl. XV).

Figured specimens: 26292, 26293, 26296, 26298.

Occurrence: low in zone J.

Kirkella yersini Hintze n. sp.
Plate XIV, figs. 7-15

Only in proportions of its features does this species differ from its predecessors and from later forms. The most obvious differences are these: the posterior limb is intermediate in character between the more massive one of *K.* accliva, and the more slender one of *K.* cf. *K. vigilans*. The palpebral lobe is about the size of that of *K. accliva*, not nearly so large as that of the later appearing forms. The pygidium, on the other hand, is more like that of K. cf. K. vigilans, considerably wider than long, rather than like that of K. accliva. The hypostome is like that of K. vigilans except that it is considerably shorter than wide, whereas that of K. vigilans is about equally as wide as it is long.

Thorax not known.

As Ross pointed out for K. declevita t pygidium of a Kirkella species varies somewhat in shape according to size of the individual. Four pygidia of different sizes are figured to show the variation in K. yersini (see figs. 12, 7, 14, and 15, pl. XIV).

Holotype: 26281; paratypes, 26276-26280, 26282-26285.

Occurrence: zone I.

Kirkella accliva Hintze n. sp.
Plate SIV, figs. 6, 16, 17,
Plate XV, figs. 1, 2

This species is distinguished from its descendant and closest imitator, K. yersini, by its more massive triangular-posterior limbs and by the pygidial proportions. The distance from the posterior end of the axis to the edge of the pygidium (in other words, the width of the posterior rim at midline) is about twice as great in K. accliva as in K. yersini for mature specimens. This width is reflected in the width of the doublure which is considerably greater on K. accliva than on K. yersini. Comparison with other species is not deemed necessary.

An immature specimen (fig. 6, pl. XIV) shows the bilobed character of the pygidium similar to that of the immature K. declevita figured by Ross (1951, pl. 21, fig. 1). Hypostome and thorax not known.

Holotype: 26289; paratypes, 26286-26288, 26275.

Occurrence: zone H, low in zone I

Kirkella fillmorensis Hintze n. sp.
Plate XIV, figs. 1-5

This species is distinguished from all others yet described for the genus by the greater roundness of its posterior and lateral corners, the head and tail shields approaching the conventional sub-semicircularity of unspecialized asaphid trilobites. If found alone, the cranidium would be difficult to distinguish from that of K. accliva, but the posterior limbs of the latter are not quite so large. Ross (1951, p. 108) has described and figured Asaphellus ? sp. B., from the same zone as K. fillmorensis and which, except for the free cheeks, is remarkably like K. fillmorensis.

The hooded Panderian opening and ridge are present on the doublure of the free cheek in this early species as in later species. The function and significance of these features are described by Ross (1951, p. 93). The doublure on the pygidium is very broad, as in K. accliva, with a notch in the anterior margin of it at midline beneath the termination of the axis. Due to conditions of preservation, the ventral side of the cranidium showing possible muscle scars and median tubercle are not visible on the present material at hand. Hypostome and thorax unknown.

Holotype: 26271; paratypes, 26270, 26272-26274.

Occurrence: zone G-2.

Genus LACHNOSTOMA Ross, 1951

Lachnostoma latucelsum Ross
Plate XVIII, figs. 4-16

This is one of the most abundant trilobites in the Wahwah formation of the Pogonip group of central Utah. It ranges throughout the J zone without apparent change. As this species has now been very thoroughly described by Ross (1951, pp. 94-97), only a few comments will be made. As in most trilobites, the relative size of the eyes decreases with increase in size of the individual. In _Lachnostoma_, the constriction in width of the cranidium at the eyes becomes progressively more apparent in large specimens. A series of cranidia is figured to illustrate this change (figs. 6, 7, 11, 9, pl. XVIII).

Ross (1951, pp. 96-97) noted the lack of "hoods" over the Panderian opening at the end of the inner ridge on the doublure of the free cheek. We verify this lack of a "hood" on the free cheek, but are able to note that a hood _is present_ on the Panderian opening on the doublure of the thoracic segment. A hooded Panderian opening was noted by Ross (1951, pp. 93, 97) for _Kirkella declevita_, and the possible significance discussed.

Figured specimens: 26334-26346.

Occurrence: zone J.

Lachnostoma ? sp.
Plate XX, fig. 17

An hypostome which has not yet been associated with any other trilobite parts shows a considerable degree of similarity to the hypostome of _L. latucelsum_ and is figured here as a matter of record. Comparison of the two (compare fig. 17, pl. XX with fig. 10, pl. XVIII) shows _L._ ? sp. to be shorter and to have short posterior projection at midline like _Pseudonileus_, _Paranileus_ and

Trigonocerca of lower zones. Although the two occur together *L.* ? sp. is quite rare and *L. latucelsum* very abundant in west central Utah.

Figured specimen: 26379.

Occurrence: zone J.

Genus LEIOSTEGIUM Raymond, 1913

Leiostegium Raymond, 1913, Canada Geol. Surv., Victoria Mem. Mus., Bull. 1, p. 68.

The widespread distribution of this genus in the American hemisphere is indicated by the following list of described species:

- *L. quadratus* (Billings) 1860 (genotype) - "Limestone no. 2", Point Levis, Quebec.
- *L. puteatum* Raymond, 1924 - Highgate limestone, Vermont.
- *L. cingulosum* Raymond, 1924 - " " Vermont.
- *L. obtectum* Raymond, 1937 - " " Vermont.
- *L. elongatum* Raymond, 1937 - " " Vermont.
- *L. mccoyi* (Walcott), 1884 - Pogonip group, Eureka, Nevada.
- *L. manitouensis* Walcott, 1925 - Manitou limestone, Colorado; and Cushina formation, British Columbia.
- *L. manitouensis* Walcott in Ross 1951 - zone D, Garden City formation, northeastern Utah and southeastern Idaho.
- *L. douglasi* Harrington, 1938 - Northern Argentina.

In addition, the virtually identical genus *Leiostegiodes* has been described by Kobayashi (1934, p. 538) from South Chosen. Inasmuch as the genus *Leiostegium* has much widespread areal distribution its stratigraphic range, compared to other key genera, is of considerable interest. Kobayashi

(1937, pp. 414-415) noted that *Leiostegium* succeeded the unrelated but useful guide genus *Kainella* in the shelly faunas of South America. Harrington (1938), however, placed *Leiostegium* as a contemporary in the *Kainella* zone. We are in accord with both views. In our western Utah and eastern Nevada collections, *Leiostegium manitouensis* appears in zone D of the Pogonip group along with *Kainella* and *Apatokephalus*. Limestone slabs containing these three genera together have been obtained just above the *Paraplethopeltis*-bearing C zone in the Ibex area and Willden Hills, Utah, and somewhat above a B zone faunule at Sunnyside, Nevada. Thus, the contemporeity of *Kainella* and *Leiostegium* is proved. However, *Leiostegium* is found still higher in the stratigraphic section in zone E (as the new species *L. formosa*) whereas *Kainella* does not appear to extend that high in the Pogonip group.

A cranidial feature, shown definitely by several species of *Leiostegium* and possibly present on others, is the presence of not only a pair of deep anterior pits at the intersection of the dorsal and marginal furrow, but also a second pair of pits in the dorsal furrow a very short ways behind the anterior pits. Raymond (1924, p. 455) called attention to these two pairs of pits on *L. cingulosum* as did Walcott (1925, p. 104) for *L. manitouensis*., *L. douglasi*, *L. mccoyi*, and *L. puteatum* also appear to possess these pits and they are definitely present on *L. formosa* described below. Unfortunately, the genotype *L. quadratus* is too poorly described and figured to ascertain its status in this regard.

Leiostegium formosa Hintze n. sp.
Plate VIII, figs. 8-10

Cranidium sparsely pustulose on small specimens, virtually smooth on large individuals. Except for pustulosity, cranidial features, as far as known, are the same as described for *L. manitouensis*; however, no complete cranidium of *L. formosa* is yet available.

Specimens show two pairs of pits in the dorsal furrow, as mentioned above under the generic discussion. The anterior pit at the intersection of the dorsal and marginal furrows has been noted for many other trilobite genera, but the "shallowing" of the dorsal furrow, just behind the anterior pit and the presence of a second pair of pits in the dorsal furrow just behind the "shallowing" is unique.

Free cheek, similar to that of L. manitouensis. Walcott (1925, pl. 23, fig. 15), shows the genal spine to be rather slender and delicate, but since the spine has been largely sketched in by retouching on his photograph there is the possibility, in fact probability, that the spine of L. manitouensis is actually thicker and blunter than shown by Walcott. If so, the cheek of L. manitouensis would very closely resemble that of this species (fig. 8, pl. VIII).

The pygidium is typical for the genus except for the possession of a pair of short tubular marginal spines directed postero-laterally.

Holotype: 26193 (pygidium); paratypes, 26191-26192.

Occurrence: zone E.

Genus LICNOCEPHALA Ross, 1951

Licnocephala ? cavigladius Hintze n. sp.
Plate X, figs. 1-5

This trilobite is characterized by a broad rim which on the pygidium and free cheeks is exceeded in width by an even broader doublure. Facial suture Niobe-form, cutting the anterior margin in front of the eye and following around the frontal margin. Posteriorly, facial suture runs laterally and nearly at right angles to midline to define slender postero-lateral limbs, at distal end of which suture cuts outward and downward around small articularing "hook" on ventral surface. This "hook" is one portion of a rather discontinuous "doublure" along the posterior ventral side of the cranidium which is widest beneath the occipital ring and at the distal end of the postero-lateral limbs (see fig. 2b, plate X).

Glabella unfurrowed (except for faint occipital furrow mentioned below), separated from rest of cranidium by dorsal furrow which fades rapidly anteriorly from the eyes, in front of which it has so little relief that it scarcely can be made to show on the photographs. The anterior part of the dorsal furrow can be followed on the ventral side of actual specimens, however, and it traces a semicircular path around the front of the glabella, leaving a brim between the marginal and dorsal furrows; brim is about half the width (sag.) of the rim at midline. Presence of occipital furrow suggested by faint impression transversing glabella on a line even with posterior of eyes. Palpebral lobes large, semicircular, horizontal, and without palpebral rim or furrow. Eyes must have been moderately tall and semicylindrical. Marginal furrow is most prominent furrow on cranidium and marks the line where the convex arc of brim meets the horizontal rim.

Free cheek dominated by genal spine; marginal furrow narrows posteriorly on free cheek. Anterior edge of doublure beveled at midline suggesting that a small triangular-epistomal plate may have been present. Posterior edge of doublure is notched by hypostomal suture from midline four-fifths of the distance to where the doublure passes beneath the facial suture in vertical view. Hypostome almost circular in plan; anterior edge uniquely upturned forming a "prow". At intersection of the "prow" and broad lateral-hypostomal rim is a small anteriorly projecting node on either side. Behind "prow" and separate from it, a pair of slender projections, the anterior wings, extend upwards to about same height as "prow" apparently to join cranidium beneath anterior edge of eye.

