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

the interstellar gas, and the depletion of some of these elements onto interstellar dust grains was established. The achievements of Copernicus were many; Spitzer records several of them and carefully notes their ramifications.

The book is written for those familiar with physical principles who seek an overview of an important field of research. The presentation is clear and may be read without reference to mathematical representations (which are included, where appropriate, in parenthetical statements). The most delightful aspect of the book is that it communicates the excitement of scientific research: questions posed, estimates and theories suggested, and finally answers sought. The book ends, as it must, not with a compendium of "answers" but with a new, more sophisticated way of asking the questions.

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Colonial Invertebrates

Recent and Fossil Bryozoa. Papers from a conference, Durham, England, Sept. 1980. GILBERT P. LARWOOD and CLAUS NIELSEN, Eds. Olsen and Olsen, Fredensborg, Denmark, 1981. viii, 334 pp., illus. Paper, $55.

Bryozoologists have been getting together for mutual stimulation and enlightenment triennially since 1968. This volume is the fifth report of their meetings. Although the original intent of the gatherings was to share ideas and talk about current research, the proceedings volumes have contained along with papers that do this a preponderance of completed research reports that normally would be published in journals. The happy result is that biologists, including invertebrate zoologists, paleontologists, and other bryozoologists, can obtain in this volume a cross-section of the ideas, research trends, and the types of information found in the study of Bryozoa today.

Among the 35 papers presented I found the ecological studies of competition between encrusting colonies of particular interest. The "war games" school of J. Jackson and L. Buss and their associates is providing broadly applicable insights into competition for space and food in sessile communities. Factors such as angle of encounter (frontal, oblique, and flanking attacks), ability to scale defenses (frontal budding), to lay siege (starve out the opponent), and to detect and retreat, sacrifice of rear guard but gain in recruits (colony fission), and David and Goliath (zooid size) strategies are some of those shown to be important by Buss, Jackson and J. Winston, and S. Lidgard. As if the sessile combatants did not have enough problems, predators such as dorid nudibranchs apparently have highly specialized feeding requirements and pick out a small number of bryozoan prey species (S. Chadwick and J. Thorpe).

Two patterns of polypide (tentacle and gut) generation-degeneration examined by P. Dyrynda are considered in relation to colony growth and sexual reproduction. Cyclic regeneration of these parts allows reutilization of zooids, extending zooid active life and increasing larval productivity, in contrast to inefficient nonregenerative patterns. Dyrynda also describes androzooid and gynozooid seasonal development and for the first time the presence of a nurse cell associated with oogenesis.

Of general interest is an essay on growth and reproduction in colonial animals by J. Ryland. Ryland observes that colonial invertebrates tend to have short-lived larvae, implying that their prime role is site selection and not dispersal and that, like the colonial habit itself, this is adaptive to adult life in stable ecosystems.

Several evolutionary themes deserve special note. S. Mundy *et al.* suggest that the horseshoe-shaped lophophore and epistome of phylactolaemate bryozoans are adaptive features correlated with large zooid size. This interpretation and the lack of pre-Tertiary statoblasts lead them to propose a late origin of the phylactolaemates from a phoronid ancestor, an independent earlier derivation of marine bryozoans (also from phoronids), and thus a polyphyletic origin for the phylum. This is supported by comparative ultrastructural studies of spermatids and spermatozoa by A. Franzén. P. Taylor presents a well-considered hypothesis that the spectacular phases of bryozoan diversification during the Ordovician and Cretaceous were related to the evolution of new modes of tentacle eversion. J. Thorpe and J. Beardmore find an unusually low level of genetic variation at 393 enzyme loci; only 53 of the loci are polymorphic. Thorpe and Beardmore relate this to a high selective pressure to optimize metabolic efficiency and growth rate, important features in organisms whose fecundity is dependent on colony size.

Other themes of investigation with Recent Bryozoa are development of rooted colony forms (P. Cook and P. Chimonides), early colony growth (R. Wass *et al.*), regional faunas (A. Occhipinti Ambrogi and J.-L. d'Hondt on that of Italy; V. Gontar on that of the Kurile Islands), heavy metal uptake (S. Mundy and J. Soule and D. Soule), and body wall innervation (G. Lutaud).

Paleontological studies also show a diversity of interests. The first known fossil bryozoan-seagrass association is reported by E. Voigt from his remarkable specimens from the Upper Cretaceous Maastrichtian localities in the Netherlands. Other topics include intraspecific competition in Devonian fistuliporid and trepostome bryozoans (F. Bigey), colony growth forms (F. McKinney with R. Wass and T. Stedman, G. Brown and E. Daly, G. Illies), global Paleozoic biogeography (C. Ross and J. Ross), stratigraphic, paleofacies, and paleogeographical studies from England (P. Balson, P. Taylor *et al.*), Baltoscandia (K. Brood), eastern Europe (V. Ghiurca, N. Mongereau, N. Varva), Japan (T. Hayami), China (J. Yang and L. Lu), and California (R. Cuffey *et al.*). Cretaceous cribrimorphs receive taxonomic treatment by G. Larwood.

Twenty-one abstracts of other papers presented at the conference are also included in the volume. A number of these papers are now published in full elsewhere.

Finally, I nominate Dyrynda's figure 3, on growth and reproduction relationships, and Taylor's figure 4, of stylized, tentacle eversion diagrams, for inclusion in invertebrate zoology textbooks.

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Books Received

Advances in Agronomy. Vol. 34. N. C. Brady, Ed. Academic Press, New York, 1981. xiv, 486 pp., illus. $49.50.

Advances in Catalysis. Vol. 30. D. D. Eley, Herman Pines, and Paul B. Weisz, Eds. Academic Press, New York, 1981. xiv, 420 pp., illus. $58.50.

Advances in Clinical Chemistry. Vol. 22. A. L. Latner and Morton K. Schwartz, Eds. Academic Press, New York, 1981. x, 306 pp. $38.

Advances in Neurochemistry. Vol. 4. B. W. Agranoff and M. H. Aprison, Eds. Plenum, New York, 1982. xii, 232 pp., illus. $32.50.

Advances in Substance Abuse. Behavioral and Biological Research. A Research Annual. Vol. 2. Nancy K. Mello, Ed. Jai Press, Greenwich, Conn., 1981. x, 352 pp. $45.

Advances in Thyroid Neoplasia 1981. Papers from a colloquium, Rome, Sept. 1981. Mario Andreoli, Fabrizio Monaco, and Jacob Robbins, Eds. Field Educational Italia, Rome, 1981. xxiv, 364 pp., illus. Lit 10,000.

Agricultural Plants. R. H. M. Langer and G. D. Hill. Illustrations by Karen Mason. Cambridge University Press, New York, 1982. viii, 344 pp. $39.95.

Allosteric Effects in Haemoglobin. Kiyohiro Imai.

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