



THE IONIC RELATIONS OF CHAETOMORPHA DARWINII  
(HOOKER) KUETZING

by

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This thesis contains no material which has been accepted for the award of any other degree or diploma in any University. To the best of my knowledge no material has been included which has been written or published by another person except where due reference is made in the text.

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## SUMMARY

Chaetomorpha darwini is a marine green alga with large coenocytic cells and is suitable for ion permeability experiments.

The movement of sodium and potassium ions across the cell boundaries was studied. An analysis of the rate at which isotope diffuses out of the tissue shows three distinct phases in series and this is consistent with the model suggested for the Characean cells. An analysis of each compartment of the cell was made and the metabolic inhibitor DNP was used to elucidate the active and passive fluxes.

Using a microelectrode technique it was found that the vacuole was  $-35$  mV and the cytoplasm was  $+10$  mV relative to the external solution. The coenocyte of Chaetomorpha thus has a significant potential difference across the tonoplast.

A range of metabolic inhibitors was used to trace the source of energy used in the ion transport. In Chaetomorpha energy for ion transport appears to be derived from ATP or ATP mediated reactions.

## SYMBOLS USED

$a$	Ion activity coefficient
ATP	Adenosine tri phosphate
ADP	Adenosine di phosphate
$C$	Concentration of ions (m.equiv./l)
DNP	2-4 di nitro Phenol
$E_M$ or $E_J$	Transmembrane potential (mV) for any ion (j) from Nernst equation
$F$	Faraday's constant
$F_3$	Free space
$k_1$	Rate constant for exchange of ions from Cytoplasm
$P_1$	Permeability constant <sup>1</sup> of plasmalemma
$R$	Universal gas constant
$S_0$	Specific activity of the external solution (counts/min/10ml)
$S_2$	Specific activity of the cytoplasmic phase
$S_3$ or $S_V$	Specific activity of the vacuole
$Q_0$ or $Q_2$	Amount of ion in the vacuole (m.equiv./kg)
$Q_C^k$	Amount of isotope in cytoplasm (counts/min/10ml)

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$$^1 P_1 \text{ defined as } \beta_1 = P_1 \frac{\ln \exp E_1 F / RT \cdot C_2}{1 - \exp E_1 F / RT}$$

where  $C_2 = 600$  m.equiv./l

$T$	Absolute temperature ( $^{\circ}\text{K}$ )
$t$	Period in solution
$t^{\frac{1}{2}}$	Time for half exchange of isotope from a compartment
$z$	Charge on the ion
$\phi_1$	Fluxes between free space and cytoplasmic phase (net flux = zero)
$\phi_2$	Fluxes between cytoplasmic phase and vacuole (net flux = zero)