Lower Ordovician conodonts from Washington Land, western North Greenland

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Early Canadian (Lower Ordovician) conodonts have been recorded from loose slabs which were collected by J. C. Troelsen in 1941 at Kap Clay, Washington Land, western North Greenland. The samples probably derived from the Cape Clay Formation which is exposed in the steep coastal cliff. The macrofauna of the samples includes *Symphysurina* sp. of Early Ordovician age. The conodont fauna comprises "*Paltodus*" *bassleri* Furnish, *Utahconus oneotensis* (Furnish), "*Oistodus*" *triangularis* Furnish, and species of *Cordylodus* Pander and "*Acontiodus*" Pander. The fauna correlates with Fauna C of the North American Mid-continental Faunal succession and with the *Cordylodus angulatus* Zone of the Baltic-Scania succession. Locally, it correlates with the conodont fauna recorded from the Cape Clay formation of Southern Devon Island, Canadian Arctic Archipelago.

The conodont fauna is described applying multielement taxonomy. In all 314 specimens, representing 20 multielement species, were recorded. Some species are new, but they are referred to only in open nomenclature because of the unsettled stratigraphical status of the loose blocks.

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Introduction

Preliminary mapping of the western part of North Greenland (Fig. 1) and reconnaissance work in various part of Ellesmere Island, Arctic Canada was undertaken by J. C. Troelsen (1950). He worked in the field in 1939–1941 as a member of the Danish Thule-Ellesmere Land Expedition. In this remote area the use of dog sledge was necessary and hence fieldwork was restricted to the periods from march to early june and from october to november, where ice conditions were favourable.

Previous to and during the years 1939–1941 mapping was hampered by the lack of basic topographical maps and often only the outline drawings of the coastline existed. The first geological map was published by Poulsen (1927). This was followed by geological maps presented by Koch (1932, 1933). At that time the Cambro-Ordovician succession was known only sporadically. The stratigraphy established by Poulsen (1927) and Koch (1929a, b) formed the basis for a preliminary division of the sediments which Troelsen (1950) adopted with modifications. De-

spite the severe working conditions and the little information available Troelsen (1950) provided much new information and added greatly to the knowledge of the area (Fig. 2).

Later Dawes (1971, 1976) did geological reconnaissance work in North Greenland, and Henriksen & Peel (1976) continued with establishing a reference section of the Cambro-Ordovician succession for the area. Since then a mapping project by the Geological Survey of Greenland produced major stratigraphical changes which had influence on the divisions of Poulsen (1927), Koch (1929a, b), and Troelsen (1950). In addition a similar project on the Canadian side by the Geological Survey of Canada will certainly increase the knowledge of the Paleozoic stratigraphy in the North Greenland-Canadian Arctic Region.

Geological setting

The sequence in western North Greenland rests upon the Precambrian crystalline basement which is overlain by autochthonous Proterozoic to

Figure 1. Location map of the Kap Clay area, Washington Land, western North Greenland. (Modified from Troelsen (1950). For new information on the geology, see Henriksen & Peel (1976)).

Lower Palaeozoic sediments with a marked angular unconformity. The sediments occur in a wide east-west trending belt and dip towards north forming a platform in front of the North Greenland foldbelt (Dawes 1976). The North Greenland foldbelt is a continuation of the Franklinian foldbelt in the Arctic Canada.

The Lower Palaeozoic in North Greenland is represented by platform carbonates, evaporites and shales. The Silurian strata include a giant reef complex (Hurst & Surlyk 1983) that also developed across Arctic Canada.

Cape Clay Formation

Poulsen (1927) and Koch (1929a, b) introduced the Cape Clay Formation based on the succession at the Kap Clay cliff in Washington Land, western North Greenland (Fig. 1). This term was

adopted also for Ellesmere Island (Troelsen 1950; Christie 1967). Koch (1929a, b) and Troelsen (1950) were unable to define the lower and upper boundaries of the Cape Clay Formation, because of deep snow at the time of their visit.

Henriksen & Peel (1976) reexamined the area at Kap Clay and established the stratigraphic boundaries of the Cape Clay Formation.

