the corps began, he says, there were slots for 27,000 youths. Now, the Government claims that it is retraining 600,000.

The shift of Headstart to HEW will place it squarely under the control of Secretary Robert H. Finch, who is the President's closest political ally.

Finch has incorporated Headstart into a new Department of Child Development, and is now looking for someone to head it. The top contender is said to be Jules Sugarman, a highly regarded former Headstart executive.

IMMUNOGLOBULIN

Deciphering a giant

The mighty immune system that wipes out invading bacteria, protects against cancer and rejects transplanted hearts is primarily in the business of recognizing three-dimensional shapes. When it spots an intruding shape—a foreign antigen such as a virus or bacterium or abnormal cell—it makes antibodies (proteins) to carry it away.

Gamma globulin or immunoglobulin is the protein watchdog that is the key to immunity. Unlike other proteins it comes in a vast array of shapes. It has a 1,320 amino-acid chain, 19,996 atoms, a molecular weight of 150,000.

After 12 years' effort, it has finally been analyzed, but in what amounts to only two of its three dimensions.

Scientists at Rockefeller University have deciphered one immunoglobulin, learning in exactly what order its amino acids are strung together. Amino-acid sequence determines an antibody's shape. Its shape determines its ability to recognize an antigenic shape, and that is what makes the system run. But the shape is the third and still unknown dimension.

"If we could really understand the three-dimensional architecture of an antibody-antigen combination," says Dr. Gerald M. Edelman, who headed the Rockefeller team, "we could perhaps design a drug to control it."

Currently, Dr. Edelman and others are trying to produce pure crystals of immunoglobulin that, when submitted to X-ray crystallography, will reveal the protein's full three-dimensional structure, showing precisely how its 1,320 amino-acid chain is organized in space.

In his sequence studies, reported at the meeting of the Federation of American Societies for Experimental Biology in Atlantic City last week, Dr. Edelman used homogeneous immunoglobulin drawn from a patient with multiple myeloma, a cancer of antibody-producing white blood cells. Immunoglobulin molecules, he observes, contain two different types of subunits or poly-

peptide chains (a polypeptide is a comparatively small string of amino acids) —two identical light chains contain 214 amino acids each; two identical heavy ones contain 446 amino acids each. Both light and heavy chains contain constant regions and variable regions: that is, regions in which the amino-acid order is fixed from immunoglobulin to immunoglobulin, and regions in which it varies.

"The variable regions," the 39-year-old biochemist explains, "permit an enormous number of combinations with antigens." These variable regions are in charge of the immune system's recognition function. The constant regions of the immunoglobulin molecule are responsible for eliminating an antigen once it has been recognized.

The variability among immunoglobulins or antibodies is enormous. In light chains, the position of 108 amino acids can change; in heavy chains, 115 are variable. Thus there are possibilities for multibillions of antibodies.

Dr. Edelman believes that the body contains a vast library of antibodies of various shapes ready to recognize any antigen that comes along. He contends that the idea that antibodies are formed from scratch when an antigen appears is "dramatically not true. What is true is that we have all the information in our bodies already in the form of a multiplicity of antibodies."

Antibodies sit on the surface of cells. If one happens to meet an antigen it recognizes, the two combine like pieces of a jigsaw puzzle, and the cell is triggered into division, producing a large amount of antibodies where there was little before. The newly produced antibodies then circulate through the blood, seeking the intruding antigens.

Dr. Edelman's research appears to confirm previous hypotheses that the amino-acid chains forming the giant immunoglobulin molecule were once, in evolutionary history, small antibodies themselves. In spite of variability within the four chains of the giant molecule (the largest molecule to be so chemically analyzed), striking similarities between them suggest that, once the abbreviated chains defended early forms of life, and hooked together in a more powerful single antibody as living organisms evolved.

Each chain, studies suggest, is coded for by two genes, a V gene for the variable region, and a C gene for the constant region. "We suppose," Dr. Edelman says, "that the V gene and the C gene fuse to become one VC gene. This allows each antibody-producing cell to make only one kind of antibody molecule out of the many different types which it could synthesize from the information it contains."