

Classics

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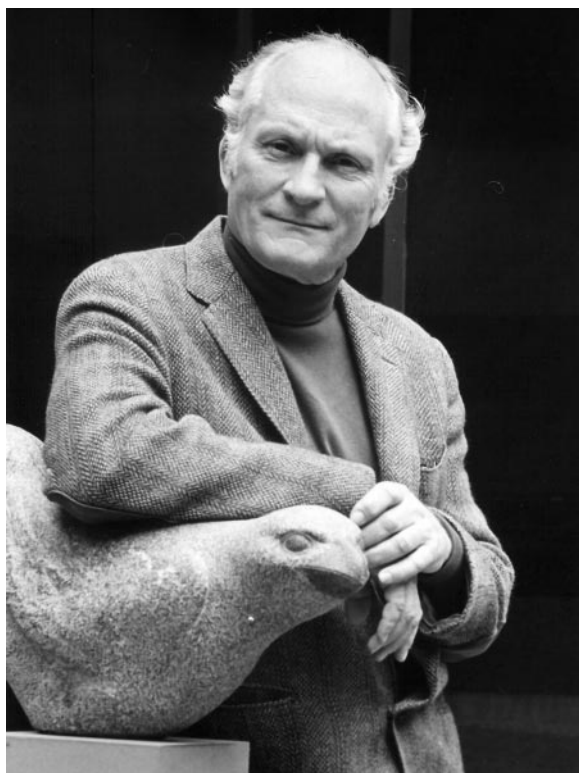
JBC Centennial 1905–2005

100 Years of Biochemistry and Molecular Biology

The Mechanism of Amino Acid Activation: the Work of Mahlon Hoagland

Enzymatic Carboxyl Activation of Amino Acids

(Hoagland, M. B., Keller, E. B., and Zamecnik, P. C. (1956) *J. Biol. Chem.* 218, 345–358)



Mahlon Hoagland

Mahlon Bush Hoagland was born in Boston, Massachusetts in 1921. He attended Harvard University and graduated in 1943. Knowing that he wanted to be a surgeon, Hoagland then enrolled at Harvard Medical School. However, he was diagnosed with tuberculosis, and his poor health prevented him from becoming a surgeon when he received his M.D. in 1948. Instead, he accepted a research position at Massachusetts General Hospital. In 1953, he became a postdoctoral fellow with *Journal of Biological Chemistry* (JBC) Classic author Fritz Lipmann (1) at Huntington Laboratories (also at Massachusetts General Hospital), and a year later, he moved to an adjoining laboratory to work on protein synthesis with JBC Classic author Paul Zamecnik (2).

Inspired by Lipmann's insights into acyl activation mechanisms, Hoagland used a cell-free system created by Zamecnik that carried out net peptide bond formation using ^{14}C -amino acids (3) to uncover the mechanism of amino acid activation. As reported in the JBC Classic reprinted

here, he isolated an enzyme fraction that, in the presence of ATP and amino acids, catalyzed the first step in protein synthesis: the formation of aminoacyl adenylates or activated amino acids. Using data from analysis of this fraction, Hoagland presented a scheme for amino acid activation in his Classic paper.

A few years later, Zamecnik and Hoagland discovered a molecule that is essential for protein synthesis: tRNA. This discovery is the subject of the Zamecnik Classic (2).

After the discovery of tRNA, Hoagland spent the next year (1957–1958) at Cambridge University's Cavendish laboratories working with Francis Crick. During that year he traveled to France to visit the Institute Pasteur in Paris. Experiments begun at the Institute would, by 1960, lead to the discovery of messenger RNA (mRNA).

When he returned to the United States, Hoagland was appointed associate professor of microbiology at Harvard Medical School. He remained there until 1967 when he accepted a position as professor at Dartmouth Medical School. In 1970, he became the director of the

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Worcester Foundation for Experimental Biology, a Massachusetts research institute founded by his father. He retired in 1985 and currently lives in Thetford, Vermont.

Hoagland has received several awards and honors in recognition of his contributions to science. These include the 1976 Franklin Medal, the 1982 and 1996 Book Awards from the American Medical Writers Association, and membership in the American Academy of Arts and Sciences and the National Academy of Sciences.

Nicole Kresge, Robert D. Simoni, and Robert L. Hill

REFERENCES

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2. JBC Classic: Hoagland, M. B., Stephenson, M. L., Scott, J. F., Hecht, L. I., and Zamecnik, P. C. (1958) *J. Biol. Chem.* **231**, 241–257 (<http://www.jbc.org/cgi/content/full/280/40/e37>)
3. Zamecnik, P. C., and Keller, E. B. (1954) Relation between phosphate energy donors and incorporation of labeled amino acids into proteins. *J. Biol. Chem.* **209**, 337–354