Pygidium semicircular; axis small, triangular, smooth; three pairs pleural furrows and intrapleural grooves fade into broad rim which occupies outer half of pygidial diameter ; doublure very broad.

Ross (personal communication) has suggested that this species might be assignable to his genus Licnocephala. Although the pygidium of L. ? cavigladius is quite similar to that tentatively assigned to the genotype, L. bicornuta (see Ross, 1951, plate 30, fig. 25), we must reserve definite assignment to that genus until such time as the hypostome of the genotype of Licnocephala becomes known inasmuch as the form of the hypostome is critical in the classification of asaphid trilobites. L. ? cavigladius also superficially resembles the Chazyan form, Bathyurellus pogonipensis (see plate X).

Holotype: 26214; paratypes, 26213, 26215-26217.

Occurrence: zone G-2.

Licnocephala ? sp.
Plate VIII, fig. 7

A single cranidium characterized by its extremely low relief is questionably referred to this genus. It differs in several respects from the genotype, L. bicornuta Ross. First, there is no definite marginal furrow; second, there is only a faint indication of an occipital furrow; third, the palpebral lobes, though longer, do not constitute so great a part of a circle as those of the genotype; and fourth, the glabella tapers anteriorly.

Figured specimen: 26187.

Occurrence: zone F.

Genus NIESZKOWSKIA Schmidt, 1881

Nieszkowskia ? sp.
Plate XXVIII, figs. 6-7

Glabella peaked; coarsely pustulose, three pair well-defined glabellar furrows.

The only portion of the entire carapace of this trilobite that has been recovered so far is the glabella, consequently the identification can only be tentative. Nieszkowskia is said by Barton (1915, p. 117) to be recognizable among all other Cheirurids by the swollen glabella produced at the posterior into a marked hump or spine. However, this swollen glabella apparently may also be found in some species of Kawina, for Barton (1915, p. 118) has, notwithstanding his aforementioned criteria, also assigned Cheirurus vulcanus billingsi (Raymond, 1905) to the genus Kawina. The Utah species seems to be most like Kawina billingsi (Raymond) (as figured in Billings 1865, p. 324, fig. 310) or like Nieszkowskia tunidus gibbus (Angelin, 1854, plate 39, fig. 13; or see Schmidt 1881, plate 8, fig. 23-24).

Figured specimens: 26512, 26513.

Occurrence: zone N.

Genus PARABELLEFONTIA Hintze n. gen.

Morphologically, this genus appears to be somewhere between its contemporary genera Bellefontia and Symphysurina. In outline, the cranidium resembles that of Bellefontia but differs from that genus in that the dorsal and marginal furrows are faint to absent. Except for the lack of the marginal furrow and genal spine in adults, the free cheek is like that of Bellefontia, the doublures on both being very similar, especially in the anterior part. Pygidia of the two genera differ in the better definition of the axis and its segments on Bellefontia.

From _Symphysurina_ the genus differs in its lack of pits on the doublure of the free cheek, in the expansion of the cranidium forward from the eyes, and in the possession of a marginal furrow around the pygidium. Hypostome and thorax unknown. As the genus is at present monotypic, description of detail is left under discussion of the genotype below.

Genotype: _Parabellefontia_ _concinna_ Hintze n. sp.

Parabellefontia concinna Hintze, n. sp.
Plate III, figs. 1-8

Cephalon moderately convex, semicircular in outline, surrounded by broad rim which shows only on immature specimens (see fig. 3, plate III) being entirely obsolete on large ones; likewise the short genal spine of small specimens is not present on mature forms. Cranidium arched, with poorly defined glabella; dorsal and marginal furrows show faintly on ventral side (see fig. 1b, plate III) indicating continued presence of rim in maturity. Glabella apparently no wider in front of, than between palpebral lobes. Anterior facial suture diverges from axial line across rim then turns sharply inward remaining on the dorsal surface and paralleling the leading edge of the cranidium. Posteriorly the suture defines triangular postero-lateral limbs then twists under to cut occipital doublure.

Broad doublures of free cheek meet along median suture; proximal edge flexed upward and cut away to receive the anterior edge of the hypostome as in _Bellefontia_. On large specimens a heavy Bertillian line parallels the outside base of the free cheek forming a pseudo-rim.

Hypostome and thorax not known. Thorax must have had wider axis at front than to rear as indicated by width of dorsal furrow at rear of cranidium and at leading edge of pygidium.

Pygidium semicircular, axis about one-quarter width of pygidium at anterior edge tapering posteriorly; ill-defined. Marginal furrow shallow, rim about one-fifth width of radius of pygidium; doublure same width as rim.

Holotype: 26087; paratypes, 26088-26094.

Occurrence: high in zone B.

Genus PARAHYSTRICURUS Ross, 1951

Parahystricurus aff. P. fraudator Ross
Plate VIII, fig. 1

The only appreciable difference between the specimens figured here from the Pogonip group of west central Utah and the type specimens of Ross (1951, p. 58) from northeastern Utah is that Ross' specimens show a deeper marginal furrow on the cranidium. It is felt that this might have some significance in representing a form transitional between P. carinatus Ross of zone E and P. fraudator Ross of zone F; hence, its distinction by an "aff." designation.

Figured specimen: 26184.

Occurrence: zone F.

Parahystricurus bispicatus Hintze n. sp.
Plate VIII, figs. 3-4

The cranidium of this species is virtually identical with that of P. aff. P. fraudator, with the exception that this species has a pair of posteriorly directed occipital spines which enable its immediate distinction from all other members of this genus yet described. Inasmuch as P. bispicatus and P. aff. P. fraudator were obtained from the same locality and are so similar in cranidial configuration it has been impossible to assign with absolute certainty the associated free cheeks. It is believed, however, that the figured free cheek is correctly associated with _P. bispicata_. It is notable that the posterior branch of the facial suture cuts into the proximal side of the peculiarly curved genal spine at its base.

The anterior part of the doublure on the free cheeks is not known. Rostrum, hypostome, thorax, and pygidium not known.

Holotype: 26189; associated free cheek, 26190.

Occurrence: zone F.

Genus PARANILEUS Hintze n. gen.

This genus is erected to contain the following three species, which occur in stratigraphic sequence in the lower Ordovician Pogonip group of west central Utah and differ among themselves only in proportions of their parts:

zone J - _Paranileus utahensis_ Hintze n. sp.
zone I - _Paranileus ibexensis_ Hintze n. sp.
zone H - _Paranileus elongatus_ Hintze n. sp.

The genus is notable in that the appearance of _P. elongatus_ in zone H marks the earliest known occurrence of the truly forked hypostome in the Ordovician of Utah (see table 14). _Paranileus_ derives from _Pseudonileus_ of zone G-2, a genus of similar aspect but possessing an incipiently forked hypostome.

Cephalon and pygidium semicircular, smooth, convex and unfurrowed; slight downdips at front edge of pygidium and rear edge of cranidium mark the position of dorsal "furrow". From this, it is inferred that the thoracic axis is not quite half as wide as total width of carapace, probably not much if any taper of axis from front to rear. Cranidial length about equally divided among posterior limb, eye, and anterior limb. Small glabellar node at midline behind the eyes can be seen only on ventral surface (as pit). Posterior facial suture diverges in gentle arc from eye to cut the rear edge of the cephalon about halfway from dorsal "furrow" to genal angle. Anteriorly the suture cuts outward and "downslope" to the rim, then curves sharply inward to follow top edge of rim to midline. Median suture separates free cheeks at midline. Free cheeks with narrow wire-like rim which becomes obsolete close to the genal angle. Doublure broad, notched in front for hypostome and with ridge and groove near postero-lateral corner presumably for reception antero-lateral edge of pygidium during enrollment. Small unhooded Panderian opening a short distance posteriorly and proximally from posterior end of this ridge and groove.

Hypostome forked; short anterior wings and middle body dominated by large isotelid posterior wings. Middle "furrow" appears as two deep pits on either side of indistinctly defined middle body. At midline, between posterior wings, is situated a small posteriorly directed projection.

Number of thoracic segments not known.

Pygidium smooth, convex, semicircular with broad doublure. At midline, doublure possesses small node near outer edge. Taper of axis and segmentation are faintly discernible on ventral side of pygidium.

This Lower Ordovician genus bears some morphologic similarity to the genera Nileus and Brachyaspis but it is probably unrelated to these later appearing Middle and Upper Ordovician forms. Nileus is readily distinguished by its unforked hypostome. Brachyaspis probably represents parallel but later evolution of a smooth form from some such ancestor as Isotelus.

Genotype: Paranileus ibexensis Hintze n. sp.

Zone	PARANILEUS	ISOTELOIDES	LACHNOSTOMA	TRIGONOCERCELLA
J	Paranileus utahensis	Isoteloides polaris	Lachnostoma latucelsum	Trigonocercella acuta
I	Paranileus ibexensis	Isoteloides flexus	?	?
H	Paranileus elongatus	?		
G-2	Pseudonileus willdeni	Asaphellus ? venta		

Table 14.- Evolution of the forked hypostome in the lower Ordovician of Utah.

Paranileus elongatus Hintze n. sp.
Plate XII, figs. 2-5

This species is distinguished from the succeeding species by the greater relative length of its pygidium. For medium-sized comparable specimens the ratio of maximum pygidial length to width is as follows: P. elongatus, 1.3; P. ibexensis, 1.6; P. utahensis, 1.9; On the other hand, the hypostome of this species is relatively slightly shorter than that of P. ibexensis, but longer than that of P. utahensis. The free cheek shows one feature not found on the other two species, namely that in ventral view in the postero-lateral corner there can be seen a small U-shaped notch in inner edge of the doublure as it rounds the genal angle. The function of this notch in this species is not known. The small unhooded Panderian opening is found on the doublure between this notch and the ridge and groove, as mentioned above, under the generic discussion.

Cranidium and thorax not known.

Holotype: 26243; paratypes, 26411, 26244-26245.

Occurrence: zone H.

Paranileus ibexensis Hintze n. sp.
Plate XII, figs. 6-12

Cephalon and pygidium semicircular. Cranidium smooth, convex, unmarked by furrows, the only trace of subdivision being at rear edge where cranidium is faintly indented to meet with axial lobe of first thoracic segment. Palpebral lobes large, semicircular, extend horizontally out from curved cephalic surface. Ventral view shows small glabellar node (pit in ventral view) situated on midline about one-third the distance from the rear of the eyes to the rear edge of the cranidium. Indentations in the doublure at the rear edge of the cranidium mark the position of dorsal furrow.

