CANADA
DEPARTMENT OF MINES AND RESOURCES
MINES AND GEOLOGY BRANCH

GEOLOGICAL SURVEY
PAPER 45-28

THE LOWER TRIASSIC OF LIARD RIVER, BRITISH COLUMBIA

(REPORT, THREE FOSSIL PLATES, AND APPENDIX)

BY
F. H. McLEARN

OTTAWA
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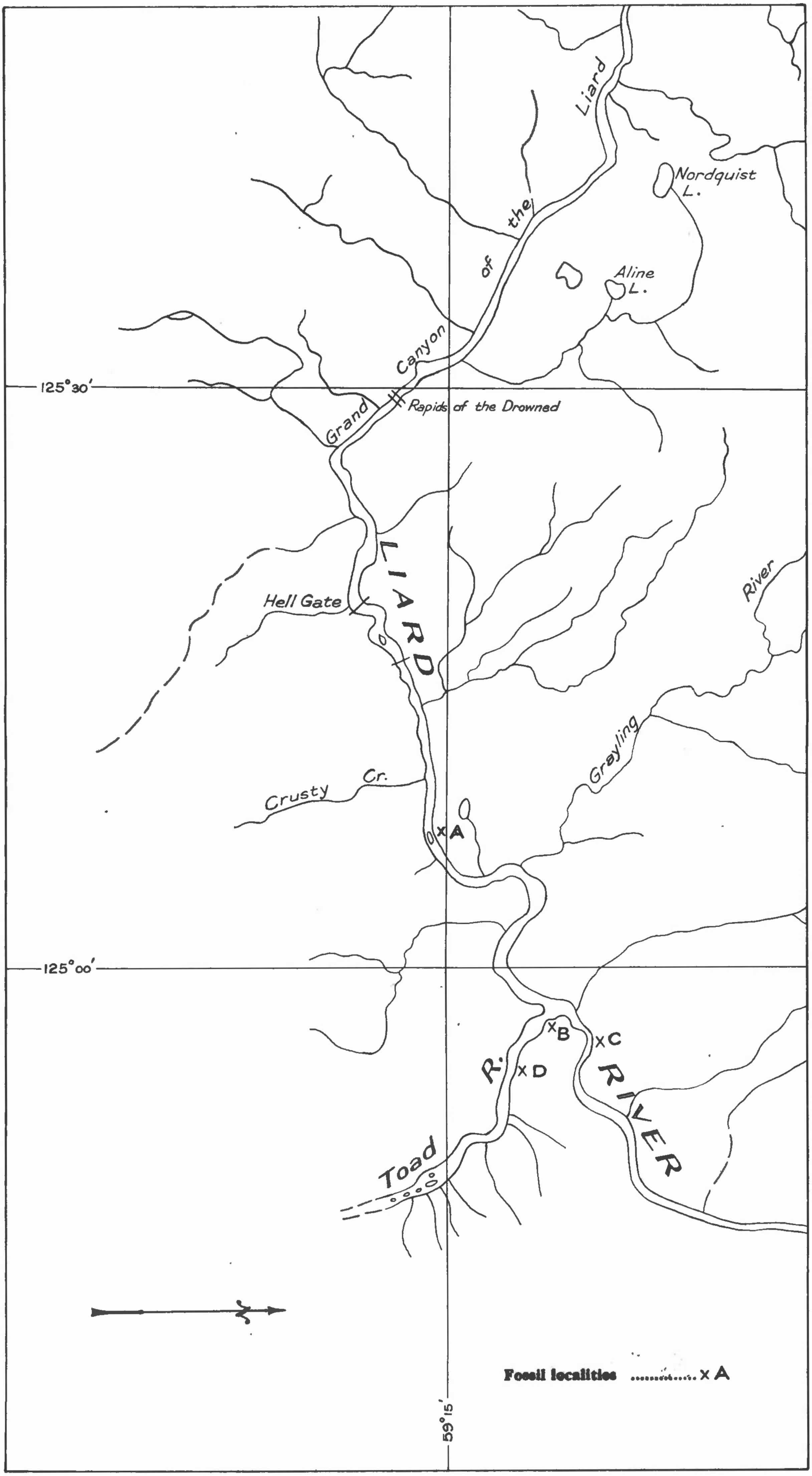

Figure 1. Index map to fossil localities.

