THE SILURIAN CONODONT *OZARKODINA SAGITTA* AND ITS VALUE IN CORRELATION

by R. J. ALDRIDGE

ABSTRACT. A reconstruction of the apparatus of *Ozarkodina sagitta* (Walliser) is proposed, consistent with the composition of other apparatuses of the genus *Ozarkodina* and based on collections of disjunct conodont elements from Bohemia, Britain, Ireland, and the Carnic Alps of Austria. Descriptions of the apparatuses of the three subspecies of *O. sagitta* include details of the previously undescribed hindeodellan, plectospathodontan, and trichonodellan elements.

The stratigraphical distribution of *O. sagitta* in Britain and Bohemia is consistent with a range for the *sagitta* Zone from the lower Wenlock into the lower Ludlow and indicates a possible chronological sequence within the zone from *O. sagitta rhenana* to *O. sagitta bohemica*.

THE conodont form-species *Spathognathodus sagitta* was first described by Walliser (1964) in his comprehensive account of Silurian conodonts from Europe. Walliser (1964, pp. 82–84) recognized three subspecies, which he named *S. sagitta sagitta*, *S. sagitta rhenanus*, and *S. sagitta bohemicus*. *S. sagitta sagitta* was found by Walliser only in the Carnic Alps of Austria, *S. sagitta rhenanus* was recovered only from the Rheinisches Schiefergebirge of Germany, and *S. sagitta bohemicus* occurred only in Bohemia. The geographical separation of these forms indicated that they were possibly geographical subspecies, but Walliser appreciated that the differences may also be due to stratigraphic age and that the forms possibly represented chronological subspecies. The restricted stratigraphic range of the *sagitta* group rendered it useful for correlation, and in the provisional conodont zonal scheme for the Silurian proposed by Walliser (1964, fig. 10) a *sagitta* Zone was distinguished. The complete sequence of Walliser's conodont zones is displayed at the Cellon section in the Carnic Alps, where it is unfortunately impossible to relate the *sagitta* Zone directly to the graptolite zonal scheme or to the Silurian Series defined in the Welsh Borderland. In Bohemia, however, *S. sagitta bohemicus* occurs with *Monograptus testis* at Loděnice and in the lower part of the *M. nilssoni* Zone at Jinonice (Walliser 1964, p. 97) and from this Walliser inferred a range for the *sagitta* Zone from the uppermost Wenlock into the lower Ludlow. An extension of this range was suggested by Fåhraeus (1969, p. 9), who reported the occurrence of *S. sagitta* in the Högklint Beds of Gotland, which were correlated by Martinsson (1967) with the graptolite zone of *Monograptus riccartonensis*, of upper lower Wenlock age. This correlation is confirmed by the recovery of a *riccartonensis* Zone graptolite fauna from the Högklint Beds by Bassett and Cocks (1974).

In addition to *S. sagitta* itself, the *sagitta* Zone is characterized by the form-species *Ozarkodina edithae* Walliser and *Neoprioniodus bicurvatoides* Walliser (Walliser 1964, pl. 7, figs. 3–8). The consistent association of *S. sagitta* with *O. edithae* suggests that they belonged to the same conodont apparatus, and Walliser (1972, p. 77) grouped them together as a partial reconstruction of the multi-element species *O. sagitta*. *N. bicurvatoides* shows a less consistent association, being absent from

[Palaeontology, Vol. 18, Part 2, 1975, pp. 323–332, pl. 47.]

several large collections (Walliser 1964, table 2), and was not included in this reconstructed apparatus. *N. bicurvatoides*, however, occurs with *O. sagitta* in faunas listed from the Carnic Alps by Manzoni (1965) and from Podolia by Drygant (1968), and a possible derivation from the same apparatus is indicated. The fragile nature of this neoprioniodontan element may explain its absence from several reported faunas containing the spathognathodontan and ozarkodinan elements of *O. sagitta*.

Conodont faunas recovered recently from Bohemia (Walmsley, Aldridge and Austin 1974), Wales, and Ireland provide new evidence for the reconstruction of the *O. sagitta* apparatus and enable further comment on the stratigraphic range and value of the *sagitta* Zone.