The Cape Clay Formation conformably overlies the Cass Fjord Formation (Upper Cambrian-Lower Ordovician) and it is in turn overlain by the Lower Ordovician Christian Elv Formation (Henriksen & Peel 1976) (Fig. 2). The formation is reported to be 50 metres thick. The lithologies include bedded, yellow, dolomitic biomicrite and biosparite. The trilobites *Hystericurus* and *Symphysurina* suggest an Early Canadian age (Lower Ordovician) (Poulsen 1927). Conodonts have previously been referred to Fauna C of the North American conodont succession (Kurtz 1977;

SYSTEM	STAGE	Poulsen (1927) Koch (1929 a, b)	Troelsen (1950)	Henriksen & Peel (1976)
ORDOVICIAN	CANADIAN	Nunatani Fm	Poulsen Cliff Fm	Poulsen Cliff Fm
				Christian Elv Fm
		CAPE CLAY Fm	CAPE CLAY Fm	CAPE CLAY Fm
		Cass Fjord Fm	Cass Fjord Fm	Cass Fjord Fm
		(Hiatus)	(Hiatus)	
EMBRIAN				

Figure 2. History of Lower Ordovician lithological units from Washington Land, western North Greenland and development of ideas. Data from Poulsen (1927), Koch (1929a, b), Troelsen (1950) and Henriksen & Peel (1976).

Stouge 1977). In the present samples *Symphysurina* sp. has been recorded (C. Poulsen pers. comm. 1971).

Conodont samples and fauna

Troelsen collected fossiliferous samples, not *in situ*, but from the talus beneath the coastal cliff at

Kap Clay, Washington Land, western North Greenland (Fig. 1). It is likely, however, that the samples derived from the Early Ordovician Cape Clay Formation (C. Poulsen pers. comm. 1971; Stouge 1977). The present paper describes the conodont fauna which was recovered from the chips of the fossiliferous samples.

Troelsen labeled the samples no. 463 to 480, 26/4 1941. Of these no. 465, 470 and 472 were not processed. Except for samples no. 474 and 476, all processed samples yielded conodonts and in some cases in a relatively high number (Table 1).

The conodonts are reasonably well preserved with a CAI (Conodont Alteration Index of Epstein, Epstein & Harris 1977) of 1 which suggests that the host rock has not been severely affected by heat (50°C–60°C). The conodonts are recrystallized and have a sucrose surface. Several specimens have secondary crystal faces on the surface and at some simple cone elements the cross-section of the cusp has been slightly modified from oval to rhomboedric.

Many of the simple conodont elements are very small and morphological details, such as keels, carinae and costae are best recognized in the SEM. Also the secondary recrystallized specimens with a modified cusp morphology are best distinguished in the SEM.

Table 1. Occurrence of conodonts from productive samples at Kap Clay, Washington Land, western North Greenland.

Sample numbers	463	464	466	467	468	469	471	473	475	477	478	479	480	Total
SPECIES														
"Acontiodus" iowensis	3	2	-	1	1	1	-	1	1	-	-	-	-	10
"Acontiodus" propinquus	-	-	1	-	-	-	-	-	-	1	-	-	-	2
"Acontiodus" staufferi	-	-	1	-	-	-	1	-	1	1	-	-	-	4
"Acontiodus" aff. latus	-	-	-	1	1	-	-	-	-	-	-	-	-	2
Cordylodus angulatus	-	-	-	-	2	-	-	-	1	-	2	-	-	5
Cordylodus caboti	-	3	-	1	4	4	4	-	2	-	1	1	1	21
Cordylodus deflexus	-	6	1	1	2	1	2	5	-	1	5	-	-	24
Cordylodus intermedius	-	8	-	-	6	2	4	1	2	-	2	-	1	26
Cordylodus proavus	-	3	-	-	-	-	-	-	-	1	3	2	-	9
Cordylodus subangulatus	-	-	-	-	-	1	-	-	-	-	-	-	-	1
Clavohamulus sp. A	-	-	1	-	4	-	3	6	-	-	-	1	3	18
Cornuodus sp. A	2	3	-	1	3	2	3	-	1	11	-	-	-	26
Drepanoistodus sp.	-	-	-	-	1	-	-	1	-	-	-	-	-	2
"Oistodus" triangularis	-	2	1	-	1	-	1	-	-	-	2	-	-	7
"Paltodus" bassleri	1	6	1	-	3	1	1	-	2	4	3	2	-	24
Utahconus oneotensis	5	15	3	1	3	1	3	12	1	7	17	2	1	71
U. aff. oneotensis	-	-	-	-	3	-	1	1	-	2	-	-	-	7
Gen. et sp. indet. A	2	7	-	-	4	1	-	-	4	-	4	4	-	26
Gen. et sp. indet. B	2	3	-	-	1	2	4	1	-	4	-	3	-	20
Gen. et sp. indet. C	-	2	-	-	3	2	-	-	-	2	-	-	-	9
Weight of samples (gms.)	185	276	75	210	345	85	330	145	115	140	200	95	165	314

