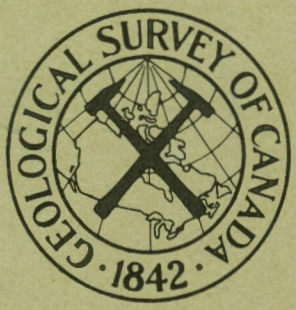


GEOLOGICAL
SURVEY
OF
CANADA

DEPARTMENT OF ENERGY,
MINES AND RESOURCES

PAPER 67-12

# NEW OCCURRENCES OF JURASSIC ROCKS AND FOSSILS IN CENTRAL AND NORTHERN YUKON TERRITORY

(Report, 2 figures and 3 plates)

Hans Frebold, Eric W. Mountjoy and D. J. Tempelman-Kluit

Price, $1.00

1967


GEOLOGICAL SURVEY

OF CANADA

PAPER 67-12

# NEW OCCURRENCES OF JURASSIC ROCKS AND FOSSILS IN CENTRAL AND NORTHERN YUKON TERRITORY

Hans Frebold, Eric W. Mountjoy and D. J. Tempelman-Kluit

DEPARTMENT OF ENERGY, MINES AND RESOURCES

Available by mail from the Queen's Printer, Ottawa,
from the Geological Survey of Canada,
601 Booth St., Ottawa
and at the following Canadian Government bookshops:

OTTAWA
*Daly Building, Corner Mackenzie and Rideau*

TORONTO
*221 Yonge Street*

MONTREAL
*Æterna-Vie Building, 1182 St. Catherine St. West*

WINNIPEG
*Mall Center Bldg., 499 Portage Avenue*

VANCOUVER
*657 Granville Street*

or through your bookseller

A deposit copy of this publication is also available
for reference in public libraries across Canada

Price $1.00 Cat. No. M44-67-12

*Price subject to change without notice*

ROGER DUHAMEL, F.R.S.C.
Queen's Printer and Controller of Stationery
Ottawa, Canada
1967

CONTENTS



Illustrations

## ABSTRACT

This report presents new information on the stratigraphy of marine Jurassic rocks in parts of central and northern Yukon. The presence of these rocks indicates that the Jurassic sea that invaded northern Yukon and northern Alaska extended at least temporarily into the Keele Range and Charley River area, and covered regions that hitherto had been considered to be land during Jurassic times. A southward temporary extension of this Arctic transgression to the sea in southern Alaska is considered possible. The report contains systematic descriptions of many of the more important guide fossils and a discussion of age and correlation based on the ammonite faunas.

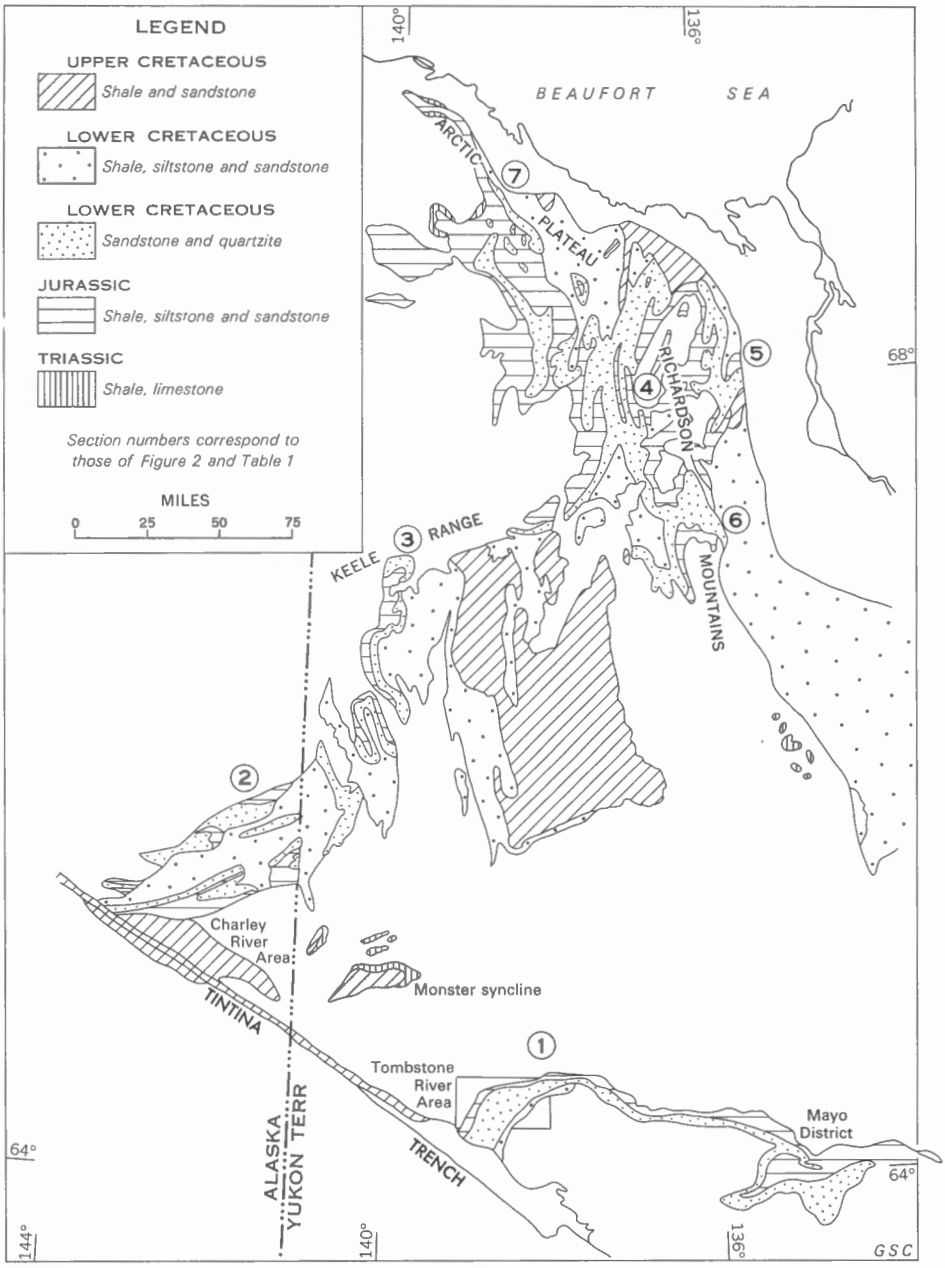


Figure 1. Distribution of Mesozoic rocks in northern Yukon.

# NEW OCCURRENCES OF JURASSIC ROCKS AND FOSSILS IN CENTRAL AND NORTHERN YUKON

## INTRODUCTION

During the field seasons of 1961, 1962, and 1965 several important Jurassic fossil localities were discovered in northern and central Yukon. The purpose of this report is to describe the faunas from these localities and to relate them to the stratigraphy of the Jurassic sequences of northwestern Canada and adjoining northern Alaska and to discuss their significance.

Green and Roddick (1962) reported some incompletely preserved Middle Jurassic ammonites in central Yukon from a locality about 50 miles northeast of Dawson, GSC loc. 47219. The Jurassic fossils occur in Green and Roddick's (1962) map-unit 19[1] that occupies a narrow, 20 mile long belt beneath overthrust Precambrian strata. Recent investigations by Tempelman-Kluit in Tombstone area (Fig. 1) elucidate the internal stratigraphy and stratigraphic relations of unit 19. Data strongly suggest that this unit is made up of Lower Cretaceous rocks above which the strata bearing the Jurassic fossils have been thrust. The data also suggest that the laterally extensive unit 14[1], known informally as the "Lower Schist" in Mayo district, represents the equivalent of the overthrust Jurassic strata. The palaeogeographic significance of the extensive occurrence of marine Jurassic strata, in a region formerly considered to comprise Precambrian sediments and to have been a landmass throughout Mesozoic time, is of particular interest.

In 1962 a reconnaissance study was made of the Mesozoic succession of northern Yukon (Fig. 1) north of latitude 65 degrees by E.W. Mountjoy in conjunction with Operation Porcupine, a helicopter-supported field investigation of the Geological Survey of Canada. This investigation resulted in the discovery of several new Jurassic fossil zones. Of particular significance are the presence of Lower Jurassic fossils in the British Mountains (7 in Figs. 1 and 2) and Upper Jurassic fossils in the vicinity of Keele Range south of Old Crow (3 in Figs. 1 and 2). These collections are related to the detailed study of Jurassic rocks previously made by J.A. Jeletzky in the region to the east between Porcupine River and the northern Richardson Mountains (Jeletzky, 1962; in press).

These discoveries indicate the extensive occurrence of marine Jurassic strata in northern Yukon. The localities northeast of Dawson and in the Keele Range occur in regions formerly considered to be land areas during the Jurassic (Frebold, 1958b; Jeletzky, 1962).

---

[1] Map unit numbers throughout this report refer to those used by Green and Roddick (1962).