The conodont fauna recovered from a sample (No. B.W. 12) from the upper Liteň Formation of Svatý Jan pod Skalou, Bohemia, was listed by Walmsley *et al.* (1974). In addition to simple cones and elements of the multi-element species *O. excavata* (Branson and Mehl), the following form-species were recorded:

Spathognathodus sagitta rhenanus Walliser	131
Ozarkodina edithae Walliser	78
Neoprioniodus bicurvatoides Walliser	36
Hindeodella n. sp.	41
Plectospathodus n. sp.	26
Trichonodella n. sp.	13
Lonchodina walliseri Ziegler	1
Ligonodina cf. *L. kentuckyensis* Branson and Branson	5
Trichonodella inconstans Walliser	1

A 20 kg sample collected by the author from the Nash Scar Limestone of Nash Scar Quarry, Presteigne, Radnorshire, Wales (SO 302 623), has yielded the following conodonts:

Ozarkodina excavata (Branson and Mehl)	
ozarkodinan element	10
neoprioniodontan element	2
hindeodellan element	3
plectospathodontan element	2
Spathognathodus sagitta rhenanus Walliser	30
Ozarkodina edithae Walliser	9
Neoprioniodus bicurvatoides Walliser	6
Hindeodella n. sp.	10
Plectospathodus n. sp.	1
Trichonodella n. sp.	2
Lonchodina walliseri Ziegler	2
Lonchodina sp.	1
Lonchodina? sp.	1
Ligonodina cf. *L. kentuckyensis* Branson and Branson	15
Hindeodella sp.	7
Neoprioniodus sp.	1
Ozarkodina cf. *O. typica*	3
Ozarkodina ziegleri aequalis Walliser	1
Trichonodella inconstans Walliser	34
Drepanodus aduncus Nicoll and Rexroad	2

A 1·5 kg coral limestone sample collected by Mr. J. Parkin from Caherconree mountain in the Anascaul inlier, Dingle Peninsula, Ireland, has yielded a small conodont collection, comprising the following form-species:

Spathognathodus sagitta cf. *sagitta* Walliser	11
Ozarkodina edithae Walliser	6
Neoprioniodus bicurvatoides Walliser	2
Hindeodella n. sp.	2

Plectospathodus n. sp.	1
Trichonodella n. sp.	1
Trichonodella inconstans Walliser	1

The reconstruction of conodont apparatuses from large collections of disjunct elements was pioneered by Walliser (1964), and subsequently many such reconstructions have been proposed. Klapper and Philip (1971) recognized that these reconstructed apparatuses, together with those apparatuses known from natural occurrences on bedding planes, conformed to a limited number of basic plans. After testing the validity of these plans on a number of faunas of disjunct elements they accepted them as models for the analysis of complex faunas. Rexroad and Nicoll (1972) and Pollock and Rexroad (1973) applied numerical techniques of reconstruction to some rather small collections of Silurian conodonts and failed to recognize groupings of the types proposed by Klapper and Philip, but many workers, dealing with larger collections, have substantiated the validity of the basic plans (Bergström *et al.* 1974; Druce, Rhodes and Austin 1974; Jeppsson 1969, 1972; Sweet and Bergström 1972; Walliser 1964, 1972; Ziegler 1972).

Klapper and Philip's 'type 1' apparatuses are perhaps the most widely recognized, and they include the genus *Ozarkodina*, which bears the following elements: P = platform (commonly spathognathodontan), O = ozarkodinan, N = neoprioniodontan, A_1 = hindeodellan, A_2 = angulodontan or plectospathodontan, A_3 = symmetrical element, e.g. trichonodellan. If it is assumed that the apparatus of *O. sagitta* is of this type, then the spathognathodontan element has been recognized in *S. sagitta* and the ozarkodinan in *O. edithae*. The faunas listed above all contain *Neoprioniodus bicurvatoides* and it seems reasonable to propose that this is the neoprioniodontan elements of the apparatus. Elements that represent the hindeodellan–plectospathodontan–trichonodellan transition series have not previously been recognized, but the three collections listed above all include similar undescribed elements of these types. The denticulation of these elements is closely comparable with that of *N. bicurvatoides* and their very fragile nature may explain why they have not been previously recorded. It is suggested that these are the remaining elements of the *O. sagitta* apparatus.

