30th Annual Conference • 1982 • Honolulu, HI, Hawaiian Hilton Village

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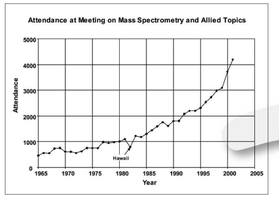
American Society for Mass Spectrometry

Explosive Growth Begins



1980 was the first 'greater than 1000 in attendance' meeting, except for the Hawaii meeting in 1982, at which attendance dropped to 789. Despite the co-sponsorship of several Pacific Rim mass spectrometry groups; the Australian and New Zealand Society for Mass Spectrometry, the Japanese Society for Medical Mass Spectrometry, and the Mass Spectroscopy Society of Japan; attendance at the 30th conference was down 30% compared to the year before -- primarily because members from the mainland had a difficult time justifying travel to Hawaii.

Making Room

By 1982, the number of papers had grown accommodated by multiple parallel oral Diego meeting, poster sessions were used for basis. There was some concern among both the members that the poster presentation regarded as a 'second class' venue for the However, with the increasing number of was no other apparent solution. An *ad hoc* questionnaires to obtain feedback and use of the poster presentation technique from viewing the posters. Results showed that 96% posters in the future and 80% were willing to poster sessions. This positive outcome poster sessions at the annual conference. guidelines in use today are essentially came out of the *ad hoc* committee report.

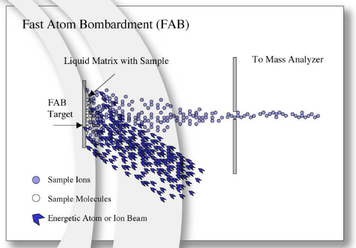
to 474, too many to be sessions. At the 1976 San the first time on a trial ASMS governance and technique would be presentation of research. contributed papers, there committee prepared suggestions regarding the both presentors and those were in favor of using present their research in guaranteed the future of The poster presentation unchanged from those that

The eclectic nature of the conference was clearly evident by 1982. Some of the more intriguing paper titles were:

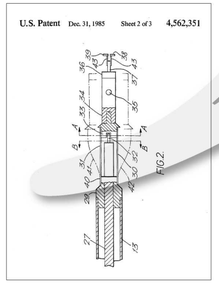
> *"The Determination of the Transport Properties of Atmospheric Gases in an Epoxy Resin by Precision Abrasion Mass Spectrometry,"*
> *"Beer and Pyrolysis Mass Spectrometry,"*
> *"Sulfur-Containing Metabolites of Polychlorinated Biphenyls in Patients with 'Yusho.'"*
> *"Ion Chemistry in the Atmosphere of Titan",*
> *"Cruise Missile Fuel Inhalation Kinetics and Metabolite Identification by GC/MS",*
> *"Archean Geochronology of India," and*
> *"Investigating the Uses of a Commodore PET Microcomputer in Conventional Ion Cyclotron Resonance Spectrometry."*

FAB Duz it All with Cheer

This punny play on words with the names of popular laundry detergents appeared at a Conference a few years after the Hawaii meeting; but it pretty much said it all; even in 1982. The development of fast atom bombardment (FAB) in Mickey Barber's lab at the University of Manchester Institute of Technology (UMIST) in 1981 was a defining moment in mass spectrometry. Now a whole range of difficult to ionize compounds could be easily analyzed with FAB. In particular, mass spectra could be obtained from those non-volatile, high molecular weight, polar compounds that were so interesting to the biological community.



While there was a great deal of discussion regarding whether or not FAB was just a re-invented version of surface ionization mass spectrometry (SIMS), there was no question that FAB or liquid SIMS or organic SIMS or whatever you wanted to call it was the ionization method of the day. New instruments came with both EI and FAB sources and older instruments were retrofitted with FAB sources as fast as the parts could be ordered and the source housing modified. At the Hawaii conference, barely a year after Barber's paper appeared in the Journal of the Chemical Society's Chemical Communications, there were four sessions in which FAB was part of the session title. The first focused topic meeting sponsored by ASMS outside of the Annual Conference was on the FAB ionization technique in the fall of 1981. Researchers throughout the world were using FAB within the year to pursue all kinds of compounds that before were barred from study due to the limitations of the existing ionization techniques. Clearly a new era in the application of mass spectrometry to problems in biology was opened with the development of FAB.



