

THE OCCURRENCE OF STREPTIS (BRACHIOPODA) IN THE ORDOVICIAN OF THE INNER OSLO FJORD

BY

A. D. WRIGHT

(Department of Geology, Queen's University, Belfast)

Abstract. The triplesiid genus *Streptis*, hitherto unknown from pre-Llandovery rocks in Norway, is described from the Upper Ordovician unit 5a of Holmen in Asker, Oslo Fjord. The species, *S. undifera* (Schmidt) (syn. *S. incompta* Ulrich & Cooper), was previously recorded only from the Porkuni Stage (= 5b) of Estonia. The relationships of this species to other early *Streptis* are discussed in the light of morphological trends, and possible routes of migration of the genus suggested.

Introduction

The triplesiid brachiopod genus *Streptis* has previously been recorded only from Llandoveryan rocks in Norway. HOLTEDAHL (1916, p. 87) erected a new variety of *S. monilifera* (M'Coy) for the form occurring in the Lower Llandovery (6a-b) at Konglungen and Spirodden in the Asker district. Recently (WRIGHT 1960) this form has been shown to be specifically distinct from M'Coy's species, an Ashgillian form originally described from Kildare, Ireland (M'COY 1846, p. 25) and subsequently recorded from Keisley, England (DAVIDSON 1867, p. 201) and also Portrane, Ireland (WRIGHT 1964, p. 251).

The specimens which constitute the present record were collected by the author in 1963 from the Upper Ordovician unit 5a on the small peninsula Holmenskjæret at Holmen, Asker. At this locality the 5a sediments consist of shale alternating with discontinuous limestone lenses rich in the alga *Palaeoporella*; the *Streptis* were obtained from these algal limestone lenses.

Family Triplesiidae Schuchert, 1913

Genus *Streptis* Davidson, 1881

Type species: — *Terebratulula grayi* Davidson, 1948, by original designation.

Streptis undifera (Schmidt, 1858)

(Pl. 1, Figs. 1–4)

1858. *Spirigerina? undifera* n. sp. — Schmidt, p. 212.

1936. *Streptis incompta* n. sp. — Ulrich & Cooper, p. 345, Pl. 50, Figs. 13, 25–27, 29, 30, 33–35.

1960. *Streptis incompta* Ulrich & Cooper — Nikiforova, Pl. 26, Figs. 11–13.

MATERIAL: — One pedicle and one brachial valve, both incomplete.

DESCRIPTION: — Pedicle valve gently convex, approaching 7 mm in width, with outline of early growth stages subcircular; sulcus originating at about 2.4 mm from umbo. Concentric ornament of very fine growth lines, density about 20 per mm, and four strong concentric lamellae (frill bases), the first occurring at about 2.3 mm from umbo, remainder only preserved laterally. Radial ribs appearing just posterior to first frill base, with between 6 and 7 per 2 mm width, measured medianly at 3 mm growth stage.

Brachial valve deeper, about 7 mm long, overall strongly convex lateral profile composed of several concave curves between pronounced, crest-like frill bases. Asymmetrical median fold developed, position of origin not established; anterior commissure with asymmetrical plication. Five strong frill bases present with a wavelength of 1.1 mm anterior to 3 mm growth stage. Fragments of two different frills preserved, extending about 1.5 mm from valve surface. Growth line density about 12 per mm, with 5 radial ribs per 2 mm at 3 mm growth stage.

Interiors not accessible.

NOMENCLATORIAL REMARKS: — *Spirigerina? undifera* was listed by SCHMIDT (1858, p. 53) as one of the most characteristic forms occurring in the Borkholm strata (in current Estonian stratigraphical nomenclature, the Porkuni Stage, F_{II}). His description (p. 212), although not accompanied by a figure, clearly indicates the distinctive features of the shell:

‘Schliesst sich eng an *S. reticularis* und *imbricata*; sie ist fast kuglig, mit flachem Sinus, der circa 6 getrennte Falten zeigt. Von den aufge-

worfenen Anwachsstreifen, die in regelmässigen Entfernungen aufeinander folgen, erscheinen die Schalen kantig und schuppig.'

The species occurs at the following localities cited by Schmidt: — Runnafer, Noistfer, Siuge, Herküll, Karjakörtz, Errinal-Krug, Borkholm.

The species *Streptis incompta* was described by ULRICH and COOPER (1936, p. 345). The type horizon and locality given by them was 'Borkholm formation, Borkholm Schloss, Estonia', i.e. the same as for Schmidt's species. The longer and well-illustrated description agrees with that of Schmidt, and there can be no doubt that it was Schmidt's species that they were describing.

