BIOMEDICINE

Immune interferon: The dark horse

The interferon race is on, and a lot has been happening in recent months: Clinical trials are underway to test natural interferon as a potential cancer fighter, and with interferon now being produced by recombinant DNA techniques much more of it should be available for clinical use than can be obtained from natural sources. But the two types of interferon that have been in the forefront — leukocyte interferon (made by leukocytes, or white blood cells) and fibroblast interferon (manufactured by cells in connective tissue) — may ultimately be overtaken by a third type — immune interferon (produced by cultures of lymphocytes, a particular type of leukocyte). There is reason to believe that this dark horse, immune interferon, may possess even more anticancer activity than do the other two types. Before immune interferon's true therapeutic potential can be tested, though, or even before it can be manufactured en masse with recombinant DNA, much has to be learned about its chemical makeup—information that is already available for the leukocyte and fibroblast interferons.

Now Y.K. Yip and colleagues at New York University School of Medicine in New York City report in the March PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES that they have devised a particular method for producing immune interferon from lymphocyte cultures. Their method appears to have yielded more immune interferon than that produced by any other production method described to date. And with this supply of immune interferon, the researchers have determined that immune interferon is a sugar-protein with a molecular weight of 58,000, compared with 15,000 for leukocyte interferon and 25,000 for fibroblast interferon. So immune interferon appears to be considerably larger than the other two interferon molecules.

Yip and co-workers believe that their particular production method can also be used to recover still larger amounts of immune interferon. With that supply, still more can be learned about immune interferon's chemistry, notably how its amino acid sequence compares with that of leukocyte interferon and of fibroblast interferon, which, in turn, share only a 29 percent resemblance.

How cataracts form

During the past several years Abraham Spector and a team of vision scientists at Columbia University College of Physicians and Surgeons in New York City have been unveiling the biochemical changes that underlie cataracts — cloudiness that forms over the lenses of the eyes and inpairs vision.

In 1978, for instance, they reported that the increase in water-insoluble material in a cataractal lens, as compared with a healthy lens, appears to be due primarily to the formation of high molecular weight disulfide-linked protein aggregates (SN: 9/2/78, p. 174). These protein aggregates in turn appear to have arisen because of oxidation that starts at the plasma membrane of the lens (SN: 4/19/80, p. 248). And now they report in the March PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES that the plasma membrane also disintegrates in cataract formation, and that this disintegration is associated with high molecular weight disulfide-linked protein aggregates.

Combining these findings along with those of other cataract investigators, Spector and his team have produced a model for how cataracts form: The plasma membrane of a healthy lens contains normal proteins. When the membrane is damaged by oxidation, osmotic shock (as in diabetic cataracts) or some other factor, so are the proteins in the membrane. This leads to the formation of high molecular weight disulfide-linked protein aggregates. And with the formation of these aggregates, the membrane disintegrates. A cataract results.

PHYSICAL SCIENCES

Dietrick E. Thomsen reports from San Francisco at the Third International Conference on Integrated Optics and Optical Fiber Communication

Wavelength division multiplexing

As fiber optic communication comes more and more into common use, ways are sought to make it do many of the technical things that wire systems do. Fiber optic communication is the use of modulated light waves traveling in special fibers to carry messages. It promises to provide more communications channels in a far smaller space than does ordinary communication by electric waves.

One of the ways of making fiber optics provide even more channels than by simple space saving, as J. Straus of Bell Northern Research in Ottawa remarked while delivering a paper prepared by Jan Conradi and himself, is wavelength division multiplexing. This technique amounts to sending several different wavelengths of light through the same fiber, perhaps in both directions. Each wavelength can have its own light source and be modulated separately, so the number of different transmissions of information that can be conveyed within the diameter of a single tiny fiber (these fibers are about 100 micrometers, that is, one tenth of a millimeter, thick) is materially multiplied.

The essential thing for such multiplexing is the development of efficient and tiny multiplexers and wavelength selectors. Multiplexers mix the different incoming colors into a beam directed down the one fiber; selectors reverse the process at the other end, separating the different wavelengths and sending them along different fibers, each to its own readout device. In principle, the three types of device commonly used to separate colors, prisms, filters and diffraction gratings, could be used. In practice mass manufacture of prisms for this microscopic technology proves too difficult. Both filters and gratings can be used. Each has advantages and disadvantages, and experiment continues.

There are field trials as well. Ninety-five percent of them are in Japan, says Straus, but one is in Canada, in Elie, Manitoba. It is what is called a subscriber loop, the level of circuitry that goes into individual houses. Using filters and gratings for multiplexing and selecting, and lately using light-emitting diodes as light sources, it carries nine TV channels on three light channels. In the future such systems can offer a variety of new and old services to individual subscribers: ordinary telephony, picture phones, piped music, home computer interaction with distant computers, interactive television, etc, etc.

Optical parametric oscillation

A circuit element commonly found in electric communications is a parametric amplifier. Parametric amplifiers are highly sensitive low-noise devices, especially suitable for work with high frequencies. Optical parametric oscillation, the basic condition for amplification, was reported by W. Sohler of the Fraunhofer Institute in Freiburg and H. Suche of the University of Dortmund, both in West Germany, "for the first time in a waveguide resonator," that is, a device compatible with fiber optics.

A parametric amplifier takes an incoming wave, mixes it with another (the pump frequency) during multiple reflections in a resonator and gives it back amplified. Under another tuning condition it can give back the same signal on a different frequency. It depends on circuit elements that display a complicated (in the technical term, "nonlinear") relation between resistance or reactance and frequency. In the optical case the corresponding element is a crystal of titanium diffused lithium niobate ($Ti:LiNbO_3$). In a strip of that material Sohler and Suche demonstrated amplification of 1.15-micrometer light by 16 decibels. They then made fiber optic waveguides out of the material 48 millimeters long and 20 micrometers wide and in them demonstrated optical parametric oscillation, that is, the wave mixing and tunability effects.