

in polymer science and to the general terminology; six chapters on physical phenomena and the characterization and testing of polymers; six chapters on polymerizing techniques and mechanisms; three chapters on colour and pigment science; four chapters on film application, formation and cure; six chapters on the chemistry and technology of plastics and rubber; three chapters on marketing and economics and twenty-one chapters which deal with the chemistry and technology of various classes of polymer. This latter group covers systems such as adhesives, printing inks, coatings, many types of resin, heat resistant polymers, fibres, household paints, plasticizers and solvents. The book concludes with two chapters concerned with the chemistry and technology of cellulose derivatives.

Each chapter is well served with an ample bibliography (1974) references are commonplace—a compensation for the photographic process used in the production of the book). There is an inevitable variation in the length of the chapters (from 3 pages to 36 pages) but this does not detract from the value of the book in any way. Each author has developed his own theme independently within the general plan stipulated by the editors and the book should prove to be a resounding success.

At the quoted price, this book is within the means of a wide readership. I heartily recommend its purchase.

J. T. Guthrie

**Adhesion Science and Technology
Volumes 9A and 9B
Edited by Lieng-Huang Lee
Plenum Press, New York, 1975,
pp 852, \$45.00**

Multidisciplinary is more descriptive of adhesion science than the word interdisciplinary. The study of case histories in adhesive behaviour does not fall in between conventionally limited disciplines but necessarily involves several of them. The scientist continues to write papers on fracture mechanics, on surface chemistry or physics or indulges himself with the latest tools for surface examination, *ESCA*, *LEED*, *SRIS*, not forgetting *FAITH* and the mere practitioners of the art look and listen with the hope that improved adhesives will eventually follow. Conferences are important, but there is a conflict between the presentation on the floor of the conference and the subsequent publication of a paper, excellent in itself but not new. The more eminent the authority — and usually people 'out of the top drawer' are clearer in their minds about the fundamentals than we lesser beings — the more likely is it for the ideas to have been presented elsewhere in substantially the same form. And so we find in these conference proceedings a mixture of papers with new experimental results of value buried in some of the less weighty papers and a substantial proportion of the 44 papers reviewing the current scene or reviewing the reviews of the current scene.

The selection of papers for comment in a short review is arbitrary but it cannot be so to draw attention to Dr Lee's own contribution. In addition to editing this, the second, as also the first ACS Adhesion Sym-

posium of 1971, Dr Lee opened the conference with a general review of advances since the earlier meeting and towards the end gave another interesting review, 'Polymers for Lithography: State of the Art' to introduce Part 8: 'Surface Energetics of Printing Processes'. He also presented papers on the 'Wettability of Functional Polysiloxanes' and the 'Thermal Fixing of Electrophotographic Images'. The former paper contains the unexpected finding that polysiloxanes containing $CF_3.C_2H_4-$ are more wettable than those based on $CH_3.C_2H_4-$.

To return to the beginning; Herman Mark and a tribute to him as Mr Polymer Science precedes Part 1 — 'Interfacial Phenomena and Adhesion'. I comment on Dr Zisman's paper on the controversy over the wetting of the noble metals and the influence of relative humidity as well as its second part on copolymers of tetrafluoroethylene and perfluoro (propyl vinyl ether) as hot melt adhesives. Also on the paper by Professor Hamann and his colleagues at Stuttgart in which descriptions are given of the covalent linking of polymers to silica, titania and copper phthalocyanine powders by radical or anionic processes. The reaction rates, molecular weight and structures of the grafted molecules are discussed.

Part 2: 'Synthetic Polymers and Adhesives' contains five papers. A paper on new polyimides (T. L. St Clair and D. J. Progar) was of interest because of the relation shown between adhesion and the solvent used at the poly(amic acid) state, in particular, the advantages of bis (2-methoxyethyl) ether (diglyme) and in the use of torsional braid analysis for T_g determination. Dr Kaebler also presented a paper in a new field of work — block copolymers — with his usual insight and clarity. I am glad to note that someone else regards these materials as among the more important of developing adhesives.

Part 3: 'Rubber Adhesives and Sealants' contains six papers of which I mention as an unusual practical paper that by R. W. Smith on the microscopy of polymer adhesive systems. Despite the absence of high glass paper, the 31 photographs have printed very clearly and make their points equally so.

Part 4: 'Natural Products and Structural Adhesives' justifies the first part of the heading with a paper on terpene resins (E. R. Ruckel, H. G. Arlt and R. T. Wojcik) used as tackifiers. The paper deals with the cationic isomerization—polymerization of alpha and beta pinenes and limonene. The Wagner—Meerwein rearrangement gives a bicyclic ring system from the four membered ring of the alpha and beta pinenes and the polymerization is limited to molecular weights of around 3500 because the camphenic carbonium ion is non-progressive for steric reasons and camphenic end groups are obtained; an interesting and thoroughly competent application of polymer chemistry to these important materials. Polyimides again feature in a paper by T. A. Bush, M. E. Counts and J. P. Wightman in which the surfaces of titanium alloy are examined by microscopy, *ESCA* or *SRIR* before bonding and after fracture of polyimide bonds. The two-phase nature of the alloy they used and changes in surface topography on etching were extensively studied by my colleagues and I a few years ago but only US work appears known to the authors. Among the newer and more exotic mate-

rials discussed in this section is a fluoro anhydride for curing fluoro-epoxy adhesives. Preparation details, and surface tensions are quoted. This paper is from the Naval Research Laboratory at Washington.

Part V has six 'Growth and Change' papers covering the different types of adhesive. Part VI is largely fracture mechanics though it deals generally with the subject of durability. Drs S. Mostovoy and E. J. Ripling present some new data on the flaw tolerance of some commercial and experimental adhesives and show the superiority in fracture resistance of joints made with the two-phase structural adhesives (nitrile-phenolics, epoxy-phenolics, etc.) over the best single phase polymers their properties being comparable to that of the aluminium adherends themselves.

The production of these two volumes is by offset lithography, but the binding is conventional and of high quality. The appearance of the typed page is quite pleasing, figures are clear and the good reproduction of photomicrographs has already been commended. There is a total of 852 pages of text added to which the rather short author and subject indices are included in both volumes. In spite of the high cost I think they should be available in the libraries of all who are concerned with adhesive behaviour. The two volumes are a credit to editor and publisher.

W. C. Wake

**Coatings: Recent Developments
M. W. Ranney
Noyes Data, New Jersey, 1976,
\$39.00**

The book is essentially a collection of précis of US patents issued mainly since 1972. The great majority of the coatings and coating procedures described are based on organic polymers. There are eight chapter headings. Six chapters deal with the subject under the heading of techniques; these are powder coatings, electrodeposition, radiation curable coatings, aqueous emulsions, other waterborne coatings, and solvent based coatings. The remaining two chapters cover the specific applications of solvent based coatings and corrosion and marine antifouling paints. Each chapter has a short but useful introductory section. The main emphasis in each chapter is the technology of the coating process although a certain amount of information is given in some cases about the properties of the resulting coatings. There is no referencing or index. Nor is there any account of the fundamental aspects of the coating procedure described.

It is difficult to comment on the usefulness of this type of book. Most people with a general interest in organic based coatings should be aware of its existence but I suspect that few will find it a wholly satisfactory reference text. Technologists whose production procedures limit them to a specific type of deposition process may be better satisfied. The book is nevertheless a wealth of useful practical information and is worth consulting if one has a specific technological problem.

B. J. Briscoe