tumor cells and spleen cells from mice immunized with human skin tumors, called melanomas. They found three categories of monoclonal antibody: some reacted only with melanomas, some reacted with melanomas as well as some other tumors and others reacted with melanomas, some tumors and also normal human cells. "These antibodies suppress growth of melanoma tumors in nude [immune deficient] mice and thus may be directed against a specific tumor antigen," Koprowski explains. "If this is the case, it opens the possibility of 'immunodiagnosis' and eventually immunotherapy of human malignancies." Therefore the monoclonal antibody technique revives an old dream — targeting a destructive element specifically to a tumor.

The monoclonal antibody technique is applicable to research problems ranging beyond cell surfaces. In quite different work, for example, biologists are trying to obtain a monoclonal antibody that will bind interferon, a natural substance that fights viral infections. Monoclonal antibodies could provide a method of purifying large amounts for use in experiments and possibly for clinical applications.

Immortalizing other functions

Going even further, antibody production is not the only transient cell function that can be immortalized in a clone of cells. Perhaps different cells fused with myeloma or other types of tumor cell might provide directly a simple, long-lived source of interferon protein or of other specialized cell products.

Hybrid cell lines have already been established that secrete "suppressor factor," a soluble transmitter chemical thought to regulate the interactions of immune system cells. Ten researchers from England, Australia and the United States, including Leonard A. Herzenberg of Stanford University, recently reported fusing cells of a thymus tumor with appropriate immune system (T) cells, artificially induced to make the factor. The fusion gave rise to a line of cells that secrete suppressor factor. "Such hybrids will be extremely useful in the more refined characterisation of the secreted products of T cells of various types, as unlimited cell numbers can be produced and the titre of suppressor factor produced by the hybrids is much higher than that of conventional factors," the researchers say in the Aug. 3 NATURE.

Other active areas of research already underway include development of monoclonal antibodies that enhance organ transplants, that diagnose and monitor leukemia and that detect subtle changes in the nervous system.

Genes and antibodies

Similarities between monoclonal antibodies and recombinant DNA extend beyond the research excitement each has generated. Workers in the two areas tend to use much the same vocabulary. Both make "hybrids" — either a fused DNA molecule or a fused cell, both "clone" — reproduce that molecule or cell — and both do "shotgun" experiments in which they first hybridize and clone a random assortment of DNA molecules or cells and then select relevant specimens from the then sufficient quantity of material.

Combination of the two techniques promises to engender much semantic confusion, but also a powerful approach to molecular genetics. "One can now contemplate cloning any gene," says Bernard Mach of the University of Geneva. "That was not the case six months ago."

For instance, if a collection of genes is inserted into bacteria and reproduced, the researchers need a way to select among the genes. The most general way would be to look for expression of the inserted gene, but often no measurable activity of the gene product is known. However, if the researcher had monoclonal antibodies to the product of the desired gene, antibodies could identify bacterial cells containing that gene. Mach says, "Give me any antibody directed against a protein and with time that gene can be cloned."

Selling of an antibody

A logistics problem arises as more and more biologists of different talents and training begin incorporating monoclonal antibodies into their research plans. A workshop on cell hybridization in immunology held in November at NIH considered the problem: Does every laboratory need to make its own antibodies or will they be distributed either privately or commercially? Mach predicts a central bank of monoclonal antibodies "either capitalistic or NIH." Koprowski agrees: "We are waiting impatiently for a central depository." The Wistar Institute researchers provide their cell strains to other investigators, but doing so involves much extra work.

Herzenberg says that his laboratory's solution is to provide cells to other laboratories that want to produce large amounts of an antibody, but also to provide the cells to commercial firms that sell antibodies to the "casual" user. (The Cell Distribution Center at the Salk Institute in San Diego stores cells to provide to investigators.) Other researchers, however, claim that companies do not want investigators to be giving away the cells that make monoclonal antibodies the company plans to sell. A major commercial use of monoclonal antibodies will be in kits for radioimmune assays that now contain animal sera.

Milstein explains that none of the basic work on monoclonal antibody production has been patented. Although the technique is now being applied eagerly in laboratories around the world, at the time, he says regretfully, he was unable to convince the MRC administrators that the procedure had important enough applications. □

SCIENCE ON TV

SCIENCE NEWS prints the latest written word of scientific developments and noteworthy news. We've set this space aside to inform our readers of programs of scientific interest that are scheduled on television. Check your local listings for exact times.

January 3 (PBS) The Cousteau Odyssey — **"Calypso's Search for the Britannic,"** originally broadcast in 1977, blends myth with documentary in an attempt to solve the mystery of the sinking of the *Britannic*.

January 4 (PBS) NOVA — **"Black Tide"** examines the 1978 *Amoco Cadiz* oil spill disaster that occurred off the coast of Brittany. Cleanup cost $100 million, but the worst effects are yet to be felt.

January 7 (PBS) National Geographic Society — **"Gold!"** looks at the precious metal from all angles — from how it's mined to how it affects our daily lives.

January 11 (PBS) NOVA — **"The Long Walk of Fred Young"** examines the conflicting worlds of a Navajo Indian who is also a nuclear physicist. Now working on the laser fusion project at the Los Alamos Scientific Laboratory, Young "has bridged the entire span of human technological development."

January 18 (PBS) NOVA — **"A World of Difference"** profiles the life of controversial behavior psychologist B. F. Skinner. More than 30 years ago Skinner introduced the climate-controlled crib in order to test his theory that environment controls behavior. His book *Walden Two*, published in 1948, grew out of his belief that humans could design a better society shaped by positive personal reinforcement. This program travels with Skinner to visit Twin Oaks, a rural, 11-year-old cooperative based on the book's ideals.

January 25 (PBS) NOVA — **"The Mind Machines"** is a repeat of last year's program looking at Artificial Intelligence. Although research in Artificial Intelligence was begun less than 30 years ago, the results are impressive. There are critics, however, and some claim that computers are not really capable of subtle human-like thought. Others fear that someday computers will outpace their creators.

January 28 (PBS) National Geographic Society — **"Hong Kong: A Family Portrait"** takes viewers to one of the most fascinating cities of the twentieth century and reveals it through the eyes of a single family.

January 28, 29, 30 (PBS) — **"The Energy War"** details the battle in Congress over the natural gas pricing bill.