Free cheek smooth except for wire-like rim which becomes obsolete as it rounds the genal angle. Posterior facial suture cuts rear edge of cephalon about halfway between dorsal "furrow" and genal angle, measured on curved surface. Anteriorly the suture curves outward from eye descending directly "downslope" to the rim where it turns sharply inward to midline. Median suture separates right and left free cheek at midline. Doublure notched in front for reception of hypostome and is ornamented with lines which roughly parallel the doublure itself. At posterolateral corner doublure possesses a ridge and groove presumably for reception of edge of pygidium during enrollment. A small-unhooded Panderian opening is present a short distance behind and upwards from the rear edge of the ridge and groove.

Hypostome forked; anterior wings and middle body short; middle "furrow" consists of a pair of pits on either side of indistinct middle body. Posterior wings long - at midline between posterior wings is a short posteriorly directed projection. This hypostome differs from that of _P_. _utahensis_ in its greater relative length and from _P_. _elongatus_ in the outline of curvature of its posterior wings as well as a slight overall difference in relative length-width ratio.

Thorax unknown.

Pygidium subcircular. Length-width ratio discussed under the preceeding species.

Holotype: 26249; paratypes, 26246-26248, 26250-26252.

Occurrence: zone I.

Paranileus utahensis Hintze n. sp.
Plate XIII, figs. 1-4

This species differs from the two above described species principally in the lesser relative length of its parts. Ratios of pygidial proportions have been noted under P. elongatus. The hypostome of P. utahensis is conspicuously different from those of the other two described species in the shortness of its middle body. The glabellar node is located further forward than in P. ibexensis.

The single free cheek from locality J-8 in pl. XII, fig. 1 is given an "aff." designation to differentiate it from the type material of this species from locality J-1, thirty-eight feet lower in the section. Unfortunately, the J-8 cheek cannot be directly compared with the J-1 material for they are of quite different sizes. Future collecting will tell whether there is any difference in the proportions of J-8 and J-1 material, but in view of the changing character of this genus through time, as already demonstrated, we suspect that there is a difference.

Holotype: 26254; paratypes, 26253, 26255-26256.

Occurrence: low in zone J.

Genus PARAPLETHOPELTIS Bridge and Cloud, 1947

Paraplethopeltis Bridge and Cloud, 1947, Am. Jour. Sci., vol. 245, pp. 555-556; 1948, Univ. Texas Pub. 4621, pl. 38.

Two species, P. ? genarectus and P. ? genacurvus, from the C zone of the Pogonip formation are questionably referred to this genus, the genotype of which is described by Bridge and Cloud from the Tanyard formation in Texas. The principal reason for the hesitancy to make an unequivocal assignment lies in the different preservation of the genotype material and the present specimens. Whereas most of Bridge and Cloud's specimens are "impressions of the under surface of the test, preserved in chert", all of the Utah specimens are silicified replacements of the test which have been artificially leached from limestone. Two features stand out on the Utah material which show vaguely if at all on Bridge and Cloud's figures: first, the Utah material shows a definite marginal furrow as a break in slope between brim and rim on the front of the cranidium; secondly, the Utah material shows a faint ocular ridge.

The C zone material from Utah, described herein, and the Texas species appear to have existed at about the same time based on other faunal elements, and it was felt advisable to point out the similarity by using the name Paraplethopeltis, even if tentatively, for the present rather than to do otherwise. Ross (1951) has described three forms from the same stratigraphic interval of the Garden City formation of northeastern Utah which are undoubtedly congeneric with P. ? genarectus and P. ? genacurvus, but which encounter the same question of congenerity with the Texas Paraplethopeltis. These are Hystricurus ? sp. E. Ross, Hystricurus ? sp. I. Ross and Pachycranium ? sp. From East Greenland, Poulsen (1937) has described a similar species, Hystricurus nudus.

Paraplethopeltis ? genacurvus Hintze n. sp.
Plate VII, figs. 1-5

Cephalon (excluding spines) and pygidium semicircular in outline, surface nonpustulose. Dorsal furrow complete on cranidium; glabella subovoid, widest just in front of occipital furrow; no glabellar furrows; glabella slightly over two-thirds of midlength of cranidium. Anterior limb divided by marginal furrow into convex brim and rim. Palpebral lobes extend horizontally from fixed cheek and consist of thickened lunate rim and faint palpebral furrow. Low ocular ridges extend from front of eye antero-proximally to dorsal furrow and can be detected on both ventral and dorsal sides of silicified tests.

Free cheek with convex ocular platform; faint marginal furrow becomes obsolete as it rounds the genal angle; rim and doublure produced into long gracefully curved spine. Anterior facial suture cuts almost straight frontwards from eye to rim then curves inward and downward across rim turning under to cut doublure. Free cheeks do not meet at midline. A trapezoidal rostrum like that of Hystricurus (see pl. VI, fig. 1c) is probably present between the cheeks and the doublure of the cranidium though none has yet been found. Hypostome, if any, unknown. Posteriorly, the facial suture cuts laterally then curves posteriorly defining a more slender postero-lateral limb than in P. ? genarectus.

Thorax not known.

Pygidium almost two and one-half times as wide as long. Prominent axis of four distinct ring-like segments and a terminal segment which is indefinitely separable into a fifth and possibly sixth segment. Three distinct pairs of pleura on pleural platforms and a fourth indistinct pair behind. Each pleuron is divided by a diagonal furrow, best-developed in front, poorly developed in posterior pleura. Pleura fade into steeply sloping sides of pleural platform, base of which is surrounded by a narrow wire-like rim.

This species compares closely with Hystricurus ? sp. E. Ross (1951, p. 54, pl. 15, figs. 10, 11, 13, 14), Pachycranium ? sp. Ross (1951, p. 73, pl. 17), Hystricurus nudus Poulsen (1937, p. 34, pl. 2, fig. 10) and Paraplethopeltis depressa Bridge and Cloud, 1947. Although the specimens figured on plate VII are of small to moderate size, fragments of much larger specimens indicate that P. ? genacurvus ranges in size to cranidia 20 mm. wide at palpebral lobe and pygidia 21 mm. wide. It is undoubtedly closely allied with and probably an offshoot from the genus Hystricurus from which it differs in the flatness of its fixed cheek, presence of ocular ridge, greater size in general and in particular the much larger pygidium, the average of which is several times that of any pygidia associated with Hystricurus.

Holotype: 26173; paratypes, 26171, 26172, 26174, 26175.

Occurrence: zone C.

Paraplethopeltis ? genarectus Hintze n. sp.
Plate VII, figs. 6-9

This species occurs together with P. ? genacurvus, but is not as abundant as that prolific species, which together with the brachiopod Syntrophina comprise thin layers of shell rock in the upper House limestone in west central Utah. P. ? genarectus differs from P. ? genacurvus in several respects: the cranidium is more convex and has heavier postero-lateral limbs; the free cheek possesses a short straight genal spine and the doublure is broader; from the anterior course of the doublure it is probable that the rostrum was broader and wider.

Hypostome, if any, and thorax not known.

The pygidium (association of pygidia and cranidia of the two species based on relative abundance) is longer than for P. ? genacurvus, otherwise similar.

Closely comparable species are Hystricurus ? sp. I. Ross (1951, p. 56, pl. 17, figs. 1-3) and Paraplethopeltis obesus Bridge and Cloud, 1947. Differences with the latter have been mentioned under the generic discussion above.

Holotype: 26178; paratypes, 26176, 26177, 26179.

Occurrence: zone C.

Genus PILEKIA Barton, 1915

Pilekia ? trio Hintze n. sp.
Plate XXI, fig. 1

Five partial cranidia, the most complete of which is figured, were obtained from a silicified zone E faunule at locality E-17. Features of the glabella agree remarkably well with the genotype, P. apollo, as figured by Billings (1865, p. 413, fig. 397), Raymond (1913, pl.4, figs. 1, 2.) and Barton (1915, p. 113, fig. 7a). Unfortunately, except for the glabella, the features of the genotype are not well known so that again we encounter the problem of comparing a well-preserved silicified specimen with an incompletely known type. Some light is shed on this matter by Ross (1951, p. 129) who says, "From casts of Billings' and Raymond's type material of P. apollo it has been possible to establish the presence of palpebro-ocular ridges in that species. The original specimens are apparently poorly preserved at the anterior ends, and it is not possible to be absolutely certain whether these ridges are a continuation of the cranidial rim or whether they were discrete from the rim. They appear to originate from the dorsal furrow close to its intersection with the anterior glabellar furrows, the distal ends being located opposite the ends of the third pair of glabellar lobes." Examination of P. ? trio shows that it conforms to Ross' comments on the genotype. All that prevents us from making an unquestioned assignment is the lack of any associated parts to substantiate the cranidial comparison. If the figured cranidium is actually a Pilekia it is the most completely preserved cranidium yet known. We must reiterate that caution need be employed in classification of trilobites which have glabellas like P. apollo, for similar glabellar features are known to have developed again later in the Ordovician and Silurian in other genera.

The rear edge of the cranidium of P. ? trio is ornamented by three large spines - a posteriorly directed occipital spine, and a pair of laterally directed genal spines.

This may possibly be the same species as the immature specimen described as "Pilekia ? sp." by Ross (1951, p. 125, pl. 35, figs. 8-10) from northeastern Utah.

Holotype: 26380.

Occurrence: zone E.

Genus PROTOPLIOMEROPS Kobayashi, 1934

Protopliomerops aemula Hintze n. sp.
Plate XXII, figs. 9, 13-17

Surface finely granulose except on fixed cheeks and postero-lateral limbs, which are pitted. Cephalon lunate in outline, convex in front view. Glabella subquadrate with rounded front end; widest at fourth glabellar lobe, narrowing slightly forward. Three pairs glabellar furrows. Photograph of holotype cranidium (fig. 14a, pl. XXII) does not show anterior pair of furrows clearly, as they are in a shadow cast by the prominent rim. The holotype specimen is larger than the specimen of fig. 9, pl. XXII and has a higher rim; during photography the specimens were oriented slightly differently; that of fig. 14a was rotated backwards to emphasize the rim while that of fig. 9 was in normal position to show all of the glabellar furrows. Actually, the anterior glabellar furrows of the holotype cranidium have the same course as that shown on fig. 9. Palpebro-ocular ridges slightly thicker over eye than close to glabella. Palpebro-ocular ridge, anterior glabellar furrow, dorsal and marginal furrows all converge at anterior pit. Tubular anterior rim elevated; but less so on small specimens. Anterior facial suture crosses marginal furrow into rim turning sharply inwards. Rim of cranidium possesses no doublure, all of which is carried on the free cheeks. No entire specimen of cheek available to show the complete anterior course of the facial suture, but it is probable that the cheeks are separated from each other by a rostrum.

