

# BIOLOGY

Julie Ann Miller reports from Bethesda at the National Institutes of Health science writers seminar on chemical carcinogenesis

## More biochemistry for cancer

The search for the internal molecules that make a cell malignant is progressing rapidly on several fronts. Scientists working on viruses that cause cancer in certain animals are identifying points in a cell's metabolism at which excessive amounts of a natural enzyme seem responsible for the malignancy (SN: 3/21/81, p. 180). In work perhaps more closely related to human cancer, Takeo Kakunaga of the National Cancer Institute observes the conversion in the laboratory of normal human fibroblast cells, taken from connective tissue, into malignant (or "transformed") cells able to initiate tumors. Kakunaga has compared the array of more than 1,000 proteins present in a normal cell with that of a cell transformed by exposure to a chemical in order to learn what it is that has changed in the biochemistry of the malignant cell. He finds evidence for about twenty differences — extra or missing polypeptides — in the transformed cells.

Most of the polypeptide differences will be due to alterations in what genes are expressed and how their products are processed, Kakunaga expects. But it appears that at least one very suggestive change is due to genetic mutation. A polypeptide that turned up in one chemically transformed cell line is a variant of normal actin, a protein important in determining the shape of a cell, how it moves and to what it adheres. Because these properties are altered in transformed cells, Kakunaga is optimistic that the altered actin may be a key to the change. Furthermore, he finds that the ratio of the altered actin to the normal form is highest in the most malignant cells of the transformed line. He has used recombinant DNA techniques to make large amounts of the altered actin and has discovered that it differs from the normal actin in only one amino acid. In his next experiments Kakunaga plans to put the altered gene into normal cells to see whether they become transformed. "Transformation has been considered a change in gene expression, but not a change of the gene," Kakunaga explains. "Our results seem to provide the first molecular evidence for the occurrence of mutation in the chemically transformed cells." And the scientists still have at least 19 other biochemical differences to investigate.

## DNA repairs and the cancer cell

The mechanisms for repairing damaged DNA are defective in the cells of persons with several genetic syndromes that predispose toward cancer. Xeroderma pigmentosa patients are the most obvious examples (SN: 10/11/80, p. 232), but others include patients with Fanconi's anaemia, ataxia telangiectasia and perhaps Gardner's syndrome. While some scientists argue that repair deficiencies are not a widespread cause of cancer, Rufus S. Day III of the National Cancer Institute suggests that the ability to repair DNA is important for keeping cells cancer-free and that some tumors in normal persons may arise when rare mutations among the cells of an adult damage the repair process.

Day and colleagues have measured the DNA repair potential in 88 sets of cells taken from human tumors and grown in the laboratory. They find that 17 of the strains have deficient DNA repair mechanisms. This suggests that approximately 20 percent of human tumors arise from repair-deficient cells, Day says. He finds that the repair-deficient cells are dramatically sensitive to certain (alkylating) chemotherapeutic agents. "We believe, therefore, that tumors composed of such repair deficient cells may be those tumors against which alkylating chemotherapeutic agents are effective," Day speculates. Scientists now are trying to identify the cellular proteins responsible for the DNA repair process so that they can test tissue slices of tumors for repair deficiencies and find those most susceptible to killing with chemotherapy.

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# PHYSICAL SCIENCES

Dietrick E. Thomsen reports from Phoenix at the meeting of the American Physical Society

## Energy conversion by chlorophyll

Plants have a great advantage in the possession of chlorophyll as a converter of solar energy: Chlorophyll's quantum efficiency is 100 percent. That is, for every photon of light absorbed by the chlorophyll molecule, an electron is ejected from the molecule. These electrons are the energy carriers for the photosynthetic reaction.

Scientists seeking means to convert solar energy for non-botanical processes would like to use chlorophyll or something with the same high quantum efficiency. In plants and photosynthetic bacteria chlorophyll often does its work while bound to certain protein molecules in so-called reaction centers. It seems to be the structure of these reaction centers that is responsible for the high quantum efficiency of the action, but that structure is quite unknown. Attempts to reproduce the operation of the reaction centers with chlorophyll alone have not been successful.

Scientists at Battelle's Columbus Laboratories in Columbus, Ohio, have chosen a different approach, R. M. Pearlstein of Battelle reported: They have tried to make complexes of chlorophyll and proteins of known structure, hoping to be able to mimic the operation of the reaction centers, and if that were possible, then to use the known structure of the protein to try to explain what happens.

They have not got quite that far, but recently they have discovered that chlorophyllide (which is chlorophyll without its hydrocarbon tail) and the protein apomyoglobin can be put together in large structures called M- and H-complexes. These M- and H-complexes absorb polarized light in ways similar to those of the reaction centers. Absorption of polarized light depends on the details of the molecular structure. If the structure of the M- and H-complexes is as similar to that of the reaction centers as the polarized light absorption seems to indicate, this could be the way to go to substances that mimic the operation of the reaction centers.

## Magnetic bacteria at the equator

Magnetotactic bacteria were discovered about 1975 in the waters around Woods Hole, Mass. Magnetotactic bacteria have little magnets inside them by which they seem to orient themselves in the earth's magnetic field as they swim.

All of the magnetotactic bacteria studied around Woods Hole seemed to prefer to go northward. This led to a theory that the behavior was connected with foodseeking. In the northern hemisphere geomagnetic field lines point downward into the earth as they point north. Downward is where the food-rich sediments are.

If this theory is supportable, magnetotactic bacteria in the southern hemisphere (if any exist) should have south-seeking internal compasses. In that half of the world to go southward along magnetic field lines is to go down at the same time. Such south-seeking magnetotactic bacteria were indeed found (SN: 4/26/80, p. 267).

Now comes a third test of the theory: at the magnetic equator. R. B. Frankel of the Francis Bitter National Magnet Laboratory, R. P. Blakemore of the University of New Hampshire, F. F. Torres de Araujo of the University of Ceará in Brazil, and D. M. S. Esquivel and J. Danon of the Brazilian Center for Physical Research found and studied magnetotactic bacteria at the magnetic equator in Brazil. This population contains about equal numbers of north-seeking and south-seeking individuals. That is what would be expected according to the theory. At the geomagnetic equator the field lines are generally horizontal. This means they offer no clue to foodfinding. Therefore neither magnetic polarization in the bacteria would have a survival advantage.

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