Scale: 1 inch to 4 miles

		DIVISIONS (Spath, 1934)	NEVADA (Muller & Ferguson, 1939)		FORT DOUGLAS, UTAH (Mathews, 1929)		IDAHO (Newell & Kummel, 1941 Perrin Smith, 1932)		CENTRAL CAN. ROCKIES (Warren, 1945)			LIARD RIVER, B.C. (E. D. Kindle, 1944)	
LOWER TRIASSIC (Eo-Triassic)	Late Eo-Triassic	Prohungaritan	Candelaria formation		Pinecrest formation	*Columbites*	Thaynes group	*Columbites*	Spray River formation	Hiatus ?	Interval of erosion or nondeposition ?	Toad formation	
		Columbitan				*Tirolites*		*Tirolites*					
		Owenitan				*Wasatchites* *Meekoceras*		*Meekoceras*					*Wasatchites*
	Early Eo-Triassic	Flemingitan			Woodside formation		Woodside formation			Sulphur Mountain member		Grayling formation	
		Gyronitan		*Proptychites*									
		Otoceratan		*Claraia stachei*				*Claraia stachei*			*Ophiceras* *Otoceras* } *C. stachei*		*Claraia cf. stachei*

Figure 2. Correlation Table, LOWER TRIASSIC FAUNAS

THE LOWER TRIASSIC OF LIARD RIVER, B.C.

INTRODUCTION

In the autumn of 1943, E.D. Kindle of the Geological Survey supplied several interesting fossil collections of Lower Triassic age, obtained by him from the valley of Liard River, British Columbia. Their study has revealed the presence of two faunas, one of earlier Lower Triassic age and the other of later Lower Triassic age. The occurrence of the faunas has already been made known in preliminary announcements (McLearn and Kindle, 1943; Kindle, 1944),[1] and their stratigraphic relations have been described

1 Dates within brackets refer to year of publication, and appear in list of references at the end of this report.

(Kindle, 1944). It is proposed, in this mimeographed report, to review their succession and location, to treat their correlation at some length, and to add a few notes on the fossils themselves. In addition, the species are illustrated in three printed plates, and the new species are described in an accompanying printed appendix.

This may also be considered as the third in a series of illustrated reports on the characteristic fossils of the Mesozoic formations of the western interior of Canada. The two preceding reports are: "Revision of the Lower Cretaceous of the Western Interior of Canada", Geol. Surv., Canada, Paper 44-17, second edition; and "The Upper Cretaceous Dunvegan Formation of Northeastern British Columbia and Northwestern Alberta", Geol. Surv., Canada, Paper 45-27. These reports are designed for the geologist who wishes to be able to recognize faunas in the field, and thereby identify the formations in which they occur. For this purpose, the illustrations of fossils on the plates are arranged according to faunas and formations and not in the usual biological order.

STRATIGRAPHY

The name Grayling has been given by Kindle[2] to a

2 The stratigraphy of that part of Liard River basin from which the present summary is taken is discussed at length by E.D. Kindle (1944).

formation, 600 to 1,000 feet thick, that outcrops on Grayling and Liard Rivers. It is composed of grey, soft, laminated shales with rare, sandy and calcareous beds. Specimens of *Claraia* cf. *stachei* Bittner were collected by Kindle from this formation on the north bank of Liard River opposite the west end of an island about 1½ miles east of the mouth of Crusty Creek (*See* locality A, Figure 1). Specimens of the same species were also obtained by Kindle from talus on the east bank of Toad River at its junction with the Liard (*See* locality B, Figure 1).

The Toad formation overlies the Grayling conformably, and consists of black and brown platy shales, siltstones, sandstones, and limestones (Kindle, 1944). It is 800 feet thick near the mouth of Toad River, from which it receives its name, and nearly 2,400 feet thick 9 miles to the west. Kindle examined a well-exposed section on the north bank of Liard River about 2 miles north of the mouth of Toad River (See locality C, Figure 1). About 400 feet above the base is a thin bed of limestone containing a Lower Triassic fauna with 'Prionites' hollandi n.sp., Wasatchites canadensis n.sp., W. meeki var. deleeni n.var., Anawasatchites tardus n.sp., Anawasatchites merrilli n.sp., Xenoceltites robertsoni n.sp., X. cf. hannai Mathews, X. warreni n.sp., Pseudomonotis ovalis Whiteaves, P. ovalis var. kindli n.var., and Orthoceras sp. Wasatchites procurvus n.sp. is probably from this locality.

About 300 feet higher stratigraphically in the same section (Kindle, 1944) is a 2-foot bed of black, impure limestone carrying a Middle Triassic (Anisian) fauna with species of the ammonoid genera Beyrichites, Sturia, Parapopanoceras, etc.

The Lower Triassic Wasatchites fauna has been collected in the same formation on the northeast bank of Toad River about 2 miles upstream from its confluence with the Liard (See locality D, Figure 1). Here are Wasatchites meeki var. deleeni n.var., Pseudomonotis ovalis Whiteaves, and P. ovalis var. kindli n.var.

