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The penetration of arsenic into living cells[1].

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The purpose of these experiments was to study directly the penetration of arsenic into living cells. The organism used was the fresh water alga *Nitella,* which furnishes single cells several inches in length, whose contents may be easily expressed and analysed. Freshly collected cells only were used.

To determine whether there is any relation between H ion concentration and arsenic penetration ten .033 M phosphate buffer solutions were made up covering the range P_H 5.6 to 7.5, and at least twenty-five cells of *Nitella* placed in each of these for each experiment. After 24 hours counts were made of the number of cells still in good condition, *i.e.,* turgid and with cell sap clear and free from chloroplasts.

A series of similar experiments was performed in which arsenic in the form of atoxyl was added to the buffer solutions in sufficient quantity to make the concentration of atoxyl .05 M; and still another series in which a set of 0.05 M arsenate buffers was used (arsenic acid plus NaOH) having the same P_H range as the phosphate buffers. In each case the proportion of cells of *Nitella* still in good condition after 24 hours in the solutions was determined.

In both experiments with arsenic the sap of all the cells in good condition was expressed (precautions for preventing contamination being taken), a constant quantity (0.036 c.c.) incinerated, and the arsenic determined by the Gutzeit method, which is sensitive to about one micromilligram.

All experiments were conducted at laboratory temperature, which was usually not far from 20° C.

1. The influence of both hydrogen ions and buffer salt ions upon the condition of *Nitella* is shown by the facts that:

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a. In phosphate buffers of .033 M the proportion of cells surviving in good condition was greatest, (92 per cent.) at P_H 6.2, and decreased when the medium was more acid or alkaline.

b. When atoxyl (in .05 M concentration) was present the number of cells in good condition after 24 hours was greatest, (94 per cent.) at P_H 5.6, decreased gradually to 86 per cent. at P_H 6.4 and then suddenly to 6 per cent. at P_H 7.5.

c. Arsenate buffers (of .05 M) acted much like phosphate buffers, but showed a greater general toxicity: thus under the most favorable conditions (P_H 6.4) 80 per cent. of the cells survived in good condition as compared with 92 per cent. in the case of the phosphate buffers.

d. The optimum P_H for survival of *Nitella* when placed in either phosphate buffers or arsenic buffers was 6.2-6.4, and was not the same as the normal P_H of the cell sap of *Nitella,* which was found to be 5.7.

2. The conditions affecting arsenic penetration are illustrated by the experiments with solutions containing atoxyl, in which no arsenic penetrations was observed between P_H 5.6 and 6.4, while positive tests were obtained at all higher values of the P_H with a maximum of 22 mg. in 0.036 c.c. of cell sap at P_H 7.5, which was the most alkaline solution used.

3. The amount of arsenic in living (even though perhaps injured) cells was always considerably less than the arsenic content of the solution in which the cells were placed.

4. Dead cells, *i.e.,* those which were limp and with shrunken cell contents had an arsenic content approximately equal to that of the solution in which they were placed.

5. The cell walls were found to contain considerably more arsenic than the cell sap.

From these experiments it may be concluded that the penetration of the arsenic of atoxyl into the cell sap of *Nitella* is strikingly correlated with the H ion concentration of the suspension fluid. This apparent relationship between the H ion concentration of the suspension fluid and the penetration of arsenic may possibly be due to (1) an influence of the H ion concentration upon the dissociation of atoxyl, or (2) changes in the permeability of the cell for arsenic due to the action of either buffer ions or H ions.