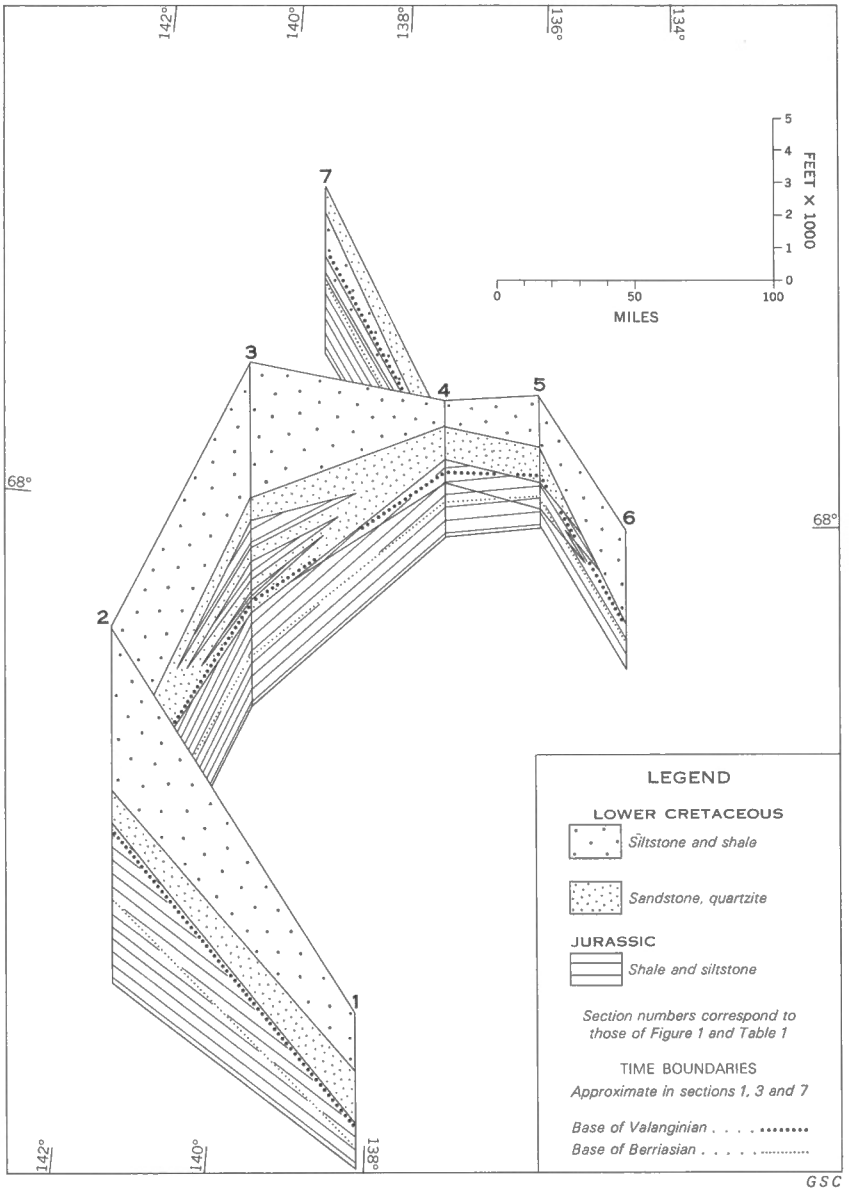


Figure 2. Fence diagram showing correlation and variation in thickness of Jurassic and Lower Cretaceous strata in northern Yukon and east central Alaska. (Sections 6 and 7 slightly displaced to illustrate details.)

## FIELD RELATIONS

### (a) Tombstone area (D.J. Tempelman-Kluit)

Tombstone area (Fig. 1) contains a 5,000-foot succession of Precambrian(?) and Lower Palaeozoic strata that is unconformably overlain by about 6,100 feet of Permian and Mesozoic sedimentary rocks. The structural sequence of these Permian and Mesozoic strata is given below.

STRUCTURAL SEQUENCE IN TOMBSTONE AREA

| | |
|---|---|
| Precambrian rocks | Unit 3 |
| Thrust Fault | |
| Black slate containing Jurassic fossils – 1,000 feet or more | Unit 19 |
| Impure fetid limestone containing abundant pelecypod fragments of probable Upper Triassic age – 150 feet | |
| Thrust Fault | |
| Siltstone and shale – no fossils, but probably Lower Cretaceous – 2,000 feet | |
| Green and red phyllitic and siliceous slate – no fossils, but probably Lower Cretaceous – 500 feet | |
| Thick-bedded, fine-grained, massive orthoquartzite – no diagnostic fossils, but probably Lower Cretaceous – 1,800 feet – equivalent of "Keno Hill Quartzite" of Mayo district | Unit 17 |
| Black slate – no fossils, but probably Jurassic – 1,500 feet – equivalent of "Lower Schist" in Mayo district | Unit 14 |
| Impure fetid limestone – Lower, Middle and Upper Triassic fossils – 200 feet | Not previously recognized |
| Crystalline limestone – Tahkandit Formation – Upper Permian fossils – 100 feet | |
| Unconformity | |
| Precambrian and Lower Palaeozoic strata | Units 3 & 9 |

The sedimentary rocks are thrust faulted and folded and intruded by syenite and quartz monzonite stocks (unit 21) that were probably emplaced in mid-Cretaceous time (Tempelman-Kluit, 1966b).

Repetition of two lithologically similar and probably time equivalent stratigraphic units in the above sequence strongly suggests that it represents a structurally repeated stratigraphic succession. It appears therefore that the upper two members of unit 19 are overthrust equivalents of Triassic, and probable Jurassic rocks that occur below unit 17. The upper black slate member of unit 19, that contains the Jurassic fossils, is probably the stratigraphic equivalent of the lithologically similar unit 14, in which no fossils have so far been found. This strongly suggests a Jurassic age for unit 14. The lateral equivalent of unit 14 (i.e. the "Lower Schist" of Mayo district) was previously included with the Yukon Group, which is thought to be Precambrian, and Green and Roddick (1962) suggested a Devono-Carboniferous age for unit 14.

The probable Jurassic and Lower Cretaceous formations (units 14 and 17 i.e. "Lower Schist" and "Keno Hill Quartzite") underlie a large part of central Yukon and occur in a 120 mile belt that extends from Tombstone area to Mayo district (Bostock, 1947; Greene and Roddick, 1962) (Fig. 1). The Mesozoic succession of Tombstone area therefore applies to a much larger region and merits restatement.

Lower Cretaceous
- Siltstone and shale – 2,000 feet or more
- Green and red phyllitic and siliceous slate - 500 feet
- Thick-bedded, fine-grained, orthoquartzite - 1,800 feet

Jurassic
- Black slate - 1,500 feet

Triassic
- Impure limestone - 200 feet

At present there is no evidence of the presence of marine Jurassic rocks older than Bathonian and younger than Oxfordian, but it is possible that such rocks are present but that fossils have not yet been found. The immediately underlying rocks known in this area belong to the Upper Triassic. E. T. Tozer (1965, unpublished report) has identified Monotis cf. subcircularis Gabb. from these Upper Triassic beds. The next younger sedimentary rocks of the area have been assigned to the Upper Cretaceous (?) and later.

## (b) Northern Yukon (E.W. Mountjoy)

The reconnaissance study of northern Yukon has furnished considerable new stratigraphic information requiring revision of our knowledge concerning the distribution of rocks of various ages (compare 1962 edition of

Geological Map of Canada (map 1045A) with GSC Map 10-1963, Norris et al., 1963). Mesozoic rocks in general and Jurassic rocks in particular are now known to be much more widespread than previously realized (Fig. 1). Some of this new information has been summarized in Douglas et al., (1963).

The two-fold subdivision observed in the Tombstone area by Tempelman-Kluit of a lower shaly formation (mainly Jurassic) and an upper quartz sandstone formation (mainly Lower Cretaceous) occurs over an extensive region to the northwest and north. It is present in east central Alaska (Brabb, 1965; Brabb and Churkin, 1964) and continues northward to the Keele Range and the northeast flank of the British Mountains, a distance of over 300 miles (Figs. 1 and 2).

## Keele Range

One of the thickest lower Mesozoic successions in northern Yukon occurs in the Keele Range west of the Porcupine River (locality 3, Figs. 1 and 2). A section of the lower shaly formation was estimated to be at least 4,000 feet thick. These shales overlie Carboniferous strata with apparent conformity. Unfortunately the lower half of this sequence is not exposed. It could however include some Upper Palaeozoic argillaceous sediments, although this appears unlikely from drilling information to the east (Moorhouse, 1966).

The upper half of the Jurassic shale formation consists of silty dark grey to black shales. Some siltstone interbeds between 2,000 and 3,000 feet below the top contain Upper Jurassic Buchia cf mosquensis, B. ex. gr. mosquensis-piochii and Aucellina n.sp. aff. schmidti, dated as late Kimmeridgian to late Portlandian by J.A. Jeletzky.

The overlying, dominantly orthoquartzite formation here comprises a series of sandstone ridges 500 to 1,000 feet thick separated by somewhat thicker covered intervals presumably underlain by shales and siltstones. Four prominent sandstone ridges are present and the measured thickness to the uppermost thick quartz sandstone is over 6,000 feet. Poorly preserved Buchia sp. were collected from the lower sandstone ridge of this sequence. Evidence from a section 12 miles to the south indicates that the Jurassic – Cretaceous boundary as determined on the basis of various species of Buchia occurs approximately 1,500 feet below the quartz sandstone formation. These sandstones consist of 90 to 96 per cent quartz, and the remainder chert. They are fine-grained, moderately well sorted and weather in massive, resistant cliffs. These sandstones are lithologically identical to the "Keno Hill Quartzite" of the Tombstone area.

British Mountains

In the central part and on the northern flank of the British Mountains (locality 7 in Figs. 1 and 2) Jurassic and Lower Cretaceous strata outcrop in a series of mesa-like mountains. The lower argillaceous formation is here between 2,000 and 3,000 feet thick and in places may be thicker. It consists of a sequence of dark grey to black shales with intervals of siltstone and ironstone concretions and thin interbeds of siltstone. It overlies a thin sequence of Upper Triassic rocks and in places rests directly on Carboniferous carbonates of the Lisburne Group (Mountjoy, in press b). Early Middle and Late Jurassic fossils have been found in this argillaceous formation. New faunas were collected by the author establishing the wide extent of the Pliensbachian. These faunas are described in this report together with faunas collected earlier by other geologists in both the British and Richardson Mountains (Frebold, 1961, 1964). All these occurrences are listed on the correlation chart under the headings for British Mountains and Richardson Mountains.

The upper quartz sandstone formation is about 500 to 1,000 feet thick, considerably thinner than in Keele Range. These sandstones are predominantly quartz, fine-grained, massive, and cliff-forming. Again they are very similar to the orthoquartzites of the Keele Range and Tombstone area.

