Minisymposium: Metal Ion Transport and Accumulation in Living Organisms

Convener: W. SCHNEIDER; Zurich, Switzerland

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The Transport and Accumulation of Metal Ions in Living Organisms

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The fundamental chemistry involved in the uptake of metal ions by biological systems is well recognized by now [1]. It is an operational necessity of bioinorganic research to separate problems such as the capture of ions, their transport to the final site, and their function. However, the ultimate goal is certainly the elucidation of complete cycles with respect to the fate of metal ions in all the compartments of a biological system and its environment. We are faced with a vast variety of organisms on one hand and a rather restricted series of metal ions on the other hand.

Copper, calcium, and iron are chosen here to represent chemically widely different metal ions for which characteristic pathways emerged from evolution. In natural water systems the overall concentration level drops in the series $Ca \gg Fe > Cu$. Actually, biological processes exert a significant perturbation on the fluxes of copper in aquatic eco-systems as outlined in the first paper (P. Baccini and D. Piemontesi). The work reported includes a thorough study of selected peptides and their complex formation. The results are revealing with regard to copper–protein interaction. At this conference, this contribution may well be one of the few which is directed towards the full cycle linking an eco-system via phytoplankton to small molecules.

The capture of calcium ions does not raise problems with respect to abundance or hydrolysis. However, the regulation of local concentrations and fluxes are crucial problems in cells (E. Carafoli). Much work has been devoted to the molecular requirements for selective complex formation of Ca^{2+} (*viz.* minisymposia, Nos. C and H).

The biochemistry of iron is largely governed by the competition of biogenic ligands with hydroxide, *i.e.* hydrolysis, which yields solid oxide-hydroxide phases as the limiting product. There are arguments which support the idea that in intracellular iron transport, a symbiotic effect operates whereby delayed hydrolysis secures the passage of iron from the cell membrane to the storage protein ferritin [2]. The latter has been recognized as an ingenious device to encapsulate ferric hydroxide in cells [3, 4]. The dissolution of ferric hydroxide operates at both ends, *i.e.* in the mobilization of iron from stores, and in the uptake of iron by, *e.g.*, microbes. Spectacular mechanisms of iron acquisition via powerful chelating ligands, such as siderophores and enterobactin, were detected about a decade ago. The third contribution (A. Bindereif, P. E. Thorsness and J. B. Neilands) provides deep insight into the molecular genetics of induction and repression of iron transport pathways in microbial systems. The study pushes the elucidation of mechanisms to a sensational limit. Transferrins are ubiquitously involved in iron transport in vertebrates [5]. The mononuclear binding of ferric ions to the protein provides a safe protection from spontaneous hydrolysis. The two-sited nature of transferrin (P. Aisen) has raised even more severe questions than the structure of the sites and the ligand groups of the chromophore. The work presented here provides a splendid case of *in vitro* and *in vivo* studies which complement each other. It is hoped that in the discussions attention will be given to this point with regard to all the contributions.

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3 P. M. Harrison, G. A. Clegg, and K. May, 'Iron in Biochemistry and Medicine II'. Eds. A. Jacobs and M. Worwood, Chapter 4. Academic Press, London, 1980.
4 R. R. Crichton, 'Transport by Proteins', p. 243–255. Eds. G. Bauer and H. Sund. Walter de Gruyter, Berlin, 1978.
5 P. Aisen, *Ann. Rev. Biochem., 49,* 357–393 (1980).

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The Role of Peptides in the Copper Transport of Aquatic Ecosystems

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The flux of copper through an aquatic ecosystem is controlled by three types of processes, namely

(a) hydrodynamic mixing and particle transport (physical processes)

(b) abiotic transfers from dissolved to particulate phases and *vice versa* (purely chemical processes)

(c) biological processes (*e.g.* assimilation, excretion, decay)