

## SOME UPPER JURASSIC AMMONITES OF THE GENUS *RASENIA* FROM SCOTLAND

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ABSTRACT. Three species (one of them new) of the ammonite genus *Rasenia* from the Lower Kimeridgian of Eathie (Scotland) are described. They are of interest as being probable ancestors to different species of the one genus *Aulacostephanus*.

FOR the preparation of a monograph on the Upper Jurassic ammonite genus *Aulacostephanus* (Ziegler 1962) it was necessary to study much material from the whole of central and Western Europe. For this purpose, Dr. C. D. Waterston, Edinburgh, had the kindness to send me some specimens from the Lower Kimeridgian of Eathie (Ross-shire, Scotland). Since one of the species contained in this material was hitherto unknown and of special interest as being ancestral to some *Aulacostephanus*, it seems useful to describe the ammonite fauna briefly.

I am much indebted to Dr. C. D. Waterston for sending me the material, and to Dr. J. H. Callomon, London, and Dr. O. F. Geyer, Stuttgart, for much advice, help, and discussion. The photographs were made by Mr. J. Aichinger, Zürich. In translating the text, I was assisted by Dr. M. Schnitter and Mr. A. Somm, Zürich.

The specimens studied are part of the Hugh Miller Collection of the Royal Scottish Museum, Edinburgh. They were collected, together with other ammonites, during the last century. Stratigraphical data therefore are not given. They seem, however, to come from the limestones described by C. D. Waterston (1951) as belonging to the *uralensis* Zone.

All the specimens are perfectly preserved. Often even the shell, though recrystallized, is present. The phragmocones are usually filled with white crystals of calcium carbonate; the body-chamber, however, is filled with sediment. Since parts of the body-chambers are crushed, the peristomes are never preserved. Sometimes the ammonites are accompanied by other fossils (such as *Meleagrinnella* and *Buchia*).

### SYSTEMATIC DESCRIPTIONS

The ammonites are characterized by short primary, and long fine secondary, ribs crossing the venter. These features permit their classification as members of the genus *Rasenia*. Within this genus Geyer (1961) distinguishes six subgenera. Three of them (*Rasenia* s.str., including *Zonovia*, *Eurasenia*, and *Prorasenia*) bear coarse and/or sharp ribs, a fourth (*Involuticeras*) is very involute with a rather steep umbilical slope. Our ammonites, on the contrary, are finely ribbed, slightly involute to evolute and possess a gentle umbilical slope. Therefore they must be placed with the subgenera *Rasenioides* and/or *Semirasenia*.

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According to Geyer a small shell is characteristic of *Rasenioides* (type: *A. striolaris*); some species (if not all) bear lappets on the peristome. Thus *Rasenioides* is a microconch (Callomon 1955). *Semirasenia*, on the other hand, seems to be a macroconch. The shell of the type species is, however, also of small size. Although its peristome is not known, it is quite probably devoid of any lappet, since the derivatives of *Semirasenia* (the subgenus *Aulacostephanoides*) do not bear lappets.

Geyer emphasizes the late appearance of the primary ribs in *Semirasenia* (in *S. möschi* the umbilical parts of the whorls remain smooth up to the body-chamber). This feature does not necessarily seem to imply subgeneric rank. Experience with the closely related genus *Aulacostephanus* shows very great variation in the appearance of the primaries.

Summarizing, it may be justifiable to classify all apparently macroconch species of *Rasenia*, with fine ribs and gentle umbilical slopes, with the subgenus *Semirasenia*. However, there is no proof or phylogenetic justification for this procedure. Since the British *Rasenia* have not been monographed it is impossible to draw lineages in any other ways than merely on morphological and arbitrary grounds.

*Rasenia (Rasenioides) lepidula* (Oppel)

Plate 111, figs. 1-7

1863 *Ammonites lepidulus* Oppel, p. 242, pl. 67, fig. 4.

1961 *Rasenia (Rasenioides) lepidula* (Oppel 1863), Geyer, p. 112, pl. 8, figs. 5, 6.

The small shell does not exceed approximately 40 mm. in size. The body-chamber (bearing lappets at the peristome, but only partly preserved in our specimens) is about two-thirds to three-quarters of a whorl in length. The maximum diameter of the phragmocone, therefore, is about 25 mm. However, the majority of our specimens from Scotland being somewhat smaller, the diameter of the phragmocone averages about 20 mm. Often the last two or three septa are approximated (see Pl. 111, fig. 1). This may be considered a feature of adulthood.