Patent illustration of dual target FAB probe for accurate mass measurement by peak matching.

Because of the interaction of reference compounds, usually salts, with the sample and matrix, accurate mass measurements by FAB using an internal mass reference were not always successful. The probe shown in this patent drawing has two FAB targets, one for the sample and matrix and one for the mass reference. A motor drove an eccentric in the probe body to alternatively move the targets into position in front of the ion exit slit in the FAB ion source. Operating the mass spectrometer in peak matching mode, alternate voltage scans would scan the reference mass peak on one target and the sample/matrix peak on the other target.

The Environment

By 1982, GC/MS instruments with data systems were offered by a variety of manufacturers, based on both magnetic sector and quadrupole mass filter designs. While gas chromatography had a long and well-documented history of analysis of environmental pollutants, the need for unambiguous identification of compounds required interfacing the gas chromatograph to some other analytical tool. Both infra-red spectrophotometers and mass spectrometers were natural choices to provide the specificity needed in environmental analysis, but combined GC/MS became the instrument of choice. Mass spectral libraries and the library search algorithms necessary to match the mass spectrum of the analyte with 'hits' in the library had reached a fair degree of sophistication.

Pulp mills in West Virginia discharge pollutants into the Columbia River.
Photograph by Gene Daniels. National Archives and Records Administration

With time, the less expensive GC/MS data system instruments (GC/MS/DS) based on the quadrupole mass filter came to dominate the environmental analysis market while the more expensive sector instruments were reserved for problems that required higher resolving power. The impact of combined GC/MS on every aspect of the environment is hard to overestimate. Both the Environmental Protection Agency (EPA) and chemical manufacturers had relatively inexpensive tools at hand that could clearly and unambiguously determine and quantify the products and byproducts of industrial chemical processes in water and in air. In addition, the detection limits for this instrumentation were such that disposal by dilution was not a viable option for those wishing to avoid proper waste handling procedures.

The dilution approach, taken by a waste oil hauler in Missouri in the '70s led to one of the most notorious environmental pollution episodes in the country. It exploded onto the national scene with the discovery that waste oil sprayed for dust control in Times Beach, Missouri contained dioxin. Times Beach was one of three toxic waste sites that inspired passage of the historic Superfund law in 1980. The ensuing investigation and clean-up affected the lives of every resident of the town, displacing them all and adding fear of the unknown health consequences of dioxin exposure to their everyday life. Both GC/MS and high resolution tandem mass spectrometry played an important role in determining and quantifying the presence of dioxin during the investigation and remediation of Times Beach.

Computer Technology and Mass Spectrometry

While computers; analog, digital, and hybrid; had been used in a variety of analytical settings for the collection and analysis of mass spectral data as early as 1945, they were limited in scope. The high data acquisition rates and massive amounts of data produced in a typical mass spectrum were always a challenge to the computer systems brought to bear on the problem in the early decades of interfacing computers to mass spectrometers.

In the '70s, computer hardware was macroscopic. Random access memory (RAM) was composed of ferrite cores in which one bit took up a reasonable fraction of a cubic inch. Central processors were discrete component circuits mounted on printed circuit boards. Costs, particularly for RAM, were prohibitive for more than 4 kbytes, since bit costs were on the order of cents. This translates to word costs on the order of a dollar, depending on word size.

In 1971, Intel introduced the 4000 series of integrated circuits for computers and the clock was set at t=0 for Moore's Law. It took the greater part of the next decade for integrated circuit technology to reach the mini-computers used in the mass spectrometer laboratory. By the late '70s, companies such as Digital Equipment Corporation with the PDP-8 and Data General with Nova had introduced data systems that could alleviate the drudgery of manually extracting mass and peak intensities from oscillographic chart recordings.

Charles Sweeley examining print out from Digital Equipment Corporation's (DEC) PDP 8/I. DEC computers were used extensively in mass spectrometer data systems.

Even so, digital computers of the era would be considered archaic by today's standards. Typically, programming was done in machine language and frequent memory swaps were required due to the limited amount of RAM available to accomplish the simplest of tasks. Inexpensive media, such as punched paper tape, were used to store programs and transfer them from the vendor to the customer. Interaction with the mini computer was by means of toggle switches on the front panel and keyboard input was via teletype. There was no real-time display of mass spectra on the fly and many laboratories required the on-site assistance of a computer professional to deal with computer related problems.

