MS—the works

Mass Spectroscopy. H. E. Duckworth, R. C. Barber and V. S. Venkatasubramanian, eds. Second edition 1986 and first paperback edition 1990. Cambridge University Press. pp. xiv + 337.

Receiving this book reminds one of an advertisement that used to appear in science newsmagazines in the late sixties or early seventies. The ad showed a lab-coated figure, back to viewer, pushing a large box, mounted on castors, through a door leading to a dark interior. A large-lettered caption said something to the effect, 'Organic chemists are stealing mass spectrometers from the physics lab.'

Being an organic chemist (practitioner of one of the dirtier sides of physics, in the words of a famous man), I am not ashamed to confess that I turned first to page 210, where the chapter 'Applications to organic chemistry' began. I found short but full descriptions of ionization methods, source configurations, sample-inlet procedures, methods of preliminary separation of mixtures (GC, HPLC and so on) and interfacing of the separation equipment with the source, etc. The historical aspect had, by no means, been neglected in that early findings in hydrocarbon analysis (petroleum can also be valuable in the development of analytical tools, besides starting wars based on primitive instincts of 'possession of resources') that led to the takeover of mass spectroscopy by non-physicists had been treated. Short but comprehensive coverage had been given to fragmentation patterns of fundamental organic structural types and to the newer techniques of tandem mass spectrometry ('MS–MS') in its various *avatars*. Leading references, not only to the development of these latter techniques but also to the specifics of many of their applications, were to be found. Included were means of extraction of information packed in 'metastable' ions ($M^* = M_B^2/M_A$ for an $A^+ \rightarrow B^+ + C$ reaction) and in data from soft-ionization techniques like chemical and field ionization, field desorption, fast atom bombardment, etc. of value in the analysis of oligomers and other higher-molecular-weight substances.

That first morsel being tasty, I assumed the 'competence of the layman' and turned to examine the rest (the greater part) of the book. The book begins at the beginning—with Thomson's positive-ray parabolas, detectable at the back of a cathode in an electron tube, and Aston's development, therefrom, of a mass spectrograph, quickly followed by contributions from others (Dempster, Bainbridge), more to do with accurate determination of relative atomic masses, packing fractions, isotopic abundances and so on (described and discussed, along with the latest developments in technique, in more detail in chapters individually devoted).

The authors then proceed to discuss ion optics and attendant magnet design, controlled inhomogeneity, geometries of electric fields, as well as the large amount of experimental work that went into the setting-down of practical formalisms, all of which are stated and derivation of many of which given. Following are descriptions of ion sources—from ordinary gas discharges through chemical and field ionization to extraction of ions from confined plasmas, the last bordering on methods used in the 'big science' of particle accelerators. Principles and layouts of double-focusing machines which lead to mass discrimination at high resolution (Mattauch–Herzog, Nier–Johnson, Ogata–Matsuda and a number of others) are then treated. I found the next chapter, on time-of-flight and radio-frequency instruments, especially informative since such instruments seem well on the way to displacing ponderous ones with combined geometry (double-focusing) incorporating magnetic focusing in routine analyses of mixtures of medium-molecular-weight components. Indeed, one manufacturer who makes an instrument that records FT-IR spectra of separated components simultaneously with recording of their mass spectra and calls his product an MS engine uses a hyperbolic quadrupole mass filter which does away with cumbersome electromagnet and associated stabilized power and scanning circuitry.

Completeness of coverage can be illustrated by the following random selection of topics: production and mass analysis of negative ions, digital data acquisition/processing, on-line applications in isotope-enrichment factories (e.g. for 'weapons-grade' uranium), applications in environmental monitoring, in the biochemical/medical field (from peptide sequencing (somewhat sketchily treated) to analysis of physiological fluids, or from investigation of genetically induced disease to equally unhappy cases of drug-taking athletes), space research, study of variations in isotopic composition of light elements through complex natural processes (e.g. variation by 4–8% in the isotopic composition of sulphur induced by enzymic processes), the strange case (p. 184) of selective burn-up of ^{235}U from uranium ore by an ordinary-water-modulated *natural* reactor that was in intermittent operation over 10^5 yr in an uranium-rich lode in the Republic of Gabon ('anything you may want to do has already been demonstrated by nature'!), ion-cyclotron resonance storage-extraction-mass discrimination systems, ion-molecular reactions, the hot topic of ion implantation, and so on. (Incidentally, tandem mass spectrometers with flexible geometry that render possible ion-molecular reactions equipped with a choice of sources and detectors have indeed been referred to as 'complete chemical laboratories' (Biemann).)