## JURASSIC FOSSIL LOCALITIES

### (a) Tombstone Area (D.J. Tempelman-Kluit).

The Jurassic fossils discovered by Green and Roddick in 1961 (GSC loc. 47219) occur about 300 feet above the base of a black slate member, near the top of their unit 19 at N64°24', W138°10' (Fig. 1). They are found in a 100-foot bed that contains abundant, spherical, 6-inch chert-ironstone concretions.

Green and Roddick's locality was revisited by L.H. Green and D.J. Tempelman-Kluit in 1965 and additional material was collected (GSC loc. 68091). Another collection (GSC loc. 70444) was made by Tempelman-Kluit at N64°19'56", W138°23'00" (about 10 miles southwest of Green and Roddick's original locality) from the same black slate member and at approximately the same stratigraphic level.

H. Frebold identified the following fossils in these collections (See Description of fossils and Table 2):

GSC loc. 47219 Arctocephalites (?) sp. indet.
Cadoceras (?) indet.

GSC loc. 68091 Cardioceras sp. indet.

GSC loc. 70444 Cardioceras (?) indet.
Pleuromya sp.

(b) Northern Yukon (E.W. Mountjoy)

Keele Range

Jurassic fossils were collected mainly from two localities; an eastern portion of the Keele Range and from an unnamed ridge about 15 miles to the south. The Keele Range localities occur in gently folded strata east of, and beneath, the Yukon thrust (locality 3, Figs. 1 and 2).

The following fossils were identified by J.A. Jeletzky:

GSC loc. 52718 Buchia cf. mosquensis (von Buch)

GSC loc. 52739 Buchia ex. gr. mosquensis (?)

GSC loc. 52739, 52636 Buchia ex. gr. mosquensis - piochii

GSC loc. 52635, 52641, 52738 Buchia sp. indet.

GSC locs. 52718, 52738, 52739, 52636, 52641 are all from the main section (field number 230 MJ) located at 66°59'N and 139°52'W. The Upper Jurassic strata were also examined in an adjoining section (232MJ) 67°00'N and 139°55'W) about 1 1/2 miles west of section 230 MJ and included fossil collections GSC locs. 52635 and 52643. The above fossil zones occur between 1,000 and 1,900 feet below the base of a prominent cliff-forming quartz sandstone formation (section 3).

The second locality occurs to the south of the first at 66°51'N and 139°54'W. The following fossils were identified by J.A. Jeletzky.

GSC loc. 52673, 52639 Buchia sp. possibly of late Upper Jurassic affinities.

GSC loc. 52638 Buchia sp. probably of Jurassic affinities, and
Aucellina n. sp. aff. schmidti Sokolov.

Overlying strata contain Buchia cf. inflata of middle to late Valanginian age. These Valanginian fossils occur about 1,300 feet below a prominent cliff-forming sandstone unit and 170 feet above strata containing Buchia sp. with Upper Jurassic affinities.

British Mountains

Black Jurassic shales and siltstones occur extensively in the vicinity of the Babbage River (locality 7, Figs. 1 and 2) and also in a small area along Loney Creek, a western tributary of Firth River (20 miles southwest of Herschel Island).

At Loney Creek all the fossils were collected from within 100 to 300 feet of the base of a black shale formation which overlies Upper Triassic strata (Mountjoy, in press). Amaltheus stokesi (J. Sowerby) was identified by H. Frebold from the following localities: 5287 (=52690), 52688 (=52692), 52690, 52698, localities 52687, 52692 also contain Amaltheus bifurcus Howarth. These fossils were collected from outcrops along Loney Creek about 2 miles upstream from its mouth, except for GSC loc. 52698 which was about 5 miles upstream from the mouth of Loney Creek. GSC loc. 52689 which contains Harpoceras aff. H. exaratum (Young and Bird) and Dactylioceras aff. D. semicelatum (Simpson) is close to GSC loc. 52688.

GSC loc. 44071 with Cardioceras sp. indet. aff. C. cordatum occurs in Caribou Creek about 2 1/2 miles upstream from its junction with Babbage River. The stratigraphic relations suggest that this collection was obtained from the middle part of a recessive shale and siltstone formation, 1,000 to 2,000 feet in thickness. GSC loc. 41426 and 41484 with Cardioceras sp. indet. aff. C. alphacordatum occur west of Babbage River; 41426 about half way between Trail and Babbage Rivers, and 41484 from Philip Creek 3 miles west of Trout Lake. Both occur in the middle part of the shale and siltstone formation at about the same stratigraphic position as GSC loc. 44071.

Amoeboceras sp. and Buchia concentrica were collected from shales low on the northeast side of Sleepy Mountain (GSC loc. 52782), east of Babbage River and near the head of Ladas Creek. These strata occur about 500 feet below Valanginian Buchia sp. and 700 feet below quartz sandstones which cap the mountain. Amoeboceras sp. (GSC loc. 69124) was obtained from shales and siltstones on the west side of Babbage River about 1 mile south of Trout Lake in the upper part of the recessive weathering shale and siltstone formation. These data are summarized in Table 2.

GSC loc. 52699 containing Arkelloceras elegans n.sp. and Inoceramus lucifer Eichwald were collected from a shale and sandstone sequence in an eastern tributary near the head of Fish Creek in the northern Richardson Mountains at 67°58'N and 136°25'W.

Table 1

TENTATIVE CORRELATION CHART OF JURASSIC AND LOWER CRETACEOUS FORMATIONS IN NORTHERN YUKON AND EAST CENTRAL ALASKA

| | STANDARD STAGES | 1 TOMBSTONE AREA (Tempelman-Kluit) | 2 CHARLEY RIVER ALASKA (Brabb & Churkin) | 3 KEELE RANGE (E.W. Mountjoy) | 4 HEADWATERS BELL RIVER (Jeletzky, 1961) | 5 AKLAVIK RANGE (Jeletzky, 1958 and in press) | 6 EAST FLANK RICHARDSON MOUNTAINS (Jeletzky, 1960) | 7 BABBAGE RIVER ARCTIC PLATEAU (E.W. Mountjoy) |
|---|---|---|---|---|---|---|---|---|
| LOWER CRETACEOUS | HAUTERIVIAN | .....?..... UNIT 14 500 .....?..... | 5000 | .....?..... | COALY QUARTZITE * 840 WHITE * QUARTZITE 200 | COAL BEARING DIVISION * 520 | OVERLAP EROSIONAL GAP | Sandstone +500 .....?..... |
| | VALANGINIAN | * + UNIT 17 1700 .....?..... | Member A KANDIK FORMATION +1000 | Sandstone with lesser siltstone and shale + 3700 | BLUISH-GREY SHALE + DIVISION +400 | LOWER SANDSTONE DIVISION + +500 | LOWER SANDSTONE | Blue-grey shale 1500 + |
| | BERRIASIAN | | unnamed | Shale and + siltstone with minor sandstone | +LOWER SANDSTONE 300 | + HUSKY FORMATION (Shale and Siltstone) | LOWER SHALE-SILTSTONE DIVISION | Siltstone and sandstone 500 |
| JURASSIC | PORTLANDIAN | | | | LOWER SHALE-SILTSTONE DIVISION | | | + LOWER SHALE |
| | KIMMERIDGIAN | + UNIT 14 | + Shale and argillite, minor quartzite | 4000 | | | | |
| | OXFORDIAN | | | ---?-------?--- | + | +850 | | |
| | CALLOVIAN | +1500 | 5000 | | | BUG CREEK FORMATION | | |
| | BATHONIAN | ----------?-------?---- | | unknown | | (Siltstone and Sandstone) | | |
| | BAJOCIAN | | | | | | | |
| | TOARCIAN | | | | | | | |
| | PLIENSBACHIAN | unknown | unknown | | +1700 | +600 | 1250 | 2500 .....?..... |
| | SINEMURIAN | | | | Sandstone 200 | | | |
| | HETTANGINIAN | ----------?----------?---------- | | | | | | |

+ Marine
* Nonmarine
(Thicknesses in feet)

Table 2: Subdivision and guide-fossils of the Jurassic beds in central Yukon, Keele Range, Richardson and British Mountains and northern Alaska (compiled from various sources by H. Frebold. Determination of Canadian Buchias by J.A. Jeletzky).

| Stages | Northern Alaska after Imlay, 1955 | British Mountains including region as far southeast as Bonnet (Bonny) Lake | Richardson Mountains | Keele Range Age-determinations by J.A. Jeletzky | Central Yukon |
|---|---|---|---|---|---|
| Upper Volgian | Unknown | Buchia fischeriana s. lato<br>Buchia piochii | Buchia fischeriana<br>Buchia piochii | | Unknown |
| Portlandian s. str. (lower Volgian | Buchia mosquensis, B. rugosa | Buchia mosquensis | Buchia mosquensis | Aucellina n. sp. aff. schmidti ?,<br>Buchia cf. mosquensis,<br>Buchia ex gr. mosquensis-piochii | |
| Upper and Middle Kimmeridgian | | | | | |
| Lower Kimmeridgian Upper Oxfordian | Amoeboceras spp. iuv., Buchia concentrica | Amoeboceras sp. indet., Buchia concentrica | Buchia concentrica | | |
| Lower Oxfordian | Unknown | Cardioceras sp. indet. aff. C. cordatum, C. sp. indet. aff. C. alphacordatum | Unknown | | Cardioceras sp. indet. |
| Upper Callovian | Unknown | Unknown | Unknown | | Unknown |
| Middle Callovian | Reineckia cf. R. stuebeli<br>Pseudocadoceras grewingki | | | | |
| Lower Callovian | Unknown | Cadoceras arcticum, C. cf. canadense | Cadoceras septentrionale var. latidorsata, C. canadense, C. voronetsae | | Cadoceras ? sp. indet. |

| | | | | | |
|---|---|---|---|---|---|
| Upper Bathonian | Arcticoceras sp. | Unknown | Cadoceras spp., Arcticoceras kochi | | Unknown |
| Middle Bathonian | Unknown | Unknown | Cadoceras crassum, Arctocephalites cf. A. ornatus, A. elegans | | Arctocephalites ? sp. indet. |
| Lower Bathonian | Unknown | Unknown | Unknown | Unknown | |
| Upper Bajocian | Unknown | Unknown | Cranocephalites borealis | | |
| Middle Bajocian | Unknown | Unknown | Arkelloceras elegans Inoceramus lucifer | | |
| Lower Bajocian | Tmetoceras, Erycites, and Pseudolioceras Whiteavesi | Erycites cf. E. howelli, Pseudolioceras sp. indet. | Pseudolioceras sp. indet. | | |
| Upper Toarcian (Yeovilian) | Pseudolioceras cf. P. lythense | Unknown | Unknown | | Unknown |
| Lower Toarcian (Whitbian) | Dactylioceras spp. | Dactylioceras aff. D. semicelatum, Harpoceras aff. H. exaratum | Dactylioceras sp. | | |
| Upper Pliensbachian | Unknown<br>Amaltheus spp. | Unknown<br>Amaltheus stokesi<br>A. bifurcus | Unknown | | |
| Lower Pliensbachian | Unknown | Unknown | Unknown | | |
| Upper Sinemurian | Unknown | Arctoasteroceras sp. | Echioceras sensu lato sp. indet., Oxynoticeras oxynotum, Arctoasteroceras jeletzkyi | | |
| Lower Sinemurian | "Arietites" cf. "A." bucklandi | Unknown | Arietites sensu lato gen. et sp. indet. | | |
| Hettangian | Unknown | marine beds unknown | marine beds unknown | | |