Our shells are slightly evolute (in contrast to Geyer's statement for his central Euro-

EXPLANATION OF PLATE 111

Figs. 1-7. *Rasenia (Rasenioides) lepidula* (Oppel); Lower Kimeridgian, *uralensis* Zone; Eathie, Ross-shire, Scotland. 1, Natural size. Diameter of the phragmocone 19 mm. Royal Scottish Museum, Department of Geology, 1859.33.3844. 2, Natural size. Diameter of the phragmocone 18.5 mm., 1859.33.3858. 3, Natural size. Ventral view. 1859.33.3858. 4,  $\times 2$ . Ventral view, secondary ribs diminishing in height, 1859.33.3853. 5, Natural size. Diameter of the phragmocone 15.8 mm., 1859.33.3853. 6, Natural size. Diameter of the phragmocone 28 mm. 1859.33.3859. 7,  $\times 2$ . Ventral view, secondary ribs interrupted by a narrow median ledge on the internal side of the shell. 1859.33.3857.

Figs. 8-9. *Rasenia (Semirasenia) cf. möschi* (Oppel); Lower Kimeridgian, *uralensis* Zone; Eathie, Ross-shire, Scotland. Royal Scottish Museum, Department of Geology, 1859.33.3856. Natural size. 8, Lateral view, diameter of the phragmocone 35 mm. 9, Ventral view.

Figs. 10-13. *Rasenia (Semirasenia) askepta* sp. nov.; Lower Kimeridgian, *uralensis* Zone; Eathie, Ross-shire, Scotland. All natural size. 10, Diameter of the phragmocone about 35 mm. (?). Royal Scottish Museum, Department of Geology, 1859.33.3846. 11, Same ventral view. 12, Diameter of the phragmocone about 33 mm. (?). 1859.33.3850. 13, Diameter of the phragmocone 59 mm., length of the body-chamber (crushed) more than three-quarters whorl. 1859.33.3845. Accompanying fossils: *Meleagrinnella leeana* Waterston and *Buchia concentrica* (Sowerby).

pean material). The lateral parts of the whorls are nearly flat (at least on the outer whorls), and the venter is rounded. The umbilical slope in the phragmocone and the body-chamber is gentle. As a whole the whorl section is oval.

Around the umbilicus, but somewhat removed from the umbilical seam, there are narrow, sharp but low, prorsicostate primaries. They split into rather dense, radial secondaries. These secondaries cross the venter. Only occasionally is there observed a narrow ledge in the middle of the venter on the internal surface of the shell. This ledge points to a developmental trend leading to *Aulacostephanus*. The tendency is for the siphuncle to sink more and more into the interior of the whorl. The aforesaid narrow ledge is the first step; the second step is a clear interruption of the ribs in some parts of the venter; the third step is the interruption on the whole of the venter; and the last step is a real furrow as in *Aulacostephanus eudoxus*.

*Measurements:*

<i>Specimen number</i>	<i>Diameter (mm.)</i>	<i>Height of whorl</i>	<i>Whorl width</i>	<i>Umbilical diameter</i>	<i>Number of primaries (at a diameter of 20 mm.)</i>	<i>Number of secondaries (at a diameter of 20 mm.)</i>
1859.33.3858	26 18	36 37	32 33	36 37	26	86 (3.3)
1859.33.3844	28.4 23	34 35		39 39	24	78 (3.25)
1859.33.3853	21.7	36	35	41	26	102 (4.4)
1859.33.3857	18	39	38	37	30	80 (2.7)
1859.33.3859	29	35	31	39	20	108 (5.4)

(at a diameter of 30 mm.)

Our specimens differ slightly from the material from central Europe described by Geyer (1961). The shells are more evolute, the number of primaries at the diameter of 20 mm. is greater, and therefore the ratio of primaries to secondaries is not the same. Most likely this is not due to specific (or subspecific) differences, but to the small number of specimens studied.

*Rasenia (Semirasenia) cf. möschi (Oppel)*

Plate 111, figs. 8-9

cf. 1863 *Ammonites Möschi* Oppel, p. 240, pl. 65, fig. 2.

cf. 1961 *Rasenia (Semirasenia) moeschi* (Oppel 1863), Geyer, p. 105, pl. 8, figs. 7, 8.

According to Geyer the medium size in *Rasenia möschi* is less than 70 mm. If we assume the body-chamber to be nearly a whorl in length (Oppel 1863) the mean diameter of the phragmocone would be about 30 mm. Our specimens fit these measurements quite well. Two individuals show the end of the phragmocone at 33 and 35 mm. respectively. In other specimens (most likely immature ones) the body-chamber begins at 23 and 21 mm. respectively. The shells are involute. As in *Rasenia lepidula* the umbilical slope is very gentle. The lateral parts of the whorl are very slightly vaulted, the venter is rounded.

In our specimens no peristome is preserved; but, as mentioned above, it is probable that no lappets are present. The body-chamber seems to comprise nearly a complete whorl. In our specimens, however, only the beginning of the body-chamber is to be seen.

On the inner whorls the umbilical region of the whorl is smooth. In the last half whorl of the phragmocone of our specimens, narrow somewhat elongate ribs appear. These primaries are separated from the secondaries by a smooth band. The secondaries are bent forward and arranged very densely. They cross the venter without any interruption but sometimes with an indistinct loss of relief.