In order to test this reconstruction, a sample from a horizon (14D of Walliser 1964) in the *sagitta* Zone of the Cellon section in the Carnic Alps has been processed and picked with care. In addition to simple cones, the sample yielded 268 specimens of the spathognathodontan element of *O. sagitta* and 108 specimens of the ozarkodinan element. Also recovered were *N. bicurvatoides* (13 specimens) and very fragile hindeodellan (25 specimens), plectospathodontan (11 specimens), and trichonodellan (5 specimens) elements morphologically similar to those recovered from Bohemia, Wales, and Ireland. This association of specimens is consistent with the proposed reconstruction of the apparatus of the multi-element species *O. sagitta*.

The record of *O. sagitta rhenana* by Walmsley *et al.* (1974) is the first record of this subspecies in Bohemia and it is significant that it occurs at an older horizon than that at which Walliser found elements of *O. sagitta bohemica*. The horizon containing *O. sagitta rhenana* is referred to the *Monograptus flexilis* Zone, which is approximately equivalent to the British zone of *Cyrtograptus linnarssoni*, both zones succeeding the *rigidus* Zone in the separate areas. The *linnarssoni* Zone is of upper middle

Wenlock age, and this occurrence supports a downward extension of the range of the *sagitta* Zone, as suggested by Fåhraeus (1969, p. 9). A greater extension may be indicated by the recognition of the zone in the Nash Scar Limestone. Although the precise age of this formation has not been determined, Cocks *et al.* (1971, fig. 2) drew a very tentative upper boundary for the unit at the base of the *riccartonensis* Zone. If this is approximately correct, a lower Wenlock age is indicated and the evidence from Gotland for a range of the *sagitta* Zone from within the lower Wenlock is thus corroborated. The total range of the *sagitta* Zone now appears to be from the lower Wenlock into the lower Ludlow.

The recognition of the *sagitta* Zone in strata of lower and middle Wenlock age raises the question of the position of the *patula* Zone, which underlies the *sagitta* Zone and was tentatively placed by Walliser (1964, fig. 10) in the middle Wenlock. The *patula* Zone has not, as yet, been recognized in Britain, Gotland, or Bohemia, so a direct answer is not available. In Britain, the *amorphognathoides* Zone, which underlies the *patula* Zone, is present in the lowermost Wenlock of the Wenlock Edge area (Aldridge 1972, p. 141) and in Bohemia characteristic species of the *amorphognathoides* and *sagitta* Zones occur in association in the Liteň Formation (Walmsley *et al.* 1974). It is thus possible that the characteristic species of the *patula* Zone are somewhat limited in their geographical distribution and that the *patula* Zone of Austria is equivalent to part of the *amorphognathoides* Zone and/or part of the *sagitta* Zone of other areas. It is also possible that the *patula* Zone is widespread but occupies a short stratigraphic interval in the lower Wenlock between the *amorphognathoides* and *sagitta* Zones.

The relationships between the three subspecies of *O. sagitta* remain obscure, but there is now some evidence that *O. sagitta rhenana* and *O. sagitta bohemica* may be chronological subspecies. As noted above, the Bohemian fauna with *O. sagitta rhenana* is of middle Wenlock age, whereas the Bohemian faunas with *O. sagitta bohemica* are of uppermost Wenlock and lower Ludlow age. In Britain, *O. sagitta rhenana* occurs in the Nash Scar Limestone, which may be of lower Wenlock age. The presence of *lundgreni* Zone graptolites in the overlying shale (Bassett, 1974) puts an absolute upper limit of a low upper Wenlock age on the limestone. *O. sagitta rhenana* also occurs in the Dolyhir Limestone of Radnorshire, which is generally regarded as a correlative of the Nash Scar Limestone on the grounds of lithological and faunal similarity and geographical proximity. The spathognathodontan element of *O. sagitta bohemica* is common in the Wenlock Limestone, of uppermost Wenlock age, in Shropshire and the Malvern Hills, and was reported by Austin and Bassett (1967) from a horizon of high upper Wenlock age in the Usk Inlier. Austin and Bassett (1967, p. 278, pl. 14, fig. 15) also reported the spathognathodontan element of *O. sagitta rhenana* in the Usk fauna, but their single specimen does not show the characteristic arrow-shaped basal cavity of this subspecies and their assignment must be considered doubtful. Thus in Britain and Bohemia *O. sagitta rhenana* occurs in older strata than *O. sagitta bohemica*, although this distribution might be influenced by environmental rather than chronological controls. If further evidence supports a chronological sequence from *O. sagitta rhenana* into *O. sagitta bohemica*, it may prove possible to subdivide the *sagitta* Zone, at least over part of its geographical range.

