XV.—*On the Recent and Fossil Foraminifera of the Shore-sands of Selsey Bill, Sussex.*—VI. *A Contribution towards the Ætiology of Massilina secans (d'Orbigny sp.).*

By EDWARD HERON-ALLEN, F.L.S., F.R.M.S., and
ARTHUR EARLAND, F.R.M.S.

(Read October 19, 1910.)

THE more than merely superficial student of the Foraminifera comes rapidly to the conclusion that familiarity with the robust and conspicuous, and above all exceedingly common shells of *Massilina secans* has bred for it a species of contempt. Certainly no Rhizopod has had greater liberties taken with its name, and from its original appearance as *Frammentaria seminula* (Soldani) in 1795, through *Quinqueloculina* (d'Orbigny) in 1826, *Miliolina* (Brady) in 1884, *Sigmoilina* (Schlumberger) in 1887, to *Massilina* (Schlumberger) in 1893, under which generic name it is now enjoying a brief rest, it has been the prey of the species-monger or "splitter." It is undoubtedly, as we have had occasion to remark elsewhere, the commonest of all British Foraminifera.* It is by no means a rare thing to find stretches of sand upon our southern, and probably other, coasts, strewn with a thick deposit of pure Foraminifera extending for a mile or more, and many yards in breadth, ninety-five per cent. or more of which is entirely composed of *Massilina secans*. At Dog's Bay, in Connemara, its shells are blown up from the beach, with a small intermingling of other species, in such vast quantities as to form extensive banks or dunes high up on the shore, thus forming a true organic sub-aerial deposit. It is, therefore, the more remarkable that, as far as we know, there is no published record of its occurrence east of Bognor, where it was recorded by Earland,† or, south of the Orkney and Shetland Islands (where it has been found by Earland during the cruises of the Fisheries Commission steamer 'Goldseeker') on the east coast of the British Isles. This is recorded here for the first time, together with the fact of its occurrence in the shore-sands at St. Andrews on the shores of Fife, N.B., and also at Kingsgate and Broadstairs, in the Isle of Thanet (Kent), where it has been found by Heron-Allen. In view of the enormous quantity in which the species is found, it is not remarkable that it is liable to extraordinary eccentricities of form,

* Knowledge, xxxiii. No. 505 (Aug. 1910) p. 304.

† The Foraminifera of the Shore-sand at Bognor, Sussex. Journ. Quekett Micr. Club., Nov. 1905, p. 187.

and that it has tempted students of the family to separate its eccentricities under varietal names. In the year 1889 Mr. Edward Halkyard, F.R.M.S., thus differentiated a variety having strongly marked transverse striae, which he described and figured under the name *Sigmoilina secans* var. *obliquistriata*.^{*} It is true that in 1891 he reconsidered the advisability of so distinguishing it, and abandoned the varietal name.[†] In the year 1856, Costa proposed the specific name *denticulata* for specimens the outer periphery of which was more or less strongly carinated, or keeled, the carination being scalloped into points almost as pronounced as those of *Cristellaria calcar*, or those that are characteristic of the early stages of *Polystomella crispa*.[‡]

Earland found Costa's variety in the shore-sands of Bognor, Sussex, and figured it in the paper already referred to, and in the same sands he found, and in the same paper recorded, a striking and very recurrent variety distinguished by fine hair lines, or striae, running closely together, parallel to the long axis of the outer chamberlets of the shell. To this variety he gave the name *tenuistriata*.

In March of this year (1910) a large tract of the shore of Selsey Bill was strewn half an inch thick with a pure deposit of foraminiferal shells, the vast majority of which were those of *Massilina secans*. We have devoted a great many hours to the examination of this deposit, and have found in it almost every eccentricity and monstrosity of form of which the genus *Miliolina* is capable (which is saying a good deal), but we never found any sign of the three varieties which we have just described. Exhibited upon the table are two slides, one containing peculiarities of form or marking, together with Miliolids other than *Massilina secans*, and the other containing absolute monstrosities from this deposit of last March. In April, however, we made an expedition to the Mixon Reef and Beacon, some two miles out at sea from the point of Selsey Bill, and made a gathering of mud and sand from the algæ adherent to the rocks, with a view to studying the life-history of the common British Foraminifera, and this gathering is still under observation. Some of the results of those observations, regarding *Massilina secans* and *Polystomella crispa*, have already been published elsewhere;[§] the further results we hope to place before this Society at an early date. The gathering was stored in narrow observation-tanks, and is continually examined by means of a Zeiss-Greenhow binocular Microscope, constructed for us

^{*} E. Halkyard, Recent Foraminifera of Jersey. Trans. and Ann. Rep. Manchester Micr. Soc., 1889, p. 61, pl. I. fig. 7.

[†] E. Halkyard, A Comparative List of the Recent Foraminifera of the Islands of Guernsey, Hern, and Jersey. Trans. and Ann. Rep. Manchester Micr. Soc., 1891, p.

[‡] *Quinqueloculina denticulata* Costa, 1856, Atti Acad. Pontaniana, vii. fasc. 2, p. 325, pl. xxv. fig. 6 a, b, c.

[§] Knowledge, loc. cit.

by Mr. H. F. Angus, and the observations recorded. In September, the number of shells in the tanks having greatly increased (though we must confess that we have never been able to observe the actual processes of reproduction), we washed out the contents of two of the tanks for examination. We were astonished to find that the majority of the shells of *Massilina secans*, the principal denizen of our tanks, were more or less distorted or idiosyncratic. Among the dried and floated shells we found all three of the varietal forms above described, and not only was this the case, but we found them in extraordinary combinations: var. *denticulata* also *tenuistriata*, var. *tenuistriata* also *obliquistriata*, and there is one shell on the slide exhibited this evening which exhibits all three variations, so that it might be referred to as *Massilina secans*, var. *denticulata-tenuistriata-obliquistriata* d'Orbigny-Costa-Earland-Halkyard!

It must be borne in mind that these shells were grown under peculiarly starved conditions. The tanks measure on an average 5 in. by 6 in. in height and breadth, and have a diameter from back to front of only $\frac{3}{4}$ in. It is therefore obvious that the supply of carbonate of lime and other salts at the disposal of the Foraminifera born in the tanks is very limited, for it must be remembered that these observations have been carried on in London, and the sea-water has never been renewed. It has been kept sweet by the growth of green algæ, which oxygenate the water, and evaporation has been compensated by the addition of fresh-water from time to time when the specific gravity bulbs warned us of increasing salinity.

We are therefore led to the conclusion that these varietal markings, in *Massilina* at any rate, are nothing more than the effect of the animal having to live under starved and unnatural conditions, and it will be interesting to see whether the same tendency to variation will be exhibited by other species grown under similar conditions.

The curious monstrous forms, of which a number of specimens are exhibited, are usually the result of damage. It is difficult to surmise to what dangers of damage *Massilina* may be exposed when clinging to rocks or algæ, but it seems indifferent to casualties. We have frequently, in the attempt to dislodge a shell for closer examination, smashed the ultimate or penultimate chamber. In the former case the pseudopodia were soon extended from the point of fracture, and in the latter from the end of what would have been the last chamber if its growth had been checked at that point, and it is a common thing to find a *Massilina* whose shell has been broken, repaired by the secretion of a new shell over the protoplasm protruded at the point of fracture.