Hypostome possesses three pairs of blunt marginal spines and blunt posterior spine. Thorax not known.

Pygidium highly convex with five ring-like axial segments each produced into closely spaced pleural spines. Small triangular boss at tip end of axis. Pygidium very similar to those of P. contracta and P. celsaora.

Holotype: 26434; paratypes 26435-26438, 26430.

Occurrence: zone G-1.

Protopliomerops aff. P. celsaora Ross
Plate XXII, fig. 10

A rather poorly preserved cranidium shows the characteristics described for this species by Ross (1951, p. 135). The central Utah specimen differs from Ross' northeastern Utah type material in that the palpebral lobes do not appear to be quite so high or narrow as those of the type material, hence the "aff." designation.

Figured specimen: 26431.

Occurrence: zone G-1 (note: the figured specimen came from a float block. The zone is based on other material.)

Protopliomerops aff. P. contracta Ross
Plate XXII, figs. 11, 18-20

Specimens from west central Utah are virtually identical with the type material from northeastern Utah described by Ross (1951, p. 136) with the following exceptions: the glabella does not appear to contract anteriorly so rapidly; the palpebral lobes do not appear quite so elevated; the lateral spines on the hypostomes are not quite as pronounced. Although these differences are picayune, yet it is felt desirable to point them out by an "aff." designation as they may represent a slightly earlier stage of evolution than Ross type specimens, a form intermediate from _P_. _celsaora_ towards _P_. _contracta_.

Figured specimens: 26432, 26439-26441.

Occurrence: zone G-2.

Protopliomerops firmimarginis Hintze n. sp.
Plate XXII, figs. 1-8

Surface finely granulose except on fixed cheek and postero-lateral limbs, which are pitted. Cephalon as described for _P_. _aemula_ except for the following: cranidial rim broad, flattened on top, smoothly curved in front, but indented along rear edge above front of glabella; eyes further to rear, about at midlength of cranidium; ocular platform on free cheek smaller.

Hypostome intermediate in outline between that of _P_. _Superciliosa_ Ross and _P_. _Aemula_; marginal spines very low. Number of thoracic segments not known.

Pygidium easily distinguished from _P_. _aemula_, _P_. _contracta_ and _P_. _celsaora_ because spines are more widely separated and more pointed, and because pygidium is not so convex.

This species is believed to be ancestral to the genus _Pseudomera_ (see table 13). It probably derived from some form such as _Protopliomerops superciliosa_ Ross.

Holotype: 26423; paratypes, 26422, 26424-26429.

Occurrence: zone G-1.

Protopliomerops ? quattuor Hintze n. sp.
Plate XXI, figs. 9-14

This species differs from other species of Protopliomerops yet described from the Lower Ordovician of Utah in three important respects: first, the cranidium is more highly convex; second, the genal spines of immature forms are retained as a blunt spine on adults; third, the pygidium has only four pairs of pleural spines.

This species is believed to be the ancestor of the genus Kawina (see table 13), which could easily have evolved from P. ? quattuor by further increase in the bulbosity of the glabella and a decrease, by one, in the number of pygidial segments.

Holotype: 26390; paratypes, 26388, 26389, 26391-26393.

Occurrence: zone G-2, zone H.

Protopliomerops sp. 6
Plate XXII, fig. 12

Several pygidia have been found which differ from those of P. contracta only in the number of pygidial pleura, having six pairs instead of five. In fact, one specimen has been found to have seven pairs. A cranidium and hypostome found associated with these pygidia are shown in figs. 11 and 19, pl. XXII. These have been given the designation "P. aff. P. contracta" and it is possible that the pygidia, P. sp. 6, are merely a variation of the species P. contracta. Unfortunately, none of our specimens of Protopliomerops have been an entire carapace; the cranidia and pygidia are associated only on the basis of occurrence and our sample of the trilobite population of the time of P. sp. 6 is not adequate to demonstrate on a numerical basis the relative occurrence of forms with three, four, five, six, and seven pairs of pygidial pleura.

It seems advisable merely to point out the unstability of the pygidial development of Protopliomerops at this time, and to leave the erection of new species or varieties until such time as the association between heads and tails can be definitely demonstrated.

Figured specimen: 26433.

Occurrence: zone G-2.

Protopliomerops sp. 5
Plate XXI, fig. 5

A single pygidium has been found which is quite similar in outline, convexity, and axis to that of P. superciliosa Ross, but differs in having only four pairs of pleural spines rather than five. A single short spine at the end of the axis takes the place of this fifth pair of spines of P. superciliosa.

Figured specimen: 26387.

Occurrence: zone F.

Protopliomerops sp. 4
Plate XXI,figs. 4,8

Pliomerid pygidia with short curved pleural spines, as distinguished from the longer straight spines of P. quattuor and Undetermined genus and Species plate XXI, figs. 6-7, have been given the blanket designation "P. sp. 4." It is possible that more than one species is included in the present identification, but the number of specimens secured so far is so small that it has not been useful to differentiate them. Associated cranidia or other parts are unknown. Possible significance is discussed under P. sp. 6, above.

Figured specimens: 26383, 26384.

Occurrence: zones G-2, H.

Genus PSALIKILUS Ross, 1951

Psalikilus Ross, 1951, Peabody Mus. Nat. Hist., Yale Univ., Bull. 6, p. 62.

Ross noted, in his original generic discussion, that there was a species of *Psalikilus*, then undescribed, which differed from the genotype, *P. typicum*, in the possession of an occipital spine. I had figured these spined forms on Plate IX (figs. 3-6) as one species, "spinosum", when it was called to my attention by Ross that it was possible to distinguish two species in this group and he suggested the additional name "paraspinosum" for the other species. I am indebted to Professor Ross for pointing out differences in these two similar species and recognizing the stratigraphic significance of the distinctions. Thus, we now have recognized four species, three of them newly described below, in the Canadian beds of Utah. They occur in the following sequence:

zone H	- *P. pikum* Hintze n. sp.
zone G-2 (high)	- *P. paraspinosum* Hintze n. sp.
zone G-2 (low)	- *P. typicum* Ross
zone G-1	- *P. spinosum* Hintze n. sp.

At Ibex, *P. spinosum* occurs some 230 feet below *P. typicum*, which ranges through over 50 feet of beds and is found about 100 feet below *P. paraspinosum*. *P. pikum* occurs about 220 feet above *P. paraspinosum*.

Although Ross did not mention it in his original description of the genus, it should be noted that all of the species of *Psalikilus* possess an ocular ridge. It is well shown on *P. pikum* (see plate IX, fig. 1b) and is faintly present on the other three species, in the case of *P. typicum* being somewhat masked by pustules.

Psalikilus spinosum Hintze n. sp.
Plate IX, figs. 3, 6, 7

Cranidium finely granulose and somewhat pustulose, with pustules more widely separated than on P. typicum. Commonly four, but sometimes three or five pairs of pustules ornament the glabellar midline. These pustules are slightly larger than other cranidial pustules, and are also found on the glabella of P. paraspinosum. Anterior rim only gently up-arched in contrast to P. typicum and P. paraspinosum. Occipital spine slender, weak. Free cheeks similar to P. typicum and P. paraspinosum in form, but lack pustules on ocular platform and genal spine, and lack denticles on the inner side of the genal spine. Length of largest cephalon, 4 millimeters; width 8 millimeters. Thorax and hypostome not known. The pygidium, illustrated in figs. 7a, b, c, plate IX, is the largest (5 mm. in width) of five pygidia which were found in association with P. spinosum cranidia and free cheeks, at Locality D-3. The smallest of these pygidia, 3 mm. in width, is somewhat similar to the pygidium of P. typicum, as figured on Plate XX, fig. 15, but has a relatively stronger terminal "spine" and a rim which is discontinuous at the posterior midline forming an arch just beneath the "spine". In all of the four unfigured specimens in the D-3 collection, the marginal apron slopes backwards ventrally, the slope being steeper the larger the specimen. Also the posterior upraising of the rim decreases proportionally with increase in size. In the figured specimen it will be noted that the marginal apron slopes forward ventrally. This change in slope of the apron with increasing size would have resulted from a tendency for the overall length of the ventral carapace, rim to rim, to remain unchanged. The relative decrease in the amount of upraising of the posterior rim would indicate that the opening tended to remain constant in size. In all specimens the pygidial axis is divided into four rings, the axial grooves being deeper and more distinct on the smaller specimens. The pleural platforms are with three pairs of pleura.

Holotype: 26200 (cranidium); paratype, 26203 (free cheek); associated pygidium, 26204.

Occurrence: zone G-1.

Psalikilus typicum Ross
Plate IX fig. 2, Plate XX fig. 15

Nothing need be added to Ross' (1951, p. 62-63) description of the cranidium and free cheek of P. typicum. Ross figured, but did not describe an associated pygidium. It is now confidentially felt, both by Ross (personal communication) and the author, that the associated pygidium, as figured by Ross (1951, plate 30, figs. 11, 15) and in this paper, plate XX, fig. 15, is definitely assignable to P. typicum. Pygidium subtriangular in dorsal view; axis with five rings; pleural platforms horizontal with four paits of pleura; marginal apron is broad, sloping backwards ventrally, and bordered by a wire-like rim which is very slightly upraised at the posterior midpoint. The posterior edge of the pleural platform, directly behind the axis, is produced into a short blunt "spine".

Figured specimens: 26199, 26377.

Occurrence: low in zone G-2.

Psalikilus paraspinosum Hintze n. sp.
Plate IX, figs. 4, 5

Glabella pustulose and commonly with four pairs of slightly larger pustules along midline (see fig. 4b, plate IX); fixed cheek almost free of pustules. Occipital spine strong, curved; anterior rim strongly uparched, in contrast to P. spinosum. Free cheek not illustrated, but similar to that of P. typicum in form and ornamentation bearing pustules and denticles. The denticles on the inner side of genal spine are somewhat longer and more numerous than those of P. typicum (see Ross, 1951, plate 11, fig. 8 for illustration of denticles).

Thorax, hypostome and pygidium unknown.

Holotype: 26202; paratype, 26201.

Occurrence: high in zone G-2. Note: the figured specimens both come from Locality G-10A, a float block. _P. paraspinosum_ is found in place at locality G-17, and it is the latter locality upon which the stratigraphic information is based.

Psalikilus pikum Hintze n. sp.
Plate IX, fig. 1

Cranidium with a few small widely separated pustules; anterior rim gently arched; occipital spine slender, weak. This species differs from _P. spinosum_, _P. paraspinosum_ and _P. typicum_ in having a peaked "dunce-cap" glabella, and in the greater prominence of the ocular ridge.

