life sciences

Gathered at the Symposium on Biological Molecules in their Excited States at Arden House, Harriman, N.Y., last week

DNA

X-ray for triplets

The DNA molecule, which determines how living cells are duplicated, can be stimulated into various excited conditions, one of which is called the triplet state. Biologists would like to study the molecule in this excited state, but because DNA is composed of a number of different bases, they would also like to study the individual bases in their triplet states.

An effective method of producing triplet states in nucleic acid bases is to dissolve them in solvents which will form transparent, glassy solutions when cooled to the temperature of liquid nitrogen, 77 degrees K., and to irradiate them with X-rays, reports Dr. H. B. Steem of the Norsk Hydro Institution for Cancer Research in Oslo, Norway.

A major effect of the X-rays, Dr. Steem finds, is to tear single electrons from the base molecules and deposit them in traps in the glassy solvent. The electrons then return slowly to the molecule from which they came. In three-fourths of the excited molecules formed in this way, the returning electron had the same spin as the one with which it had been paired before excitation. This is the configuration called the triplet state.

IMMUNOLOGY

Flexible Y-shape for antibodies

Fluorescence polarization experiments support the idea that antibody proteins have a flexible joint that lets them adjust to the geometry of the antigens to which they will attach themselves.

Dr. Lubert Stryer of Yale University Medical School attached immunoglobulin antibody molecules to a fluorescent dye called a dansyl group. He then turned on a light absorbed only by the dansyl group, and observed whether the polarization of the light emitted by the dansyl changed during the course of emission.

Dr. Stryer found that the fluorescence of the combination of dansyl and antibody became depolarized after a few billionths of a second, indicating that the dansyl, probe was free to rotate independently of the rest of the antibody protein. Small fragments of the combination behaved as though the probe was rigidly attached to the protein.

These results support the idea that the antibody is shaped like a Y, with an active site at the end of each arm and a flexible section near the joint.

RADIATION DAMAGE

New model needed

A new explanation of the mechanism by which ultraviolet light causes lethal gene mutations may be needed, according to experiments by M. L. Meistrich of Bell Telephone Laboratories, Murray Hill, N.J.

Previously, researchers had thought such mutations resulted when bonds were formed between two adjacent components of DNA. The combined molecules are called thymine dimers.

To test this hypothesis Meistrich introduced thymine dimers into the DNA of a bacterial virus known as T4 bacteriophage, or phage for short, producing phage DNA whose only defect was thymine dimers.

Meistrich found that on the average, 30 thymine dimers were needed to produce enough mutations to kill one phage. Direct ultraviolet irradiation of the DNA, on the other hand, kills a phage when only 10 thymine dimers have been formed. He therefore concluded that direct irradiation was producing some kind of lethal damage in addition to that of thymine dimers.

VISION

Classical model corrected

Changes in the molecular shape of the visual pigment called retinal, attached to protein, have been thought to be responsible for setting off electrical impulses to the optic nerve in the brain. Now, Dr. E. W. Abrahamson of Case-Western Reserve University in Cleveland has evidence that changes that theory.

Retinal, he says, is chemically bound to lipids or fat molecules in the eye. After this visual pigment molecule absorbs a quantum of light energy, it changes its shape and migrates from the lipid to a protein. It is this migration from one molecule to another that presumably triggers the electrical impulse that makes vision possible, Dr. Abrahamson reports.

Migration occurs at the same time as a small electrical signal, discovered by Dr. Richard Cone of Harvard and called the Early Receptor Potential. The ERP may well stimulate the much larger late receptor potential that eventually reaches the optic nerve.

NUCLEIC ACIDS

Ultraviolet causes reaction

A type of chemical reaction that takes place in a test molecule also might occur in nucleic acid when it is irradiated by ultraviolet light. The reaction might help explain the effects of radiation on living cells.

Hydrogen bonded pairs of the test molecules, which are analogous to pairs of the components or bases of nucleic acid, can exchange hydrogen atoms in their excited state, according to Dr. M. Ashraf El-Bayoumi at Michigan State University.

Dr. El-Bayoumi came to this conclusion when he found that the fluorescent emission from concentrated solutions of 7-azaindole (a simple chemical that bonds like nucleic acid base pairs) was at lower energy and covered a broader range of wavelengths than emission from similar molecules which could not form hydrogen bonded pairs.

Exchange of hydrogen bonded atoms has been suggested as a cause of mutations in cells. The process may conceivably occur in the excited states of base pairs of nucleic acids, as it does in Dr. El-Bayoumi's test molecule. However, it is unlikely to produce mutations by itself, since the bonded hydrogens would almost certainly return to their original positions in much less than a millionth of a second, before genetic messages could be transcribed from DNA.