*Measurements:*

<i>Specimen number</i>	<i>Diameter (mm.)</i>	<i>Height of whorl</i>	<i>Whorl width</i>	<i>Umbilical diameter</i>	<i>Number of primaries</i>	<i>Number of secondaries</i>
1859.33.3856	35.5	40	34	31	9	66 (7.3)
1859.33.3847	35	39	34	32	5	59 (11.8)
1859.33.3854	23.5	42	35	30	..	66
1859.33.3852	29	44	36	27	..	68

The Scottish material differs from *Rasenia möschi* (typ.) in the primaries appearing already on the phragmocone. In the type of *Rasenia möschi* and in additional (but very scanty) material, on the other hand, the primaries are restricted to the second part of the body-chamber. Therefore specific identity with our material cannot be proved.

*Rasenia (Semirasenia) askepta* sp. nov.

Plate 111, figs. 10-13

*Holotype.* Plate 111, figs. 10-11; Royal Scottish Museum, Edinburgh, 1859.33.3846.

*Locus typicus.* Eathie (Ross-shire, Scotland).

*Stratum typicum.* Lower Kimeridgian, presumably upper part of the *uralensis* Zone.

*Description of the holotype.* Maximum diameter 52 mm. Height of whorl 41 per cent., whorl width 31 per cent., umbilical diameter 30 per cent. Umbilical slope very gentle, lateral parts of the whorl slightly rounded, venter vaulted, whorls oval to somewhat trapezoidal. Peristome not preserved. Doubtful whether the body-chamber is present, but the state of preservation points to a maximum diameter of the phragmocone of about 35 mm. Sutures not visible.

Primaries distant from the umbilical seam, narrow, sharp, bent forward. On the last four half whorls: 8, 8, 10, and 9 primaries, respectively. Secondaries: 55, 42, and 50, respectively, on the last three half whorls, densely arranged and prorsicostate. Ribs cross the venter without interruption but slightly diminish in height. Ratio of secondaries to primaries 6.9 (at a diameter of 50 mm.), 5.3 (diameter 35 mm.), and 5.0 (diameter 25 mm.).

*Remarks.* Some other specimens similar to the holotype may be grouped with the same species. They differ in the number of primaries per half whorl (8-13). The number of secondaries per half whorl may reach 60, and the ratios of secondaries to primaries differ from 4.6 to 8. It seems that smaller ratios are consistent with small diameters. Another variable feature is the degree of the ribs' relief on the venter. But a clear, smooth, external band is never developed.

The diameter of the phragmocone is also variable: it measures 59 mm. (Royal Scottish Museum, 1859.33.3845), about 72 mm. (1859.33.3849), and 110 mm. (1859.33.3843), but it never seems to reach such immense dimensions as reported for *Aulacostephanus mutabilis* (Ziegler 1962).

*A. mutabilis* (Sowerby) is very closely related in sculpture but of greater size and with ribs interrupted on the venter. Apart from these two features there are no other differences between the two species. *A. mutabilis* occurs in younger beds, in the *mutabilis* Zone, while *Rasenia askepta* seems to be found in the upper part of the *uralensis* Zone (as proved by the accompanying species *Rasenia lepidula* and *R. cf. möschi*). It is clear that *R. askepta* and *A. mutabilis* belong to one phylogenetical lineage. It must be mentioned, however, that neither size nor sculpture of the venter of a single specimen permits specific determination. As in other cases some individuals may differ from the morphological mean of a population. Therefore only the expression of a feature found in the majority of the specimens would be of taxonomic value. Sometimes additional support may come from other contemporaneous species.

#### CONCLUSION

The three species described are true *Rasenia* (sensu Geyer), meaning that they bear ribs crossing the venter. They belong to the subgenera *Rasenioides* and *Semirasenia*. For each of the three species there are similar species known with clear external interruptions of the ribs. The latter are therefore grouped with *Aulacostephanus* (Ziegler 1962). The boundary between *Rasenia* and *Aulacostephanus* is arbitrary. Callomon (1963) places all individuals with *Aulacostephanus* in which the external ribs are interrupted—either on all stages or on parts of a whorl. Geyer (1961) and I prefer to interpret *Aulacostephanus* as a genus in which the majority of all individuals in every population show interruption of the external ribs throughout life.

It seems highly probable that the three *Rasenia* described are ancestral forms of the corresponding species of *Aulacostephanus*. Probable relationships are that *Rasenia lepidula* leads to *Aulacostephanus eulepidus*, *R. möschi* is ancestral to *A. variocostatus*, and *R. askepta* gives rise to *A. mutabilis*. The genus *Aulacostephanus* therefore is polyphyletic in the narrow sense of the word, but monophyletic if derivation from the one genus, *Rasenia*, is considered.

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