There is little evidence of the relationship of *O. sagitta sagitta* to the other subspecies. Walmsley *et al.* (1974) noted that some of the spathognathodontan elements in the population of *O. sagitta rhenana* from Bohemia were morphologically similar to specimens of *O. sagitta sagitta* from the Carnic Alps. Similarly, the spathognathodontan elements in the Irish fauna are close to *sagitta*, but in some characteristics tend towards *rhenana*.

Although a greater span than that ascribed by Walliser is now recognized for the *sagitta* Zone, it has proved valuable in biostratigraphy. The usefulness of the zone in correlation on an international scale is indicated by its wide recognition throughout Europe and North America. Occurrences in Europe have been summarized by Walliser (1971) and North American records were discussed by Rexroad and Nicoll (1971). Further evidence on the relationships between the subspecies of *O. sagitta* should serve to increase the value of the zone.

SYSTEMATIC PALAEONTOLOGY

Genus OZARKODINA Branson and Mehl, 1933

Ozarkodina sagitta (Walliser, 1964)

1964 *Spathognathodus sagitta* Walliser, pp. 82–84, pl. 18, figs. 8–24.
1964 *Ozarkodina edithae* Walliser, pp. 55–56, pl. 26, figs. 12–18.
1964 *Neoprioniodus bicurvatoides* Walliser, p. 46, pl. 29, figs. 36, 37.

Ozarkodina sagitta bohemica (Walliser, 1964)

Plate 47, fig. 21

1964 *Spathognathodus sagitta bohemicus* Walliser, p. 83, pl. 18, figs. 23, 24.
p1964 *Ozarkodina edithae* Walliser, pp. 55–56, pl. 26, figs. 13, 15, 16 (only).

Remarks. The material to hand, from Britain, Bohemia, and Gotland, is insufficient for expansion of the descriptions given by Walliser (1964). The spathognathodontan elements display a characteristic subcircular flaring of the basal cavity and there is a tendency for fusion of the denticles above the anterior half of the cavity. The few specimens of the ozarkodinan element are indistinguishable from the same element in the other subspecies. The neoprioniodontan, hindeodellan, plectospathodontan, and trichonodellan elements are unknown.

Material. Fifty discrete conodont elements.

Ozarkodina sagitta rhenana (Walliser, 1964)

Plate 47, figs. 1–12, 22, 23

1964 *Spathognathodus sagitta rhenanus* Walliser, pp. 83–84, pl. 18, figs. 12–22.
p1964 *Ozarkodina edithae* Walliser, pp. 55–56, pl. 26, fig. 17 (only).
p1964 *Neoprioniodus bicurvatoides* Walliser, p. 46, pl. 29, fig. 36 (only).

Description. Spathognathodontan element—the blade is straight or slightly curved and higher at the anterior end than at the posterior. The denticles are erect and number from 11 to 17, with most specimens bearing 12–14. The basal cavity flares laterally from about midlength of the blade, tapering posteriorly and giving the unit

an arrow-shaped outline in oral view. The denticles over the posterior two-thirds of the cavity are broader, lower, and more widely spaced than the remainder, which are often fused nearly to the apices. The denticles in the central portion of the blade are occasionally totally fused and the three or four denticles at the anterior end are commonly higher and a little less crowded. Specimens are generally robust.

Ozarkodinan element—the blade is flat or very slightly curved and bears posteriorly inclined, slender, sharp denticles, which are fused nearly to their apices. The posteriorly inclined cusp is situated a little posterior of midlength. The denticles increase in height gradually from the anterior end so that their apices form a straight line terminating with the tip of the cusp. The denticles of the posterior part of the blade are lower and increase a little in height anteriorly. The aboral edge of the unit is straight or slightly arched. The subcircular basal cavity is situated beneath the cusp.