## SYSTEMATIC DESCRIPTIONS OF FOSSILS (H. Frebold)

### (a) Tombstone area

Family Cardioceratidae Siemiradzki, 1891

Subfamily Cadoceratinae Hyatt, 1900

Genus Arctocephalites Spath, 1928

Arctocephalites ? sp. indet.

Plate II Figures 1a, b, 2

Material. Two whorl fragments, GSC Nos 19945 and 20058 from GSC loc. 47219. Collected by L.H. Green and J.A. Roddick.

Description. Specimen 19945 represents somewhat less than half a whorl with rounded rectangular cross-section. The flanks are moderately convex, they grade gently into the rounded venter. The umbilicus is apparently very narrow. The flanks are smooth but the venter is transversely crossed by straight rounded ribs. The intervals between the ribs are of equal size as the ribs. Apparently the whorl is part of the body-chamber with the last septum present at the beginning of the whorl.

Specimen 20058 is a fragment of a venter with transversely crossing ribs that are thinner than those of specimen 19945. This fragment could belong to a more adult specimen of the same species as GSC No. 19945.

Comparison. In general appearance the two fragments are similar to certain species of Arctocephalites but the very incomplete state of preservation does not permit detailed comparisons.

Age. Probably middle Bathonian.

Cadoceras ? sp. indet.

Plate II Figures 3, 4, 5; 6a, b

Material. Four fragments, GSC Nos 20344, 20345, 20347, 20348 from GSC loc. 47219. Collected by L.H. Green and J.A. Roddick.

Description. Three of the specimens are rather small fragments of younger whorls that are moderately compressed and have a fairly narrow venter. The larger specimen GSC No. 20344 is platycone and its last whorl covered

probably more than two-thirds of the preceding one. The ribs are bent forward and most of them bifurcate at about the half height of the whorl. There are also some intercalated ribs. Some of them do not extend beyond the outer half of the flank, others seem to go from the venter to the umbilicus. The ribs cross the venter without becoming weaker, they are here bent forward in a rounded angle. No keel is present. No suture lines observed.

Comparisons. In the shape of the ribs, the specimens resemble the Bathonian genus Arcticoceras and some Callovian subgenera of Cadoceras, i.e. Pseudocadoceras Buckman and Stenocadoceras Imlay. Arcticoceras has a venter that is broader than that of the described specimens, while the venter of the above mentioned subgenera of Cadoceras is similar. The incomplete preservation of the specimens prevents, of course, any attempt to an accurate identification.

Age. The specimens are tentatively placed in the lower Callovian.

Ammonite genus et species indet.

Plate II Figure 7

Material. One fragment of a larger whorl, GSC No. 20350 from GSC loc. 68091. Collected by D.J. Tempelman-Kluit.

Description and comments. The fragment represents the outer part of a whorl with forward bent ribs some of which are subdivided at different heights of the flank. They are also bent forward on the venter. The pattern of the ribs seems to be similar to that of the Cadoceras ? sp. indet. described above and the fragment could be of an adult whorl of the same species.

Age. Probably late Middle Jurassic.

Subfamily Cardioceratinae Siemiradzki, 1891

Genus Cardioceras Neumayr et Uhlig, 1881

Cardioceras sp. indet.

Plate II Figures 8, 9a, b; Plate III Figure 4

Material. One imprint, GSC No. 20340, and two fragments 20341, 20342, from GSC loc. 68091 and two very poorly preserved fragments (median sections of possibly one and the same specimen) from GSC loc. 70444. Collected by D.J. Tempelman-Kluit.

Description. The rubber cast made from the imprint GSC No. 20340 belongs to a medium-sized specimen with 18 fairly widely-spaced straight primaries on the last whorl which at half the height of the flank end in a node. At this node they are subdivided in three secondaries that are much finer than the primaries and strongly bent forward. They end in rather fine and, on account of unsatisfactory preservation, only weakly recognizable chevrons.

Specimen 20341 is a whorl fragment that has 5 primary ribs preserved. They are subdivided at about half the height of the whorl in 3 secondaries that are very strongly bent forward, and form rather strong chevrons on the partially preserved keel. Intercalated secondaries occur. The secondaries and chevrons of this specimen are stronger than those of specimen 20340. The two other fragments from GSC loc. 68091 belong to younger specimens of apparently the same species as specimen 20341.

The not illustrated specimen from GSC loc. 70444 has apparently a keel with very weakly recognizable chevrons.

Comparison. The unsatisfactory state of preservation of all the specimens does not permit any detailed comparison with known species.

Age. Early Oxfordian.

(b) Northern Yukon

Family Amaltheidae Hyatt, 1867

Genus Amaltheus de Montfort, 1808

Amaltheus stokesi (J. Sowerby)

Plate I Figures 1, 2, 3; 5; 7

Ammonites stokesi J. Sowerby, 1818, p. 205, pl. 191.

Amaltheus stokesi (J. Sowerby), Howarth, 1958, p. 3, pl. I, figs. 5, 7, 12-14; pl. II, figs. 1, 3, 10; Text-figs. 4, 5.

Amaltheus cf. A. nudus (Quenstedt), Imlay, 1955, p. 87, pl. 10, fig. 5.

Amaltheus stokesi (J. Sowerby), Frebold, 1964a, p. 9, pl. 2, figs. 2-6.

Amaltheus stokesi (J. Sowerby), Frebold, 1966, pl. I, figs. 1-4.

For additional synonymy see Howarth, 1958, p. 3.

Material. Several specimens from Loney Creek, GSC locs. 52698, 52690, 52687 (= 52690), 52688 (= 52692). Collected by E.W. Mountjoy.

Description. Large to medium-sized and small specimens, most of them secondarily flattened. There are about 24 primary ribs that are fairly strong and slightly sigmoidal. Bifurcation of the primaries is well visible in GSC No. 20343 (pl. I, fig. 5). The chevrons on the venter are strong, the keel is only slightly differentiated. The whorl fragment GSC No. 20346 (pl. I, fig. 1) has a height of 63 mm and is the largest representative of the species in this collection. None of the specimens show the suture line or spiral striae.

Comparison. The specimens show the characteristics of the species and agree well with the specimens described from northwestern British Columbia, the Fernie Group of Alberta, and Howarth's figures and descriptions of the species. The specimen described by Imlay from northern Alaska as Amaltheus cf. A. nudus (Quenstedt) (Imlay, 1955, p. 87, pl. 10, fig. 5) seems to be a typical representative of A. stokesi.

Occurrence and age. In the Loney Creek area of the British Mountains the species is associated with Amaltheus bifurcus Howarth, in northwestern British Columbia and southern Yukon with Arieticeras algovianum and Leptaleoceras pseudoradians. The species is characteristic of the lower part of the Margaritatus Zone, i.e. the lowermost part of the upper Pliensbachian.

## Amaltheus bifurcus Howarth

Plate I Figures 4; 6

Amaltheus bifurcus Howarth, 1958, p. 2, pl. I, figs. 1-4, 6, 8-11; pl. 10, fig. 3.

Material. Two specimens from Loney Creek; GSC No. 20355 from GSC loc. 52687, GSC No. 20356 from GSC loc. 52692. Collected by E.W. Mountjoy.

Description. Both specimens are imprints from which rubber casts were made. They are secondarily compressed. The smaller specimen (GSC No. 20355) has a whorl height of 7.5 mm and an umbilical width of 10 mm at a diameter of 23 mm. There are 23 fairly strong ribs on the last whorl. Most of them are bifurcated. The secondary ribs have almost the same strength as the primaries. There is a fine tubercle at the point of bifurcation. The chevrons on the venter are strong. Suture lines are not visible.

Specimen 20356 has a diameter of about 50 mm. There are 24 primaries on the last whorl which tend to be more sigmoid towards the end of the whorl. The primaries, secondaries, and the chevrons on the venter are strong. In the front half of the whorl bifurcation of most of the primaries can be seen. The secondaries are equal in strength to the primaries.

Comparison. The two specimens agree well with Amaltheus bifurcus Howarth.

Occurrence. In the Loney Creek area the species is associated with Amaltheus stokesi (J. Sowerby). Not known from other localities in North America. In England it occurs in the Stokesi Subzone according to Howarth (1958, p. 2).

Family Hildoceratidae Hyatt, 1867

Subfamily Harpoceratinae Neumayr, 1875

Genus Harpoceras Waagen, 1869

Harpoceras aff. Harpoceras exaratum (Young and Bird)

Plate I Figure 8

Material. One whorl fragment (GSC No. 20358) from Loney Creek, GSC loc. 52689. Collected by E.W. Mountjoy.

Description. The fragment shows the flat whorl side, the rather sharp keel and numerous falcoid ribs.

