laser and atomic physics division, admits, "We don't understand this yet." In the case of etching, the discharge-generated plasma species are probably reacting with surface atoms to create volatile products that evaporate, leaving vacancies behind. But the chemistry of both the deposition and etching processes is far from being understood.

Johnson, however, is enthusiastic about the flexibility and efficiency that plasma-initiated laser deposition seems to promise. He sees the possibility of designing a table-top unit for chip manufacture, one in which a single laser can both deposit and etch films as required while different gases are introduced to form the various layers and provide the necessary doping ingredients. He says such a system could be used for creating a small number of special-purpose chips by using the laser to "write" the needed patterns on a chip or for mass producing chips by shining the laser light through patterns or "masks."

Laser processing combined with some form of chemical vapor deposition would considerably simplify the manufacture of integrated-circuit chips. Normally, to create circuitry, a silicon wafer with an insulating coating, or in some cases, a metallic film, must be covered with a polymeric material called a "photoresist," which reacts to ultraviolet light. Light passing through an electron-etched mask strikes the resist, hardening it. Solvents remove the unexposed resist, and acid etches the unprotected surface to create the circuits. Finally, the remaining resist is removed. As each layer of material is added, this set of operations must be repeated. The Sandia process, if successful, would eliminate the messy resist stage and do away with much of the apparatus needed for chip manufacture.

Researchers at the Lawrence Livermore National Laboratory in Livermore, Calif., are working on a similar scheme. Recently, they demonstrated that direct laser writing alone was capable of inscribing transistors and somewhat more complicated circuits on silicon chips. Their process begins with a wafer of silicon coated with an insulating silicon dioxide layer. Silane gas introduced into a vacuum chamber decomposes where the laser is focused on the wafer surface to form spots of silicon. Other gases allow the etching of the silicon dioxide layer to unveil underlying silicon, the doping of exposed silicon with phosphorus to change its conductivity and the deposition of tungsten metal tracks to complete the circuit.

Work on chemical vapor deposition is also going on at the Massachusetts Institute of Technology's Lincoln Laboratory in Cambridge, where Thomas F. Deutsch and his colleagues used the technique to fabricate solar cells. An ultraviolet laser beam causes boron trichloride gas to dissociate and melts the wafer's surface to allow boron atoms to diffuse quickly into the material. —*I. Peterson*

It's all in the immunoglobulin superfamily

An elusive protein that regulates the body's response to tissue transplants, infectious agents and tumor cells finally has been pinned down by analysis of its gene. The protein is the specialized receptor molecule on T-cells, one of the two major cell types responsible for the body's immune response. This receptor allows the cells to recognize foreign substances, the first step in immune system activity.

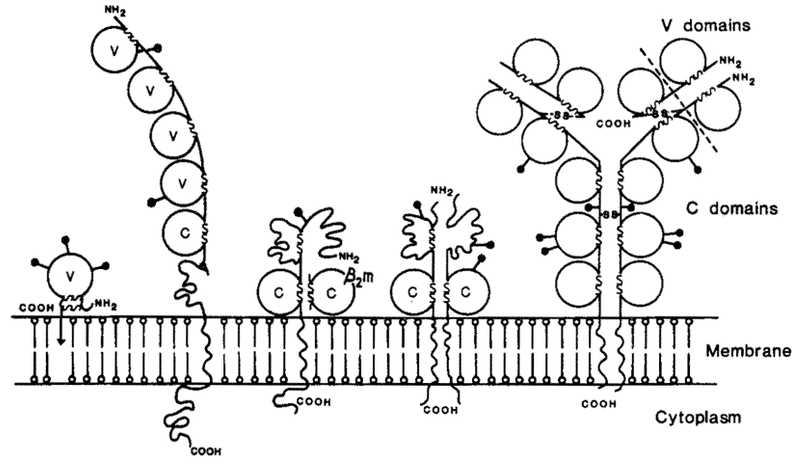
The first analyses of what appears to be the T-cell receptor gene indicate a surprising similarity between the T-cell receptor and important molecules of the other arm of the immune system—receptors on the other major cell type, B-cells, and also the antibodies, or immunoglobulins, which are made by B-cells and which circulate throughout the body in the blood. A better understanding of the molecular basis of immunity is expected to lead to new diagnostics and therapies for immune system disorders and for autoimmune diseases, to improved success in tissue transplants and to more effective vaccines for infectious diseases.

"The molecular nature of the T-lymphocyte [cell] antigen receptor has been the most mysterious and controversial issue in immunology over the past decade," says Alan F. Williams of the University of Oxford in England. He comments on papers in the March 8 NATURE that describe at least one of the T-cell receptor's two chains as resembling, but distinct from, the antibody component called the immunoglobulin light chain. The work was performed independently on the human gene by Yasuke Yanagi, Tak W. Mak and colleagues at the University of Toronto in Canada and on the mouse gene by Stephen M. Hedrick of the National Institutes of Health in Bethesda, Md., Mark M. Davis at Stanford (Calif.) University and colleagues.

These publications follow closely on a report in the March 1 NATURE that puts the B-cell receptor that recognizes immunoglobulins in the same structural "superfamily" as immunoglobulin itself. Keith Mostov, Martin Friedlander and Gunter Blobel of Rockefeller University in New York found that an immunoglobulin receptor contains five domains, which extend beyond the cell, that are "strikingly homologous" to each other and to parts of immunoglobulin. The scientists speculate that the genes for immunoglobulins, for these receptor molecules and for other cell surface molecules involved in recognition of foreign substances are all derived from the same ancestral gene.

This dramatic extension of information about both B-cells and T-cells comes out of work using recombinant DNA. A striking property of immunoglobulin genes was one of several characteristics used to identify the elusive T-cell receptor. The immunoglobulin gene rearranges in the chromosome during maturation of B-cells. Similarly the gene just identified as a T-cell receptor is rearranged in mature T-cells but not in other cell types. As further evidence that this gene codes for the T-cell receptor, Hedrick and colleagues say that antibodies against synthetic peptide fragments made to match portions of the identified gene can inhibit a T-cell response.

"From now on things will move fast," Williams predicts. "All the questions that have been answered for immunoglobulin genes and sequences will be asked of the T-receptor molecules and their expression in T-cell subsets will be eagerly investigated." —*J. A. Miller*



Superfamily portrait at a cell surface: Immunoglobulin (far right) has characteristic variable (V) and constant (C) domains. Other members of the superfamily have similar sections, designated here by circles marked V or C. The B-cell immunoglobulin receptor (second from left) shares five regions with immunoglobulin. The T-cell receptor, not portrayed here, has one V-like and one C-like domain on at least one of its two subunits.