Age of the conodont fauna

The Kap Clay conodont fauna is biostratigraphically characterized by species of the multielement genus *Cordylodus* Pander. Simple cones are relatively most abundant and among those *Utahconus oneotensis* (Furnish) is the most frequent.

The fauna comprises elements which usually are referred to the Midcontinent Province, but *Cordylodus* is also characteristic in the North Atlantic Faunal Province (Sergeeva 1963; Lindström 1971; van Wamel 1974; Viira 1974).

In North America *Cordylodus intermedius* Furnish and *Cordylodus angulatus* Pander are important, because they occur together in the Lower Ordovician Fauna C (Ethington & Clark 1971) or in the *Loxodus bransonii* Interval (Ethington & Clark 1981) of the North American conodont faunal succession. *Loxodus bransonii* is the key species for the *Loxodus bransonii* Interval, but has not been recorded in the Kap Clay material. *Utahconus oneotensis*, however, which is present in all of the Kap Clay samples, first appears within the *Loxodus bransonii* Interval, where it is associated with *Cordylodus angulatus*. Thus a correlation with the *Loxodus bransonii* Interval is suggested for the Kap Clay material. The other Kap Clay species are consistent with this age assignment.

In the Lower Ordovician of the Baltic-Scania area *Cordylodus intermedius* and *Cordylodus angulatus* occur together in the *Cordylodus angulatus* Zone (Tremadocian) of the North Atlantic Faunal Province.

The composition of the Kap Clay conodont fauna from Washington Land, western North Greenland is similar to the association described by Landing & Barnes (1981) from the Cape Clay Formation, southern Devon Island, Arctic Archipelago, Canada.

Systematic Palaeontology

In this paper the multielement approach is applied where it is possible. When referring to an original single-element-based taxon we follow the recommendations of Jeppsson & Merrill (1982) by using *sensu*, the name of the author and the year.

The following species are illustrated but not described because either they occur in sufficient number to allow new taxonomic interpretation or have been discussed elsewhere and are not dealt with further in this section.

- "*Acontiodus*" *iowensis* Furnish (Pl. 1, Figs 1, 3).
- "*Acontiodus*" *propinquus* Furnish (Pl. 1, Fig. 2).
- "*Acontiodus*" *staufferi* Furnish (Pl. 1, Fig. 4).
- "*Acontiodus*" aff. "*A.*" *latus* Pander (Pl. 1, Fig. 5).
- Cordylodus angulatus* Pander (Pl. 1, Figs. 6–7; Text-fig. 3J, K).
- Cordylodus caboti* Bagnoli, Barnes & Stevens (Pl. 1, Figs. 8–10; Text-fig. 3C, L).
- Cordylodus deflexus* Bagnoli *et al.* (Pl. 1, Figs. 11, 12; Text-fig. 3C, L).
- Cordylodus intermedius* Furnish (Pl. 1, Figs. 13–15; Text-fig. 3G, H, I).
- Cordylodus proavus* Müller (Pl. 1, Figs. 16, 18; Text-fig. 3A, B).
- Cordylodus subangulatus* Furnish (Pl. 1, Fig. 17).

We follow the interpretation of Ethington & Clark (1981) for the genus "*Acontiodus*" Pander and the interpretation of Bagnoli, Barnes & Stevens (in press) for the species of the multielement genus *Cordylodus* Pander.

All the illustrated elements are deposited at the Mineralogical Museum, Copenhagen (MGUH).

Genus *Clavohamulus* Furnish, 1938.

Type species – *Clavohamulus densus* Furnish, 1938.

Clavohamulus sp. A. Pl. 2, Figs. 1–2.

