

interest to chemists. Dr. Alexander does an excellent job of discussing the chemical reactions which take place between carcinogenic substances and biological macromolecules, such as proteins and nucleic acids. He does a particularly good job with the various alkylating agents such as the nitrogen mustards, epoxides, ethyleneimines and mesyloxy compounds. He also discusses the interactions of ionizing radiation and of polycyclic hydrocarbons and aminoazo compounds with tissue components. Badger, in his chapter, on the other hand, deals much more extensively with the polycyclic compounds and azo compounds. The other chapters on carcinogenesis are more biological in nature.

Two chapters deal with chemotherapy. One is an excellent review of cancer chemotherapy in general, entitled, "Experimental Cancer Chemotherapy," by C. Chester Stock of the Sloan-Kettering Institute for Cancer Research, N. Y. It covers the various methods used for assaying chemotherapeutic agents and a résumé of the most important compounds which have been studied. The other chapter is, "Some Aspects of Clinical Use of Nitrogen Mustards" by Calvin T. Klopp and Jeanne C. Bateman, of the George Washington University Medical School, Washington, D. C. The biochemists and nutritionists will be interested in the chapter entitled, "Energy in Nitrogen Metabolism in Cancer" by Leonard D. Fenninger and G. Burroughs Mider of the National Cancer Institute, National Institutes of Health, Bethesda, Maryland.

The two remaining chapters deal with biological aspects of the study of cancer and are, "The Survival and Preservation of Tumors in the Frozen State" by James Craigie, Imperial Cancer Research Fund, London, England, and "Genetic Studies in Experimental Cancer" by L. W. Law, National Cancer Institute, Bethesda, Maryland.

The convenience, for the cancer investigator, of having such excellent discussions of these pertinent topics cannot be over-emphasized.

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Paper Chromatography. By FRIEDRICH CRAMER of the University of Heidelberg. Second revised and enlarged edition. Translated by Leighton Richards, B.Sc. St. Martin's Press, Inc., 103 Park Avenue, New York 17, N. Y. 1954. xii + 124 pp. 16 × 23 cm. Price, \$5.00.

In the preface to this book Dr. Consden humorously relates the circumstances under which the first two-dimensional (or directional) paper chromatogram was born. From these uncertain beginnings a lusty development occurred and the technique has now touched most branches of chemistry and has been applied in innumerable ways in biochemistry and biology. Inevitably the need for laboratory manuals has been anticipated and a number of texts already exist. The present "practical manual" comes by way of a translation from the 2nd German edition which, in the German or Italian version, no doubt introduced many continental workers to the technique. However, the experienced user of chromatography in the English speaking countries, where the technique has already flourished, may find that it tends to recount much that is already familiar, but those about to embark upon such work will obviously find it instructive.

Since the book is more apt to be used by beginners there are some features that may seem to be regrettable. Almost every laboratory quickly assembles its own "gadgets" and an almost unnecessary stress seems to have been given to describing particular but rather obvious aspects of this "gadgetry." These may not always appear happily chosen. It is doubtful whether "circular filter paper chromatography," which is after all only a special form of one-directional chromatography, has ever produced sufficiently distinctive results to justify directing the reader so forcibly to it. The fetish that all reagents must be applied with an atomizer spray is a relic of the past. For many purposes e.g., amino acids the reagent (ninhydrin) may be more uni-

formly and less wastefully allowed to run on the paper (dissolved in ethanol) from a modified wash bottle by touching the fine jet to the paper and drawing it repeatedly to and fro. Even in some cases dipping the paper in solution is adequate. Similarly, undue reverence seems to be given to the R_f value and far too little warning given to the errors that may be incurred by identifying substances by their position alone. The chromatographic technique is most valuable when applied to the separation of complex and often incompletely known mixtures and it is just here that the beginner needs to be warned of the many and increasingly obtrusive cases in which different substances can superimpose. A minimum of experience should enable the operator to dispense with such rigid devices as the keys shown in Figure 28 or the transparent Key "A" for sugars. It is doubtful whether the comfort in the oft repeated phrase that "a substance may be characterized by the speed at which it migrates" and "it is thus possible to separate and characterize a substance on the paper" is worth the later disillusionment that may arise if a too implicit faith is placed on such evidence alone, without recognizing that each worker must learn to evaluate the particular characteristics of his own system. This is not to discredit the technique any more than one should discard an instrument because in unskilled hands it may produce discord. Since the advances made possible by chromatography are now self evident, it is almost more necessary to dwell on the pitfalls than on the advantages. It is true that one short paragraph at the end of the introduction (page 2) sounds this warning note but it is soon lost in the account that follows.

The author traces the origin of the chromatographic technique to studies of protein hydrolysates and dwells for almost half the book on its applications to amino acids, etc. Unaccountably the selection of results cited in this field to give an idea of the scope of the method and the range of new amino acids that have been found in plants and animals seems to be quite unrepresentative. It is to be regretted, also, that the one color plate of a two-directional amino acid chromatogram is so poor. Even though made on standard solutions the resolution is unimpressive in certain regions, and the tendency of the spots to "beard" and "tail" is unduly obtrusive while the lines of "flow" seem obviously "skewed." Lacking the amides and being limited to 10 amino acids, this plate gives but a poor impression of the capacity inherent in a good chromatogram to resolve a complex mixture of nitrogenous compounds.

In use the book should not be taken too literally. The temptation to achieve facile identifications of substances in complex mixtures by slavish application of the many tables of data should be resisted. If this is done, however, it will be helpful to many who contemplate the use of chromatography by indicating something of its scope and power. By far the most interesting and helpful chapters to many will be those which, though brief, describe the application of chromatography to different classes of substances such as sugars, alcohols, nucleic acids, phenols and organic acids, sterols, etc., for these chapters describe the most useful solvent combinations and the appropriate developing reagents. Even here, however, the account is hardly infallible. Collidine figures prominently as a solvent for use with amino acids, but where this type of solvent is to be used it becomes far more effective in an appropriate mixture, say 1:3 of 2,4,6-collidine and 2,4-lutidine. Use of the heterogeneous fractions often labeled "collidine" can only lead to a distressing lack of uniformity in the chromatograms according to the source of this solvent.

Certain less familiar technical devices such as retention analysis, reverse phase chromatography, etc., are described and these will be helpful to many. A very brief reference recognizes that the techniques of paper chromatography also have applications in the separation of inorganic substances.

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