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Ion Intake in Valonia as Affected by HCl and CO_2.*

S. C. BROOKS.

From the Department of Zoology, University of California.

Living cells of *Valonia ventricosa* J. G. Ag. were placed in sea water acidulated to pH 5.2 with CO_2 or HCl. After 3 or 12 hours in these solutions groups of 7-11 cells were removed, and the K, Na, and Cl concentrations in the sap extracted from them were determined, and compared with the mean of those in the sap from 3 similar groups of untreated cells. The cells in each sample were selected so as to be of similar approximately uniform size. Excess CO_2 was removed from the sea water-HCl mixture before using it.

In no case was there any clearly demonstrated change during the first 3 hours, although the low value of K at this time in the HCl experiments may be significant.

Cells kept 12 hours in sea water-HCl mixture showed a 2.7% increase in K, and a 20% decrease in Na. These correspond to changes of 14 and 10 milli-equivalents per liter, respectively, and are more than double the mean variation between the individual groups of control cells. There was no significant change in Cl.

Cells kept 12 hours in sea water-CO_2 mixtures showed a 1.7% decrease in K and a 64% increase in Na. These corresponded to changes of 9 and 32 milli-equivalents per liter, respectively. The change in K, although too small to be considered significant when evaluated alone, probably represents a real change, since it accompanies an indisputable increase in Na. There was again no change in Cl.

Thus HCl led to an increase in K and a decrease in Na, while CO_2 had the opposite effect. The sea water acidulated with CO_2 differed

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from that acidulated with HCl principally in its higher content of CO_2 and HCO'_3: there was no significant difference in pH or in Cl' content. Experiments of M. M. Brooks[1, 2] indicate that similar differences in CO_2 and HCO'_3 and likenesses of pH probably prevailed in the sap of the cells throughout most of the experiment. The pH of the sap was observed to be close to that of the surrounding solution at the end of the present experiments also. These facts alone do not lead to any explanation of the observed changes of K and Na concentrations in the sap.

These changes can be explained in accordance with the writer's hypothesis of ion accumulation as a non-equilibrium condition involving ionic exchange,[3] if one assumes that decreased pH leads to a transient decrease in permeability to cations, which, at least in the presence of abnormally large concentrations of CO_2 (and) (or) HCO'_3, soon gives place to an increased permeability which ends in injury and death. Such a succession of changes in permeability to ions as a result of decreased pH has been shown for *Laminaria* by Osterhout.[4]

During the phase of decreased permeability to cations the rate of intake of Na would be retarded more than that of K, while those of Cl and H_2O would remain intermediate. K would therefore enter faster than H_2O and increase in concentration, while Na would enter slower than H_2O and decrease in concentration. This would lead to the situation found after 12 hours immersion of the cells in sea water + HCl. In sea water + CO_2, on the other hand, the secondary increase in permeability would have become established considerably before the end of the 12 hours, so that its effects, namely, an increase in the rates of intake of Na > Cl, H_2O > K, would have led to changes opposite to those just described, and resulted in conditions such as were actually found.

[1] Brooks, M. M., *Pub. Health Reports*, 1923, **38**, 1449.

[2] Brooks, M. M., *Pub. Health Reports*, 1923, **38**, 1470.

[3] Brooks, S. C., *Protoplasma*, 1928, **8**, 389.

[4] Osterhout, W. J. V., *J. Biol. Chem.*, 1914, **19**, 493.