Description – The elements of *Clavohamulus* sp. A have a reduced bulb and in some specimens the bulb is barely seen. The basal cavity is very shallow and the tip is located anteriorly. The elements have white matter above the base. The cross section of the base varies from oval to rounded. The base is expanded posteriorly and a small flare which is located close to the aboral edge is present in large specimens.

Material – 18 specimens.

Repository – MGUH 16358–16359.

Figure 3. Lateral outlines and basal cavity silhouettes of *Cordylodus* species from Kap Clay, Washington Land, western North Greenland.

3A, B: *Cordylodus proavus* Müller *sensu* Bagnoli *et al.* 3A: cordylodontiform (= rounded; p element), Sample 470, MGUH 16370, $\times 110$. 3B: cyrtioniodontiform (= compressed; q element), Sample 479, MGUH 16371, $\times 85$.

3C, L: *Cordylodus deflexus* Bagnoli *et al.* 3C: cyrtioniodontiform (= compressed; q element), Sample 467, MGUH 16366, $\times 80$. 3L: cordylodontiform (= rounded; p element), Sample 473, MGUH 16365, $\times 40$.

3D, E, F: *Cordylodus caboti* Bagnoli *et al.* 3D: cordylodontiform (= rounded; p element), Sample 464, MGUH 16363, $\times 75$. 3E: cyrtioniodontiform (= compressed; q element), Sample 471, MGUH 16364, $\times 100$. 3F: cordylodontiform (= rounded; p element), Sample 468, MGUH 16362, $\times 40$.

3G, H, I: *Cordylodus intermedius* Furnish *sensu* Bagnoli *et al.* 3G: cordylodontiform (= rounded; p element), Sample 464, MGUH 16368, $\times 35$. 3H: cyrtioniodontiform (= compressed; q element), Sample 480, MGUH 16369, $\times 65$. 3I: cordylodontiform (= rounded; p element), Sample 478, MGUH 16367, $\times 40$.

3J, K: *Cordylodus angulatus* Pander *sensu* Bagnoli *et al.* 3J: cordylodontiform (= rounded; p element), Sample 478, MGUH 16360, $\times 35$. 3K: cyrtioniodontiform (= compressed; q element), Sample 478, MGUH 16361, $\times 40$.

Genus *Cornuodes* Fähræus, 1966.

Type species – *Drepanodus longibasis* Lindström, 1955.

Cornuodus sp. A. Pl. 2, Figs. 3–7.

Synonymy

?1970 *Oneotodus altus* sp.n. – Viira, p. 229–230, Pl. A, Fig. 10; Text-fig. 7.

?1974 *Oneotodus altus* Viira – Viira, p. 97–98, Pl. 1, Fig. 24; Text-figs. ?119, 120.

1981 *Cornuodus longibasis* (Lindström) – Landing & Barnes, p. 1614, Pl. 2, Fig. 6.

Description – *Cornuodus* sp. A comprises proclined to suberect, symmetrical and asymmetrical, elements with a rounded to oval cross section. The base varies from short to long. The deep basal cavity has an anteromedian tip which is located at the maximum point of curvature of the elements. The elements are finely striated. White matter is confined to the cusp. The asymmetrical elements have an oval cross section.

Remarks – In this paper we assign to *Cornuodus* a species which Landing & Barnes (1981) referred to *Cornuodus longibasis* (Lindström). Although the generic assignment may be correct, the species is not identical with the Baltic *Cornuodus longibasis*.

Löfgren (1978) fully described the apparatus of *Cornuodus longibasis* (Lindström). According to her (Löfgren 1978) *Cornuodus* includes symmetrical elements A and B and asymmetrical elements. In our material the symmetrical element B is missing.

Cornuodus sp. A differs from *C. longibasis* by the lack of posterior costae on the symmetrical element (see Löfgren 1978); in *Cornuodus* sp. A the element is keeled.

It is possible that *Oneotodus altus* Viira belongs to this species. The Kap Clay specimens are very small which prohibits species identification.

Material – 26 specimens.

Repository – MGUH 16373–16377.

Genus *Drepanoistodus* Lindström, 1971.

Type species – *Oistodus forceps* Lindström, 1955.

Drepanoistodus sp. Pl. 2, Fig. 8.

Remarks – Only drepanodontiforms were recorded and a species determination is not possible, because the diagnostic oistodontiform is missing.

