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New quantitative observations on the penetration of acids and alkali bicarbonates into living and dead cells.

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Cells of the green alga *Valonia* from which cell-sap can be obtained free from contamination in sufficient quantities for accurate observation were placed in solutions of acids dissolved in sea water. The concentrations of acid were such so as to give a P_H of 3.6. At intervals cells were taken out and the H ion concentration of the sap noted. It was found that two sets of observation were necessary; one set comprised the H ion concentrations of the sap as it came from the cell and containing considerable free CO_2; the other when the free CO_2 was removed by thorough aeration by means of a stream of CO_2-free air. This method showed that normal cells have a P_H of 6.2 to 6.4 when CO_2 is present and 6.6 to 6.8 when CO_2 has been removed. The acids used could be divided into two broad classes with respect to their action on the cells: to the first class belong HCl, HNO_3, H_2SO_4, arsenic, phosphoric, tartaric, citric, oxalic, mono- di- and tri-chloracetic acids. To the second class belong acetic, butyric, benzoic and salicylic acids. All the acids of the first class increased the amount of free CO_2 in the cell-sap, presumably by decomposing the bicarbonates present. When the P_H of the cell-sap had reached 5.2 it remained stationary until no more CO_2 could be detected by the method, the time varying according to the acid used. Acids of the second class penetrated rapidly and produced little or no free CO_2 in the cell-sap. Acids of the first class appear to penetrate less rapidly than they actually do, because instead of existing free in the cell-sap they form neutral salts with the basic ions of the cell bicarbonates. The carbonic acid liberated in this process is so weak as to have relatively little effect on the P_H.

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Dead cells behave somewhat like living ones. In the case of acids of the first class, free CO_2 could be detected as in living cells: while acids of the second class penetrated dead cells at about the same rate and in apparently the same manner with reference to CO_2 liberation as in living cells.

The rate of penetration of an acid depends therefor upon the nature of the acid used. Previous investigators have neglected the fact that carbonate decomposition would delay changes in the H ion concentration of the cell; and have therefore been misled as to the rates of penetration of acids of the first class.

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Plants were also placed in sea water containing the following: (1) enough CO_2 to make the P_H 7.2; (2) $KHCO_3$, .03M; (3) $NaHCO_3$, .03M; the P_H of the last two solutions was 7.8. In all three cases free CO_2 accumulated rapidly in the sap, the P_H of which first became about 5.2 but later slowly increased and ultimately exceeded the normal. The P_H of sap from which the free CO_2 had been blown out was observed to have increased; and the longer the cells remained in the solution the more alkaline the CO_2-free sap became until finally a P_H of 8.6 had been reached. This process was quicker in the case of $KHCO_3$ than in that of $NaHCO_3$, possibly because K' penetrates more rapidly than Na'. The known preponderence of K' in the cell-sap of *Valonia* may be in part due to such selective permeability. When NaCl, KCl or KNO_3 were dissolved in sea water in the same concentration (.03 M) no such changes in P_H were noted. They are therefore characteristic effects of the penetration of HCO_3' into the cell. Details of this study will appear in a later journal.