MASS SPECTROMETRY

1973
The self-training interpretative and retrieval system (STIRS) for interpretation of mass spectra is introduced.

1974
Fused silica capillary gas chromatography columns are introduced for GC-MS.

Fourier transform-ion cyclotron resonance mass spectrometry is introduced.

An atmospheric pressure chemical ionization interface for LC-MS is developed.

1975
Mass spectrometers are placed on board NASA's Viking spacecraft for its mission to Mars.

1976
The selected ion flow tube is developed by scientists in Great Britain to enable precise control of reactant ions.

Plasma desorption mass spectrometry and its application to the study of biomolecules is developed at Texas A&M University.

Japanese researchers take isotope-ratio measurements using the first combination of gas chromatography combustion mass spectrometry.

Mixture analysis by tandem mass spectrometry is first demonstrated.

1977
American and Australian researchers introduce the tandem quadrupole mass spectrometer.

Accelerator mass spectrometry is introduced.

The simulated ion optics programme (SIMION) is designed and developed.

A kinetic method to determine gas-phase proton affinities is introduced.

1978
Hydrogen-deuterium exchange as a structural tool for the study of gas-phase ions is developed at the University of Colorado.

Electron-capture negative ion chemical ionization mass spectrometry extends detection limits for derivatized compounds to the attomole level.

1979
Researchers in Canada develop the theory of field-induced ion evaporation.

1980
Inductively coupled plasma mass spectrometry is developed at Iowa State University.

GC-MS is used in the investigation of the hazardous waste disposal site at Love Canal.

1981
Fast atom bombardment is introduced by researchers in the United Kingdom.

ASMS holds a fast atom bombardment workshop.

The first commercial triple-quadrupole mass spectrometers are introduced.

1982
GC/MS is included as an approved analytical method in the U.S. Environmental Protection Agency's Resource Conservation and Recovery Act and the Superfund program.

A complete insulin spectrum is obtained by FAB and particle desorption ionization methods.

HISTORY

1973
Egypt and Syria attack Israel, beginning the Yom Kippur War.

An OPEC oil embargo leads to fuel shortages and high gasoline prices in the United States.

U.S. forces withdraw from Vietnam.

1974
A Communist coup overthrows Emperor Haile Selassie I of Ethiopia.

The U.S. Freedom of Information Act is passed.

Richard Nixon resigns the presidency.

1975
Francisco Franco dies after ruling Spain for thirty-six years.

Saigon falls to North Vietnamese forces.

The first personal computers are introduced.

The first home VCRs are introduced.

1976
The superstring theory is introduced, originally to explain the origins of the strong nuclear force.

The Viking I probe lands on Mars.

Mao Zedong dies, opening the way for moderate government in China.

1977
Recombinant DNA technology is first used to produce insulin.

Smallpox is officially eradicated worldwide.

Raymond V. Damadian introduces magnetic resonance imaging (MRI) for medical diagnosis.

1978
Egypt and Israel sign the Camp David Accord.

Joy Louise Brown, the first "test-tube baby," is born in England.

1979
In Cambodia, invading Vietnamese forces overthrow the Khmer Rouge.

The most serious nuclear accident in U.S. history occurs at Three Mile Island power plant near Harrisburg, Pennsylvania.

The Sandanistas gain control of Nicaragua.

The Shah of Iran is overthrown, and the Ayatollah Khomeini becomes leader of the country.

The Soviet Union invades Afghanistan.

1980
Lech Walesa helps found the Solidarity labor union in Poland.

Mt. St. Helens erupts in Washington State.

Father-and-son scientists Luis W. and Walter Alvarez propose that an asteroid impact caused the extinction of the dinosaurs.

1981
The first cases of AIDS are identified.

The first space shuttle, Columbia, is launched.

Sandra Day O'Connor becomes the first woman to serve on the U.S. Supreme Court.

1982
Surgeon William C. DeVries installs a Jarvik-7 artificial heart in Barney Frank.

A worldwide ban on commercial whaling is implemented.

Audio compact discs are introduced.