Material – 2 specimens.

Repository – MGUH 16378.

Genus *Oistodus* Pander, 1956.

Type species – *Oistodus lanceolatus* Pander, 1856.

"*Oistodus*" *triangulatus* Furnish. Pl. 2, Figs. 9–10.

Synonymy

1938 *Oistodus? triangularis* n.sp. – Furnish, pp. 330–331, Pl. 42, fig. 22; Text-fig. 1.

1981 "*Oistodus*" *triangularis* Furnish – Ethington & Clark, pp. 70–71, Pl. 7, Figs. 15, 18, 22, 23.

1981 *Utahconus? bassleri* (Furnish) – Landing & Barnes, pp. 1622, 1624 (*pars*), Pl. 1, Fig. 21; Text-fig. 3: 14 (only).

Remarks – We follow the interpretation of Ethington & Clark (1981) for this species.

Material – 7 specimens.

Repository – MGUH 16379–16380.

Genus *Paltodus* Pander, 1865.

Type species – *Paltodus subaequalis* Pander, 1856.

"*Paltodus*" *bassleri* Furnish. Pl. 2, Figs. 15–17.

Synonymy

1938 *Paltodus bassleri* n.sp. – Furnish, p. 331, Pl. 42, Fig. 1.

1938 *Paltodus variabilis* n.sp. – furnish, p. 331, Pl. 42, Figs. 9–10.

1971 *Paltodus bassleri* Furnish – Ethington & Clark, p. 72, Pl. 2, Figs. 2, 4, 6.

?1971 *Scolopodus asymmetricus* Druce & Jones – Jones, pp. 61–62, Pl. 5, Figs. 1, 2.

?1971 *Scolopodus bassleri* (Furnish) – Jones, pp. 62–63, Pl. 5, Figs. 3, 6; Pl. 9, Figs. 2, 3.

1977 *Paltodus variabilis* Furnish – Lindström, pp. 429–431, (*pars*), *Paltodus* – Pl. 1, Fig. 10 (only).

1981 "*Paltodus*" *bassleri* Furnish – Ethington & Clark, pp. 74–75, Pl. 8, Figs. 11, 12.

1981 *Utahconus? bassleri* (Furnish) – Landing & Barnes, pp. 1622–1624 (*pars*), Pl. 1, Figs. 9, 19, 22; Pl. 3, Fig. 14; Text-fig. 3: 10, 15 (only).

1982 *Scolopodus bassleri* Furnish – Repetski, pp. 37, Pl. 14, Fig. 12.

1983 *Utahconus? bassleri* (Furnish) – Landing, pp. 1181–1182 (*pars*).

Remarks – In this paper we adopt the concept of "*Paltodus*" *bassleri* Furnish *sensu* Ethington & Clark, 1981 and Repetski, 1982. According to those authors *Paltodus bassleri sensu* Furnish, 1938 and *Paltodus variabilis sensu* furnish, 1938 are elements of the same apparatus forming a symmetry transition series.

Discussion – Sweet & Bergström (1972) suggested that the formspecies *Acodus oneotensis*

PLATE 1.

Fig. 1. "*Acontiodus*" *iowensis* Furnish, posterior view, Sample 469, MGUH 16354, ×100.

Fig. 2. "*Acontiodus*" *propinquus* Furnish, posterior view, Sample 466, MGUH 16355, ×125.

Fig. 3. "*Acontiodus*" *iowensis* Furnish, posterior view, Sample 463, MGUH 16353, ×125.

Fig. 4. "*Acontiodus*" *staufferi* Furnish, posterior view, Sample 466, MGUH 16356, ×80.

Fig. 5. "*Acontiodus*" aff. "*A.*" *latus* Pander, posterior view, Sample 467, MGUH 16357, ×60.

Figs. 6–7. *Cordylodus angulatus* Pander. 6: p element, lateral view, Sample 478, MGUH 16360, ×50. 7: q element, lateral view, Sample 478, MGUH 16361, ×60.

Figs. 8–10. *Cordylodus caboti* Bagnoli, Barnes & Stevens. 8: p element, lateral view, Sample 464, MGUH 16363, ×115. 9: p element, lateral view, Sample 468, MGUH 16362, ×60. 10: q element, lateral view, Sample 471, MGUH 16364, ×150.