These Lower Triassic faunas of the Toad formation seem to have been almost entirely overlooked by McConnell in his descent of Liard River in 1887 (See McConnell, 1890). However, he made no collections below Hell Gate, where Kindle's collections were found, all his fossils having been obtained farther upstream at and between the Rapids of the Drowned and Hell Gate (See Figure 1). One specimen found by McConnell and described by Whiteaves (1889), Pseudomonotis ovalis, is of the Lower Triassic Wasatchites fauna, and, presumably, Lower Triassic beds as well as Middle Triassic beds of the Nathorstites zone are exposed at the Rapids of the Drowned. In fact, McConnell's collection from this locality seems to have been a mixed one, representative of more than one faunal zone.

At Hell Gate (See Figure 1), limestone and sandy limestone near the top of the Toad formation contain the Nathorstites fauna, which was collected by McConnell in 1887 and by Kindle in 1944. This fauna does not appear to be present in the east near the mouth of Toad River, in which direction, as previously noted, the formation thins and, thereby, may have lost the higher horizons of the west. From other sections in northeastern British Columbia, it is known that the Nathorstites fauna overlies the Middle Triassic (Anisian) fauna mentioned in a preceding paragraph.

In northeastern British Columbia the sequence of the known Lower and Middle Triassic faunas is as follows:

Middle Triassic (Meso-Triassic)	(Ladinian	- Nathorstites fauna
	(Anisian	- Beyrichites fauna
Lower Triassic (Eo-Triassic)	(Upper	- Wasatchites fauna
	(Lower	- Claraia cf. stachei fauna

CORRELATION

The present paper is concerned only with the two Lower Triassic faunas, the Claraia cf. stachei fauna in the Grayling formation and the Wasatchites fauna in the Toad formation (See Figure 2, Correlation Table).

As the only fossil known in the Grayling formation is Claraia cf. stachei, the determination of its age depends on the stratigraphic range of this species alone. In eastern Greenland Claraia stachei Bittner has a comparatively long range, from the Glyptophiceras to the Proptychites zones (Spath, 1935), that is, it ranges through both the Otoceratan and Gyronitan ages of Spath's nomenclature, the first two of the three ages of the Lower Eo-Triassic. Providing that the imperfect specimens from the Grayling, designated Claraia cf. stachei, are of that species, the fossiliferous beds of the Grayling can be dated early Lower Triassic, but how early cannot be inferred. They may represent the early Otoceratan age, the later Otoceratan age, or some part of the Gyronitan age. Thus, they may be of earliest Lower Triassic age or some later date in the earlier part of the Lower Triassic.

An early Lower Triassic fauna has been recently reported from the central Canadian Rockies. In an interesting paper Warren (1945) has recorded the probable presence of the ammonoid genus Otoceras in the lower part of the Sulphur Mountain member of the Spray River formation. With it he lists the ammonoid genera Ophiceras and Protychites, identified, so the author states, from flattened, imperfect specimens. If present, the association of Otoceras and Ophiceras suggests the upper or second Otoceras-bearing zone of the Lower Triassic (Spath, 1935). This implies an earlier age for Protychites than has hitherto been supposed, earlier, in fact, than upper Gyronitan. However, an early Lower Triassic age is at least indicated. The occurrence, too, of Otoceras in any Canadian or even any North American formation is of unusual interest and its discovery a most important contribution to our knowledge of the American Triassic.

At about the same horizon but not the same locality, Warren (1945) records the presence of Claraia stachei. This suggests at least a tentative correlation of the C. cf. stachei beds of the Grayling formation with some lower part of the Sulphur Mountain member of the Spray River formation (See Figure 2).

In Nevada Claraia stachei occurs about 150 feet above the base of the Candelaria formation and 40 to 50 feet below beds with Proptychites and Prionobolus of Gyronitan age (Muller and Ferguson, 1939). It is probable, therefore, that the C. cf. stachei-bearing beds of the Grayling formation can be correlated with some lower part of the Candelaria formation (See Figure 2). In making these correlations it should be remembered that the Grayling specimens of C. cf. stachei are imperfect, although probably of this species. It should be remembered, further, that the pelecypod C. stachei has a fairly long range as compared with most ammonoids, ranging as it does throughout the first two ages of the early Lower Triassic, the Otoceratan and Gyronitan (Spath, 1935).

In the Fort Douglas area, Utah, no fossils have as yet been found in the Lower Triassic Woodside formation or in the basal part of the overlying Pinecrest formation. The lowest fossil-bearing beds of the Pinecrest, however, are not far above the base of that formation and they contain fossils above the known range of C. stachei. It is, therefore, inferred that the C. stachei beds of the Grayling formation are to be correlated with the Woodside, or at most with a basal part of the Pinecrest (See Figure 2).