Neoprioniodontan element—the cusp is tall, slender, and inwardly curved. The cross-section of the cusp is lenticular, with sharp anterior and posterior edges. The posterior bar is long, straight or somewhat bowed, and directed aborally. The denticles on the posterior bar are closely packed, slender, and of subequal size; they are often fused so that only the apices are free. Anterior to the cusp may be up to four small denticles, which decrease in size anteriorly. The basal cavity is small, rounded, and situated beneath the cusp.

Hindeodellan element—the cusp is tall and elliptical in cross-section with sharp to rounded anterior and posterior margins. The posterior bar is long and straight with tall, slightly posteriorly inclined denticles of subequal size. The anterior bar is much shorter, inwardly curved, and directed a little aborally, with very slender, crowded denticles that tend to be taller at the anterior end. The basal cavity is very small and is situated beneath the cusp.

Plectospathodontan element—the cusp is tall, slightly twisted, and inclined towards the shorter bar. The cross-section of the cusp is elliptical. The denticles on both bars are slender, of subequal size, closely packed, and inclined away from the tip of the longer bar. The shorter bar bears one or two much taller and broader denticles at the end. The basal cavity is very small and restricted beneath the cusp.

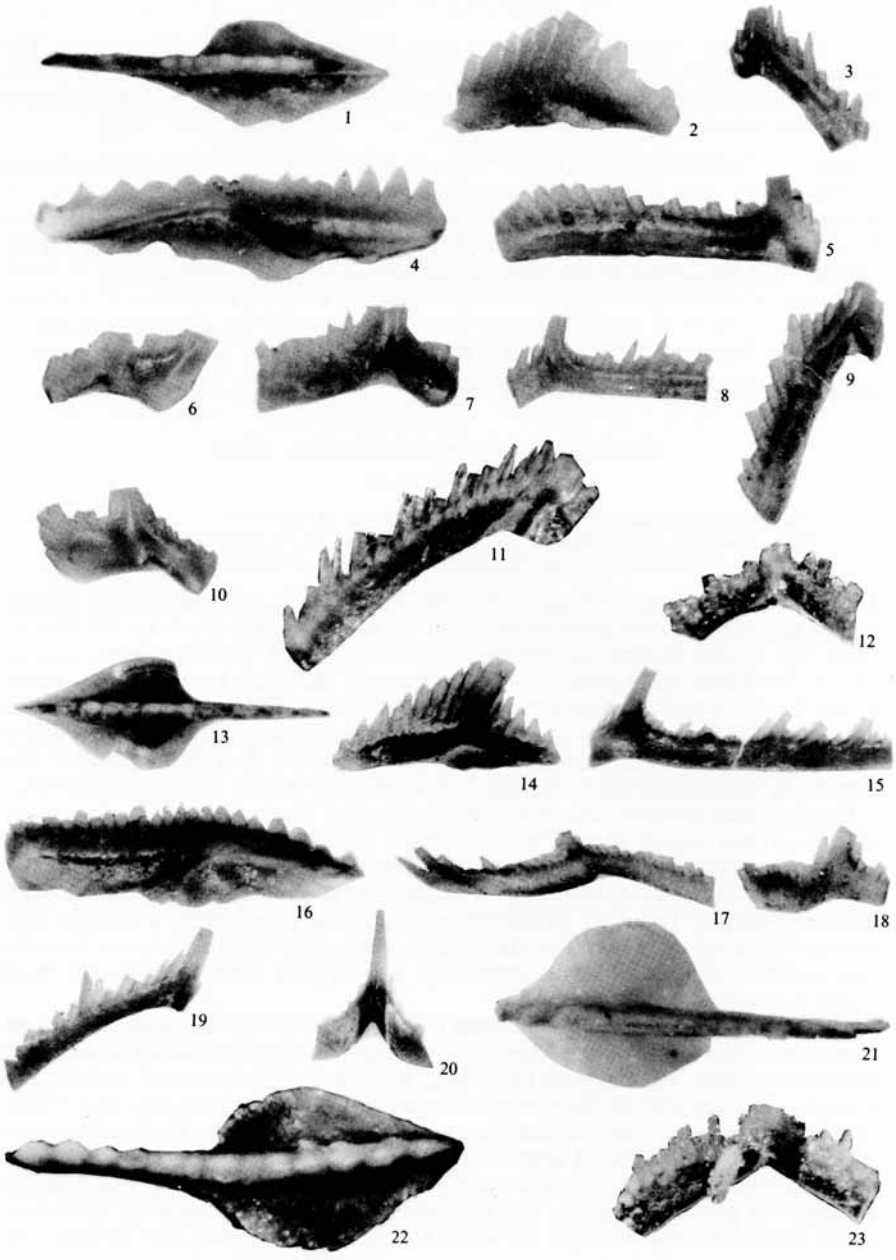
EXPLANATION OF PLATE 47

All specimens ×80, and are in the conodont reference collection, Department of Geology, Nottingham University.