Comparison. Accurate determination of this fragment is not possible. It closely resembles some Harpoceratinae from Prince Patrick Island described by Imlay (1955, p. 88, pl. 11, figs. 12, 13, 15) as Harpoceras cf. H. exaratum (Young and Bird) and the small specimen described by the author (Frebold, 1960, p. 19, pl. 5, fig. 9) from Borden Island, also described as Harpoceras cf. H. exaratum. Wright's specimen (1878-86, pl. 62, figs. 1-3) of H. exaratum (Young and Bird) = H. cf. exaratum (Young and Bird) Donovan (1954, p. 46) has the same kind of ribbing at the end of the last whorl as the fragment from Loney Creek.

Occurrence and age. The fragment from Loney Creek is associated with Dactylioceras. In Canada, Harpoceras cf. exaratum is known from the Toarcian of the Fernie Group of the Rocky Mountains and Foothills, various localities in British Columbia and the Arctic Islands. In England it occurs (Howarth, 1962, p. 191) in the Exaratum Subzone of the Falciferum Zone of the Whitbian substage (lower Toarcian).

Family Dactylioceratidae Hyatt, 1867

Genus Dactylioceras Hyatt, 1867

Dactylioceras aff. D. semicelatum (Simpson)

Plate I Figures 9; 10, 11

Material. Three specimens (GSC Nos. 20359, 20360, 20361) from Loney Creek, GSC loc. 52689. Collected by E.W. Mountjoy.

Description. Specimens 20360 and 20361 are imprints from which rubber casts were made, specimen 20359 is a whorl fragment. The largest specimen (GSC No. 20361) has a diameter of about 64 mm. Its last whorl is considerably flattened, the inner whorls to a lesser degree. The whorl fragment shows the moderately convex flanks gently grading to the umbilicus and the moderately rounded venter. The specimens are characterized by fairly fine, slightly forwardly inclined straight and dense ribs. Many of them bifurcate, others remain single. Some secondaries are intercalated or indistinctly connected with the primaries. On the venter of the whorl fragment the secondaries are slightly arched forward. The point of bifurcation is sometimes faintly swollen but real tubercles are not developed.

Comparison. The specimens resemble in certain aspects Imlay's (1955, p. 87, pl. 10, figs. 6, 13) Dactylioceras aff. D. semicelatum (Simpson) from northern Alaska but the ribs of his form are apparently still finer and more widely spaced than in ours. D. semicelatum (Simpson) figured by Buckman (1911, pl. 31) is very similar but poor preservation does not permit detailed comparison.

Occurrence and age. In the Loney Creek area the three specimens were found associated with Harpoceras aff. H. exaratum (Young and Bird). In England D. semicelatum belongs to the zone of Dactylioceras tenuicostatum of the Lower Whitbian, and according to Sylvester-Bradley (see Dean, Donovan, and Howarth, 1961, p. 476) locally characterizes the uppermost horizon of this zone.

Family Stephanoceratidae Neumayr, 1875

Arkelloceras elegans n.sp.

Plate III Figures 8a, 6

Material. One medium-sized specimen, GSC No. 20362 and the imprint of a small specimen from Upper Fish Creek, N.W.T., GSC loc. 52699. Collected by E.W. Mountjoy.

Description. The specimen is fragmentary. A rubber cast made from its imprint offers a more complete outline of the ammonite. The measurements in millimetres are as follows:

| Diameter | Whorl height | Whorl thickness | Umbilicus |
|---|---|---|---|
| 43 | 17 (.40) | 15 (.35) | 15 (.35) |

The flanks of the specimen are slightly compressed with rounded margin to the rather steep but not high umbilical wall. Greatest thickness of the whorl is in its inner third and diminishes towards the rounded ventro-lateral border; the venter is almost tabulate. Ribs forwardly inclined, most of them bifurcated, point of division below half of the height and with moderate swellings, but no tubercles. At the ventro-lateral border there are tubercle-like elongated thickenings; ribs on both sides of the venter are not opposite to each other. The venter appears almost smooth but faint alternating zigzagging connections of the ribs of both flanks are present. On the preceding whorl the central part of the venter appears to be smooth with well developed tubercles on both sides of the smooth zone. Also, at this stage of growth, the ribs on both the flanks are not opposite to each other.

Parts of the suture line are fairly well preserved and show the trifid first lateral lobe that is much longer than the second lateral; the first lateral saddle is trifid. The suture line appears to be similar to that of A. tozeri Frebold and A. mclearni Frebold.

Comparison. This specimen is clearly distinguished from Arkelloceras tozeri Frebold, the type species of the genus, mainly by its thinner whorls.

Arkelloceras mclearni Frebold (Frebold, 1957, p. 11, pl. 12, Figs. 1a-c, 2a-g, 3a-c; pl. 13, figs. 1a-d, 2a-c, 3a, b; 1961, p. 8, Figs. 3a, b; 1964, p. 18, Fig. 4) has at an equivalent diameter a cross-section that is more rounded than that of Arkelloceras elegans n.sp. and its ribs are stronger and have thicker swellings on the points of bifurcation. "Arkelloceras(?) sp. iuv." described by Imlay (1964, p. B53, pl. 28, Figs. 7-9) is, as already stated by Imlay, similar to A. mclearni but is too small for accurate comparison and identification. The author agrees with Imlay in assigning this juvenile specimen tentatively to the genus Arkelloceras.

The author placed the genus Arkelloceras tentatively in the family Stephanoceratidae Neumayr (Frebold, 1961, pp. 8, 9) which include some genera with ventral furrow, as for example Ermoceras H. Douvillé, 1916, and Telermoceras Arkell. When describing a somewhat doubtful specimen of Arkelloceras from the Fernie Group, Westermann (1964, p. 407) assigned Arkelloceras to a new unnamed subfamily of the "Family Otoidae Mascke, 1907(?) (or nov.?)". In an addendum to the same paper

Westermann (loc. cit., p. 409) changed his opinion suggesting "Arkelloceras and Ermoceras should best be included in a new subfamily and tentatively placed in the Thamboceratidae".

The writer does not follow Westermann's suggestions. There is no reason for removing Ermoceras from the Stephanoceratidae and placing it in the Thamboceratidae Arkell, which according to Arkell (1952) comprise "bicarinate oxycones with ..... highly variable degenerate sutures .....". The genus Arkelloceras has nothing in common with such oxycones.

Occurrence and age. At GSC loc. 52699 Arkelloceras elegans n.sp. was found associated with Inoceramus lucifer Eichwald and poorly preserved fragments of other pelecypods.

The genus Arkelloceras Frebold was originally described from Prince Patrick Island (Frebold, 1958a). At that time two main possibilities regarding the age of Arkelloceras were mentioned, i.e. late Bajocian or late Bathonian to early Callovian.

The reasons for these tentative age-determinations were as follows:

Arkelloceras was found associated with Inoceramus lucifer Eichwald that occurs in Alaska in the Bajocian. On the other hand, field observations in Prince Patrick Island seemed to indicate close stratigraphic relationships to Cranocephalites vulgaris that had been considered by Spath (1939) as late Bathonian in age. In a subsequent paper (Frebold, 1958b, p. 31), the author considered the age of the two species of Arkelloceras known at that time, i.e. A. tozeri Frebold and A. mclearni Frebold as "younger than lower Bajocian and older than beds with Arcticoceras" but Westermann suggested a Callovian age (see Frebold, loc. cit., p. 31, footnote). Westermann's suggestion was not followed by the author because Arkelloceras occurred below Arcticoceras that at that time was considered to be of early Callovian age – it is now placed in the late Bathonian (see Callomon, 1959; Frebold, 1961, 1964). In these two papers the author still considered the approximate age of the Canadian Arkelloceras tozeri and A. mclearni as late Bajocian to early Bathonian.

When supposing that Imlay's (1964, loc. cit.) "Arkelloceras ? sp. iuv." from the middle Bajocian of the Cook Inlet region of southern Alaska actually belongs to the genus Arkelloceras the age of the genus can be determined more accurately. According to Imlay it was found associated with Inoceramus lucifer, Bradfordia and an immature sonniniid, probably representing Witchellia. "Directly above were found Otoites sp., Stephanoceras (Skirroceras) sp., Bradfordia costidensa Imlay, n.sp., and

Inoceramus lucifer Eichwald." Imlay (loc. cit. p. B53) concludes: "On the basis of associated fossils the age of Arkelloceras ? sp. iuv. must correspond either to the zone of Sonninia sowerbyi or to the zone of Otoites sauzei ....." and that it is probably not older than the zone of Otoites sauzei. The association of the new species Arkelloceras elegans and of A. tozeri and mclearni with Inoceramus lucifer suggests that also these species are of middle Bajocian age.

A middle Bajocian age of Arkelloceras seems also to be supported by the alleged occurrence of the genus in the middle Bajocian Rock Creek member of the Fernie Group in the Snake Indian Valley, Jasper Park, Alberta. Unfortunately, the single specimen described by Westermann as a new species (1964) is very poorly preserved but in spite of some doubts about its identity it probably belongs to this genus.

However, the possibility has to be kept in mind that not all the species of Arkelloceras are restricted to the middle Bajocian and that some species may go beyond its boundaries.

Family Cardioceratidae Siemiradzki, 1891

Subfamily Cardioceratinae Siemiradzki, 1891

Genus Cardioceras Neumayr et Uhlig, 1881

Cardioceras sp. indet. aff. C. cordatum (J. Sowerby)

Plate III Figure 1

Material. Two specimens, GSC Nos 20363, 20364, from GSC loc. 44071, near Babbage River, Northern Yukon. Lat. 68°48'N., Long. 138°38'W. Collected by Triad Oil Company.

Description. Both specimens are poorly preserved and more or less distorted. The diameter of the larger specimen is about 99 mm, other reliable measurements cannot be taken. The keel seems to be rather prominent. There are comparatively few ribs that are prominent and have nodes at the bifurcation point and close to the ventro-lateral border. Projection of the ribs on the venter and dentation of the keel are not preserved.