The Woodside formation in southeastern Idaho carries an early Lower Triassic fauna with C. stachei, as does also the Dinwoody of Wyoming (Newell and Kummell, 1941). A correlation of the Grayling with these formations in Idaho and Wyoming is, therefore, suggested (See Figure 2).

The Wasatchites fauna in the Toad formation affords a much more reliable basis for correlation than C. stachei in the Grayling, because it has a shorter stratigraphic range. The genus Wasatchites is not known from many parts of the world, although the known occurrences are widely scattered. It was first recognized by Mathews (1929) in the Fort Douglas area, Utah; later reported from Spitzbergen and Timor (Spath, 1934); and finally collected by Kindle on Liard River in 1943. It occurs in what is best known as the Anasibirites beds or zone, but the genus Anasibirites has not yet been found on Liard River. Its fairly restricted time range is about later Owenitan to possibly Columbitan (Spath, 1934), that is, near the middle of the Later Eo-Triassic or upper Lower Triassic.

In North America the stratigraphic position of the Wasatchites fauna with respect to other Triassic faunas is probably best defined in the Fort Douglas area of Utah (See Figure 2). There it occurs in the Pinecrest formation (Mathews, 1929, 1931), above beds with Meekoceras and below those with Tirolites and Columbites. Associated with Wasatchites are species of Xenoceltites, Hemiprionites, Gurleyites, and Anasibirites. To this fauna the Wasatchites fauna on Liard River shows considerable resemblance. Wasatchites canadensis n.sp. can be compared with coarsely ornate species like Wasatchites perrini Mathews and W. magnus Mathews; W. meeki var. deleeni n.var. with W. meeki Mathews; and Xenoceltites cf. hannai with X. hannai Mathews.

A species of Wasatchites has been described by Spath (1934) from the Anasibirites beds on the island of Timor in the Netherlands East Indies, suggesting a correlation of these beds with a part of the Toad formation. He has also described a species of Wasatchites from the Posidonomya beds on the island of Spitzbergen. Spath (1934), however, does not consider that an exact correlation can be made of these Spitzbergen beds with the Wasatchites beds of Utah. They may be slightly later, thus extending the range in time a very little beyond that recorded in Utah and, consequently, probably a little later than that recorded by Wasatchites in the Liard River section.

It is possible that beds of this age are missing in the Triassic section of the central Canadian Rockies. Warren does not record the occurrence of any genera or species of the Wasatchites fauna from that region. He does, however, tentatively identify the ammonoid genus Flemingites at the top of the Sulphur Mountain member and a fauna with the ammonoid genus Gymnotoceras at the bottom of the overlying Whitehorse member of the Spray River formation. If these ammonoids are present it follows that there is a break or hiatus in the section equivalent to most of Upper Eo-Triassic or upper Lower Triassic time; for Flemingites occurs in the highest stage of the Lower Eo-Triassic or lower Lower Triassic, and Gymnotoceras is of Middle Triassic (Anisian) age. Warren (1945) infers the presence of a disconformity between the Sulphur Mountain and Whitehorse members (for hiatus See Figure 2).

In the Candelaria formation of Nevada Muller and Ferguson (1939) record no other than early Lower Triassic faunas. As these faunas are confined to the lower part of the formation (See Figure 2), some higher and unfossiliferous part of it may be of the same age as the Wasatchites-bearing beds of Liard River.

In Idaho, beds equivalent in time to the Wasatchites beds may be included in the Thaynes group. In Wyoming equivalent strata may be some red beds of the Chugwater formation.

NOTES ON FOSSILS

The printed appendix that accompanies this mimeographed report is brief, and the following notes are supplementary to it. Both appendix and notes are intended only to record the results of a preliminary study of the fauna, and it is hoped later to publish a more complete account of the palaeontology.

The following abbreviations are used in the printed appendix:

pl. for plate
fig. for figure
hol. for holotype
par. for paratype
G.S.c. for Geological Survey collection
meas. for measurements

Measurements of ammonoids are given in standard order: diameter in millimetres; height of whorl, as percentage of diameter; thickness of whorl, as percentage of diameter; width of umbilicus as percentage of diameter. Unless otherwise stated all measurements of ammonoids are made at the anterior end of the specimen, that is, at the maximum diameter, and, unless otherwise stated, are taken from the holotype. All types are lodged in the Geological Survey collections at Ottawa.

The collections of Lower Triassic fossils from Liard River are small, and little study of variation is possible. It is hoped, in a later publication on Middle Triassic fossils, to give more attention to variation in ammonoids.

Spath's classification of Triassic ammonoids, as presented in recent publications (*See* Spath, 1934, 1935), has been followed. Mathews' work on the Lower Triassic of the Fort Douglas area (*See* Mathews, 1929) has also been made use of.

