Since this interpretation is not in complete accord with other types of evidence an alternative explanation is here suggested.

The Suva formation and the conditions under which it was laid down have recently been described in a general report on the island of Vitilevu;[2] this volume includes a section on the smaller foraminifera by Dr. J. A. Cushman. The most recent publications dealing with the formation are a posthumous paper on echinoids by Dr. F. A. Bather[3] and a note on a fossil barnacle by T. H. Withers.[4] These two papers were in press when the general report on the island appeared. The Suva formation in its type area consists mostly of marls ("soapstones") with minor amounts of limestone and conglomerate. Cushman studied samples from two "soapstones" rich in foraminifera. He noted that the material was particularly rich in Lagenidae and this fact, judging from similar Recent faunas from the Philippines, indicated a depth of 100 to 250 fathoms. He also noted the almost complete absence of shallow-water Miliolidae and interpreted this to mean a depth of certainly more than 30 fathoms and in all probability considerably more. He stated that a depth of at least 150 to 250 fathoms seemed a fair estimate. Bather attempted to weigh all types of evidence and concluded that the "soapstones" were probably laid down in water not less than 150 fathoms deep and possibly much deeper. Withers described a fossil barnacle attached to the echinoids described by Bather. He stated that it evidently belongs to a Recent Malayan species which is known to occur at depths in excess of 285 fathoms.

Evidence which seems to oppose the above interpretations is found in the type section of the formation. This section includes a lenticular mass of conglomerate and limestone which is underlain and overlain by typical "soapstones." In the limestone are many heads of reef corals which are still in their original positions of growth. It is known that such corals do not flourish below a depth of 40 fathoms; in fact, so far as I can determine, no living colonies have ever been dredged from a depth greater than 50 fathoms. The coralliferous limestone of the type section grades laterally into foraminiferal limestone. Cushman, who examined a sample of this rock, wrote me[5] that it contained all large foraminifera belonging either to *Operculina* or *Operculinella* and that these indicated a depth of less than 30 fathoms.

[2] H. S. Ladd and collaborators, *Bernice P. Bishop Museum Bull.* 119, May, 1934.

[3] F. A. Bather, *Geol. Soc. Amer. Bull.*, 45: 799–874, Oct., 1934.

[4] T. H. Withers, *Geol. Soc. Amer. Bull.*, 45: 875–876, Oct., 1934.

[5] May 24, 1932.

The evidence detailed thus far may be explained in at least three different ways:

(1) It is possible that the conglomerate and the coralliferous limestone of the type section record a sudden elevation of the sea floor, followed by equally sudden subsidence. This interpretation seems improbable because the area concerned is so very small and because the lenticular mass of conglomerate and limestone in the type section is only one of a number of such masses in the Suva area. The other calcareous masses do not show the reef corals clearly in position of growth, but their fauna and lithology are so similar that it seems probable that all were deposited under similar conditions.

(2) The lenticular mass of the type section may represent a shallow water deposit on a high point of a sea bottom having considerable relief. This possibility is rendered improbable by the fact that over the entire Suva area the beds of "soapstone" are horizontal or show very gentle dips.

(3) A third interpretation takes into account the general distribution of Globigerina beds in the "soapstone" facies of the Suva formation. This facies, though widely distributed over the island, is best developed in the Suva area near the southeast coast. Even in this area only an occasional bed is as rich in Globigerinidae as were the two samples studied by Cushman. Most outcrops of "soapstone" contain but a few foraminifera and many are completely barren. The island lies in the belt of the Southeast Trade Winds and the rich foram beds, therefore, lie to windward. It seems probable that the formation as a whole was laid down in shallow waters—waters which, locally at least, did not exceed 50 fathoms—and that during periods of unusually heavy weather large numbers of pelagic foraminifera were washed in to form an occasional foram-rich layer.

This last explanation does not account for the barnacle described by Withers, but the evidence offered by the reef corals, whose depth range is so definitely limited, seems to outweigh this consideration. It may be that future collecting will extend the range of the barnacle into shallower waters.

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THE OCCURRENCE OF CUPULAE ON LATERAL-LINE ORGANS

A CUPULA similar to the cupula of the crista ampullaris of the vertebrate ear has been observed on the lateral line organs of *Fundulus heteroclitus*. This structure has been studied in living specimens as well as in fixed material.