Schmidt's species was listed by ÖPIK (1952, p. 12) as *Atrypa? undijera*, but the more recent lists, e.g. JAANUSSON (1956, p. 392), RÕDMUSOKS (1960, p. 66), use the generic name of *Streptis*. The species was illustrated as *Streptis incompta* by NIKIFOROVA (1960, Pl. 26, Figs. 11–13). Figs. 12 and 13 of this work are taken from Ulrich and Cooper, but Fig. 11 is an original, the horizon and locality being given as the Lower Silurian of the pre-Baltic, which horizon and locality are also applied to the reproduced Ulrich and Cooper figures of specimens from Borkholm Schloss.

DISCUSSION: — The placing of the Holmen specimens in the species *S. undijera* is based essentially on the very distinctive ornament common to the Norwegian and Estonian shells.

The diagnostic characters of the ornamentation of the species are:

1. The relatively small number of frill bases.
2. The relatively large distance between frill bases on the shell surface.
3. The very prominent nature of the frill bases, standing well above the shell surface to give a markedly notched lateral profile to the shell.
4. The continuous nature of the frill bases.
5. The well-developed radial ribs in between frill bases.

The five strong frill bases recorded on the Holmen brachial valve and only four on the pedicle valve are less than the 'six or seven' stated by ULRICH and COOPER (1936, p. 345) to characterize the species. However, one of their figured specimens (Pl. 50, Fig. 25) does not appear to have more than four frill bases; further, the variation in number of frill bases for samples of other species (WRIGHT 1960,

Tables 2, 3) is larger than Ulrich and Cooper's descriptions would suggest. Accordingly, no significance can be attached to this dubious and slight difference at present. No other differences in the characters listed above are apparent between the Holmen shells and the Borkholm specimens figured by Ulrich and Cooper.

In all of these characters, the species can be readily distinguished from *S. monilifera* (M'Coy), the other described Upper Ordovician form. In *S. monilifera* the frill bases are distinctly more numerous and closer together; they do not stand as far above the general shell surface (cf. Pl. 1, Fig. 1 and Fig. 5), and become less prominent in the intercostal spaces. The ribs are not well developed on the shell surface between the frill bases, and in fact it must have been a combination of these last two factors which caused M'COY originally to figure the ornament as concentric rows of tubercles (1846, Pl. 3, Fig. 3). Ulrich and Cooper stated that the unequally convex valves of *S. undifera* (*incompta*) distinguished that species from *S. monilifera*; but a deeper brachial valve is also present in *S. monilifera*, and indeed in varying degrees is characteristic of all triplesiid (WRIGHT 1963, p. 753).

Conclusions

Future palaeontological studies on faunas of Upper Ordovician strata may indeed show that *Streptis undifera* is far more abundant than hitherto suspected; but it may nevertheless be profitable to speculate on the positive evidence at present available concerning the distribution and development of the genus in northwest Europe.

The species has so far not been recorded from beds earlier in age than the Porkuni Stage in Estonia, at which horizon it forms a useful index fossil. The Porkuni (Borkholm) stage was shown by KLÆR (1897, pp. 50–52) to be equivalent in age to the 5b of the Norwegian succession, a view which is still generally held (e.g. JAANUSSON 1956).

However, in Oslo Fjord, the species is here shown to occur in beds of 5a age. An interpretation that can be placed on this evidence is that *S. undifera*, present in the Oslo region in 5a times, had migrated to the East Baltic by late Ashgillian (5b) times.

Before considering the possible relationships between *S. undifera* and *S. monilifera*, it would be appropriate to consider the relationships between the latter and its closely related Lower Llandovery descend-

ant, *S. altosinuata*. An examination of these two species (WRIGHT 1960) shows certain differences between the earlier and the later species enumerated below; should these changes in fact represent consistent shifts which affected a series of forms, they could be referred to as 'trends'.

1. The number of frill bases on the shells increases, and at the same time the frill bases become closer together.
2. The radial ribs increase in number and become more closely spaced.
3. The fold and sulcus develop at an earlier stage in ontogeny.
4. The ventral interarea becomes shorter relative to width.

Considering these 'trends' with reference to *S. undifera*, the total number of frill bases of *S. undifera* is less than on both *S. monilifera* and *S. altosinuata*; at the same time, the frill bases are more widely spaced. Thus, if this 'trend' were orthogenetic, *S. undifera* would be the most primitive of these species. The 'trend' would be further endorsed should the modal number of frill bases turn out to be significantly less on the older Holmen form than on the one from Estonia; but at present material is not available to test this possibility.