The genus *Anawasatchites* is described in the appendix. A few additional observations are here recorded in order to explain why this new genus is erected. The genera now established in the families Prionitidae Hyatt emend. Spath and Sibiritidae Mojsisovics emend. Spath are somewhat narrowly defined, and it does not seem possible to place a small group of species from Liard River in any of them without making them more inclusive than their authors intended. It is true that at maturity the species of this small group acquire a *Wasatchites*-like ornament; tubercles are present on the umbilical shoulder; about three ribs branch from each tubercle; these ribs are faint on the sides but become strong on the ventral shoulder and continue as strong, straight ribs or folds across the venter. This ornament, however, is assumed at a late stage of growth, and the ornament of the inner whorls and the posterior part of the ultimate whorl is quite different from that of typical *Wasatchites*. These earlier whorls are almost smooth and show only faint folds, whereas in *Wasatchites* they have an *Anasibirites*-like ornament, with single ribs on the sides and extending across the venter. In *Anawasatchites* also the whorls are fairly well compressed at all stages of growth, and the umbilical enlargement is more rapid. The compressed, nearly smooth, inner whorls suggest the *G. smithi* group of *Gurleyites* Mathews, but in *Anawasatchites* a stage of *Wasatchites*-like ornament is attained, the umbilical enlargement is not so abrupt, and there is no straightening of the whorl on the body chamber. Compared with the *bastini* group of *Gurleyites* there is no single ribbed *Anasibirites*-like stage of ornament; rounded nodes are present, although some are a little bullate in form; the ribs branch from the node; the ornament is becoming stronger, not declining; and the umbilical enlargement is more even and gradual. Compared with Arctoprionites Spath the nodes are on the umbilical shoulder, not on the middle of the sides; they are not strongly bullate, and the ribs cross the venter. Anawasatchites in a sense occupies a position between Hemiprionites and Wasatchites and between Gurleyites and Wasatchites.

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APPENDIX. NEW LOWER TRIASSIC SPECIES, Liard River, B. C., by F. H. McLearn

'Prionites' hollandi n. sp. Pl. II, fig. 8. Posterior part ultimate whorl much higher than thick; has narrow, somewhat convex venter; rounded ventral shoulder; rounded, distinct umbilical shoulder with distant faint swellings. Anterior part of same whorl inflated, little higher than thick; somewhat convex venter, rounded ventral shoulder; lateral folds, each supporting tubercle. Shallow furrows cross venter. Folds not rounded as in *Prionites.* Tubercles too close to umbilical shoulder for *Arctoprionites*, venter not so tabulate. Meas.: 64.0; 43.5; 37.5; 23.5. G. S. c.: hol. 9469.

Anawasatchites n. gen. Earlier whorls and part of ultimate whorl involute, compressed, with flatly convex venter, nearly smooth or with faint ribs or folds. Gradual umbilical enlargement. On anterior part of ultimate whorl assumes a *Wasatchites*-like ornament. Ceratitic suture line, large ES and Sl. Compared with *Wasatchites* has more compressed whorls at all stages, smoother inner whorls, no *Anasibirites* stage of ornament, and *Wasatchites* ornament assumed at later stage of growth. Compared with *Gurleyites*, umbilical enlargement not so abrupt; no *Anasibirites* stage of ornament, and at maturity has *Wasatchites*-like ornament. *Genotype: Anawasatchites tardus* n. sp.

Anawasatchites tardus n. sp. Pl. III, figs 1, 2. Discoidal, moderately evolute species, high compressed whorls, narrow flatly convex venter, rounded ventral shoulders. Gradual umbilical enlargement, but no straightening of whorl. Earlier whorls nearly smooth, and faint folds on sides, faint furrows on venter. Anterior part ultimate whorl has coarse tubercles from which branch indistinct ribs, strong and projected on ventral shoulder and strong and straight across venter. Differs from all species of *Wasatchites* principally in smoother inner whorls and later assumption of *Wasatchites* ornament. Meas. at and near anterior end: 68.0; 42.5; --; 25.5: 59.0; 44.0; 32.0; 23.5. G. S. c.: hol. 9470.

Anawasatchites merrilli n. sp. Pl. III, figs. 3, 4, 5. Compared with *A. tardus* n. sp., ribs on ventral shoulder are less prominent, and on venter consist merely of broad folds separated by shallow furrows. Some tubercles are bullate. Posterior part ultimate whorl and inner whorls nearly smooth or with faint folds somewhat thickened at umbilical shoulder. Shell proportions like *A. tardus.* Ll has coarser and fewer indentations than in *A. tardus.* Meas.: 73.0; 42.5; -- ; 23.0: 67.0; 43.0; 29.8; 23.0: 51.5; 47.5; 31.0; 20.5. G. S. c.: hol. 9471.