Figs. 1–12, 22, 23. *Ozarkodina sagitta rhenana* (Walliser). 1–10 from sample B.W. 12, Bohemia; 11–12 from sample N.S. 3, Nash Scar Limestone; 22, 23 from sample V.G.W. 1, Dolyhir Limestone. Spathognathodontan element—1, oral view of SZ1; 4, lateral view of SZ4; 22, oral view of SZ22. Ozarkodinan element—2, lateral view of SZ2. Neoprioniodontan element—3, lateral view of SZ3; 9, lateral view of SZ9; 11, lateral view of SZ11. Hindeodellan element—5, lateral view of SZ5; 8, lateral view of SZ8. Plectospathodontan element—6, posterior view of SZ6; 10, posterior view of SZ10. Trichonodellan element—7, posterior view of SZ7; 12, posterior view of SZ12; 23, posterior view of SZ23.

Figs. 13–20. *Ozarkodina sagitta sagitta* (Walliser). From sample Cellon 14D, Carnic Alps. Spathognathodontan element—13, oral view of SZ13; 16, lateral view of SZ16. Ozarkodinan element—14, lateral view of SZ14. Neoprioniodontan element—19, lateral view of SZ19. Hindeodellan element—15, lateral view of SZ15; 18, lateral view of SZ18. Plectospathodontan element—17, posterior view of SZ17. Trichonodellan element—20, posterior view of SZ20.

Fig. 21. *Ozarkodina sagitta bohemica* (Walliser). From the Wenlock Limestone of the Ridgeway, Malvern Hills. Oral view of spathognathodontan element, SZ21.



ALDRIDGE, Silurian conodont *Ozarkodina*

Trichonodellan element—the cusp is erect and subcircular in cross-section. The lateral bars diverge at an angle of 120–150 degrees and bear slender, closely packed, erect denticles of subequal size. The cavity below the cusp is small and is commonly a little expanded posteriorly.

Remarks. Morphological variation is most marked in the spathognathodontan element, with specimens in some collections showing transition towards the spathognathodontan element of the two other subspecies. The collection from Bohemia shows a complete transition between *O. sagitta rhenana* and *O. sagitta sagitta*, with specimens at the *rhenana* end of the spectrum dominating. A small collection of twelve spathognathodontans from the Dolyhir Limestone of Radnorshire is dominated by typical *rhenana* forms, but three of the specimens display a subcircular flaring of the cavity that is more characteristic of *O. sagitta bohemica*.

Material. c. 400 discrete conodont elements.

Ozarkodina sagitta sagitta (Walliser, 1964)

Plate 47, figs. 13–20

1964 *Spathognathodus sagitta sagitta* Walliser, p. 84, pl. 18, figs. 8–11.
p1964 *Ozarkodina edithae* Walliser, pp. 55–56, pl. 26, figs. 12, 14, 18 (only).
p1964 *Neoprioniodus bicurvatoides* Walliser, p. 46, pl. 29, fig. 37 (only).

Description. Spathognathodontan element—the blade is straight or very slightly curved and higher at the anterior end than the posterior. The denticles are slender, erect, and closely packed, numbering from 14 to 20, with most specimens bearing 16–19. The flared basal cavity is situated beneath the posterior half of the blade, giving the unit a characteristic arrow-shape in oral view. The cavity extends as a very narrow groove to the anterior tip of the blade. The denticles over the posterior portion of the cavity are broader, lower, and less closely packed than the remainder. The denticle at the anterior tip of the unit is also generally smaller than its neighbours.

Ozarkodinan element—the unit consists of a flat blade with a straight or very slightly arched aboral edge. The blade bears slender denticles that are inclined posteriorly and fused nearly to their apices. The laterally compressed cusp is situated a little to the posterior of midlength. The denticles of the anterior part of the blade increase regularly in height posteriorly so that their apices form a straight line, terminating at the tip of the cusp. The posterior part of the blade bears lower denticles that increase slightly in height anteriorly. The slightly flared, subcircular basal cavity is situated beneath the cusp.

