BIOMEDICINE

Cataracts are heavy-weights

A cataract is a cloudiness that forms in the lens of the eye so that vision is impaired. It may be due to degenerative changes that can come with age, trauma, disease, drugs or other sources. But what happens to the lens as it loses its transparency?

Scientists have known since 1913 that a cataract lens contains more water-insoluble proteins than a healthy lens does; that, in fact, such proteins may constitute up to 90 percent of a cataractous lens's total protein content. Now water-insoluble proteins in a cataractous lens also appear to differ chemically from those in a healthy lens, according to research by Abraham Spector and Debdutta Roy of Columbia University College of Physicians and Surgeons. The cataractous lens contains high molecular weight proteins composed of disulfide-linked small proteins not found in the healthy lens.

This protein material, Spector and Roy conclude in the July PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES, "may account for a significant proportion of the increased abundance of the water-insoluble [protein] fraction in cataractous lenses, and it may possibly contribute to the opacity of such tissue."

Enzymes incognito

A number of serious diseases are due to inherited enzyme deficiencies. So naturally researchers would like to inject healthier versions of such enzymes into patients to correct their problems. Such enzyme replacement, however, has some serious obstacles to overcome before it becomes widespread and practical. One is to get enzymes targeted to the right tissues (SN: 7/22/78, p. 60). Another is to get a patient's immune system not to reject injected enzymes as foreign.

A promising solution to the latter difficulty is reported in the July 8 LANCET by M. H. Remy and M. J. Poznansky of the University of Alberta in Canada. They have found that whereas a free form of a specific enzyme induces antibody production in animals which are injected with it, this is not so if the enzyme is first polymerized (chemically attached) to albumin. Such polymerization apparently renders the enzyme nonimmunogenic. "The results," they conclude, "suggest an important advantage of these soluble enzyme polymers in enzyme replacement therapy."

Low-class sperm

Women from lower socioeconomic classes have long been known to be more vulnerable to cervical cancer than women from higher classes. As far back as 1910 researchers described a fourfold increase in the incidence of the disease in wives of "day laborers, unskilled workers, paupers, factory hands and lower officials," when compared with the wives of "physicians, lawyers, heads of firms and other high officials." But why should lower-class women be more vulnerable? Australian researchers offer a tentative explanation in the July 8 LANCET.

Intercourse is well known to predispose women to cervical cancer, so there may be something in sperm that triggers the disease. And now Bevan L. Reid and Peter W. French of the University of Sydney and their colleagues have found that men vary considerably in the amount of the protein protamine found on the heads of their sperm — the lower the social class, generally the greater the amount of protamine. In fact, the researchers have noted statistically similar correlations between low social class, venereal disease and cervical cancer. So sperm protamine may play a role in cervical cancer, they conclude. They do not, however, offer any evidence that protamine is able to cause cancer, nor do they speculate on why lower-class men have more of the protein than do higher-class men.

SPACE SCIENCES

Measuring moons

Although Jupiter's Galilean satellites (Io, Europa, Ganymede and Callisto) all were photographed by the Pioneer 10 and 11 spacecraft, scientists have generally preferred earth-based telescopic observations as a basis for calculating the moons' sizes. (Europa, smallest of the four, is nearly as big as earth's moon; Ganymede is larger than Mercury.) The reason is that the Pioneer photos have resolutions of several hundred kilometers, whereas an event such as a stellar occultation by one of the moons can be measured from earth to yield a diameter accurate to within tens of kilometers. A newly reported analysis of the photos, however, is claimed by its author not only to give sizes with accuracies roughly comparable to earth-based methods (though with slightly different results), but also in two of the four cases to yield significant improvements.

The problem is one of identifying the satellite's edge, or limb, whether from an occultation (in which the blocking of the light from a star can be precisely timed) or from a photograph. It is virtually impossible to tell exactly where the limb lies on any one of the thousands of individual picture elements, or pixels, that comprise the Pioneer photos, since each pixel shows only a single brightness value to represent an area hundreds of kilometers across. What is possible, according to P. Hollingsworth Smith of the University of Arizona, is to locate the limb on a whole image by fitting it along a circle of appropriate size. (This ignores oblateness effects and assumes that the moons are spherical, Smith admits, and it may be a critical assumption: One published theoretical calculation, for example, concludes that Io may be a triaxial ellipsoid whose long and short dimensions differ by 38 km.) It is a complex process that Smith reports in ICARUS (35:167), but a key factor is that an analysis of the Pioneer imaging system can indicate how much of a pixel of a given brightness covers the moon's surface and how much covers the dark sky background. A long sequence of thus-analyzed pixels can then reveal the limb's location considerably more accurately than can any single pixel. In Smith's method, the circular arc that best fits the resulting curve yields the satellite's radius. (Better images should result from the improved cameras and closer encounters of the Voyager 1 and 2 and Galileo missions.)

Calculated results:	**IO**	**EUROPA**	**GANYMEDE**	**CALLISTO**
radius (km)	1,840 ± 30	1,552 ± 20	2,650 ± 25	2,420 ± 20
mass (x 10^{23} g)	889 ± 4	479 ± 5	1,481 ± 6	1,075 ± 3
Density (g/cm^3)	3.41 ± 0.19	3.06 ± 0.15	1.90 ± 0.06	1.81 ± 0.05
Distance of closest images (km)				
Pioneer 10		323,620 ± 70	805,500 ± 1,800	
Pioneer 11	718,200 ± 730		767,250 ± 650	782,030 ± 80
Predicted closest encounters (km)				
Voyager 1	22,000	733,000	115,000	124,000
Voyager 2		206,000	63,000	212,000
Galileo			~2,000	~2,000

An interesting application of Smith's results may be in the case of Ganymede, whose size was once determined from a 1972 stellar occultation. According to the observers, data from the event, though "noisy," suggested that the star's light may have disappeared and reappeared "non-abruptly," as though it was being progressively affected by an atmosphere. The surface pressure was calculated to be greater than about 0.001 millibar, and earlier infrared studies had set an upper limit of 1.0 mb. The radius calculated from the occultation data thus contained a large uncertainty (2,635 $\pm\,^{15}_{100}$ km). Smith's method yields a smaller uncertainty, possibly constraining the atmospheric pressure to nearer the 0.001 mb figure.

The uncertainty for Callisto is also reduced, and the calculated radius lowered. With a mass calculated from the Pioneer data, this yields a more Ganymede-like density than in previous calculations, possibly suggesting a similar bulk composition.