Wasatchites canadensis n. sp. Pl. II, figs. 1, 2, 3. Compared with *Wasatchites perrini* Mathews whorls are thicker, tubercles appear at later stage of growth, some decline in ornament at maturity. Compared with *W. meeki* Mathews, whorls are thicker but not so high, umbilicus wider, ribs stronger on sides, tubercles more prominent. Compared with *W. orientalis* Spath whorls are thicker, tubercles probably stronger. Has stout, thick whorls, slightly convex venter, rounded ventral shoulders. Mature ornament of strong ribs and tubercles, about three ribs branching from each tubercle. Inner whorls have single ribs. Meas.: 50. 0; 42. 0; 40.0; 28.5. G. S. c.: hol. 9472; par. 9473.

Wasatchites meeki var. *deleeni* n. var. Pl. II, figs. 4, 5, 6. Compared with type of *W. meeki* Mathews, whorls are not so high, the umbilicus is wider, and the ribbing is a little stronger. The whorls are much more compressed than those of *Wasatchites canadensis* n. sp., the ribbing is weaker, and the tubercles are weaker and bullate in form. Strength of ribbing and proportions vary, but all specimens higher than thick, with rounded ventral shoulder, weak ribbing on sides, stronger on venter, and tubercles are bullate. Meas.: 46. 0; 40.5; 35.5; 30.5. G. S. c.: hol. 9474.

Wasatchites procurvus n. sp. Pl. II, fig. 7. Compared with *W. canadensis* n. sp. whorls are not so stout but subquadrate in outline, umbilicus is wider, ornament finer, ribs more projected on ventral shoulder, and ornament declines at anterior end. Differs in similar features from *W. perrini* and *W. magnus,* and whorls are not compressed. Compared with *W. tridentinus* Spath, whorls are thinner and umbilicus wider. Prominent features are subquadrate whorls and marked projection of ribs on ventral shoulder. Meas.: 59. 0; 37.5; 35.5; 34.0. G. S. c.: hol. 9475.

Xenoceltites robertsoni n. sp. Pl. I, figs. 8, 9. A somewhat compressed serpenticone. With growth, venter from broadly to narrowly rounded, whorl becomes more compressed. Stages of ornament include: lateral widely spaced swellings; closer broad swellings; fairly widely spaced, narrow ribs projected forward near venter; constrictions and ridges curved forward on venter. Compared with *X. hannai* Mathews, umbilicus wider, stage of lateral swellings persists to later stage; in rib stage ribs narrower and venter narrowly rounded at maturity. Wider umbilicus, lower whorls than in *X. spitzbergenensis* Spath, Meas.: 40. 5; 25.5; 23. 5; 55.5. G. S. c.: hol. 9476.

Xenoceltites warreni n. sp. Pl. I, figs. 2, 3. A compressed serpenticone. Stages of ornament include: lateral widely spaced swellings; more closely spaced low swellings or flat ribs; low, flat ribs separated by narrow furrows or shallow constrictions which, with ribs, are projected on ventral shoulder and are straight across venter. Whorls relatively thicker and umbilicus wider; flat folds on penultimate whorl more distantly spaced than in *X. matheri.* Meas.: 38.5; 30.0; 26.0; 49.5. G. S. c.: hol. 9477.

Pseudomonotis ovalis var. *kindli* n. var. Pl. I, figs. 5, 6. Left valve obliquely ovate, about as long as high, fairly convex, slightly flattened in postero-dorsal angle. Indefinitely segregated, convex anterior ear. Surface ornamented with numerous irregularly spaced radial striae. Length, 19 mm.; height, 19.5 mm. Right valve, par., only gently convex, with well-defined byssal notch; finer striae than on left valve. This variety has finer striae than *P. ovalis* Whiteaves and shorter hingeline than *P. himaica* Bittner. G. S. c.: hol. 9478.

OTTAWA, CANADA,
NOVEMBER, 1945.

