Mutagenicity

Sister Chromatid Exchange. SHELDON WOLFF, Ed. Wiley-Interscience, New York, 1982. x, 306 pp., illus. $70.

The recognition, based largely upon the Ames test, that most carcinogens are mutagens has led to an explosion of interest in mutagenicity, from both theoretical and applied viewpoints. Of the many assays for mutagenicity, only the Ames test is more widely used than the measurement of SCE's (the acronym for sister chromatid exchanges). Hence, this comprehensive book is assured of a wide and attentive readership. The book is crammed with detail, all of which is well referenced and is made accessible through an excellent index. Indeed, a newcomer to the field could get lost in a forest of facts, for the book lacks a good introductory chapter to serve as a guide.

Strange as it may seem given the popularity of the SCE assay, neither the origin nor the significance of SCE's is known. Cytologically they appear to be exchanges between homologous sites on the two (sister) chromatids of one chromosome. As the two chromatids are genetically identical, a precisely homologous exchange should have no consequence for the cell or its offspring; in fact, cells can survive perfectly well in culture with more than 100 such exchanges. Why, then, are SCE's so popular? The answer is that they are a very frequent and easily measured consequence of exposure to mutagens. Although just why this should be is unclear, and may remain so until more is known about the mechanisms involved, the assay is being used as the mechanisms are being studied. One of the difficulties that a novice will have when reading some of the chapters of the book is that several contain a mixture of information about the use of SCE assays and information about how SCE's arise. In fact, most of the chapters are written about particular systems such as plants or mammalian cells in vivo.

The chapters about mechanisms include a retrospective view by J. Herbert Taylor, the first cytogeneticist to see an SCE, reiterating his conclusion that SCE's involve breakage and reunion of DNA. Subsequent chapters emphasize that this process differs in many ways from the breakage and reunion leading to chromosomal aberrations (fragments and rearrangement); certainly the relative proportions of chromosomal aberrations, mutations, and SCE's vary greatly from one mutagen to another. The strongest theme is that all arise from DNA damage and that all are influenced by, or are produced by, DNA repair mechanisms. The evidence for this is presented most clearly by Maurizio Gatti in a very careful review of the data on repair-deficient mutants of *Drosophila* and by H. J. Evans in a stimulating (but slightly error-prone) review of human disease states, including the conditions associated with deficiencies in DNA repair and proneness to cancer.

Other chapters deal with tests for human exposure to carcinogens by means of blood cultures, testing chemicals on mammalian cells in vitro, and the relationship between SCE induction and mutagenesis. Although the book is not a handbook of techniques, many technical hints are to be found in it. It contains relatively little that has not been published elsewhere, but nowhere else can all of this information be found in one place.

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The Interstellar Medium

Searching Between the Stars. LYMAN SPITZER, JR. Yale University Press, New Haven, Conn., 1982. xvi, 180 pp., illus. $25. Mrs. Hepsa Ely Silliman Memorial Lectures.

Astronomers seem to be particularly fascinated with two types of phenomena: the newly discovered and mysterious objects whose nature we can barely fathom (such as black holes) and those seemingly tractable phenomena that most severely challenge the depth of our understanding. The gas and dust between the stars—the interstellar medium—are in the latter category; investigations of the interstellar medium have occupied a central position in astrophysics for the last 25 years. In this volume Spitzer not only synthesizes our knowledge of the interstellar medium but also communicates the fascination of this subject.

The gas and dust in the galaxy, though insignificant in terms of their contribution to the total mass of the galaxy (less than 2 percent of the mass is in interstellar gas), occupy our interest because they respond to and accurately reflect their environment and history. Thus the interstellar medium provides astrophysicists with a record of past events and continuing trends that is akin to the geological record of the earth. The temperature of the interstellar medium reflects the influence of stellar radiation fields; the degree of ionization provides a measure of the flux of cosmic-ray particles in the galaxy; the atomic composition indicates the rate at which material is processed through the nuclear-burning cores of massive stars and then returned to the interstellar medium; and the turbulence and clumpiness of the gas are manifestations of the efficacy with which supernovas stir the gas. Since theories of all these phenomena (and others) predict their effect on the interstellar gas, one can use observations of the interstellar medium to verify and modify such theories.

Spitzer begins by summarizing our understanding of the interstellar medium as of 1970; he notes how very tantalizing the observations of that epoch were. In particular, microwave detections of molecular species such as OH, H_2O, and H_2CO in interstellar clouds implied that much, perhaps even most, of the mass of the clouds was in the form of molecular hydrogen, but H_2 could not be observed directly from the ground because it has no microwave or optical transitions. The existence of cold, neutral interstellar clouds at great distances from the galactic plane was another puzzle because the stability of such entities seemed to require the existence of a very hot, 10^6 K, yet tenuous confining component of the interstellar gas; direct evidence of such a medium was lacking. Spitzer notes that such puzzles could only be resolved by observations in the ultraviolet, particularly at wavelengths between 1100 and 912 angstroms. In a fascinating section he describes how, with considerable difficulty, the Copernicus satellite was designed specifically for spectroscopic observations of the interstellar medium in the far ultraviolet. The reader is thus allowed to witness the preparation and launch of an important astronomical satellite through the account of a participant. (The account of crucial last-minute adjustments to the telescope focus is most memorable.)

Copernicus, launched in 1972 and operated until 1980, was entirely successful. It revolutionized our understanding of the interstellar medium and the processes that affect that medium. Molecular hydrogen was detected and shown to be a ubiquitous constituent of interstellar clouds; wide lines of ions such as O^{5+} and N^{4+} established the existence and pervasiveness of the hot "coronal" gas that confines interstellar clouds and fills most of the interstellar void. For the first time, reliable determinations could be made of the abundance of elements in