

Given those considerations, it seems whimsical not to evaluate the potential role of nuclear energy in the future global energy equation. In the present public climate of almost religious fervor against nuclear power plants, there seems little chance that dispassionate analysis will be undertaken except within the scientific community. We have a responsibility, as always, to review such issues without regard to current political trends.

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Intrachain Calcium Binding

In the introduction of their article about vitamin K and energy transduction, Paul Dowd *et al.* (22 Sept., p. 1684) discuss the role of γ -carboxyglutamic acid (Gla) in serine proteases involved in blood coagulation. They outline a mechanism whereby Ca^{2+} ions anchor the proteins to cell membranes by means of ion bridges involving Gla side chains on the proteins

and negatively charged phosphate head groups on the phospholipid membrane surface, a hypothesis that has been favored for a long time.

Recent studies have cast new light on the mode of interaction of Gla-containing proteins with biological membranes. We have found (1) the side chains of the Gla residues to be exposed on the surface of the protein and a cluster of three hydrophobic amino acids in the interior of the protein (2). Upon Ca^{2+} binding, the Gla residues fold into the core of the domain where they ligate Ca^{2+} ions in a cooperative manner. This leads to the exposure of the hydrophobic amino acids (Phe⁴, Leu⁵, and Val⁸ on bovine factor X) that in the Ca^{2+} -free form are "hidden" in the interior of the Gla domain (3). These experiments, as well as other pieces of evidence, makes it seem likely that the reversible interaction of Gla-containing coagulation factors entails a significant component of hydrophobic interactions.

The role of Ca^{2+} in epidermal growth factor (EGF) domain-containing coagulation factors is even more complex, as a single Ca^{2+} ion, bound with five ligands from the EGF domain and one or two from an adjacent Gla domain, orients the Gla and EGF domains relative to each other in a manner commensurate with biological activity.

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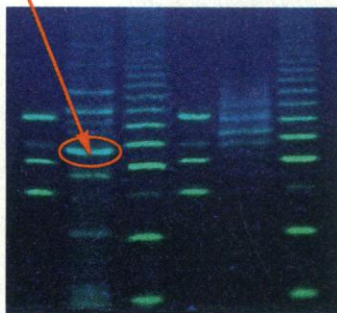
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