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Regulation of the hydrogen ion concentration and its relation to metabolism and respiration in the starfish.

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In the starfish *Pisaster ochraceus* and *Patiria miniata* the coelomic fluid was found to have a pH about 7.6, compared with the normal for sea water of 8.3. The pyloric caeca, which are naturally immersed in coelomic fluid, were found to have a pH of 6.7. All determinations were made colorimetrically and are given without correction.

Excised caeca, when suspended in a small amount of sea water, gradually altered the pH toward 6.7. Even when the sea water was changed from its natural pH by acidification and subsequent aeration till equilibrium was established, the caeca altered the pH to 6.7 when the water was initially at any pH between 8.6 and 6.3. An excellent criterion of survival of the caeca is presented by the persistence of ciliary activity of the epithelium. These cilia maintain their activity for about 48 hours on excised caeca where the initial pH of the medium is between 8.6 and 6.3. The optimum pH for survival is 6.7, the same as found normal for the caeca. If the pH was initially less than 6.3, the cilia soon ceased and the caecum disintegrated, and any caeca which fell below 6.7 were dying and approached 6.3 as the apparent natural point for disintegration.

Determinations of the rate of digestion of gelatine solutions introduced into excised caeca showed an optimum at about 6.7. The degree of digestion was followed by Van Slyke's method for amino-nitrogen, taking samples from the medium surrounding the caeca after the gelatine had been introduced. In the controls it appeared that scarcely any amino-nitrogen is produced naturally by the caeca in spite of the intense ciliary activity. As CO_2 is produced quite abundantly, oxidation of fat is suggested as the source of energy.

Using the pH change as a proper measure of CO_2, it was apparent that CO_2 production was most vigorous at pH about 6.7. In the more alkaline media CO_2 production is gradually diminished with further departure from this normal pH. Below pH 6.7 the production appears practically to cease, a condition coincident with rapid death.

The existence of an optimum condition of hydrogen ion concentration at a point different from sea water shows the existence in the organism of a regulatory process. In the production of this optimum either added HCl or the H_2CO_3 produced by its own metabolism is effective in securing the favorable condition. It appears from the fact that some of the favorable media were in equilibrium with the CO_2 of the air, while others contained a higher tension of CO_2, that the optimum point is not a matter of increased facility of CO_2 elimination because of the development of a greater CO_2 tension within the caeca. It is apparently a true optimum for CO_2 production by the tissue itself, irrespective of the particular conditions of CO_2 elimination.

24 (2547)

The carbonic acid-carbonate equilibrium in sea water.

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Ca, Mg, and CO_2 in sea water are the common constituents which are most variable in quantity. The condition of these substances is sensitive to the slight changes of the ocean, in con-