Since this line of criticism is perhaps the only one to which these admirable studies seem open, it may be considered further. To begin with, the detailed statistics now regarded as desirable in Britain and America are nowhere presented by Piaget and Inhelder. To be sure, one paragraph in Part 2 begins promisingly : "These experiments were carried out on 100 children, 21 between 4 and 6 : 6 years, 30 between 6 : 7 and 8 years, 33 between 8 and 9 : 6 years and 16 between 9 : 6 [should it be 9 : 7 ?] and 12 years", but in the subsequent text no attempt is made to relate the developmental stages in space perception to any given number of children of a particular age. It is clear, however, from the whole nature of this study that Piaget and Inhelder are primarily concerned with what follows what, and are not particularly interested in the precise age at which the different stages occur. If anyone wishes to construct a developmental quotient on the lines of the intelligence quotient, then he may do so and the present study will provide him with an invaluable starting-point ; but the authors themselves have accomplished quite a different task.

Thus the methodological criticism may be in large measure discounted, and we can accept gratefully this richly detailed natural history of how our awareness of space grows from simple juxtaposition to the manipulation of perspectives and the arguments of geometry. A central theme of the whole account is the important part played in space perception by our own activities. We have inherited from John Locke and the empiricists a view of perception in which the outside world, as it were, imposed itself upon a passive organism. Almost all recent research has shown the untenability of this view, and the present study may perhaps serve to inaugurate a new and quite different approach.

To someone who has at one time wrestled with the original French text, the present translation seems to have been excellently carried out, and any difficulties that the reader may encounter derive from the complexity of the original and not from any defect in the expression.

NEW TECHNIQUES AND APPLICATIONS IN MOLECULAR SPECTROSCOPY

Molecular Spectroscopy

Edited by George Sell. (Report of a Conference organized by the Spectroscopic Panel of the Hydrocarbon Research Group of the Institute of Petroleum, and held in London, 28–29 October 1954.) Pp. viii + 234. (London : Institute of Petroleum, 1955.) 42*s*. net.

IT is not so very long ago that self-respecting spectroscopists frowned upon anything more complex than a diatomic molecule. However, the rapid development of the petrochemicals industry has given a great fillip to applied spectroscopy, which has become much more 'broad-minded' with regard to the size of molecules and the complexity of their mixtures that its adepts take in their stride.

Perhaps one of the first of the spectroscopists of the 'old school' who sensed the power of spectroscopic methods as a tool for developing industrial processes was Victor Henri, and indeed nowadays ultra-violet and infra-red methods are necessary tools of the petroleum industry and of many other branches of the chemical industry. To this the present volume bears witness. Yet beyond this it also sheds light on techniques which still have to prove their value for the field of hydrocarbons.

This book is a collection of nineteen papers which were read by invitation at a conference which the Spectroscopic Panel of the Hydrocarbon Research Group of the Institute of Petroleum held in London in 1954. The object of the conference was to bring together people for a discussion of newer techniques. In this endeavour, and in a laudable spirit of being non-parochial, the Panel succeeded in attracting contributions from workers in Britain and overseas. The papers are written by people with widely different interests and touch upon very different aspects of applied spectroscopy. It is only natural, therefore, that they vary considerably in length, depth and breadth.

It is interesting to learn that about two thousand infra-red spectrometers are in use to-day, that cæsium iodide prisms can be made from synthetic crystals to allow measurements to 54μ, and of the possibilities opened up by additively coloured alkali halide crystals as infra-red transmission filters. There is information on gratings for use in the 2–15μ region with line spacings varying from 15,000 to 2,400 lines/inch, on the pressed-disk technique for obtaining spectra of solid materials, on infra-red reflexion spectra from small crystals, on Raman spectrometry, and on infra-red emission from gases excited by a radio-frequency discharge. Gases can be heated to temperatures in excess of 5,000° C. in fewer than ten molecular collisions by the application of shock-waves. For analytical purposes, on the other hand, low-temperature work may become useful where mixtures solidify to transparent disordered glasses. What the analyst is looking forward to very much is to be able to transfer data from one instrument to another ; that is, to assess true intensities from the measured spectra. He derives immediate benefit from a classification of the characteristic vibration frequencies of substituted benzenes. The amount and position of deuterium in mono-deutero-aromatics in the presence of their parent compounds can be determined by infra-red spectrometry. Oxidation plays a great part in the quality and shelf-life of many hydrocarbon products, and infra-red spectrophotometry can be beneficially employed as a yard-stick for the degree of oxidation.

Both Raman and ultra-violet spectrometry have their places in type analysis, and there is an interesting account of the determination of aromatic hydrocarbons in lubricating-oil fractions by work in the region of 1900 A. The future will show the part which the flash-photolysis technique and nuclear magnetic-resonance spectra can play in the field of hydrocarbons. There can be little doubt that fluorescence techniques are in the ascendancy. An article of about two thousand words, on the use of fluorescence for industrial analysis and examination, is a masterpiece of concise presentation. The book contains a record of the discussion to each paper, and a discussion on punched cards and the presentation of spectral data forms its concluding chapter.

Workers in the petroleum industry owe a debt of gratitude to the Institute of Petroleum for making available for reference purposes this fountain of information.

R. SCHNURMANN