

O. Schmidt has also occupied himself with the notion of explaining the form of the typical sponge spicules in terms of the crystallising tendencies of the different substances. He says: "The question is a difficult one, how far the nature of the lime and the flint determines the rayed and anchor-shaped forms related to the three-sided prism. For the flint the explanation holds good, but not for the lime. But while in the group of triaxial siliceous spicules (hexacts and their derivatives) we have only to choose between the triaxial and the binaxial and monaxial system, and the hexagonal does not come into account, we must remember the fact, inconvenient to mineralogists, that quartz crystals arising in amorphous matrix not unfrequently exhibit axial deviations from the hexagonal system, and that we may the more readily expect in our sponge spicules with organic basis and admixture other forms than those of the crystallographic systems."<sup>1</sup>

For my own part I must pronounce against such an attempt to bring the form of the sponge spicules, whether they consist of carbonate of lime or hydrated silica, into relation with the crystallising tendencies of these substances in the way of origin or explanation. In the first place, in regard to the siliceous spicules, the fact has to be noted that the silica in them never occurs in a crystalline state, but is always present as completely amorphous hydrated silica or opal, as is shown, for instance, by the fact that they are not doubly but only simply refractive. This is therefore against the supposition that the various skeletal elements can be reduced to or derived from the crystallisations of the substances of which they consist. Furthermore, we cannot ignore the extraordinary abundance and frequent importance of the deviations of the rays from the typical angle at which they ought to stand to one another, nor does the marked curvatures of the rays accord with the supposition of defined crystalline axes.

I must rather maintain that the form of all the sponge spicules is determined by the organic matrix in and from which they originate, and that the formative forces are in no essential way different from those which are everywhere exhibited in the shaping of the living organism and its parts.

And though we still know very little about the forces determining form, yet in these skeletal formations it is possible here and there to detect factors which, though they do not indeed explain everything, yet make much at least more intelligible.

If one can distinctly demonstrate a natural and necessary connection between the form and disposition of a skeletal element and the function which it discharges, one has, from the standpoint of utility and natural selection, rationalised the appearance of that form and disposition.

In regard to the question why the typical and primitive spicule in the calcareous sponges should be the plane, regular, triradiate form, in the *Tetrasaxonia* with their

<sup>1</sup> Grundzüge einer Spongienfauna des atlantischen Gebietes, p. 4.