Parts other than the cranidium not known.

Holotype: 26197; paratype, 26198.

Occurrence: zone H.

Genus PSEUDOCLELANDIA Ross, 1951

Pseudoclelandia aff. P. fluxafissura Ross
Plate IV, fig. 14

This species compares very closely with the type from zone F of the Garden City formation, in northeastern Utah, as described by Ross (1951, p. 119). However, the figured specimen from central Utah occurs with an E zone assemblage, thus extending the known stratigraphic range of this species of trilobites.

Figured specimen: 26117.

Occurrence: zone E.

Genus PSEUDOCYBELE Ross, 1951

Pseudocybele Ross, 1951, Peabody Mus. Nat. Hist., Yale Univ., Bull. 6, p. 137.

Two new species assignable to this genus have been found in the Fillmore limestone of the Pogonip group of west central Utah. These species are ancestral to the genotype and extend the known stratigraphic range of the genus from zone J down to zone H.

The finding of a complete adult carapace of the genotype, P. nasuta, enables us to expand Ross' generic description slightly. This specimen definitely has fifteen thoracic segments, which we may regard as typical for the genus until shown otherwise. As Ross pointed out, the pygidium, in dorsal view, is something like that of Cybelopsis, but can readily be distinguished by the pattern on the post-axial boss; on Pseudocybele it is a lunate groove; on Cybelopsis rows of pits. Even in ventral view the two can be clearly distinguished (compare fig. 11a, pl. XXIV with fig. 12c, pl. XXV). The pygidial doublure of Pseudocybele welds together the tips of the pleura and extends high into the posterior portion of the pygidium partially concealing the ventral surface of the post axial boss.

The epistomal plate is much as deduced by Ross. Prow shaped in front, it cups under the nasute rim, narrows rapidly posteriorly, and thus, fits as a wedge between the right and left free cheeks.

Pseudocybele nasuta Ross
Plate XXIV, figs. 8-11

Specimens from west central Utah conform to the description given by Ross (1951, pp. 138-140) for the type material from northeastern Utah. A complete carapace shows the features mentioned above under the generic discussion. The largest cranidium found (fig. 9, pl. XXIV) shows that the proportions of the adult hardly vary with increase in size.

Figured specimens: 26462-26465.

Occurrence: zone J.

Pseudocybele altinasuta Hintze n. sp.
Plate XXIV, figs. 1-2

The cranidium of this species is so very similar to that of the genotype, _P. nasuta_, that _P. altinasuta_ is believed to represent its direct ancestor. In one important respect do they differ. The anterior rim of _P. altinasuta_ is not as nasute as that of the later occurring species. Also it is upbowed in front and corrugated with five pairs of indentations. It is probable that these corrugations were produced by the tips of five pairs of pygidial pleura pressing against the front of the cranidium during enrollment. Although the pygidium of this species is not known, observations made on the two other known species of genus support this view. First, the complete specimen of _P. nasuta_ shows that the taper of the carapace is such that the width of the pygidium is about the width of the anterior rim of the cranidium; second, although the doublure of the pygidium of _P. nasuta_ is smooth, that of P. lemurei is corrugated in such a manner as to fit the corrugations on the rim of that species. By analogy, we must then conclude that the pygidium of _P. altinasuta_, when found, will possess five pairs of pleural spines which are separate and distinct enough on the ventral side to be able to match the corrugations on the anterior rim of the cranidium.

Hypostome much like that of _P. nasuta_ except that marginal spines are not as long.

Holotype: 26456; paratypes, 26455.

Occurrence: zones H, I.

Pseudocybele lemurei Hintze n. sp.
Plate XXIV, figs. 3-7

This species is readily distinguished from *P. nasuta* and *P. altinasuta* by its large, elevated, thickened palpebral lobes, by the greater width or openness of its glabellar, marginal and dorsal furrows, and by the greater height of the ocular platform on the free cheek. Although, from the photographs (fig. 4, pl. XXIV), the holotype may appear to be a decorticated specimen, actually, except for the left eye, it is almost perfectly preserved. It is the nature of the cranidium to have a skeleton-like appearance. The test is finely granulose except that from center of glabella to occipital ring is more coarsely granulose. Prow-like anterior rim is corrugated with five pairs of shallow depressions like *P. altinasuta*.

Hypostome like that of *P. nasuta* but marginal spines not as long. Thorax not known.

Pygidium looks much like that of *P. nasuta* in dorsal view; pleura are somewhat shorter and not quite so drawn together at tip ends. It is in ventral view that the real contrast comes. The doublure of *P. lemurei* is about of even width all around the inside of the pygidium, whereas that of *P. nasuta* is considerably wider at midline, narrowing evenly to the antero-lateral corners. Furthermore, that of *P. nasuta* welds the tip ends of the posterior pleura together, but in *P. lemurei* each remains separate below the doublure. It is this separation of tip ends of pleura on the inside of the doublure that gives credence to the deduction that during enrollment the tips of the pygidial pleura fit into the corrugations on the cranidial rim.

Holotype: 26461; paratypes, 26457-26460.

Occurrence: zones H, I.

Genus PSEUDOKAINELLA Harrington, 1938

Pseudokainella ? armatus Hintze n. sp.
Plate V, figs. 1-5

Glabella subquadrate, outlined by dorsal furrow which becomes confluent with marginal furrow in front. No brim, wide rim. Glabellar furrows, if any, indistinct on specimens at hand. Anterior facial suture cuts outward at angle of fifty degrees from midline to partially cross rim, turns sharply inward, cuts obliquely across rim. Posteriorly, suture cuts obliquely postero-laterally defining slender limb. Fixed cheek comprised entirely of long lunate palpebral lobe.

Free cheek wide; ocular platform gently convex. Marginal furrow describes rounded arc, distinct from front to rear. Long, gracefully curved, flat "genal" spine is rooted in the rim somewhat in front of genal angle. Thorax unknown.

Pygidium with highly convex subtriangular axis of four segments. Pleural platform gently convex and comprised of four pairs of flat posteriorly directed pleura.

P. ? *armatus* differs considerably from the genotype of *Pseudokainella* to which genus it is only temporarily assigned. Although the glabella of *P. armatus* expands in width slightly between the eyes it does not do so to such a degree that it could be considered an *Apatokephalus*, nor does it have the brim of a *Kainella*. It seems likely that *P.* ? *armatus* should be placed in a new genus but inasmuch as only a few specimens have been recovered to date, and all of these are rather small, it has been felt advisable to await the recovery of more material before attempting further generic classification.

Holotype: 26121; paratypes, 26122-26125.

Occurrence: high in zone B.

Pseudokainella ? sp. A.
Plate V, figs. 6-9

The free cheek of this species is virtually identical with that of P. ? armatus described above. The pygidium differs in having three pairs of pleural spines rather than four. Other parts of carapace unknown.

Figured specimens: 26126-26129.

Occurrence: zone B.

Genus PSEUDOMERA Holliday, 1942

Pseudomera Holliday, 1942, Jour. Paleontology, vol. 16, p. 473.

The main contributions of Holliday's enigmatic diagnosis and discussion of this genus are the designation of Amphion barrandei Billings (1865, pp. 288-289) as the genotype and the refiguring of what is presumably Billings' type material (Holliday, 1942, plate 73, figs. 8,10). Both Billings' original material from Newfoundland and the supplementary material from Nevada described by Holliday consists only of poorly preserved cranidia and pygidia, other parts of the carapace being undescribed. Two species assignable to the genus with associated free cheeks and hypostomes have been found silicified in the upper Pogonip group in west central Utah. Until such time as the genotype itself is better known, it seems most feasible to synthesize an account of generic characters from descriptions of the silicified specimens from Utah as well as all other known species.

Glabella subquadrate; three pairs glabellar furrows, the anterior pair not extending to dorsal furrow in most species. Median indentation in frontal glabellar lobe, cited by Holliday as generic character, does not appear in all species and is probably a specific character. Marginal furrow deep, curves frontwards while still on postero-lateral limb, extends onto free cheek as deep furrow separating pustulose rim fron pitted ocular platform; palpebral lobes extend frontwards into palpebro-ocular ridge connecting the proximal side of the eyes with the dorsal furrows; palpebral furrow deeply impressed behind palpebral lobe but shallows rapidly anteriorly. Doublure of free cheek extends under front of cranidium not quite reaching midline; an undiscovered small roughly rectangular epistomal plate must fit between the two cheeks.

Hypostome pentagonal in outline; ovoid middle body cut by faint "middle" furrow across posterior end; broad rim continuous around sides and rear of middle body and ornamented with four or five blunt projections from its edges; anterior wings short, stout.

Thorax with fifteen segments.

Pygidium semicircular, with five pairs of pleura which are extended beyond the doublure as blunt spines; axis with five segments and a small triangular post-axial boss (in which a lunate groove is impressed in some species). Silicified specimens of the two Utah species described herein show the doublure of pygidium to possess a pair of blunt ventral projections of unknown function, in this respect differing from other pliomerids for which the doublure is known (_Protopliomerops_, _Pseudocybele_, _Cybelopsis_).

Four species seem definitely assignable to the genus:

_P._ _barrandei_ (Billings) 1865
_P._ _insolita_ (Poulsen) 1927
_P._ _dactylifera_ (Poulsen) 1927
_P._ _kanoshensis_ Hintze n. sp.

In addition _Pliomera_ _mathesii_ Angelin (1854 p. 35, pl. 22, fig. 1), a form with fourteen thoracic segments, is possibly assignable to _Pseudomera_.

Holliday (1942, p. 474) tentatively reassigned Amphion nevadensis Walcott to the genus Pseudomera. We have examined the holotype cranidium, U. S. Nat. Mus. no. 24645, and concluded that it is so poorly preserved that it is impossible to classify nevadensis any closer than as a pliomerid trilobite. The locality from which the cranidium was collected was only generally designated by Walcott, and in view of the fact that several pliomerids are now known to occur in the Ordovician of Nevada it is unlikely that it ever can be determined which one of these nevadensis really is. Such being the case the name nevadensis should not be applied to specimens other than the single holotype cranidium figured by Walcott. It has no usefulness as a comparative type.

Somewhat the same situation applies for the genotype from Newfoundland, P. barrandei, although fortunately not to such a degree. Phleger (1933, pl. 2, fig. 10-11) and later Holliday (1942, p. 474, pl. 73, figs. 5-7) have used the name for one of the most common trilobites to be found in the Chazyan of the Inyo Range, California, and the Ike's Canyon locality, Toquima Range, Nevada. We think that a better procedure would be to give the California-Nevada-Utah forms a "cf." designation. It is probable that actually they are a new species, as yet undescribed. "P. cf. barrandei" from the Ike's Canyon locality is unique in that entire dorsal carapace is frequently preserved still articulated but not enrolled. Four specimens from that locality in our possession each show fifteen thoracic segments. This is the same number as shown by P. kanoshensis. Comparison of the number of thoracic segments of various pliomerids reveals considerable variation between genera: Pliomerops, 19 segments; Pliomera, 18 segments; Pseudomera, 15 segments; Pseudocybele, 15 segments; and Cybelopsis, 13 segments.