Comparison. Arrangement and shape of the ribs are very similar to the ribs in Cardioceras cordatum (J. Sowerby) to which group the specimens probably belong.

Age. Early Oxfordian.

Cardioceras sp. indet. aff. C. alphacordatum Spath

Plate III Figures 2; 3

Material. Two specimens, GSC No. 20365 from GSC loc. 41484, near Babbage River, Northern Yukon (Lat. 68°51'N., Long. 138°51'W.) and GSC No. 20366 from the same area, GSC loc. 41426 (Lat. 68°55'N., Long 138°47'). Both specimens were collected by Triad Oil Company.

Description. Specimen GSC 20365 has a diameter of 106 mm, a whorl height of 54 mm and a whorl thickness of 43 mm. The measurements are approximate. The greatest thickness is near the umbilical margin. Umbilical slope not observable, presumably steep. The cross-section is high cordate. About one half of the last whorl belongs to the body-chamber, suture lines are very poorly preserved and not traceable in detail. The ribs on the body-chamber are fairly strong. Most of them bifurcate below half the height of the flanks. The point of bifurcation is marked by bullate nodes. Occasionnally a rib is subdivided in 3 secondaries and an intercalated rib that does not join a primary occurs. The secondaries are sharply bent forward in the outer part of the whorl. They cross the fairly high poorly preserved venter.

The smaller specimen GSC 20366 has the same type of ribbing and belongs probably to the same species as the larger one.

Comparison. In the shape of the ribs the specimens are similar to Cardioceras (Scarburgiceras) alphacordatum Spath (Spath 1939, p. 94, pl. 6, figs. 10a, b and Arkell, 1946, p. 303, pl. 69, figs, 8a, b) but unsatisfactory preservation of the specimens from Northern Yukon does not warrant detailed comparison. The specimens described from the Fernie Group by the author as C. alphacordatum and C. aff. alphacordatum (Frebold, Mountjoy, and Reed, 1959, pp. 20, 21, pl. 1, figs, 1a, b and pl. 2, fig. 1) do not belong to Spath's species. They differ from the Yukon specimens by much finer ribs.

Occurrence and age. The two specimens were not found associated with other fossils. Their age is early Oxfordian.

Genus Amoeboceras (sensu lato) Hyatt, 1900

Amoeboceras sp. indet.

Plate III Figures 5; 6, 7

Material. One specimen (imprint) GSC 20367 (collected by Mr. T.P. Chamney) from GSC loc. 69124, west side of Babbage River, about 1 mile south of Trout Lake, Northern Yukon.

Three imprints, GSC 20368, 20369, 20370 (collected by Dr. E. Mountjoy) from GSC loc. 52782, Sleepy Mountain, near Babbage River.

Description. The rubber casts of specimens 20367, 20368, and 20369 show fairly dense, almost straight ribs some of which are bifurcating. They are swelling somewhat in the outer part of the whorl. A fine serrated keel is partially visible.

The rubber cast of specimen 20370 has stronger and more widely spaced ribs than the other specimens. The ribs have also tubercles near the ventro-lateral border.

Comparison. The unsatisfactory preservation of all specimens does not permit any detailed comparisons with known species and subgenera. There is a certain similarity with some Amoeboceras spp. iuv. described from northern Alaska by Imlay (1955, p. 90, pl. 12, figs. 2-6) and Amoeboceras sp. indet. described from Mackenzie King Island by the author (Frebold, 1961, p. 22, pl. 3, fig. 3 and pl. 18, fig. 3).

Occurrence. Specimens 20368, 20369, and 20370 were found associated with Buchia concentrica (Sowerby). The age of the beds is late Oxfordian or early Kimmeridgian.

## AGE, CORRELATION AND ZOOGEOGRAPHIC POSITION OF FAUNAS

(H. Frebold)

Many of the Jurassic ammonites and Buchias of the British and Richardson Mountains have been described or mentioned in previous reports (for Ammonites see Frebold, 1960, 1961, 1964a; for Buchias see Jeletzky, 1961). Recently collected new ammonites from northern and central Yukon are described in this bulletin. In most cases the age of these guide-fossils is well established and with the exception of Arkelloceras whose age is discussed elsewhere in this report, does not need any further comments. The present state of knowledge of the stratigraphic succession of the guide-fossils is summarized in the stratigraphic chart (Table 2). This chart demonstrates also the close faunal and stratigraphic relationships with northern Alaska.

Some comments on the zoogeographical position of various faunas will, however, have to be made.

The lower Jurassic and lower Bajocian ammonites of northern Yukon belong to genera of world-wide distribution.

The probably middle Bajocian genus Arkelloceras now also found in the Richardson Mountains, belongs however, to an Arctic group of ammonites. It is abundantly represented on Prince Patrick, Melville, and Axel Heiberg Islands of the Canadian Arctic Archipelago. Outside this region, only two specimens were previously known, one from southern Alaska and one from Alberta,where they were associated in each case with abundant ammonites of European aspect. Thus, all the evidence now available leads to the conclusion that the Arctic Arkelloceras fauna replaces zoogeographically the non-boreal middle Bajocian faunas of other regions.

The genera Cranocephalites (upper Bajocian to lower Bathonian), Arctocephalites (mainly middle Bathonian), Arcticoceras (upper Bathonian) and the Arctic species of Cadoceras (lower Callovian) found in the British Mountains, are typical representatives of the boreal realm, while the early Oxfordian Cardioceras and the upper Oxfordian or lower Kimmeridgian Amoeboceras are cosmopolitan ammonites. The Buchias of the Upper Jurassic are characteristic of the boreal region but are also found outside this area.

It is unfortunate that the Bathonian and Callovian ammonites found in the Tombstone area of central Yukon could not be identified accurately. The fragments described as Arctocephalites (?) sp. indet. are too poorly preserved for an unquestionable assignment to this genus and accordingly their boreal character is somewhat doubtful. The same applies for the fragments described as Cadoceras (?) sp. indet. Better material has to be found before the boreal character of the Bathonian and Callovian of central Yukon can be established beyond reasonable doubt.

## REGIONAL LITHOLOGICAL CORRELATIONS

(E.W. Mountjoy and D.J. Tempelman-Kluit)

Jurassic strata occur extensively in east central Alaska and northern Yukon (Fig. 1). The probable age, lithology, and stratigraphic relations of unit 14 of the Tombstone area ("Lower Schist") are identical to those of Member A of the Kandik Formation in east central Alaska (Brabb, 1965) and these two units are therefore tentatively correlated (Table 1, Fig. 2). The Lower Cretaceous (?) unit 17 of Tombstone area ("Keno Hill Quartzite") is tentatively correlated with the lithologically similar Member B of the Kandik Formation (Table 1).

Members A and B of the Kandik Formation can be in turn correlated with the much thicker sequence of shales and quartz sandstones of the Keele Range. The Jurassic shale formation of the British Mountains correlates with the Lower, Middle and Upper Kingak shales of northeastern Alaska. The Jurassic sequence of the British Mountains and Keele Range

also correlates with the somewhat thinner and more arenaceous successions of the Porcupine River and Richardson Mountains described by Jeletzky (1961, 1962, in press). (Table 1, Fig. 2).

## PALAEOGEOGRAPHY

(H. Frebold, E.W. Mountjoy and D.J. Tempelman-Kluit)

The close faunal and lithological relationships between northern Yukon and northern Alaska summarized in the charts (Tables 1 and 2) demonstrate that these two areas formed part of the same sea during most of Jurassic time. This opinion was expressed earlier in several palaeogeographic maps (Frebold, 1957a, p. 38; 1957b, p. VII; 1960, p. 2; and 1964, p. 38). In these maps the Keele Range area with the adjoining Charley River area, Alaska, and central Yukon were considered to have formed lands as no marine deposits were known from these regions. The recently discovered marine Upper Jurassic rocks indicate clearly that the Jurassic sea that invaded northern Yukon and northern Alaska extended at least temporarily into the Keele Range – Charley River area. As no Jurassic rocks or faunas older than middle Kimmeridgian to Portlandian have been identified in the Keele Range the transgression of the northern sea into this area remains doubtful for the early Kimmeridgian, Oxfordian, Middle and Early Jurassic times. However, as shown by Mountjoy in Keele Range (see p. 7, 8) the lower half of the thick shaly formation, the upper part of which contains the Upper Jurassic fossils, is not exposed. In this lower half older Jurassic faunas and beds may be present.

The palaeogeographic position of the Tombstone area in central Yukon is not as clear as that of the Keele Range area. As shown in Tables 1 and 2, older Jurassic fossils occur in unit 14 of Tombstone area than in the Keele Range. However the Keele Range rocks have not been adequately sampled and may contain Middle and Lower Jurassic strata.

The lithologic similarities between the Jurassic rocks of Tombstone area of central Yukon and northern Yukon (including Keele Range and Charley River area of east central Alaska) imply parallel conditions of sedimentation and development in these areas. They also suggest a direct connection between the basins in which the Jurassic strata of these areas were deposited. Both of these Jurassic basins are truncated on the southwest by the Tintina Trench, a zone of presumed Tertiary faulting (Fig. 1). Between them during much of Jurassic and Lower Cretaceous time a landmass appears to have extended from southern Richardson Mountains across the Eagle Plains to Monster syncline in northwest Ogilvie Mountains (Fig. 1) as indicated by the present distribution of Mesozoic formations in this area (Mountjoy, in press a, b; Norris, Price and Mountjoy, 1963). The region, however, may also have been thinly covered by Jurassic sediments which

were later eroded in late Lower Cretaceous time. A basin connecting the Dawson area with the Charley River – Keele Range areas must have extended around the southwest end of this landmass.

The southward extension of the Jurassic Arctic sea from the British Mountains area via Keele Range into central Yukon can now be regarded as established. At present it remains doubtful whether this transgression reached its southernmost extension in central Yukon or joined, at least temporarily, the Jurassic sea of southe Alaska. Rocks of the same age occur in the Nutzotin Mountains and Chitina Valley (Imlay, 1952, chart 8C, column 107) southwest of Dawson and the Tanana River. Because a major transcurrent fault is thought to occur along the Tintina Trench with tens of miles of right lateral displacement, it is not possible at present to relate this area with the Jurassic of the Dawson and Charley River areas. Further study is required to determine whether or not there was a connection between these areas during Jurassic time.