Figs. 11–12. *Cordylodus deflexus* Bagnoli, Barnes & Stevens. 11: p element, lateral view, Sample 473, MGUH 16365, ×60. 12: q element, lateral view, Sample 467, MGUH 16366, ×120.

Figs. 13–15. *Cordylodus intermedius* Furnish. 13: p element, lateral view, Sample 464, MGUH 16368, ×50. 14: q element, lateral view, Sample 480, MGUH 16369, ×100. 15: p element, lateral view, Sample 478, MGUH 16367, ×60.

Figs. 16, 18. *Cordylodus proavus* Müller. 16: p element, lateral view, Sample 470, MGUH 16370, ×170. 18: q element, lateral view, Sample 479, MGUH 16371, ×125.

Fig. 17. *Cordylodus subangulatus* Furnish, lateral view, Sample 469, MGUH 16372, ×65.

Figs. 19–21. Gen. et sp. indet. A. 19: lateral view, Sample 475, MGUH 16393, ×40. 20: postero-lateral view, Sample 479, MGUH 16392, ×60. 21: lateral view, Sample 464, MGUH 16391, ×125.

sensu Furnish, 1938, *Oistodus? triangularis sensu* Furnish, 1938 and *Paltodus bassleri sensu* Furnish, 1938 belonged to the same apparatus and formed a symmetry transition series.

Lindström (1977) proposed a different apparatus which he referred to the multielement genus *Paltodus sensu* Lindström, 1971. The apparatus comprised the formspecies *P. bassleri*, *P. variabilis sensu* Furnish, 1938, *A. oneotensis*, *O.? triangularis* and *Oistodus inclinatus* Branson & Mehl *sensu* Furnish, 1938.

Ethington & Clark (1981) disagreed with the two interpretations. Instead Ethington & Clark (1981) found that *A. oneotensis*, *O.? triangularis* and *P. bassleri* (together with *P. variabilis*) represented three separate taxa, each one forming a symmetry transition series.

Landing & Barnes (1981) mainly concurred with Sweet & Bergström (1972) and they referred this complex apparatus to *Utahconus? bassleri* including also *P. variabilis* and *Scolopodus sulcatus sensu* Furnish, 1938.

We agree with Ethington & Clark (1981) and consider three valid and different species are represented by the formspecies discussed above. Our material shows that the formspecies *A. oneotensis* and *S. sulcatus* are members of the same transition series. This transition series is characterized by elements which have an increasing lateral bend of the cusp. Consequently, we assign these element to the multielement genus *Utahconus sensu* Miller, 1980.

In the apparatus including the formspecies *P. bassleri* and *P. variabilis* the symmetry/asymmetry

is produced by a gradual torsion of the cusp of the element. The symmetrical and slightly asymmetrical elements (= *P. variabilis*) have two costae, whereas the ultimate asymmetrical elements have only one costa (= *P. bassleri*). A new generic name should be provided for this apparatus. At this stage we maintain the form generic name "*Paltodus*", because our specimens were obtained from loose blocks.

The apparatus composed by "*O.*" *triangularis sensu* Furnish 1938 was discussed by Ethington & Clark (1981).

Material – 24 specimens.

Repository – MGUH 16381–16383.

Genus *Utahconus* Miller, 1980.

Type species – *Paltodus utahensis* Miller, 1969.

Remarks – According to Miller (1980) the multielement genus *Utahconus* includes uni- to bicosate simple cones with a rounded base. The elements form a symmetry transition series in which the elements characteristically have a lateral bend of the cusp. Based on the Kap Clay specimens we expand the diagnosis of the multielement genus *Utahconus* to include species having the same apparatus plane, but with elements that have more than two costae.

Utahconus oneotensis (Furnish). Pl. 2, Figs. 11–14.

Synonymy

1938 *Acodus oneotensis* n. sp. – Furnish, p. 325, Pl. 42, Figs. 26–29.

PLATE 2.

Figs. 1–2. *Clavohamulus* sp. A. 1: antero-lateral view, Sample 479, MGUH 16359, $\times 200$. 2: lateral view, Sample 471, MGUH 16358, $\times 125$.