The number of radial ribs measured on the median 2 mm at the 3 mm growth stage of the Holmen brachial valve, 5, and a count of 6 taken on the brachial valve figured by ULRICH and COOPER (Pl. 50, Fig. 33) in approximately this position, suggests closer relationship to *S. monilifera* than to *S. altosinuata*. However, with the variation recorded for this character (WRIGHT 1960, Table 1B), the present sample size is not sufficient to do more than suggest to which *S. undifera* has the closer affinities.

In the case of the fold and sulcus development too, the information is rather inadequate, the origin of the fold not being established from the Holmen valve, while photographs are quite unsuitable for ascertaining this type of data. However, the origin of the sulcus at 2.5 mm for a single pedicle valve of *S. monilifera* from the Portrane Limestone (WRIGHT 1964, p. 251) is very close to that of the Holmen pedicle valve.

The ventral interarea is not seen on the Holmen specimen. ULRICH and COOPER describe the ventral interarea of *S. incompta* as 'short, slightly curved' (p. 345). This is essentially true for all *Streptis*, but

the degree of shortness can be of specific significance. ULRICH and COOPER figure an interarea of this species (Pl. 50, Fig. 30), and this appears quite long, relative to the width of the hinge-line. As far as can be ascertained from their figure, the proportion of the length of the interarea to the width of the hinge-line is about 40%; the mean proportions for samples of *S. monilifera* and *S. altosinuata* are about 29% and 20% respectively (WRIGHT 1960, p. 268). This suggests again that *S. undifera* is the most primitive of these three shells.

Summarizing, the first 'trend' indicates that *S. undifera* is the most primitive of the series *undifera-monilifera-altosinuata*; and the fourth 'trend' appears to support this, although more data are needed. The data for the second and third 'trends' suggest that *undifera* is closer to *monilifera* than to *altosinuata*, and that these two trends are not developed in the *undifera-monilifera* part of the series; but the data are at present insufficient to ratify these suggestions.

Morphologically, the frill base development strongly supports the series *undifera-monilifera-altosinuata*; the other 'trends' affecting *monilifera-altosinuata* do not upset the *undifera-monilifera* relationship. As far as can be judged without statistical support, the shape of the shells does not present any objection to the envisaged line of development. Asymmetry would appear to be common in *S. undifera*; the 'trend' in this lineage would then be of a reduction in asymmetrical development from *undifera* to *monilifera* to *altosinuata*.

As well as morphology, the support of stratigraphical evidence is necessary to establish the envisaged 'trend' lines.

The occurrences of *S. undifera* are given above; *S. altosinuata* has only so far been recorded in northwest Europe from the Lower Llandovery of the Oslo district (unit 6a). The strata in which *S. monilifera* occurs in the British Isles, i.e. Keisley, Kildare, and Portrane Limestones, can at present only be said to be of approximately Middle Ashgillian age. Detailed faunal studies are at present being carried out to establish precise correlation between these strata and the Ash Gill-Cautley succession. For the time being, it seems best to regard *S. undifera* as being contemporaneous with *S. monilifera* for at least part of Ashgillian times, with *S. altosinuata* clearly a later form.

On the basis of present knowledge then, it would appear that the genus *Streptis* had its origin possibly in the earliest Ashgillian or late Caradocian times, evolving from a small asymmetrical, costellate

triplesiid with smooth umbonal regions, which developed occasional frills on pronounced frill bases.

The genus arrived in the Oslo region by 5a times in the form of *S. undifera*; by 5b, *S. undifera* had migrated eastwards to flourish in Estonia. It is possible that *S. undifera* also migrated westwards to evolve into *S. monilifera* by the time it reached the British Isles, but the apparent contemporaneity of the Holmen *S. undifera* with the British species suggests that this was unlikely. More probably the migration centre lay to the south of the British Isles so that while some *S. undifera* (or closely related form) moved northwards and evolved to *S. monilifera*, others drifted northeast to Oslo without this evolution.

Streptis appears to be absent from 5b in the Oslo region; the arrival of *S. altosinuata* in 6a suggests the migration eastwards, with evolution, of *S. monilifera* from the British region.

Acknowledgements

I am indebted to Dr. Gunnar Henningsmoen, whose kindness in demonstrating the Lower Palaeozoic stratigraphy of the Oslo district to me led to the discovery of the fossils; and to Professor Alwyn Williams for reading the manuscript.