The organs of Fundulus differ from those of many fish in that, with the exception of a small number in canals on the head, they are exposed on the surface of

the body. These superficial sense organs are circular hillocks projecting slightly above the surface and surrounded by moat-like depressions in the epidermis. They are typical sense-organs with central, pear-shaped sensory hair-cells and more peripheral, non-sensory, supporting cells. The latter possess striated surfaces and show well-marked terminal bars between their tips. Numerous mucous cells are present in and around the moat. On the surface of the organ is the cupula, an elongated cone of gelatinous material.

Live fish were immersed in a dilute solution of methylene blue in tap water over night in order that the sense organs might be more easily located. The cupulae were unstained in these specimens and were seen as projections from the surface of the blue-tinted lateral-line organs. The tip of the cupula, however, often appeared blue, because of the staining of adherent mucus and particles of dirt. The diameter of the cupula is about that of the free surface of the organ. They vary in length, sometimes being as long as they are wide, but more often three or four times their diameter. The shorter cupulae are of the consistency of a stiff jelly and are firmly attached to the summit of the organ. After their tips had been pressed to one side with a needle they quickly returned to a vertical position as if made of an elastic material. The longer ones were less stiff and swayed to and fro with the movements of the water. The material was transparent, but when examined in the fresh condition showed vertical striations throughout its length, *i.e.*, at right angles to the surface of the body. These striations were longer than any of the hairs observed on the lateral sense cells. The source of the cupular material was not definitely determined. The supporting cells gave no evidence of secretory activity, while the sensory cells frequently contained numerous granules. However, it was not possible to relate directly the presence of granules to cupula formation.

The occurrence of this structure was irregular. Many fish showed no cupulae. Frequently they were observed on some organs but were absent from others on the same animal, and in a few cases cupulae were observed on every lateral line organ on the surface of the body. In most instances they were found on animals which had been kept in fresh water for several weeks.

Fixed and stained cupulae were also studied. In most cases there was a small space between the outer surface of the organ and the inner surface of the cupula, as if the latter had shrunken during fixation. In sections at right angles to the surface of the body the longitudinal striations described above were visible, and occasionally delicate cross striations could also be seen. The latter were not as closely or regularly spaced as the longitudinal ones. Due to the shrinkage of the cupula, its normal relation to the tips of the cells could not be determined. In cross sections, *i.e.*, those parallel to the surface of the body, the longitudinal striae were shown to be the boundaries of minute spaces or canals in the cupular material. This is similar to the condition described for the crista ampullaris of the ear by Shambaugh and others.

Both in structural detail and in their characteristic association with a sensory epithelium, the cupula of the lateral-line organs in Fundulus and the cupula of the crista ampullaris are strikingly similar. The implications are obvious, especially in the light of the theory of the phylogenetic derivation of the inner ear from a portion of a primitive lateral-line system, and suggest further that the classical descriptions of the cupula of the ampulla are not entirely products of histological fixation as some recent studies imply.

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THE LIFE HISTORY OF A POULTRY CESTODE

AN ant, *Tetramorium caespitum* Linné,[1] has been demonstrated as an intermediate host for *Raillietina echinobothrida* (Mégnin, 1880), Railliet, 1921, a tapeworm of common occurrence in poultry. Cysticercoids, which were obtained from ants collected in a poultry yard of the Zoological Division, National Research Center, Beltsville, Maryland, were fed to 3 laboratory-reared chickens. These birds were fed, respectively, 15, 12 and 3 cysticercoids and at necropsy there were recovered, 10, 8 and 2 specimens of *Raillietina echinobothrida,* respectively. Except for these cestodes, both the infected birds and 4 controls were free of helminths. No nodules in the intestinal wall, which are frequently associated with *R. echinobothrida,* were present. One bird passed gravid segments in 19 days after the first feeding of cysticercoids and another passed segments 20 days after the feeding; the third bird was killed before the worms had completed development.

Cysticercoids which were measured as living material, not under a cover slip, were approximately ellipsoidal and varied from 338 μ by 193 μ to 384 μ by 272 μ in size. The larval scolex, enclosed by the cyst walls, was armed with hooks on the rostellum and on the suckers, the hooks being similar to those of the adult worm. Neither the 6 embryonal hooks nor a caudal appendage were observed. The cysticercoids were found in 12 out of 314 specimens of *Tetramorium caespitum* (approximately 4 per cent.) which were collected in the previously mentioned poultry yard

[1] Identified by Dr. W. M. Mann, Smithsonian Institution.