Not least significant is the coverage given to what has been called physical inorganic applications, e.g. methods of determining bond dissociation energies. (Can such methods be adapted to determine energies of liberating specific (ionized) species from lattices? 'High-temperature' superconductors may, after all, yield their secrets!)

Time now to scan chapters on age determination (avoiding the expression 'dating') of geological and cosmological samples (from stony planet, stony natural satellite, dirty ice satellite/comet or of tektites, meteorites, analysed either conventionally, after retrieval, or by on-board instruments)—a field of special interest to one of the authors, who, alas, is no more. The treatment is wide and deep but rather dense (a characterization valid of most of the other parts of the book), making it more useful as a source of references for detailed information.

I confess to not having more than glanced through the first edition (1958) of this book. Well-founded is the claim made in the preface to the second edition that users of the first edition

must have liked the way intentions of writing it were fulfilled, in that a second edition with extended coverage was worth issuing (in 1986) and in that a paperback edition (the version in hand) had soon to follow (in 1990). The book abounds in schematics, with components clearly identified, of source types, analysers, layouts of multifocusing configurations, detectors, etc., as well as in line drawings illustrative of principles. The list of references is extensive. Chapter-wise division has, however, necessitated repetition of many of the references; an author index might have been useful. The (subject) index is enriched by the inclusion of acronyms —FAB, MIKES, FT-ICR, etc. but not QQQ, EBEB, BEEB or BEQQ (in reference to combinations of magnetic (B), electric (E) and quadrupole (Q) analysers in tandem (p. 229)). But it has PIG, nothing to do with female chauvinism, but only with *P*hilips *i*onization *g*auge.

Finally, the question as to who will find this mine of information useful must be faced. The blurb on the back says, '...will be of value to university and industrially based scientists in any discipline in which the mass spectrometer finds application' (to find out what flavouring agent the other fellow has put in his pickle or jam?). Of the small minority of scientists thus engaged, only a few might want to know about mass spectrometry in all its fundamentals and fewer still might be interested in its historical aspects or even in its latest techniques. In the general run, those interested in 'dating', in company with organic chemists or molecular biologists or similar others would be content to be mere 'vulgar consumers', preferring to have the instrumentation (together with operating manuals) handed to them on silver platters. This would be at great cost in 'forex' (not to be confused with a brand of baby food) for those working in the 'developing' countries. Post-graduate students of physics are not likely to be questioned deeply in mass spectroscopy in examinations. However, the book will, no doubt, find its valued niche, as a source book, in any science library.

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MEETINGS/SYMPOSIA/SEMINARS

First National Symposium on Unconventional Pests: Control vs Conservation

Place: Bangalore
Date: 15–17 October 1991

Contact: Dr (Mrs) Shakunthala Sridhara
Organizing Secretary
National Symposium on Unconventional Pests: Control vs Conservation
University of Agricultural Sciences
GKVK, Bangalore 560 065

IGCP 264 Workshop/Seminar on Geological Applications of Remote Sensing With Emphasis on Spectral Properties

Place: University of Poona, Pune, India
Date: 2–12 December 1991
Workshop/seminar is for young scientists from developing countries. It is part of the International Geological Correlation Program Project 264: Remote Sensing Spectral Properties

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International Symposium on Molecules to Materials

Place: Bhubaneswar, India
Date: 8–11 January 1992

All aspects of 'molecules to materials', specifically the following major topics will be covered: Novel coordination complexes, kinetics and machanism; Novel organometallics and catalysis; Inorganic synthons and clusters; Development of new materials and biopolymers.

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Haldane Centenary International Conference on Human Genetics

Date: 15–19 December 1992
Place: Calcutta, India

Sessions include: Formal genetics of man, segregation and linkage analyses, genetic epidemiology, evolution, population genetics, population structure, genetic studies of human populations. There will also be a panel discussion on gene–environment interaction.

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