Three species of Pseudomera are found in stratigraphic succession in the upper Pogonip group of west central Utah:

zone N - P. cf. barrandei (Billings)
zone M - P. kanoshensis Hintze n. sp.
zone J - P. cf. insolita (Poulsen)

It should be noted that Ross (1951, p. 31) errs in assigning P. barrandei to the J zone.

Pseudomera cf. P. insolita (Poulsen)
Plate XXIII, figs. 5-13

Except in mode of preservation, the cranidia of this species from Utah appear to differ in no way from those described from Greenland by Poulsen (1927, pp. 307-308, pl. 20, fig. 32). From the Utah specimens, we ascertain that the surface of the fixed cheek within the marginal furrow is pitted except for the palpebral lobe. The glabellar furrows are projected ventrally into what are presumably structures for muscle attachment (see fig. 9, pl. XXIII). This does not appear to be a generic character for it is not seen on P. kanoshensis. Free cheek is almost entirely a tubular rim atop which is a small triangular, pitted, ocular platform. The rim of the free cheek stands almost vertically under the eye but anteriorly twists outward to lie almost horizontally beneath the rim of the cranidium. Although none have been found, a small rectangular epistomal plate appears to fit between the free cheeks.

Hypostome pentagonal in outline; ovoid middle body transected by furrow near its posterior edge; broad hypostomal rim is ornamented by two pairs of blunt spines at the postero-lateral edges and one spine at the posterior midline. Anterior wings short, stout. Thorax unknown.

Pygidium consists of five complete segments and small triangular post-axial boss which has been said by some authors to be a sixth segment. Billings (1865, p. 288) shows a small lunate groove on the post-axial boss of the genotype but this groove does not appear on P. cf. insolita. The doublure of the pygidium differs from that of other pliomerids for which the doublure is known (Protopliomerops, Pseudocybele, Cybelopsis) in the possession of a pair of blunt ventral projections (see fig. 12c, pl. XXIII) whose function is unknown.

Figured specimens: 26446-26454.

Occurrence: zone J.

Pseudomera kanoshensis Hintze n. sp.
Plate XXIII, figs. 1-4

This species differs from others in its proportionately longer glabella and the more forward location of its eyes. Surface of the cranidium pustulose; that portion of fixed cheeks within the marginal furrow pitted as well. Postero-lateral limbs bear very short blunt genal spine. Hypostome roughly pentagonal in outline; ovoid middle body transected by faint "middle" furrow near its posterior edge; broad hypostomal rim with two pairs of blunt spines on edges, one pair at postero-lateral corner, the other near midline; short stout anterior wings. A complete enrolled specimen of P. kanoshensis from the type locality and now in the private collection of K. H. Fridal, Jr. of Tremonton, Utah, is said by the owner to have fifteen thoracic segments.

Pygidium with five complete segments and triangular post-axial boss. Smaller pygidia (fig. 3, plate XXIII) lack the convexity of larger specimens. Doublure with longer pair of blunt ventral projections than in P. cf. insolita.

Holotype: 26442; paratypes, 26443-26445.

Occurrence: zone M.

Genus PSEUDONILEUS Hintze n. gen.

Except for the hypostome, this genus is very similar to Paranileus and is believed to be its direct ancestor. Indeed, the generic diagnosis of the cranidial, pygidial, and free cheek features are so nearly the same for these two genera that, rather than relist the features enumerated under Paranileus, only the differences will be pointed out. The cranidium is not quite so convex in profile, especially the anterior limb, as in Paranileus. The antero-lateral corners of the cranidium are more rounded. The hypostome, however, is the point of real difference. Whereas that of Paranileus is definitely forked, that of Pseudonileus has but an enlarged postero-lateral rim which is drawn in at midline giving the hypostome a bilobed appearance. The middle body is much more distinctly outlined than that of Paranileus and is notched in the sides by a pair of short, deep furrows. The anterior wings are like those of Paranileus.

An hypostome, which very closely resembles Paranileus, is that of Asaphus pelops Billings (1865, p. 317, fig. 304). However, Billings' figure shows a less distinctly defined middle body and does not show the small posterior projection at midline at the rear of the hypostome. Nonetheless the associated pygidium is like that of Pseudonileus as is Billings' description of the free cheek and there is much likelihood that a restudy of Billings' material would prove it congeneric.

Genotype: Pseudonileus willdeni Hintze n. sp.

Pseudonileus willdeni Hintze n. sp.
Plate XV, figs. 14-17

Surface smooth. Cephalon and pygidium semicircular. Cranidium unfurrowed, except for a pair of downwarps in the convexity of the rear edge, representing the dorsal furrow. Length of posterior limbs about one-quarter midlength, length of eyes about the same, leaving anterior limb to comprise about half the length of the cranidium. Posterior facial suture arcs outwards and backwards to cut the rear edge about halfway between dorsal furrow and genal angle. Anterior suture cuts outwards at an angle of about thirty degrees to midline to within a short distance of the rim, then curves roundly inward gradually becoming parallel with rim.

Free cheek with rounded genal angles. Features of ventral surface almost identical with that of <u>Paranileus elongatus</u> (see fig. 5b, pl. XII) but do not include U-shaped notch in postero-lateral corner of that species. Ridge and groove for reception of edge of pygidium during enrollment are present in postero-lateral corner.

Hypostome subquadrate in outline; subcircular middle body notched by a pair of short deep furrows. Postero-lateral rim enlarged giving bilobed appearance. Small posterior projection at midline on rear edge. Anterior wings short.

Thorax not known.

Pygidium three-fifths as long as broad. Axis indistinctly defined except along front edge where change in slope defines dorsal furrow. Doublure broad, interior edge V-shaped in ventral view. At midline a ventrally projecting node.

Holotype: 26300; paratypes, 26301-26303.

Occurrence: zone G-2.

Genus PSEUDOOLENOIDES Hintze n. sp.

This genus is erected to include two new species, _P. dilectus_ of zone M, and _P. acicaudus_ of zone N, common in the Chazyan part of the Pogonip group of western Utah. _P. dilectus_ also occurs commonly in the lower part of the Swan Peak quartzite of northeastern Utah (Raymond, 1922) and has been figured under the name "_Symphysurus ? goldfussi_" Walcott by Ross (1951, p. 27, 33, 64; pl. 15, figs. 16-18). Ross comments that "_Symphysurus ? goldfussi_" Walcott is also present in collections in the United States National Museum from the Lower Simpson group of Oklahoma and from the "highest beds of the Pogonip formation of Nevada." Thus, the genus is of widespread distribution in the western United States and of considerable stratigraphic importance.

Ross' tentative identification of these several occurrences as "_Symphysurus ? goldfussi_" was intended to point out the resemblance to Walcott's (1884, p. 95, pl. XII, fig. 16) described form which is no doubt referable to the new genus _Pseudoolenoides_ and may possibly be conspecific with either _P. dilectus_ or _P. acicaudus_. Whether or not this will ever be determinable is doubtful; first, because Walcott's type is a poorly preserved, cranidium apparently without associated parts; second, because Walcott's type has been lost. Efforts of Dr. G. A. Cooper to locate Walcott's specimen during the author's visit to the National Museum in April, 1949, met with no success. The collecting locale given by Walcott, "Pogonip group, on the west slope of McCoy's Ridge, Eureka district, Nevada" is too indefinite to enable identification of the exact faunal zone from which Walcott's specimen was collected and thus voids any attempt at comparison by stratigraphic position. Judging from Walcott's (1884) figure 16 plate XII, _P. goldfussi_ is probably a species distinct from either _P. dilectus_ or _P. acicaudus_, for the glabella appears proportionally wider and blunter anteriorly than either of the new species.

Raymond (1922, p. 205, 207) errs in assigning "_Symphysurus_ ? _goldfussi_" to the genus Ceratopyge. Morphologically, the resemblance is not striking and stratigraphically the difference is considerable. Whereas _Ceratopyge_ occurs near the base of the Ordovician, _Pseudoolenoides_ occurs well above that in the lower Chazyan.

Cranidium roughly square in outline, with long bullet-shaped glabella outlined by well-defined dorsal furrow which becomes confluent with marginal furrow around front of glabella. One pair well-marked glabellar furrows and occipital furrow. Fixed cheek comparatively broad and with prominent ocular ridge. Eyes of medium size, free cheeks with curved genal spine. Hypostome subovoid, with prominent middle furrow, and with postero-lateral borders with spines. Thorax with nine segments. Pygidium subtriangular in outline and with from one to five pairs of pleural-marginal spines plus a telson.

Genotype: _Pseudoolenoides_ _dilectus_ Hintze n. sp.

Pseudoolenoides bears considerable resemblance to the genus _Tasmanocephalus_ Kobayashi, 1936 (see Kobayashi 1940, p. 69, pl. XII, figs. 1-4) but differs in having only one pair of glabellar furrows rather than the three pairs of _Tasmanocephalus_.

Except for its greater convexity _Pseudoolenoides_ resembles certain Middle Cambrian genera, especially _Olenoides_, hence the name. The prominent ocular ridge of _Pseudoolenoides_ is an uncommon feature on Chazyan trilobites.

Pseudoolenoides dilectus Hintze n. sp.
Plate XXVII, figs. 1-6

Surface smooth except axis which is pustulose from head to tail. Cranidium roughly square in outline. Blunt bullet-shaped glabella outlined by well-defined dorsal furrow. Glabella with occipital furrow and one pair of short deep glabellar-furrows directed inward and backwards from near glabellar midlength. Free cheeks comparatively broad and bear prominent ocular ridge. Eyes of moderate size, palpebral rim elevated above fixed cheek. Free cheeks with curved genal spine. Marginal furrow, confluent with dorsal furrow in front of glabella, is well marked around entire cephalon except at base of genal spine where it becomes obsolete. Anterior from eye, facial suture trends forward cutting across the marginal furrow then curves inward across the rim passing to the ventral surface near midline. Rostrum, if any, not known.

Hypostome subovoid, wider in front. Middle body creased by one pair well-marked furrows directed inward and backwards. Postero-lateral border with two pairs of spines, the posteriormost pair being tricuspid.

Thorax with nine segments.

