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This Week's Citation Classic

Marcus A & Feeley J. Activation of protein synthesis in the imbibition phase of **seed** germination. *Proc. Nat. Acad. Sci. US* **51**:1075-9, 1964.

Intact seeds and isolated seed embryos undergo a striking increase in capacity for protein synthesis shortly after exposure to water. Analysis of the system shows that the protein synthesis apparatus is functional in the ungerminated seed and that imbibition serves to make available the necessary messenger RNA. [The *SCI*® indicates that this paper was cited 126 times in the period 1964-1977.]

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"In the early 1960's when I was in the employ of the US Department of Agri culture at Beltsville, Maryland, my task was defined in terms of obtaining fundamental information on processes important to the germination of seeds. About this time there began to evolve a general recognition among cell biologists that major changes in the capacities of cells to grow must involve a control over the ability to synthesize macromolecules. Some general methodology had been developed for preparing broken-cell preparations from bacteria and mammalian cells and testing these for their ability to synthesize proteins. We made a number of modifications in these methods and applied them to dry seeds and to seeds at early stages of germination. The results were striking and showed that the capacity for protein synthesis was essentially nil in the dry seed and reached a very substantial level early after exposure to water. An important feature of the early work was a suggestion given to me by Louis Shuster, now Professor of Biochemistry at Tufts University College of Medicine. Learning of our results with intact seeds, he told me about a system developed by Herbert Stern (now Professor of Biology at the University of California, San Diego) for isolating large quantities of viable embryos of wheat seeds. Since the wheat embryo, on a unit weight basis, is an order of magnitude more active than any intact seed, it became possible to analyze the system in detail.

"We now know that the activation process entails bringing together a population of preformed messenger RNAs and a preformed system for translating these messenger RNAs. The process is an attractive prototype for any biological system undergoing a rapid change in its rate of metabolic function and is often cited in this context.

"Perhaps of greater significance is that the definition of the system in terms of its messenger-RNA translating potential has led to its widespread use for the analysis of the relation between a structural gene and the ultimate protein product for which it codes. Rarely has a plant system proved to be of such analytical value in eucaryotic biochemistry."