LETTERS TO THE EDITORS

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IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

Osmotic Regulation in Freshwater Animals

It has recently been shown that both brackish- and fresh-water animals can actively absorb ions from the external medium against a considerable concentration gradient. Most fresh-water animals can do so from solutions as dilute as normal fresh-

remote. Experiments with *Gammarus duebeni* lead to the same conclusion. This species is found in brackish water in most parts of Britain, but in some western districts it has invaded fresh-waters and it is the principal freshwater species of Ireland. Animals from brackish water rapidly lost chloride and died in distilled water, but the freshwater variety was resistant for at least four days (extent of experiment) and, after an initial loss, maintained a fairly constant blood chloride (see graph).

It is evident that an increase in the efficiency of a retention mechanism is mainly responsible for the adaptation of *G. duebeni* to fresh-water. The brackish water variety will live indefinitely, not only in 2 per cent sea water, but also in the same concentration of pure sodium chloride. Thus the power to retain ions other than Na^+ and Cl^- is well developed. Finally, we would quote experiments on the freshwater crustacean *Asellus aquaticus* (unpublished), which was unaffected by treatment for eight days with distilled water, and on the mosquito larva *Aedes*

waters¹. Krogh has suggested that in some cases, during periods of enforced starvation when salts are therefore not available from food, this mechanism is of survival value in maintaining the normal ionic and osmotic concentration of the blood¹. In a recent paper² on the euryhaline crab *Carcinus maenas*, Webb has gone further than this in assuming that "the active absorption of salts forms the basis of the osmoregulatory mechanism, not only in freshwater forms, but also in brackish water forms, including the euryhaline Crustacea". Without criticizing his conclusions as applied to *Carcinus*, we wish to point out that some experiments which we have carried out on brackish and freshwater species of *Gammarus* suggest that active absorption of ions from the medium is not of such universal importance as is implied in the above sentence.

The freshwater *Gammarus pulex* survived in a healthy condition when individuals were isolated and starved for at least eight days in glass-distilled water (changed twice daily). During the first two or three days there was a reduction in the blood chloride level, which thereafter remained relatively constant (see accompanying graph). Under these conditions, the possibility of absorption from the medium being excluded, retention of salts must be the predominant factor, for, as Webb points out, the possibility of the tissues possessing a store of chloride is extremely

detritus, which can live for long periods in distilled water, pure sodium chloride and glycerol solutions³.

We have also found that *Gammarus pulex* and *G. duebeni* can actively absorb chloride from the external medium, but our experiments with distilled water show that this is not an essential part of the osmoregulatory mechanism. There is, in fact, no direct evidence that any freshwater animal is dependent upon salt absorption from the medium for the maintenance of an adequate concentration and composition of its blood.

We hope to publish these experiments in detail when we have the opportunity to extend and complete them.

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¹ Krogh, A., "Osmotic Regulation in Aquatic Animals" (Cambridge 1939).

² Webb, D. A., *Proc. Roy. Soc., B*, 129, 107 (1940).

³ Beadle, L. C., *J. Exp. Biol.*, 16, 346 (1939).