## REFERENCES


Arkell, W.J.
1935-1948: Ammonites of the English Corallian Beds; Mon. Paleontogr. Soc., London.

1952: Jurassic ammonites from Jebel Tuwaig, Central Arabia; Philos. Trans. Roy. Soc. (London), Ser. B, vol. 236, No. 633.

Bostock, H.S.
1947: Mayo, Yukon Territory, Geol. Surv. Can., Map 890A.

Brabb, E.E.
1965: Stratigraphy and oil possibilities of Mesozoic rocks in Kandik basin, east central Alaska; Abstract, Bull. Am. Assoc. Petrol. Geol., vol. 49.

Buckman, S.S.
1911: Yorkshire type ammonites; vol. 1, London.

Callomon, J.H.
1959: The ammonite zones of the Middle Jurassic beds of East Greenland; Geol. Mag., vol. 96, No. 6.

Dean, W.T., Donovan, D.T., and Howarth, M.K.
1961: The Liassic ammonite zones and subzones of the North-West European Province; Bull. British Mus. (Nat. Hist.), vol. 4, No. 10.

Donovan, D.T.
1954: Synoptic supplement to T. Wright's "Monograph on the Lias Ammonites of the British Islands"; Palaeontogr. Soc., 1953.

Douglas, R.J.W., Norris, D.K., Thorsteinsson, R., and Tozer, E.T.
1963: Geology and petroleum potentialities of Northern Canada; Geol. Surv. Can., Paper 63-31.

Frebold, H.
1958a: Fauna, age and correlation of the Jurassic Rocks of Prince Patrick Island; Geol. Surv. Can., Bull. 41.

1958b: The Jurassic system in Northern Canada; Trans. Roy. Soc. Can., 3rd Series, vol. 52, sec. IV.

1960: The Jurassic faunas of the Canadian Arctic, Lower Jurassic and lowermost Middle Jurassic ammonites; Geol. Surv. Can., Bull. 59.

1961: The Jurassic faunas of the Canadian Arctic, Middle and Upper Jurassic ammonites; Geol. Surv. Can., Bull. 74.

1964a: Lower Jurassic and Bajocian ammonoid faunas of northwestern British Columbia and southern Yukon; Geol. Surv. Can., Bull. 116.

1964b: The Jurassic faunas of the Canadian Arctic, Cadoceratinae; Geol. Surv. Can., Bull. 119.

1966: Upper Pliensbachian in the Fernie Group of Alberta; Geol. Surv. Can., Paper 66-27.

Frebold, H., Mountjoy, E., and Reed, R.
1959: The Oxfordian beds of the Jurassic Fernie Group, Alberta and British Columbia; Geol. Surv. Can., Bull. 53.

Green, L.H. and Roddick, J.A.
1962: Dawson, Larsen Creek and Nash Creek map-areas, Yukon Territory; Geol. Surv. Can., Paper 62-7.

Howarth, M.K.

1958: The ammonites of the Liassic Family Amaltheidae in Britain; Mon. Palaeontogr. Soc., London.

1962: The Yorkshire type ammonites and nautiloids of Young and Bird, Phillips and Martin Simpson; Palaeontology, vol. 5, pt. 1.

Imlay, R.W.

1952: Correlation of the Jurassic Formations of North America exclusive of Canada; Bull. Geol. Soc. Am., vol. 63.

1953: Callovian (Jurassic) ammonites from the United States and Alaska, Part 2, Alaska Peninsula and Cook Inlet Regions; U.S. Geol. Surv., Prof. Paper 249-B.

1955: Characteristic Jurassic mollusks from northern Alaska; U.S. Geol. Surv., Prof. Paper 274-D.

1962: Jurassic (Bathonian or early Callovian) ammonites from Alaska and Montana; U.S. Geol. Surv., Prof. Paper 374-C.

1964: Middle Bajocian ammonites from the Cook Inlet Region Alaska; U.S. Geol. Surv., Prof. Paper 418-B.

Jeletzky, J.A.

1958: Uppermost Jurassic and Cretaceous rocks of Aklavik Range northeastern Richardson Mountains, N.W.T.; Geol. Surv. Can., Paper 58-2.

1960: Uppermost Jurassic and Cretaceous rocks, east flank of Richardson Mountains between Stony Creek and lower Donna River, N.W.T.; Geol. Surv. Can., Paper 59-14.

1961: Upper Jurassic and Lower Cretaceous rocks, west flank Richardson Mountains between headwaters of Blow River and Bell River, Yukon Territory; Geol. Surv. Can., Paper 61-9.

1962: Pre-Cretaceous Richardson Mountain Trough: Its place in the tectonic framework of Arctic Canada and its bearing on some geosynclinal concepts. Trans. Roy. Soc. Can., vol. 56, Ser. III.

in press: Jurassic and (?) Triassic rocks of the eastern Slope of Richardson Mountains; Geol. Surv. Can., Paper.

Mertie, J.B.
1937: The Yukon-Tanana Region, Alaska; U.S. Geol. Surv., Bull. 872.

Moorhouse, M.O.
1966: Eagle Plain Basin of Yukon Territory; Bull. Am. Assoc. Petrol. Geol., vol. 50, p. 628 (abstract).

Mountjoy, E.W.
in press: Triassic stratigraphy of northern Yukon Territory, Canada; Geol. Surv. Can., Paper.

Norris, D.K., Price, R.A., and Mountjoy, E.W.
1963: Geology of northern Yukon Territory and northwestern District of Mackenzie; Geol. Surv. Can., Map 10-1963.

Quenstedt, F.A.
1883-1885: Die Ammoniten des Schwäbischen Jura; Stuttgart.

Sowerby, J. 1818: The Mineral Conchology of Great Britain; vol. 2, London.

Spath, L.F.
1932: The invertebrate faunas of the Bathonian-Callovian deposits of Jameson Land (East Greenland); Medd. om Grönland, vol. 87, No. 7.

1939: The ammonite zones of the Upper Oxford Clay of Warboys, Huntingdonshire; Geol. Surv., Great Britain, Bull. No. 1.

Tempelman-Kluit, D.J.
1966a: "Keno Hill quartzite" in Tombstone River and Upper Klondike River areas, Yukon Territory; in Report of activities: Field 1965, compiled by S.E. Jenness: Geol. Surv. Can., Paper 66-1.

1966b: Stratigraphy and structure of the Keno Hill quartzite, Tombstone River area, central Yukon, unpub. Ph.D. thesis McGill Univ.

Westermann, G.E.G.
1964: Occurrence and significance of the Arctic Arkelloceras in the Middle Bajocian of the Alberta Foothills (Ammonitina, Jurassic); J. Paleont., vol. 38, No. 2.

Wright, T.
1878-1886: Monograph on the Lias ammonites of the British Islands; Palaeontogr. Soc., London.

- PLATES -

Plate I

All figures in natural size.

Figure 1. Amaltheus stokesi (J. Sowerby). GSC No. 20346. Lateral view. Upper Pliensbachian. GSC loc. 52687. Northern Yukon.

Figure 2. Amaltheus stokesi (J. Sowerby). GSC No. 20357. Lateral view. Upper Pliensbachian. GSC loc. 52689. Northern Yukon.

Figure 3. Amaltheus stokesi (J. Sowerby). GSC No. 20349. Lateral view. Upper Pliensbachian. GSC loc. 52687. Northern Yukon.

Figure 4. Amaltheus bifurcus Howarth. GSC No. 20356. Rubbercast. Lateral view. Upper Pliensbachian. GSC loc. 52692. Northern Yukon.

Figure 5. Amaltheus stokesi (J. Sowerby). GSC No. 20343. Rubbercast. Lateral view. Upper Pliensbachian. GSC loc. 52687. Northern Yukon.

Figure 6. Amaltheus bifurcus Howarth. GSC No. 20355. Rubbercast. Lateral view. Upper Pliensbachian. GSC loc. 52687. Northern Yukon.

Figure 7. Amaltheus stokesi (J. Sowerby). GSC No. 20354. Lateral view. Upper Pliensbachian. GSC loc. 52690. Northern Yukon.

Figure 8. Harpoceras aff. H. exaratum (Young and Bird). GSC No. 20358. Lateral view, Toarcian. GSC loc. 52689. Northern Yukon.

Figure 9. Dactylioceras cf. D. semicelatum (Simpson). GSC No. 20359. Lateral view. Toarcian. GSC loc. 52689.

Figure 10. Dactylioceras cf. D. semicelatum (Simpson). GSC No. 20360. Rubbercast. Lateral view. Toarcian. GSC loc. 52689. Northern Yukon.

Figure 11. Dactylioceras cf. D. semicelatum (Simpson). GSC No. 20361. Rubbercast. Lateral view. Toarcian. GSC loc. 52689. Northern Yukon.

