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BIOMEDICAL PERSPECTIVES OF AGGLUTININS OF INVERTEBRATE AND PLANT ORIGINS *

Editor

ELIAS COHEN

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ELIAS COHEN AND G. UHLENBRUCK

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* This series of papers is the result of a conference entitled Conference on Biomedical Perspectives of Agglutinins of Invertebrate and Plant Origins, held by The New York Academy of Sciences on May 21, 22, and 23, 1973.

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INTRODUCTORY REMARKS

Elias Cohen

*Department of Laboratories
Clinical Immunology and Immunohematology
Roswell Park Memorial Institute
Buffalo, New York 14203*

Landsteiner, in his classic treatise "The Specificity of Serological Reactions," published in 1936, stated that "the action of plant agglutinins is not limited to a single substrate yet to some extent, selective, has not commanded much attention in spite of its theoretical interest. The agglutinins are occasionally referred to in the literature as nonspecific, and for this reason, as well as the scarcity of the reliable data, the following experiments are presented." He then presented hemagglutination experiments with extracts of bean and lentil that were tested with rabbit and pigeon erythrocytes, and extracts of ricin that were tested with horse and pigeon red cells. Variations were observed in the titers of the pigeon red cells, in that they were not agglutinated with ricin, or showed a very low titer. He also stated that there were distinct differences in the binding capacities of the agglutinins.

Since the reactions could be termed specific, he felt it was adequate to define serological specificity as "the disproportional action of a number of similar agents on a variety of related substrata." He also then stated that, depending upon the number of substances acted upon, and the relative strength of the reactions caused by one reagent, one can distinguish differences in their range of activity and degree of specificity.

The definition included as the limiting case the specificity of immune antibodies which, "highly although not completely selective because of their origin, are uniquely related to one substance and although applicable to many chemical reactions, it serves to distinguish serological effects from apparently similar ones." Since the time of that statement, a host of workers throughout the world have described protein agglutinins from other parts of plants, such as roots, leaves, and vines.

Since the earliest investigations into blood group antigens, there has been an interest in the ability of extracts from plants to produce hemagglutination. Invertebrate animal species were also found to possess hemolymph, with agglutinins that could clump a variety of animal cells and with specificity for human erythrocyte blood groups.

Generally these agglutinins have not been thought to be produced by a mechanism similar to antibody production. The defense functions of invertebrate agglutinins such as parasite immobilization and bacteriocidal, antiviral, or protective activity have been investigated extensively. Noguchi, in 1903, was the first to call attention to the agglutinins present in the serum or hemolymph of *Limulus polyphemus*, the horseshoe crab. No interest was shown in *Limulus* until the recent independent description and investigations by some American workers. These included the isolation of the agglutinins by Edelman and colleagues, who characterized the physical properties of the agglutinin. In Germany workers such as Procop and Uhlenbruck initiated studies on cellular

agglutinins from snails, producing a voluminous literature as a result of their investigations.

Lectins in invertebrate agglutinins have primarily been studied by means of serological reactions: that is, the agglutination of red cells. Some are specific for human blood groups ABO and MN; others are mitogenic. The field of cytogenetics has been expanded as a result of the study of lectins, with a resultant increase in the understanding of relationships between chromosome abnormalities in animal and human diseases.

Lectins bind mono- and oligosaccharides specifically, and precipitate polysaccharides and glycoproteins. This has recently become useful in the isolation and purification of carbohydrate-containing polymers, and the study of their chemical structure. Recent reports of lectins that are specific for tumor cells have caused an explosion of interest among scientists engaged in cancer research. Lectins are frequently toxic to animals. Therefore they are of interest in relation to the poor nutritive value of certain plant proteins. The field of biology in medicine is infused with research into lectin or invertebrate agglutinins. Some pioneers in these areas of study have written papers for this monograph.