discuss. Occasionally, however, I wished he had discussed the alternatives he eliminates as unlikely; he does not treat the evolution of an atmosphere on a cooling earth surface, for example, although that possibility has attracted a number of other workers.

One of the most valuable parts of the book is a bibliography of more than 500 items. I cannot vouch for the meteorology, but the coverage of the pertinent geological literature is excellent. The book shows little concern with historical development of ideas; more than 90 percent of the references are post-1960. There are references as recent as 1977, but full coverage essentially ceases at the end of 1973.

I find it a little odd that Walker has not made and "operated" quantitative models; his numerical discussions of feedbacks in various systems make it clear that he has come to the verge of mathematical modeling of entire systems. Walker has done a great service in providing a book that expresses current knowledge of the subject well and one that surely heralds the development of quantitative modeling.

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Cancer Biology

Cancer Invasion and Metastasis. Biologic Mechanisms and Therapy. Papers from a workshop, New York, Dec. 1976. STACEY B. DAY, W. P. LAIRD MYERS, PHILIP STANSLY, SILVIO GARATTINI, and MARTIN G. LEWIS, Eds. Raven, New York, 1977. xxii, 518 pp., illus. $35. Progress in Cancer Research and Therapy, vol. 5.

The tumor that may kill differs from the lump that is merely inconvenient or unsightly in one of two ways. Trouble is at hand when the tumor mass breaks through nearby basement membrane or when bits of it get into the circulation, successfully seed a distant tissue, and begin their own autonomous growth. The first trouble is called invasion, the second metastasis. Tumors that can do one or the other are fittingly called "malignant": they are bad news.

The baseline for studying either invasion or metastasis is an animal bearing, or about to grow, a malignant tumor. Such animals do not provide the easiest or the best-defined systems for biochemical or genetic analysis of either malignant process. But we try our best. This book, the record of a meeting at the Sloan-Kettering Hospital, summarizes work on the subject quite well. In most cases the news is not good. Because scientists studying metastasis are dealing with a second-order (albeit lethal) event, they have no normal controls, only differences among already cancerous cell populations. Still it comes as a surprise to learn from these clinical and whole-animal studies that among the agents that increase metastasis in an animal (or a person) with a bad tumor are x-rays at the primary tumor site, glucocorticoids, and general anesthetics. That is, because of our ignorance of basic mechanisms, the triumvirate of therapies we use for the initial tumor (radiotherapy, chemotherapy, and surgery) may well be sowing iatrogenic metastases. Clearly, basic mechanisms must be intensively studied if we are ever to follow Hippocrates and "do no harm" while treating cancer.

This book contains almost three dozen laboratory review articles on the specific mechanisms and current therapies of malignancy. Metastasis seems to be a hotter subject than invasion. To a cell biologist the papers on the mechanisms of metastasis make much more interesting reading than the ones on its therapy. Certainly they are less depressing. Cell characteristics claimed to have predictive value in determining high metastatic potential include adhesion (Nicolson), aggregability (Poste), clumping (Good), platelet aggregation (Warren, Chauvin, and Philips), inability to be recognized by macrophages (Alexander), production of inappropriate surface antigen (Levine), release of angiogenic capillary-proliferative factors (Folkman and Tyler), and production of proteases (Kleinerman and Liotta) and protease activators (Weinstein). Last but not least, the exhaustive studies of Fidler, Gersten, and Riggs show that specific metastatic ability may be inherited by the tumor cells and that its biochemistry may therefore be studied in matched pairs of clones differing only in metastatic efficiency or target specificity.

These markers are not so exotic as one might have thought. Indeed, they read like a short list of key words in a National Cancer Institute research grant application. Why then are so few laboratories applying to metastasis the incisive biochemistry now lavished on the tumor viruses? Perhaps this book will help a few smart people get up the nerve to get their gels a bit dirty. One quibble: the book lacks an author index.

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