Neoprioniodontan element—the cusp is tall, very slender, and inwardly curved. The cross-section of the cusp is lenticular, with sharp to slightly rounded anterior and posterior margins. The posterior bar is long, straight or slightly curved, and directed aborally. The denticles of the posterior bar are slender, closely packed, and of subequal size. Anterior to the cusp may be one or two small denticles. The basal cavity is small, rounded, and situated beneath the cusp.

Hindeodellan element—the tall cusp is elliptical in cross-section with rounded anterior and posterior margins. The posterior bar has been broken away from most of the specimens, but on those on which it is retained it is long and straight with

posteriorly inclined denticles of varying size. The denticles nearest the cusp, at the anterior end of the bar, tend to be smaller than the rest, which are mostly fairly small and of subequal size, but are regularly interspersed with somewhat larger denticles. The anterior bar is much shorter, curved inwardly, and directed a little aborally, with slender denticles. The denticles at the end of the bar tend to be broader and taller than the remainder and are inclined inwardly. The basal cavity is very small and situated beneath the cusp.

Plectospathodontan element—the slender cusp is twisted and inclined inwardly and towards the shorter bar. The cross-section of the cusp is elliptical. The denticles on both bars are slender, of subequal size, closely packed, and inclined towards the shorter bar. The denticles at the end of the shorter bar are more strongly inclined than the remainder and are also a little taller and broader. The two bars are not greatly different in length. The small basal cavity is situated beneath the cusp.

Trichonodellan element—the cusp is erect and subcircular to elliptical in transverse section. The lateral bars diverge at an angle of 100–150 degrees and bear very slender, erect denticles of subequal size. The small basal cavity is situated beneath the cusp and may be extended slightly posteriorly.

Remarks. The elements of *O. sagitta sagitta* broadly resemble the corresponding elements in *O. sagitta rhenana*, the most apparent difference being the consistently more delicate nature of the *O. sagitta sagitta* specimens. Other morphological differences, however, occur in all elements, and this is particularly marked in the spathognathodontan components. The spathognathodontans from the Carnic Alps show a greater number of more slender, closely packed denticles on the blade than do those of *O. sagitta rhenana* from Bohemia and Britain, these differences being most marked in the larger, presumably mature, specimens. The ozarkodinan element of *O. sagitta sagitta* tends to be shorter and the cusp is more slender. The denticulation of the neoprioniodontan, hindeodellan, plectospathodontan, and trichonodellan elements of *O. sagitta sagitta* is a little less regular than that of the same elements in *O. sagitta rhenana* and the cusp is generally more slender. From the specimens available, it appears that the two bars of the plectospathodontan element differ in their proportionate lengths in the two subspecies. In *O. sagitta sagitta* the two bars are of almost equal length, whereas in *O. sagitta rhenana* one is markedly shorter than the other.

Material. Four hundred and thirty discrete conodont elements.

Acknowledgements. The collection of material from the Carnic Alps was financed by a Royal Society Grant. Samples from Bohemia, Gotland, and Radnorshire were provided by Dr. V. G. Walmsley. Samples from the Dingle Peninsula, Ireland, were provided by Mr. J. Parkin. The author is also grateful to Dr. M. G. Bassett for information on Wenlock stratigraphy. The conodont specimens were photographed by Mr. D. Jones and the manuscript was typed by Miss A. C. Pyle.

REFERENCES

ALDRIDGE, R. J. 1972. Llandovery conodonts from the Welsh Borderland. *Bull. Br. Mus. nat. Hist.* (Geol.), **22,** 125–231, pls. 1–9.

AUSTIN, R. L. and BASSETT, M. G. 1967. A *Sagitta* Zone Conodont Fauna from the Wenlockian of the Usk Inlier, Monmouthshire. *Geol. Mag.* **104,** 274–283, pl. 14.

BASSETT, M. G. 1974. Review of the stratigraphy of the Wenlock Series in the Welsh Borderland and South Wales. *Palaeontology*, **17**, 745–777.