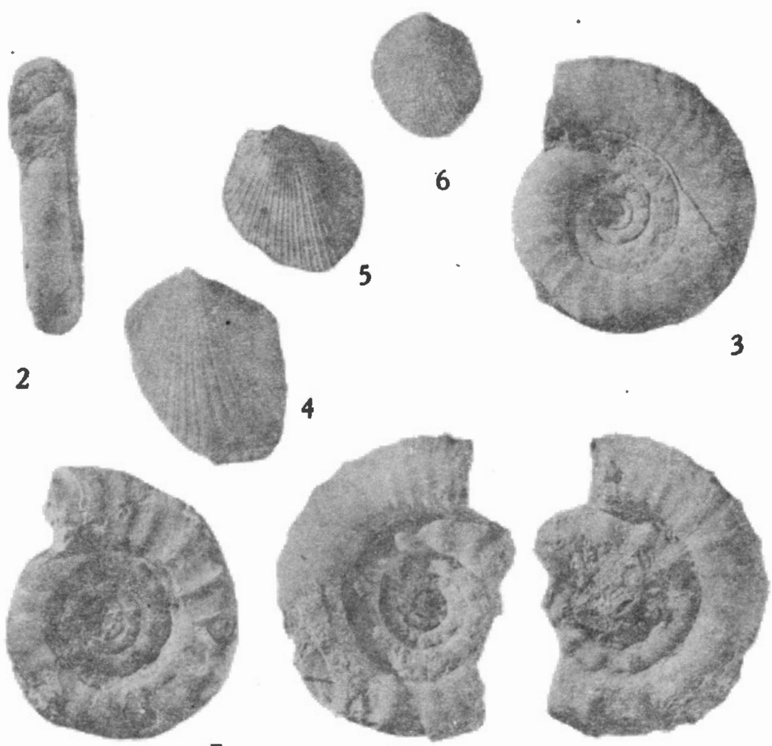
CLARAIA cf. STACHEI FAUNA

GRAYLING FORMATION

1

WASATCHITES FAUNA

TOAD FORMATION (SHEET 1)



2 3 4 5 6 7 8 9

Figure 1. *Claraia* cf. *stachei* Bittner

Figures 2, 3. *Xenoceltites warreni* McLearn n. sp. Holotype

Figure 4. *Pseudomonotis ovalis* (Whiteaves)

Figure 5. *Pseudomonotis ovalis* var. *kindli* McLearn n. var. Holotype

Figure 6. *Pseudomonotis ovalis* var. *kindli* McLearn n. var. Paratype

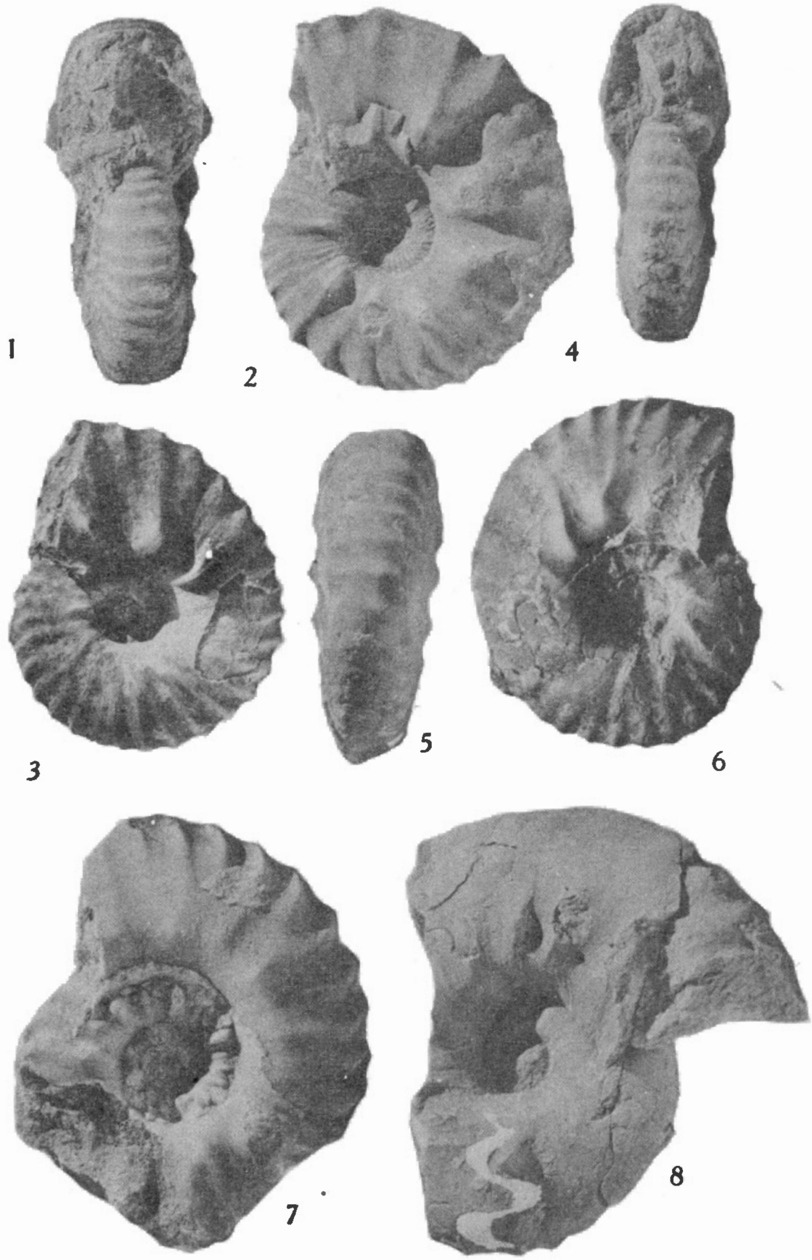
Figure 7. *Xenoceltites* cf. *hannai* Mathews