Figs. 3–7. *Cornuodus* sp. A. 3: lateral view, Sample 477, MGUH 16377, $\times 150$. 4: lateral view, Sample 467, MGUH 16373, $\times 125$. 5: lateral view, Sample 464, MGUH 16375, $\times 125$. 6: lateral view, Sample 468, MGUH 16374, $\times 125$. 7: lateral view, Sample 477, MGUH 16376, $\times 150$.

Fig. 8. *Drepanoistodus* sp., lateral view, Sample 473, MGUH 16378, $\times 125$.

Figs. 9–10. "*Oistodus? triangularis* Furnish. 9: lateral view, Sample 471, MGUH 16380, $\times 70$. 10: lateral view, Sample 466, MGUH 16379, $\times 50$.

Figs. 11–14. *Utahconus oneotensis* (Furnish) 11: postero-lateral view, Sample 468, MGUH 16384, $\times 50$. 12: postero-lateral view, Sample 466, MGUH 16388, $\times 80$. 13: postero-lateral view, Sample 464, MGUH 16385, $\times 60$. 14: antero-lateral view, Sample 464, MGUH 16386, $\times 60$.

Figs. 15–17. "*Paltodus? bassleri* Furnish. 15: postero-lateral view, Sample 466, MGUH 16383, $\times 100$. 16: postero-lateral view, Sample 477, MGUH 16382, $\times 60$. 17: lateral view, Sample 469, MGUH 16381, $\times 100$.

Figs. 18–19. *Utahconus* aff. *U. utahensis* (Miller). 18: Sample 468, MGUH 16390; 18a: lateral view, $\times 165$; 18b: antero-lateral view, $\times 175$. 19: postero-lateral view, Sample 471, MGUH 16389, $\times 125$.

Figs. 20–22. Gen. et sp. indet. B. 20: postero-lateral view, Sample 468, MGUH 16394, $\times 125$. 21: lateral view, Sample 471, MGUH 16396, $\times 125$. 22: postero-lateral view, Sample 477, MGUH 16395, $\times 115$.

Fig. 23. Gen. et sp. indet. C, postero-lateral view, Sample 464, MGUH 16398, $\times 200$.

1938 *Scolopodus sulcatus* n.sp. – Furnish, p. 334, Pl. 41, Figs. 14–15.

1971 *Acodus oneotensis* Furnish – Ethington & Clark, p. 72, Pl. 1, Figs. 3, 6, 8.

1971 *Acodus oneotensis* Furnish – Jones, p. 44, Pl. 1, Fig. 5a–c (only).

1977 *Paltodus variabilis* Furnish – Lindström, pp. 429–431 (*pars*), *Paltodus*-Pl. 1, Figs. 12, 15 (only).

1981 "*Acodus*" *oneotensis* Furnish – Ethington & Clark, pp. 20–21, Pl. 1, Fig. 16.

1981 "*Scolopodus*" *sulcatus* Furnish – Ethington & Clark, pp. 105–106, Pl. 12, Figs. 7, 8; Text-fig. 26.

1981 *Utahconus? bassleri* (Furnish) – Landing & Barnes, pp. 1622–1624 (*pars*), Pl. 1, Figs. 3, 4, 7, 8, 10, 14, 18; Pl. 3, Figs. 18–21; Text-fig. 3: 7, 8, 11, 13, 40, 41 (only).

1982 *Acodus oneotensis* Furnish s.f. – Repetski, pp. 12–13, Pl. 2, Figs. 7, 8.

1982 *Scolopodus sulcatus* Furnish s.f. – Repetski, pp. 51–52, Pl. 24, Figs. 6, 8.

1983 *Utahconus? bassleri* (Furnish) – Landing, pp. 1181–1182 (*pars*), Fig. 10R.

Description – The elements of *Utahconus oneotensis* includes the formspecies *Acodus oneotensis sensu* Furnish, 1938 and *Scolopodus sulcatus sensu* Furnish, 1938. The elements have been fully described by Furnish (1938) and Repetski (1982), who also mentioned that the two formspecies were closely related.

Remarks – No perfectly, symmetrical elements have recorded from our material. Miller (1980), however, noted that true symmetrical elements of *Utahconus* are rare.

For other interpretations of the apparatus including *A. oneotensis* and *S. sulcatus* see Ethington & Clark (1981) and this paper under "*Paltodus? bassleri*".

Material – 71 specimens.

Repository – MGUH 16384–16388.

