

regarded as glauconite, appear to be highly altered fragments of ancient rocks, or coatings of this mineral on these rock fragments. It appears that the shells are broken by the swelling out or the growth of the glauconite, and that subsequently the isolated cast becomes the centre upon which new additions of the same substance take place, the grain enlarging and becoming rounded in a more or less irregular manner,¹ as in the case of concretionary substances like silica, for example, which forms moulds of fossils. We have already referred to the size of certain alleged grains of glauconite found in geological formations; even if it be admitted that these large-sized grains are single individuals, and not agglomerations of smaller grains, their occurrence might be explained by supposing them to have been formed in Gasteropods and other calcareous organisms larger than Foraminifera.²

All the probabilities appear, then, to be in favour of the opinion that this silicate is formed originally in the cavities of organisms, whose remains are deposited in the sediments of the sub-littoral and deeper zones of the sea. In the cavities and veins of rocks in process of decomposition, green substances are frequently deposited, which for a long time were confounded with glauconite. But chlorite and green earth, for example, which are formed in this way, are minerals widely different from glauconite, and their formation may be easily explained by taking into account the mineralogical and chemical changes going on in these rocks. The initial stages of the formation of glauconite in these shells are, in all probability, due to the action of organic matter, which incontestably influences the precipitation of some mineral substances. In this case it must be admitted that the organic matters, or the sarcode elements of the organisms fallen from the surface or living on the bottom, ought to remain in the interior of the shells, at least temporarily. After the death of the organisms their shells are slowly filled with the fine mud in which they are deposited. The existence of this organic matter in these cavities, and the absence of all other causes which might there induce the deposition of the silicates, in fact, the

¹ The increase by new additions of glauconitic material is indicated by the fact that in rare cases the glauconitic casts of Foraminifera shells are found entirely enveloped by subsequent depositions of that mineral. In such a case it must be admitted that after the glauconite has broken the chambers of the Foraminifera it has continued to play the role of centre of attraction, and that the same matter has been continually deposited around this nucleus, thus causing the primitive form of the cast to disappear.

² Gümbel, who does not admit that certain grains of glauconite have been moulds in organisms, because of their large size and regular form, without trace of organic impress, suggests the following interpretation:—He compares them with entoliths, and maintains that the gases disengaged by the decomposition of organic matters, contained in the sediments where glauconite is formed, play a role in the formation of these glauconitic granules. These gases are the hydrocarbons, carbonic acid, and hydrosulphuric acid, which form bubbles of different dimensions that remain a long time in the muddy deposits and attach themselves to the grains of sand or aggregates of the mud, grouping themselves in a varied manner. At the surface of these bubbles reactions take place, provoked by the action of the gas upon the bodies held in solution in the sea-water, and a deposit of these bodies takes place there; it is usually carbonate of lime and silica that are thus deposited, and in this case glauconite would form the crust around the bubble. If this crust be formed it will be filled by intussusception in the same solution that has given birth to the primordial glauconitic sphere. If they were bubbles of sulphuretted hydrogen, pyrites would be formed in them at the same time as the glauconite; if at the same time there were disengagement of hydrocarbons there would be formed in the presence of iron, magnetite (by reduction) similar to that found enclosed in the grains of glauconite (*loc. cit.*, pp. 435-439). We felt bound to notice these views, but everything connected with them appears very hypothetical.