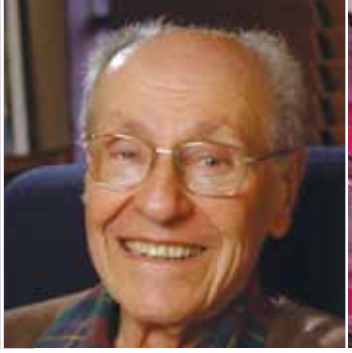

Melvin Cohn

Professor
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"The immune system is a complex of organs—highly specialized cells and even a circulatory system separate from blood vessels—all of which work together to protect the body from invading pathogens. Unlike most immunologists, who wield pipettes and petri dishes, I use computers to bring order to what might well be one of biology's most complex fields."

Unable to predict which of the diverse array of pathogens it will encounter, the immune system must nevertheless respond promptly to defend the host organism from that invader. Complicating matters, pathogens evolve at a rate that is vastly more rapid than that of their invertebrate hosts. Cohn's solution was to establish a set of basic immunologic rules based on the immune system's evolutionary origins.

Invertebrates invented a number of biodestructive and ridding mechanisms to deal with pathogens, but their limited flexibility was not enough to keep up with the rapidly changing landscape of disease-causing agents. This created a selective pressure to invent a mechanism that generated a large and random repertoire of molecules able to recognize foreign invaders, which in turn required two new regulatory mechanisms: 1) a somatic decision mechanism to sort the repertoire into anti-self (the portion that needs to be inactivated to avoid autoimmune diseases) and anti-nonself (the activated portion that is now available to recognize invading pathogens and protect the host) and 2) a germline-selected decision mechanism to control the kind and magnitude of the immune response.

The rules Cohn developed cover most of immune behavior: *the Combinatorial Theory* of the nature of the repertoire, the *Associative Recognition Theory* of the Self-Nonself discrimination, *Trauma Theory* for the determination of the magnitude and effector class of the response, *the B-Protecton Theory* of humoral responsiveness, and *the T-Protecton Theory* of cell-mediated responsiveness. These theories are linked together by a computer program based on cellular automata principles (i.e., *SIS,* the *Synthetic Immune System*). Available online, the synthetic immune system allows Cohn and others to test their assumptions about how the real immune system works, facilitating understanding and predictability.

While understanding how the immune systems functions is Cohn's primary goal, being able to predict the consequence of any given antigenic input would be an invaluable guide for the development of new vaccines, the treatment of autoimmune and allergic disorders, as well as the enhancement of the body's response to infectious disease.

For more information, please visit
salk.edu/faculty/cohn.html