Utahconus aff. *U. utahensis* (Miller). Pl. 2, figs. 18–19.

Description – The slender elements of *U. aff. U. utahensis* are almost straight and the cusp and the

base are approximately of equal length. The aboral margin is circular in outline. The base is slightly concave anteriorly. The basal cavity is deep and the tip is located close to the anterior edge.

The white matter is confined to the upper two thirds of the cusp.

Only bicostate asymmetrical elements have been recorded.

Remarks – The Kap Clay specimens resemble *Acodus sevierensis sensu* Miller, 1969 (Pl. 63, Figs. 23–24) which has been included in the multielement species *Utahconus utahensis* by Miller (1980). The limited number of specimens available preclude a closer species identification.

Material – 7 specimens.

Repository – MGUH 16389–16390.

Gen. et sp. indet. A. Pl. 1, Figs. 19–21.

Description – Compound elements with a large, blade-like cusp and a short base carrying one or two fused laterally compressed denticles are referred to Gen. et sp. indet. A. The basal cavity is small. The cusp is erect, more or less twisted. The base is small and has an inner flare. The aboral margin is sinuous in lateral view.

The small basal cavity is triangular with concave edges. The tip is located in the posterior half of the cusp and it points upwards.

The white matter is concentrated in the cusp and denticle(s). The anterior part of the base has a cloudy appearance. Fine horizontal hyaline lines within the white matter of the cusp and of the anterior portion of the base are characteristic of these elements.

Material – 26 specimens.

Repository – MGUH 16391–16393.

Gen. et sp. indet. B. Pl. 2, Figs. 20–22.

Description – Gen. et sp. indet. B has a skeletal apparatus that comprises small, simple cones which are laterally compressed and form a symmetry transition series. The elements are proclined. The aboral edge is straight or slightly con-

cave. the small basal cavity is triangular with an anteriorly located tip. White matter is confined to the cusp.

The symmetrical elements are broadly rounded anteriorly; posteriorly, they are narrow. The posterior margin is keeled. An anterior carina is present on each side of the elements. It extends from the base to the tip of the units. The cross-section of the base is subtriangular or droplike.

The asymmetrical elements are twisted and have an inner anterior carina. The base has an inner flare.

Material – 20 specimens.

Repository – MGUH 16394–16396.

Gen. et sp. indet. C. Pl. 2, Fig. 23.

Synonymy

?1981 *Oneotodus*? sp. A s.f. – Landing & Barnes, pp. 1618, 1620, Pl. 1, Fig. 6; Text-fig. 3: 30.

Description – This species includes slender, proclined, symmetrical and asymmetrical elements with a circular to oval cross-section. The basal cavity is an asymmetrical triangle in lateral view. The tip is located close to the anterior edge. The aboral margin is characterized by a constricted rim.

The symmetrical element has a rounded anterior edge, a faint carina on each side and a sharp posterior edge. The base is rounded.

The asymmetrical element has a posterior keel on the cusp and an inner-lateral faint carina. The base is oval to rounded.

Material – 9 specimens.

Repository – MGUH 16397–16398.

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Dansk sammendrag

J. C. Troelsen indsamlede i 1941 fossilholdige (*Symphysurina* sp. – Nedre Ordovicium) kalkstensprøver ved foden af Kap Clay, vestlige Nordgrønland. Conodonte fra disse prøver er relativt talrige (ialt 314 elementer kunne identificeres), og 20 multielement arter er repræsenteret. Flere af arterne er nye, men er introduceret informelt her, da prøverne ikke var indsamlet *in situ*.

Mikrofaunaen er karakteriseret af *Cordylodus* spp. og *Utahconus oneotensis* (Furnish), hvilket tillader en korrelation med den Nordamerikanske Midkontinent Fauna C eller *Loxodus bransonii* Interval (Nedre Canadien) og med den Balto-Skandinaviske *Cordylodus angulatus* Zone (Tremadocian).

Faunaindholdet og den biostratigrafiske korrelation svarer til tidligere bestemmelser fra Cape Clay Formationen i arktisk Kanada og vestlige Nordgrønland, og de løse prøver stammer sandsynligvis fra Cape Clay Formationen ved Kap Clay. Den beskrevne conodont fauna er derfor repræsentativ for Nedre Ordovicium i de pågældende områder.

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