Pygidium subtriangular in outline, highly convex. Axis tapers posteriorly, with four ring-like segments and larger fifth terminal segment. Two well-defined and third ill-defined pleura fade into rim. Rim and doublure produced into three short blunt spines: a pair near midlength and a median spine. Doublure is narrow on both pygidium and free cheeks.

Holotype: 26492; paratypes, 26490-26491, 26493-26495.

Occurrence: zone M.

Pseudoolenoides acicaudus Hintze n. sp.
Plate XXVII, figs. 7-11

This species differs from *P. dilectus* in the following respects: the glabella is relatively slightly narrower and the fixed cheeks wider than in *P. dilectus*; the hypostome (not figured) has, instead of the single pair of large tricuspid spines at the rear two pairs of closely spaced spines, the innermost being the larger. This makes a total of three pairs of spines on the hypostome. The most striking difference is in the pygidium. The axis consists of five ring-like segments and a larger sixth terminal segment. The five pairs of pleura are produced into sharply pointed spines and the doublure and rim at mid-length are produced into a telson.

Holotype: 26497; paratypes, 26419-26421, 26496, 26528. Note: 26528 (unfigured hypostome) is from Locality CP-1.

Occurrence: zone N.

Genus REMOPLEURIDIELLA Ross, 1951

Remopleuridiella caudalimbata Ross
Plate V, figs. 10-12

Specimens from the Pogonip group of west central Utah appear conspecific with the type material described by Ross (1951, p. 86) from northeastern Utah and are figured here only as a matter of record for comparison.

Figured specimens: 26130-26132.

Occurrence: zone B.

Genus SYMPHYSURINA Ulrich, 1924

Symphysurina Ulrich, in Walcott, 1924, Smithsonian Misc. Coll., vol. 75, no. 1, p. 37; 1925, Smithsonian Misc. Coll., vol. 75, pp. 108-112.

Ulrich, (in Walcott, 1925, p. 115), in his description of the genotype, *S. woosteri*, put forth the idea that the peculiar pits on the doublure of *Symphysurina* were "for the reception of the ends of the thoracic segments". Ross (1951, p. 115) reasoned that such a function of the pits was mechanically impossible. Now with the discovery of a complete dorsal carapace (*S. brevispicata*, plate III, fig. 17) we can verify Ross' deduction - unfortunately, this leaves the function of these unique pits unknown. This author also agrees with Ross that the pitted doublure is an important generic characteristic which serves to distinguish both spined and spineless species of this genus.

Although most other authors have noted the presence of the median pustule, Ross (1951, p. 114) remarked that the three species from the Garden City formation of northeastern Utah "do not possess a distinct median pustule". Our cranidia from the Pogonip group of western Utah shed some light on this apparent anomaly. The median pustule does not show up on most of our Utah silicified specimens because it is so small and faint that it is easily obscured by decortication and/or cementing of small siliceous particles to the test. In the photographs, the pustule can be seen (in reverse) in fig. 5a, plate I. We have also observed it on an unsilicified cranidium of *S.* cf. *elegans*. We therefore think that the median pustule may yet be regarded as a characteristic feature of the genus, albeit, one which is hard to see in some species and on some specimens.

Since Ulrich's original diagnosis, the most comprehensive discussion of possible relations of *Symphysurina* to other genera is that of Poulsen (1937, p. 35-37). Two genera, in particular, seem possible synonyms of *Symphysurina*; *Giordanella*

Bornemann, 1891 and Tsinania Walcott, 1914. Of the later genus Raymond (1922, p. 206) remarks that the distinguishing generic feature is that the pygidium is nearly as long as wide. However, this length-width ratio seems to us a relatively insecure basis for generic diagnosis. As noted by Poulsen and later by Ross, it is unfortunate that the ventral side of the doublure of Tsinania is not known, as the presence or absence of pits might prove to be the distinguishing feature. The cranidium of Tsinania appears to have a much broader postero-lateral limb than that of Symphysurina. The genus Giordanella, according to Poulsen (1937, p. 36) is "probably very closely related to Symphysurina. The cranidium of Giordanella differs from that of Symphysurina only in having less curved palpebral lobes, narrower glabella, larger posterior limbs, and in the absence of a median tubercle between eyes, which appears to be constant in the latter genus; the free cheeks of Giordanella do not differ essentially from those of the genotype of Symphysurina, and the thoracic segments and the hypostomes of the two genera are almost perfectly alike. The hypostome of Giordanella is here compared with specimens which are associated with the East Greenland species of Symphysurina; they differ in certain respects from Ulrich's description of the associated hypostoma."

Two small hypostomes, almost exactly like that figured by Poulsen (1937, plate 2, fig. 15) for S. elegans, were recovered by us from locality B-1 In the Ibex area, Utah, but as both S. brevispicata and "S. cf. elegans" occur there together it was impossible to decide to which of the species the hypostomes belong. As Poulsen noted, this type hypostoma differs somewhat from Ulrich's original description of the associated hypostomes.

Raymond (1937, p. 115-118) erected two species of Symphysurina and two new monotypic genera, Symphysurinella and Symphysuroides, on the basis of some rather inadequate material, mostly from one of three pebbles collected from the Corliss conglomerate in Vermont. Symphysurinella is said to differ from Symphysurina "in that the dorsal furrows of the pygidium are so shallow that the axial lobe is but slightly defined." Symphysuroides is characterized as "Asaphidae with short brimless shields, ill-defined dorsal furrows, and without pygidial spine." Although the genotype of Symphysurina has a pygidial spine Ulrich recognized that the genus Symphysurina contains both spined and spineless forms. The differences that Raymond points out seem picayune and we do not regard his genera Symphysuroides and Symphysurinella as valid. For the purpose of this paper the species which Raymond assigned to these genera are regarded as species of Symphysurina.

Complete specimens of any species of the genus Symphysurina are apparently rare. Ulrich (in Walcott, 1925, p. 109) states that the thorax of an imperfect specimen "suggests that the segments were nine in number." Our specimen of S. brevispicata, however, has but eight segments. Four species, three new, are recognized from the Ordovician Pogonip group of western Utah. All occur in the B or Symphysurina zone except S. globocapitella which occurs in the C zone.

Symphysurina globocapitella Hintze n. sp.
Plate I, figs. 1-9

Cranidium globose, about one and one-quarter times as wide at palpebral lobes as long. Dorsal furrow obsolete except between posterior limb and otherwise ill-defined glabella. Palpebral lobes almost half the length of cranidium, narrow. Posterior limbs short, not extending in width beyond the palpebral lobes. Rim narrow, wire-like. Free cheeks with rounded genal angle; largest known specimen (plate 1, fig. 2) shows nine pits on doublure while smaller specimen shows possibly five. Both free cheek specimens are incomplete, lacking the anterior part of doublure.

Pygidium twice as wide as long; axis comprising about one-third of width along anterior edge.

Segmentation of axis best developed on ventral side of smaller specimens (see fig. 6b, plate I) apparently becoming obsolete on larger specimens. Doublure progressively widens with increase in size.

Hypostome and thorax unknown.

This species differs from other known species of Symphysurina in the extreme convexity of the glabella, the narrowness of the palpebral lobe, and the shortness of the posterior limb. It cannot be argued that this species is but the juvenile stage of a larger more normal form for the convexity and other features mentioned above seem to become more instead of less prominent with increasing size. (See figures 1, 3, 5, plate I).

Holotype: 26068; paratypes, 26069-26075.

Occurrence: high in zone B.

Symphysurina uncaspicata Hintze n. sp.
Plate II, figs. 1-7

Cranidium not so convex as that of S. woosteri, the genotype; eyes situated slightly further towards the rear than in S. woosteri or S. brevispicata; outline almost parallel-sided. Posterior limb with "hook" on ventral side at distal ends for purpose of articulation with free cheek.

Free cheek dominated by large, curved, genal spine, doublure pitted, the largest specimen (fig. 2, plate II) having nine pits and a smaller one (fig. 4, plate II) seven. These pits are roughly diamond shaped in outline, the anteriormost are situated on the ventral part of the doublure and the line of pits curves upwards and inwards to the rear so that the posterior-most pits are on the inner rather than bottom edge of the doublure and thus cannot be seen in fig. 2a, plate II. A strong depression or groove in the doublure occurs at the base of the genal spine (see fig. 2a, plate II). While a similarly located depression is to be found on the other species of Symphysurina described herein, on none of the others is the depression very deep; in fact it is so shallow on other species that it might never have been noticed except for its prominence on this species. Its function is unknown but it may be a groove to receive the leading edge of the pygidium during enrollment.

Pygidium triangular in outline with spine projecting posteriorly and upwards from end of axis.

Hypostome and thorax unknown.

This species may be found to be part of an evolutionary sequence with "S. cf. woosteri" Ross (zone A) and Symphysurina sp. B. Ross (zone C) the bracketing members. Another species of somewhat similar aspect is S. spicata Ulrich which can readily be distinguished from S. uncaspicata on the basis of the curvature of the genal spine, the length of pygidial spine, and the length-width ratio of the cranidia.

Holotype: 26076; paratypes, 26077-26082.

Occurrence: zone B.

Symphysurina cf. S. cleora (Walcott)
Plate II, figs. 8-11

This species occurs in the same horizon of the House limestone as S. brevispicata, from which it is readily distinguished by lack of the genal spine on the free cheek. In an effort to identify this species, it was compared with the seven species of the genus Symphysurina which have been described as possessing rounded free cheeks, namely:

S. illaenoides (Billings) 1860
S. eurekensis (Walcott) 1884
S. cleora (Walcott) 1914
S. eugenia Walcott 1925

S. elegans Poulsen 1937
S. sp. A. Ross 1951
S. globocapitella Hintze n. sp.

It is impossible to compare with Billing's species as, except for the pygidium, it has not been figured and only rather briefly described. *S. eurekensis* bears considerable resemblance to our species but appears to lack a rim on the free cheek. *S. eugenia* may be disregarded as a possibility, for according to Lockman and Duncan (1950, p. 353) "the absence of a genal spine on the free cheek referred to *S. eugenia* is caused by the specimen's poor preservation". *S. eugenia* is regarded by them as synonymous with the spined *S. spicata*. *S.* sp. A. Ross appears to possess a more distinct marginal furrow around the free cheek and may represent a form ancestral to ours as it occurs in a slightly lower horizon (zone A). *S. globocapitella* is quite different from "*S.* cf. *cleora*' and occurs higher in the section.

