

This Week's Citation Classic®

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Schwartz A, Lindenmayer G E & Allen J C. The sodium-potassium adenosine triphosphatase: pharmacological, physiological and biochemical aspects. *Pharmacol. Rev.* 27:3-134, 1975.

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This review covered pharmacological, biochemical, and physiological aspects of Na,K-ATPase (NKA) from its discovery in 1957 to 1974. The evidence appeared to favor a receptor function for digitalis [The *SCI*® indicates that this paper has been cited in over 645 publications since 1975.]

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It is of interest that this article and our paper of 1968¹ have been selected as *Citation Classics* this year. It was exactly 200 years ago (June 1785) that Withering's superb treatise on the foxglove was published.² In 1973, Robert F. Furchgott, chairman of the department of pharmacology at Downstate SUNY, from which I graduated in 1961, suggested that I write a review on Na,K-ATPase (NKA). I was honored that a renowned scientist made such a request of a former graduate student. To undertake such a solo task even 10 years ago, when already there were over 1,000 literature references, seemed insur-

mountable. I asked two of my former fellows and colleagues, Julius Allen and George Lindenmayer, to collaborate with me. We presented an outline to the editor of *Pharmacological Reviews*, George Acheson, who was chairman of the department of pharmacology at the University of Cincinnati, a department that I would chair in 1977. George, Julie, and I divided the task approximately in thirds. We enjoyed the rigors of evaluation and interpretation and the final selection of 729 references that we felt gave a balanced view of knowledge some 17 years after NKA's discovery by J.C. Skou.³ Since the three of us were and still are primarily pharmacologists, we naturally sought to emphasize possible significance as a receptor for digitalis. Hopefully, this has been borne out by more recent contributions.^{4,5}

The significance of a review is always hard to judge. There have been and continue to be reviews published on this topic almost every year, and all are excellent. Perhaps the number of citations merely reflects a 10-year period in which this enzyme system has enjoyed tremendous interest and popularity in the very areas that were covered by the review—physiology, biochemistry, and pharmacology. I am extremely grateful to Allen and Lindenmayer, who have enjoyed highly productive careers. We continue to remain close colleagues and good friends. In this, the bicentennial year of the foxglove, it is a distinct honor to have this review selected, particularly because it occurs at about the same time that the complete amino acid sequence of the α subunit of NKA containing the digitalis site has been announced.⁶

- 1 Matsui H & Schwartz A. Mechanism of cardiac glycoside inhibition of the $(\text{Na}^+ - \text{K}^+)$ -dependent ATPase from cardiac tissue. *Biochim Biophys Acta* 151 655-63, 1968 [See also Matsui H & Schwartz A. *Citation Classic Current Contents/Life Sciences* 28(31) 19, 5 August 1985.]
- 2 Withering W. *An account of the foxglove and some of its medical uses with practical remarks on dropsy, and other diseases* Birmingham, England. Printed by M. Swinney for G.G.J. and J. Robinson, 1785. 207 p.
- 3 Skou J C. The influence of some cations on an adenosine triphosphatase from peripheral nerves. *Biochim Biophys Acta* 23 394-401, 1957. (Cited 1,230 times.)
- 4 Wassterstrom J A, Schwartz D J & Fozzard H A. Relation between intracellular sodium and twitch tension in sheep cardiac Purkinje strands exposed to cardiac glycosides. *Circ Res* 52 697-705, 1983.
- 5 Grupp I, Im W B, Lee C O, Lee S W, Pecker M S & Schwartz A. Relation of sodium pump inhibition to positive inotropy at low concentrations of ouabain in rat heart muscle. *J Physiol—London* 360 149-60, 1985.
- 6 Shull G E, Schwartz A & Lingrel J. Amino acid sequence of the catalytic subunit of the sodium-potassium ATPase deduced from a cDNA. *Nature*. In press, 1985.