Figures 8, 9. *Xenoceltites robertsoni* McLearn n. sp. Holotype

PLATE I

WASATCHITES FAUNA

TOAD FORMATION (SHEET 2)



Figures 1, 2. *Wasatchites canadensis* McLearn n. sp. Holotype

Figure 3. *Wasatchites canadensis* McLearn n. sp. Paratype

Figures 4, 5, 6. *Wasatchites meeki* var. *deleeni* McLearn n. var. Holotype

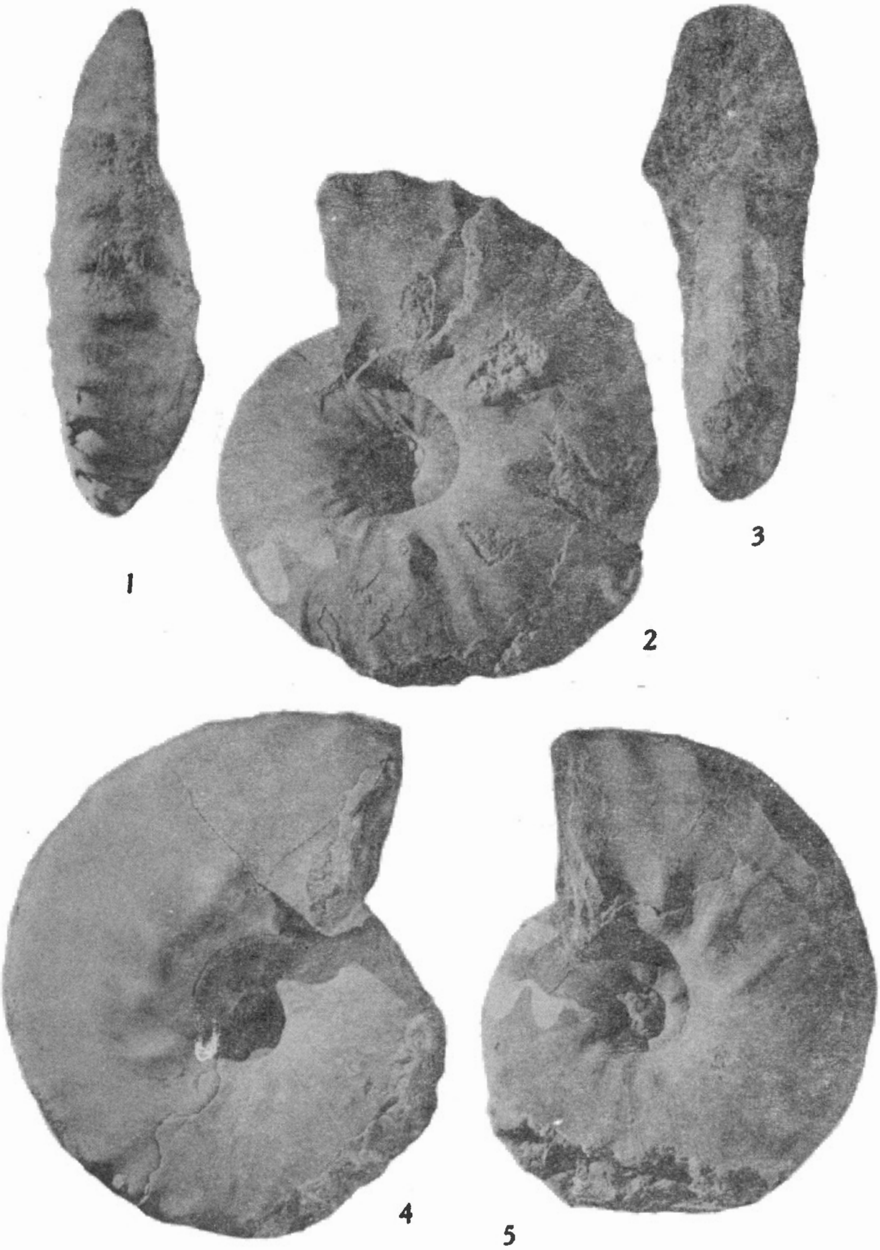
Figure 7. *Wasatchites procurvus* McLearn n. sp. Holotype

Figure 8. '*Prionites*' *hollandi* McLearn n. sp. Holotype

PLATE II

WASATCHITES FAUNA

TOAD FORMATION (SHEET 3)



Figures 1, 2. *Anawasatchites tardus* McLearn n. sp. Holotype

Figures 3, 4, 5. *Anawasatchites merrilli* McLearn n. sp. Holotype

PLATE III