REFERENCES

- DAVIDSON, T. 1848. Sur les Brachiopodes du Système Silurien supérieur de l'Angleterre. Soc. Géol. France Bull., ser. 2, 5:309–38, Pl. 3.
- 1866–1871. British Silurian Brachiopoda 3:397 pp., 50 Pl. Palaeontogr. Soc. [Monogr.], London.
- 1881. Description of New Upper Silurian Brachiopoda from Shropshire. Geol. Mag., new ser., dec. 2, 8:145–54, Pl. 5.
- HOLTEDAHL, O. 1916. The Strophomenidae of the Kristiania Region. Vidensk. Selsk. Skrifter, I, 1915, 12:1–117, Pl. 1–16.
- JAAANUSSON, V. 1956. Untersuchungen über den oberordovizischen Lyckholm-Stufenkomplex in Estland. Bull. Geol. Inst. Uppsala, 36:369–400, Pl. 1.
- KIÆR, J. 1897. Faunistische Uebersicht der Etage 5 des norwegischen Silur-systems. Vidensk.-selsk. Skr., I Kl., 1897, no. 3:1–76.
- M'COY, F. 1846. Synopsis of the Silurian Fossils of Ireland. Univ. Press, Dublin, 72 pp., 5 Pl.

- NIKIFOROVA, O. I. 1960. Superfamily Triplesiacea. *In* Osnovy Paleontologii; Mshanki, Brachiopody, vol. ed. T. G. Sarycheva, Moscow: 205–06, Pl. 26.
- ÖPIK, A. 1952. Das Ostbaltische Kambrosilur. *In* S. von Bubnoff, Fennosarmatia. Akademie-verlag, Berlin.
- RÕÕMUSOKS, A. 1960. Stratigraphy and Paleogeography of the Ordovician in Estonia. Int. Geol. Congress XXI, Part VII: 58–69.
- SCHMIDT, F. 1858. Untersuchungen über die Silurische Formation von Ehstland, Nord-Livland und Oesel. Archiv. f. Naturk. 1 ser. 2:1–248.
- SCHUCHERT, CHARLES. 1913. Class 2. Brachiopoda. *In* Zittel, K. A. von, Textbook of Palaeontology, v. 1, 2nd ed., London: 291–343, Text-figs. 489–587.
- ULRICH, E. O. and COOPER, G. A. 1936. New Silurian Brachiopods of the family Triplesiidae. Jour. Paleont. 10:331–47, Pl. 48–50.
- WRIGHT, A. D. 1960. The species *Streptis monilifera* (M'Coy). Norsk geol. tidsskr. 40:259–76.
- 1963. The morphology of the brachiopod superfamily Triplesiacea. Palaeont. 5:740–64, Pl. 109–110.
- 1964. The Fauna of the Portrane Limestone, II. Bull. Brit. Mus. (Nat. Hist.) Geol. 9, No. 6: 157–256, Pl. 1–11.

Accepted for publication June 1965

Printed December 1965

PLATE

PLATE 1

The photographs are not retouched; the specimens were coated with ammonium chloride before photographing. All $\times 6$ magnification.

Streptis undifera (Schmidt, 1858)

Ashgillian (5a), Holmenskjæret, Holmen, Asker. Coll.: A. D. Wright.

Figs. 1–3. Lateral, dorsal, and anterior views of brachial valve (Palaeontological Museum, Oslo, catalogue no. 74212). Fragments of two discrete frills arrowed on Fig. 2.

Fig. 4. Ventral view of pedicle valve. (Palaeontological Museum, Oslo, catalogue no. 74213.)

Streptis monilifera (M'Coy, 1846)

Ashgillian, Kildare Limestone, Ireland. Coll.: A. D. Wright.

Fig. 5. Lateral view of complete shell, to show frill bases for comparison with Fig. 1. (Other views of this specimen figured in WRIGHT 1960, Pl. 1 Figs. 17, 18, 20, 21.)

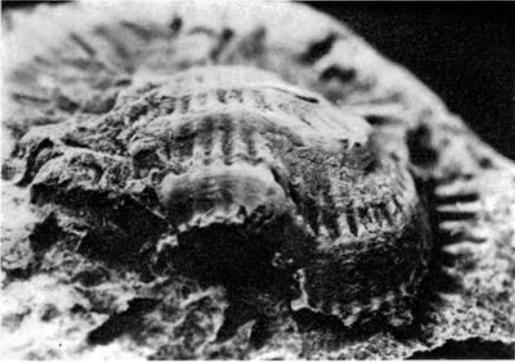
PLATE 1



1



2



3



4



5