PLATE I

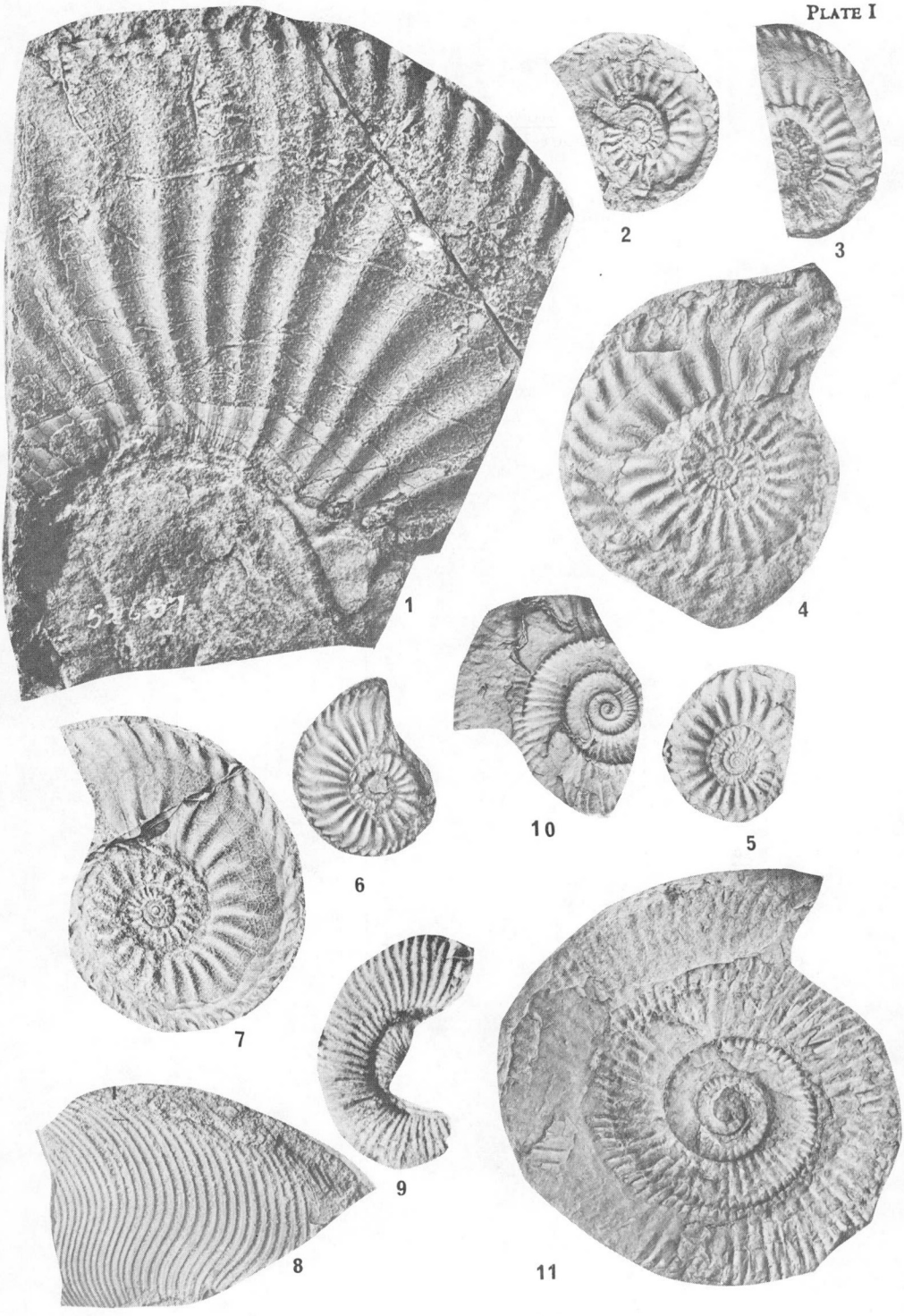

Plate II

All figures in natural size.

Figures 1a-b. Arctocephalites ? sp. indet. GSC No. 19445. 1a. Lateral view; 1b. Venter. Bathonian. GSC loc. 47219. Central Yukon.

Figure 2. Arctocephalites ? sp. indet. GSC No. 20058. Venter. Bathonian. GSC loc. 47219. Central Yukon.

Figure 3. Cadoceras ? sp. indet. GSC No. 20344. Lateral view. Callovian. GSC loc. 47219. Central Yukon.

Figure 4. Cadoceras ? sp. indet. GSC No. 20348. Venter. Callovian. GSC loc. 47219. Central Yukon.

Figure 5. Cadoceras ? sp. indet. GSC No. 20347. Venter. Callovian. GSC loc. 47219. Central Yukon.

Figures 6a-b. Cadoceras ? sp. indet. GSC No. 20345. 6a. Lateral view; 6b. Venter. Callovian. GSC loc. 47219. Central Yukon.

Figure 7. Ammonites, gen. et sp. indet. GSC No. 20350. Venter. Callovian ? GSC loc. 68091. Central Yukon.

Figure 8. Cardioceras sp. indet. GSC No. 20342. Lateral view. Oxfordian. GSC loc. 68091. Central Yukon.

Figures 9a-b. Cardioceras sp. indet. GSC No. 20341. 9a. Lateral view; 9b. Venter. Oxfordian. GSC loc. 68091. Central Yukon.

Figure 10. Cardioceras sp. indet. aff. C. cordatum (J. Sowerby). GSC No. 20363. Lateral view. Oxfordian. GSC loc. 44071. Northern Yukon.

PLATE II

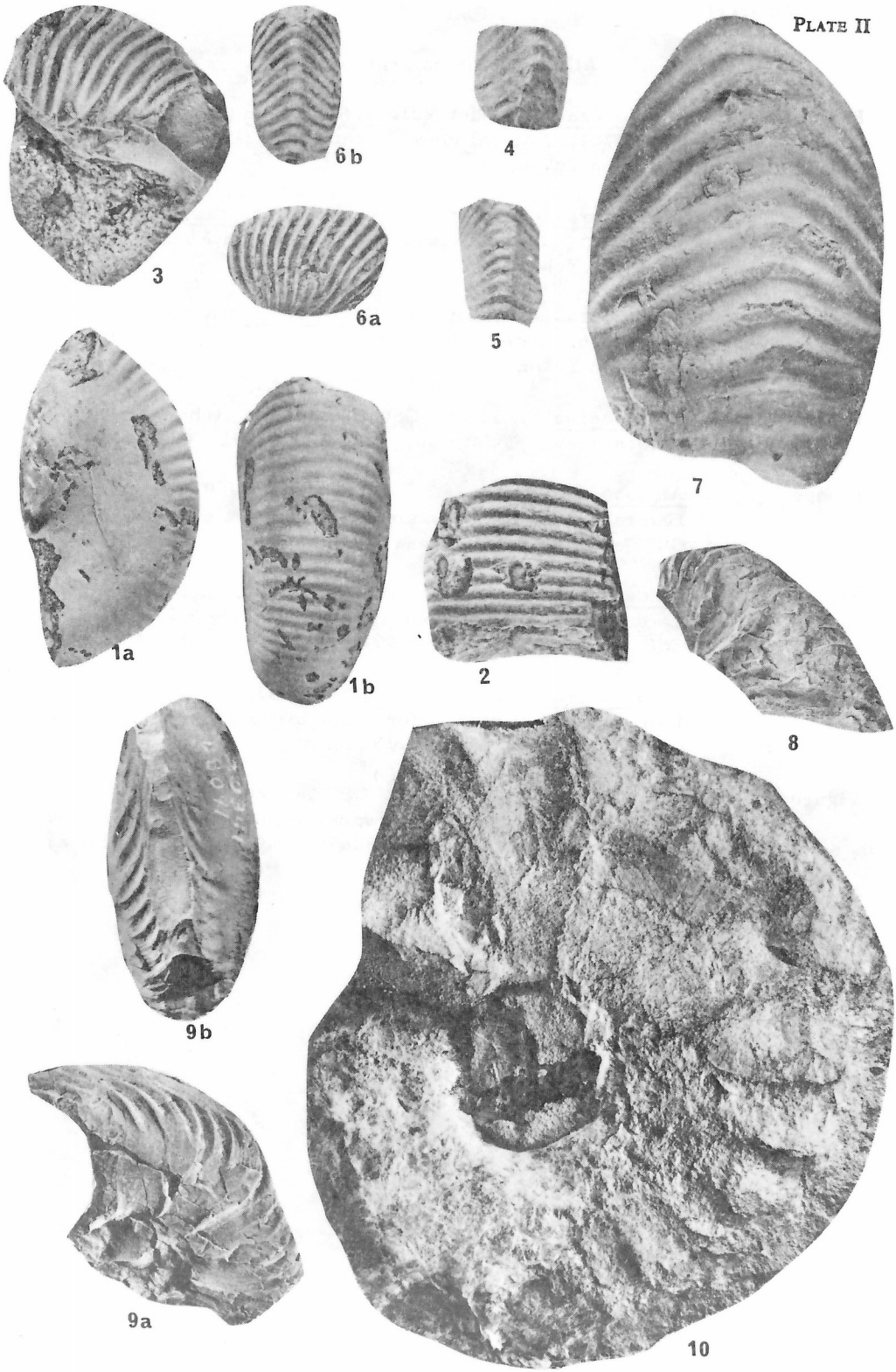

Plate III

All figures in natural size.

Figure 1. Cardioceras sp. indet. aff. C. cordatum (J. Sowerby. GSC No. 20364. Lateral view. Oxfordian. GSC loc. 44071. Northern Yukon.

Figure 2. Cardioceras sp. indet. aff. C. alphacordatum Spath. GSC No. 20365. Lateral view. Oxfordian. GSC loc. 41484. Northern Yukon.

Figure 3. Cardioceras sp. indet. aff. C. alphacordatum Spath. GSC No. 20366. Lateral view. Oxfordian. GSC loc. 41426. Northern Yukon.

Figure 4. Cardioceras sp. indet. GSC No. 20349. Rubbercast. Lateral view. Oxfordian. GSC loc. 68091. Central Yukon.

Figure 5. Amoeboceras sp. indet. GSC No. 20369. Rubbercast. Lateral view. Upper Oxfordian – lower Kimmeridgian. GSC loc. 52782. Northern Yukon.

Figure 6. Amoeboceras sp. indet. GSC No. 20367. Rubbercast. Lateral view. Upper Oxfordian – lower Kimmeridgian. GSC loc. 69124. Northern Yukon.

Figure 7. Amoeboceras sp. indet. GSC No. 20370. Rubbercast. Lateral view. Upper Oxfordian – lower Kimmeridgian. GSC loc. 52782. Northern Yukon.

Figures 8a-b. Arkelloceras elegans n.sp. GSC No. 20362. 8a. Rubbercast. Lateral view: 8b. Venter and cross-section. Middle Bajocian. GSC loc. 52699. Northwest Territories.

PLATE III