—— and COCKS, L. R. M. 1974. A review of Silurian Brachiopods from Gotland. *Fossils and Strata*, **3**, 1–56, pls. 1–11.

BERGSTRÖM, S. M., CARNES, J. B., ETHINGTON, R. L., VOTAW, R. B. and WIGLEY, P. B. 1974. *Appalachignathus*, a new multielement conodont genus from the Middle Ordovician of North America. *J. Paleont.* **48**, 227–235, pl. 1.

COCKS, L. R. M., HOLLAND, C. H., RICKARDS, R. B. and STRACHAN, I. 1971. A correlation of Silurian rocks in the British Isles. *Jl geol. Soc. Lond.* **127**, 103–136.

DRUCE, E. G., RHODES, F. H. T. and AUSTIN, R. L. 1974. Recognition, Evolution and Taxonomy of Lower Carboniferous Conodont Assemblages. *J. Paleont.* **48**, 387–402.

DRYGANT, D. M. 1968. New Palaeontological Arguments for the Ludlovian age of the deposits of Ustlevsky and Malinovetsky Horizons (Silurian of Podolia). *Paleont. Sborn.* **5**, 54–57. [In Russian.]

FÅHRAEUS, L. E. 1969. Conodont Zones in the Ludlovian of Gotland and a correlation with Great Britain. *Sver. Geol. Unders.* Ser. 6, **639**, Arsb. 63, nr. 2, 1–33, pls. 1–2.

JEPPSSON, L. 1969. Notes on some Upper Silurian multielement conodonts. *Geol. För. Stockh. Förh.* **91**, 12–24.

—— 1972. Some Silurian conodont apparatuses and possible conodont dimorphism. *Geol. Palaeont.* **6**, 51–69, pls. 1–2.

KLAPPER, G. and PHILIP, G. M. 1971. Devonian conodont apparatuses and their vicarious skeletal elements. *Lethaia*, **4**, 429–452.

MANZONI, M. 1965. Faune a Conodonti del Siluriana e Devoniano Delle Alpi Carniche. *G. Geol.* **33**, 179–203.

MARTINSSON, A. 1967. The succession and correlation of ostracode faunas in the Silurian of Gotland. *Geol. För. Stockh. Förh.* **89**, 350–386.

POLLOCK, C. A. and REXROAD, C. B. 1973. Conodonts from the Salina Formation and the Upper Part of the Wabash Formation (Silurian) in North-Central Indiana. *Geol. Palaeont.* **7**, 77–92, pl. 1.

REXROAD, C. B. and NICOLL, R. S. 1971. Summary of Conodont Biostratigraphy of the Silurian System of North America. *In* SWEET, W. C. and BERGSTRÖM, S. M. (eds.). Symposium on Conodont Biostratigraphy. *Mem. geol. Soc. Amer.* **127**, 207–225, pls. 1–2.

—— —— 1972. Conodonts from the Estill Shale (Silurian, Kentucky and Ohio) and their Bearing on Multielement Taxonomy. *Geol. Palaeont.* SB **1**, 57–74, pls. 1–2.

SWEET, W. C. and BERGSTRÖM, S. M. 1972. Multielement Taxonomy and Ordovician Conodonts. Ibid., SB **1**, 29–42.

WALLISER, O. H. 1964. Conodonten des Silurs. *Abh. hess. Landesamt. Bodenforsch.* **41**, 1–106, pls. 1–32.

—— 1971. Conodont Biostratigraphy of the Silurian of Europe. *In* SWEET, W. C. and BERGSTRÖM, S. M. (eds.). Symposium on Conodont Biostratigraphy. *Mem. geol. Soc. Amer.* **127**, 195–206.

—— 1972. Conodont Apparatuses in the Silurian. *Geol. Palaeont.* SB **1**, 75–80.

WALMSLEY, V. G., ALDRIDGE, R. J. and AUSTIN, R. L. 1974. Brachiopod and Conodont Faunas from the Silurian and Lower Devonian of Bohemia. Ibid. **8**, 39–47.

ZIEGLER, W. 1972. Über devonische Conodonten-Apparate. Ibid., SB **1**, 91–96.

R. J. ALDRIDGE

Department of Geology
University of Nottingham
University Park
Nottingham NG7 2RD

Original manuscript received 7 March 1974
Revised manuscript received 26 June 1974