The two species that are most like the specimens under consideration were found to be *S. cleora* (Walcott) and *S. elegans* Poulsen. Slight differences can be detected between Walcott's (1916, pl. 36, fig. 9) and Poulsen's (1937, pl. 2, figs. 11-18) figures but it may be that a critical comparison of type material itself would reveal the two to be synonymous. Because *S. cleora* was the earliest described, and because it was found less than twenty miles from the locality from which our figured specimens were obtained, it seemed the more likely species with which to compare. Walcott's specimens of *S. cleora* came from a float boulder on Notch Peak. The specific name first appeared in a list of species assignable to *Tsinania* (Walcott, 1914, p. 43); later it was described and figured (Walcott, 1916, pp. 227-228, pl. 36, no. 9). *S. cleora* was apparently overlooked by Ulrich in his original list of species assignable to *Symphysurina* (in Walcott, 1925, p. 112) but we have no doubt that it belongs in that genus.

Comparison between "S. cf. cleora" and S. cleora shows the free cheeks to be quite similar in top view for specimens of comparable size. The ventral surface of S. cleora is not described, but that of "S. cf. cleora" shows only five pits on the doublure except on the very large cheek of plate II, fig. 8, which shows traces of a sixth pit. It is in the pygidium that "S. cf. cleora" and S. cleora differ, for the former is relatively slightly longer than the latter. A possible explanation for this is that perhaps Walcott has portions of two species figured under one name. As mentioned before S. brevispicata occurs together with "S. cf. cleora". The pygidium figured by Walcott under S. cleora is strikingly like that known to belong to S. brevispicata and we believe that there is a very strong possibility that the associated pygidium of Walcott's S. cleora actually belongs to S. brevispicata. Pygidia of "S. cf. cleora" are readily distinguished from those of S. brevispicata by their greater length and wider doublure.

Figured specimens: 26083-26086.

Occurrence: zone B.

Symphysurina brevispicata Hintze n. sp.
Plate III, figs. 9-17

Cranidium virtually identical in proportions with S. woosteri, the genotype. Posterior limb shows "undertwisted" articulating surface at distal ends (fig. 9a, 9b.,plate 3), part of the "doublure" along the posterior edge of cranidium. The impression of this "doublure" may be what Ulrich called the neck ring. Free cheek like that of genotype but with slightly shorter spine. Pits on doublure vary from seven on small specimens to nine on the largest. No Panderian opening. Anterior part of doublure thick, tubular, with Bertillion ornamentation roughly paralleling outline. Cheeks separated by single suture at midline.

As mentioned above under discussion of genus, hypostome not definitely known. Thorax with eight segments.

Pygidium a little more than twice as wide as long, semicircular in outline with fairly well defined axis, no pygidial spine. Our specimens range in width from 2 mm. to 20 mm. and fragments indicate even larger pygidia. Doublure relatively narrower than in S. globocapitella; even on large specimens it does not cover a greater part of the ventral interior than as illustrated for the immature stage of S. globocapitella of figure 7b, plate I. S. brevispicata resembles S. latus (Raymond) in having a genal spine and spineless pygidium, but the spines appear to be of different shape and proportion in the two species.

Holotype: 26400; paratypes, 26095-26102.

Occurrence: low in zone B.

Genus TESSELACAUDA Ross, 1951

Tesselacauda aff. T. depressa Ross
Plate XXI, figs. 2-3.

Ross (1951, p. 130) has described in detail the course of the obscure marginal furrow on the cranidial rim as distinguished from the distinct palpebro-ocular furrow. On the specimens at hand the marginal "furrow" is even more obscure than on Ross' figured specimens. Also, the hypostome figured here, from west central Utah, does not possess such long spines on its rim as does Ross' figured specimen. It has been felt advisable to call attention to these slight differences by giving our specimens an "aff." designation.

Figured specimens: 26381-26382.

Occurrence: zone E.

Genus TRIGONOCERCA Ross, 1951

Trigonocerca typica Ross
Plate XI, figs. 6-11

Specimens from west central Utah seem to be conspecific with the type material from northeastern Utah as described by Ross (1951, p. 104-105, pl. 26, figs. 5-13). It should be noted that the cranidia and free cheeks figured in the present paper are much larger than Ross' figured holotype and thus are not directly comparable. Ross did not mention the presence of the small median glabellar node situated on midline just behind the eyes; it is probable that this feature did not show on Ross' small specimens. A similar node is noted by Walcott (1925, p. 112) for _T. entella_ and it is likely that it will be found on all other species of the genus once they are well known.

Figured specimens: 26229-26234.

Occurrence: zone H.

Trigonocerca typica piochensis Hintze n. var.
Plate XI, figs. 12-18

This variety differs from _T. typica_ only in relative proportions of its parts. The differences are slight but consistent for the specimens studied. The stratigraphic significance of the difference is not known. _T. piochensis_, size for size, has a slightly shorter and blunter telson than _T. typica_; regarding genal spines the reverse seems to be true that _T. piochensis_ has the longer genal spine. Excluding the spine, the pygidia are of slightly different proportions, that of _T. typica_ being slightly relatively longer when comparing length to width.

Holotype: 26241; paratypes, 26235-26240.

Occurrence: zone H.

Genus TRIGONOCERCELLA Hintze n. gen.

This genus is erected to contain at present only a single species, T. acuta, from the upper Canadian J zone. The genus is similar to Trigonocerca Ross of zone H in the possession of a "subtriangular smooth-surfaced, seemingly unsegmented pygidium with median spine", but differs markedly from that genus in having a forked hypostome. The genus resembles the middle Ordovician genus Isotelus in its smooth character and forked hypostome but differs in the possession of a telson.

Morphologic details are given below in the description of the genotype T. acuta n. sp.

Trigonocercella acuta Hintze n. sp.
Plate XI, figs. 1-5

Surface smooth. Cephalon triangular, strongly convex. Glabella low and defined by change in slope being best delimited along rear edge of cranidium where axis of thorax joins cranidium. Glabella not defined in front of the eyes where cranidium arches steeply downward to suture line. Small median node situated about halfway between eyes and rear edge of cranidium on midline. Fixed cheeks comprised entirely of small elevated palpebral lobes. Posteriorly, facial suture extends almost in a straight line postero-distally to cut rear edge of cephalon halfway between glabella and base of genal spine. Anteriorly, the suture trends directly downslope antero-distally, curving sharply inward to run along the front edge of the cephalon to midline. The suture cuts barely above the thin wire-like rim which lies entirely on the free cheek. Short median suture separates right and left free cheeks. Slender genal spine projects directly to the rear. Ventrally the doublure of the free cheek is broad, possesses an unhooded Panderian opening, and is grooved along the bottom just forward of the base of the genal spine. Groove is possibly for reception of leading edge of pygidium during enrollment.

Hypostome forked. Middle body rather poorly defined but notched by a pair of short strong furrows near postero-lateral edge. Forks of hypostome ornamented on sides near midlength with blunt lateral projection.

Number of thoracic segments unknown. Individual segments show broad axis to be of about same curvature as pleura. Tip ends of pleura produced into trailing spine.

Pygidium triangular, highly convex, axis ill-defined except on ventral view. This pygidium is very similar to that of *Trigonocerca* from which it can be distinguished by its greater convexity, its lack of any suggestion of a rim, and by the greater prominence of the spine.

Holotype: 26224; paratypes, 26225-26228; paratype thoracic segment, 26529, not figured, from Loc. J-1.

Occurrence: low in zone J.

Genus XENOSTEGIUM Walcott, 1924

Xenostegium franklinense Ross
Plate V, figs. 13-18

This species, as found in west central Utah, does not differ appreciably from the type material described by Ross (1951, p. 102-103) from northeastern Utah, and is figured here for comparative purposes only.

Figured specimens: 26133-26138.

Occurrence: high in zone B.

Xenostegium cf. X. acuminiferentis (Ross)
Plate V, figs. 19-24

The cranidia and free cheeks of our species from central Utah are apparently identical with those described by Ross (1951, p. 99) from northeastern Utah. However the pygidia differ from those of Ross in that our specimens have a much longer spine. Ross (1951, p. 101) noted that the genus *Xenostegium* may be no more than a subgenus of *Bellefontia*, but stated that cranidia and free cheeks of *Xenostegium* "differ from a typical *Bellefontia*......in the angle of divergence of the anterior facial sutures, wider cranidial rim, more posterior position of the palpebral lobes, length and shape of the genal spine, behavior of the marginal furrow at the genal angle, and the shape of the doublure at the hypostomal suture". Certainly the species *acuminiferentis* qualifies much better as a *Xenostegium* than a *Bellefontia* in the width of the rim and the shape of the doublure at the hypostomal suture, and the additional fact that the species possesses a telson seems to us to favor reassignment of Ross' species to *Xenostegium*. The pygidia, so far found in central Utah, are all small (3 mm. to 5 mm. wide) and it was not felt desirable to erect a new species or subspecies based on the difference in the length of the pygidial spine between these and Ross' species from northeastern Utah until such time as mature specimens can be compared.

Figured specimens: 26139-26144.

Occurrence: high in zone B.

Undetermined Genus and Species A
Plate XIII, figs. 5-8

This small smooth form appears to be the fore runner of such forms as *Paranileus* of zones H to J or perhaps *Benthamaspis* of zone J. It may be descended from *Symphysurina* for it is not unlike *S. globocapitella* Hintze of zone C. Parts other than the figured pygidia and cranidia are not known; thus, it is not felt desirable to assign a specific name at this time.

Figured specimens: 26257-26260.

Occurrence: zone G-1.

Undetermined Genus and Species B
Plate IX, fig. 18, Plate XIII, figs. 13-17

More than one species may be included in the identifications made under this category. This type of trilobite occurs sparingly in zone G-2 and for convenience has been given a catch-all designation. The specimen of fig. 14, pl. XIII bears considerable likeness to Undetermined Genus and Species C Ross (1951, pl. 29, fig. 20, 21, 24), but specimen fig. 18, pl. IX is more like Platycolpus ? sp. Ross (1951, p. 121, pl. 29). The associated pygidia of fig. 13, pl. XIII are not unlike those figured for Platycolpus ? sp. Ross (1951, p. 121, pl. 30, fig. 12, 13, 16).

In view of the paucity of material obtained so far and the uncertainty of correct association of pygidia, cranidia and other parts it was not felt advisable to erect a new genus to contain these specimens at this time. Two genera which seem closely allied are Platycolpus Raymond, 1913, and Benthamaspis Poulsen, 1946. However, in both of these genera the glabella is said to extend to the rim, a different situation than evident in our specimens which definitely possess a brim.

Figured specimens: 26518, 26265-26269, 26412.

Occurrence: zone G-2.

Undetermined Genus and Species C
Plate IX, figs. 13-15

This form is known only from the figured specimens and there is a question whether all three specimens belong to the same species. These cranidia are found in the same zone as Undetermined Genus and Species B, but differ in that the dorsal and occipital furrows are less distinct and the palpebral lobes smaller. Definite classification awaits the finding of better material.

Figured specimens: 26210, 26211, 26517.

Occurrence: zone G-2.

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