

correlation when its probability density is given by

$$\frac{1}{2\pi\sigma_1\sigma_2\sqrt{1-\rho^2}} \exp - \frac{1}{2(1-\rho^2)} \times \\ \times \left\{ \left(\frac{x}{\sigma_1} \right)^2 + 2\rho \frac{x}{\sigma_1} \frac{y}{\sigma_2} + \left(\frac{y}{\sigma_2} \right)^2 \right\},$$

where s_1 , s_2 , r are estimates of σ_1 , σ_2 , ρ . Taking, for simplicity, $\sigma_1 = \sigma_2 = \sigma$, the axes of the error ellipse are found to be proportional to $\sigma\sqrt{(1+\rho)}$, $\sigma\sqrt{(1-\rho)}$. Making ρ tend to unity while σ approaches a finite limit means letting the ellipse shrink down to one of its axes as a line segment. The bivariate

population then degenerates into one with a single variate whose variance is easily found from the corresponding axis, while the other axis tends to zero length. But in order to represent the usual time series, the ellipse must degenerate in other ways, a simple example being $\rho \rightarrow 1$, $\sigma\sqrt{(1-\rho)} \rightarrow a$. Here, one of the two axes becomes infinite, the other remaining finite. The ellipse is then stretched out into two parallel lines. Without an entirely new definition, the "population correlation" here can only be taken as unity. Attaching the usual meaning to the r formula is, therefore, now out of the question.

COMMENSALISM IN SPONGES*

BY

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WELL-KNOWN examples of commensalism in the animal kingdom are found between crabs and sea-anemones. The sea-anemone *Adamsia* lives in association with a hermit-crab. The crab *Dorippe* carries a sea-anemone on the top of a bivalve shell which is mounted on its back and held in position by its hind pair of legs. But among the Krusadai littoral fauna are found instances of commensalism in siliceous sponges which being extraordinary deserve the special notice of naturalists.

(1) The sponge *Spirastrella inconstans* (Dendy) has imbedded in the outer portion of its body numerous cirripedes of the species *Balanus longirostrum* (Hoek). The sponge belongs to the family *Clavulidæ* of the order *Tetraxonida*. It is common all round the island, especially on the south-western side. The sponge is composed of a bunch of stout, erect, digitate processes springing from a basal mass. Its colour is light brown; and it is often washed ashore. The cirripedes evidently draw their supply of food through the current of water set up by the choanoflagellate cells of the sponge. The cirripedes have therefore to expend little or no energy in producing the current. In return the sponge probably gains mechanical support by the inclusion of the exo-

skeleton of the cirripedes. The sponge may also help itself to surplus food-material broken by the cirripedes into finely divided grains. The number of barnacles in a sponge is very variable; but on an average there are fifteen barnacles to thirty-five grammes of the sponge, thus showing that the barnacles are rather sparsely distributed.

(2) The sponge *Adocia dendyi* (Burton)¹ is another example; but here the commensal is an alga, *Ceratodictyon spongiosum* (Zanard).² Further, as this is an intimate association between an animal and a plant, it is an example of symbiosis. For the symbiotic life sunlight is necessary. As the host occupies shallow flats, sunlight can reach the alga and photosynthesis is possible, the alga liberating oxygen for the choanoflagellates from the carbondioxide supplied by the latter. The sponge belongs to the family *Haploscleridæ*, of the order *Tetraxonida*. The sponge is found all round the island within the one-fathom zone, and is frequently washed ashore by waves. The alga belongs to the family *Gracilariaceæ* of the group *Rhodophyceæ*. The sponge when fresh is light green in colour. In this case also, the sponge does derive some rigidity by the presence of the branching alga.

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¹ The sponge was identified Dr. by M. Burton, D.Sc., of the British Museum, London.

² The alga was identified by Prof. M. O. Parthasarathy Iyengar, University of Madras.