1st Annual Conference • 1953 • Pittsburgh, PA, Hotel William Penn

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American Society for Mass Spectrometry

Society Origins

Prior to the creation of Committee E-14 on Mass Spectrometry and Allied Topics of the American Society for Testing and Materials (ASTM), information was shared among a small group of mass spectrometrists through users conferences of the various manufacturers. The most active of these users conferences was that organized by Consolidated Engineering Corporation, a California firm that manufactured magnetic sector instruments. Attendees felt the need to have a more open forum with a scientific venue.

In 1952, a group of mass spectrometrists attending the Mass Spectrometry Sessions at the Pittsburgh Conference (when it was actually held in Pittsburgh!) met and decided to explore the formation of an ASTM 'E' committee devoted to mass spectrometry. In 1953, the ASTM Committee E-14 co-sponsored the Pittsburgh Conference, holding the 1st Annual Conference on Mass Spectrometry and Allied Topics.

The Scope of Committee E-14 was outlined in the beginning:

"Promotion of knowledge and advancement of the art of mass spectrometry by:

- Coordinating scientific applications and methods of analysis based on mass spectrometry.
- Sponsoring meetings at which scientific papers relative to mass spectrometry may be presented and discussed.
- Standardizing nomenclature relating to mass spectrometry.
- Initiating, sponsoring and reporting work in the field of mass spectrometry, without prejudice to the jurisdiction of other technical committees over their respective materials.

It is the objective of the committee to encourage participation, on the widest possible basis, of individuals interested in mass spectrometry, in order to coordinate work and promote the exchange of information in the field. Emphasis will be placed on presentation, at national meetings, of papers on all phases of mass spectrometry, with subsequent publication in the most appropriate medium."

Petroleum Chemistry and Fundamental Studies Dominate First Conference

There were 26 papers presented in 4 mass spectrometry sessions over a three day period at the 1st Conference. The content was heavily focused on problems in the mass spectrometry of hydrocarbons, since many users were employed in the petroleum industry. In particular, attendees were interested in using mass spectrometry as a quantitative tool to speed up the analysis of hydrocarbon process streams.

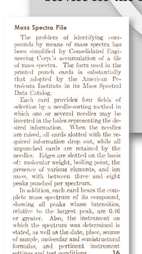
However, there were several papers in other areas, such as "Detection of Atoms and Free Radicals in Flames by Mass Spectrometric Techniques", "Half-life of Negative Metastable Ions", "A Method for Determination of Values for Nitrous Oxide in Blood with the Mass Spectrometer", and Mass Spectrometric Studies of Mixtures of Water and Deuterium Oxide."

In addition, four technical Sub-Committees were formed:

- "Theoretical and Fundamental Aspects"
- "High Molecular Weight and Solid Techniques"
- "Methods, Data, and Nomenclature", and
- "New Instruments and Techniques"

Early Mass Spectral File Search Technology

Computers in mass spectrometry were almost non-existent in 1953. Nevertheless, the latest technology in Library Search methods was being pressed into service for the small database of hydrocarbon mass spectra. Reproduced below is the description of the 'search' algorithm taken from the January, 1953 issue of Analytical Chemistry.



Mass Spectra File

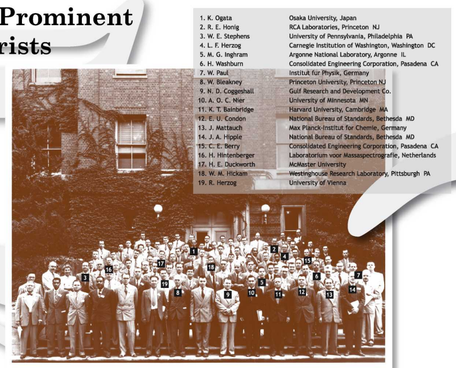
The problem of identifying compounds by means of mass spectra has been simplified by Consolidated Engineering Corp.'s accumulation of a file of mass spectra. The form used in the printed punch cards is substantially that adopted by the American Petroleum Institute in its Mass Spectral Data Catalog.

Each card provides four fields of selection by a needle-sorting method in which one or several needles may be inserted in the holes representing the desired information. When the needles are raised, all cards slotted with the required information drop out, while all unpunched cards are retained by the needles. Edges are slotted on the basis of: molecular weight, boiling point, the presence of various elements, and ion mass, with between three and eight peaks punched per spectrum.

In addition, each card bears the complete mass spectrum of its compound, showing all peaks whose intensities, relative to the largest peak, are 0.01 or greater. Also, the instrument on which the spectrum was determined is stated, as well as the date, place, source of sample, molecular and semistructural formulas, and pertinent instrument settings and test conditions. 16

Early Meeting of Prominent Mass Spectrometrists

In 1951, a meeting of physical mass spectrometrists was held at the National Bureau of Standards (NBS, now NIST). It is quite probable that this meeting had the largest assemblage of physicists working in the field of mass spectrometry at any time before or since. In the photo taken at the conference, many prominent mass spectrometrists were present.

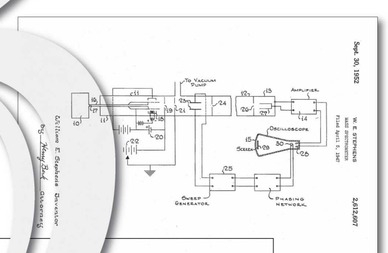


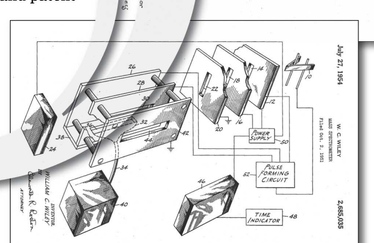
1. K. Ogata	Osaka University, Japan
2. R. E. Honig	RCA Laboratories, Princeton NJ
3. W. E. Stephens	University of Pennsylvania, Philadelphia PA
4. L. F. Herzog	Carnegie Institution of Washington, Washington DC
5. M. G. Inghram	Argonne National Laboratory, Argonne IL
6. H. Washburn	Consolidated Engineering Corporation, Pasadena CA
7. W. Paul	Institut für Physik, Germany
8. W. Weakney	Princeton University, Princeton NJ
9. N. D. Coggeshall	Gulf Research and Development Co.
10. A. O. C. Nier	University of Minnesota MN
11. K. T. Bainbridge	Harvard University, Cambridge MA
12. E. U. Condon	National Bureau of Standards, Bethesda MD
13. J. Mattauch	Max Planck-Institut für Chemie, Germany
14. J. A. Hipple	National Bureau of Standards, Bethesda MD
15. C. E. Berry	Consolidated Engineering Corporation, Pasadena CA
16. H. Hintenberger	Laboratorium voor Massaspectrografie, Netherlands
17. H. E. Duckworth	McMaster University
18. W. M. Hickam	Westinghouse Research Laboratory, Pittsburgh PA
19. R. Herzog	University of Vienna

Important Advances in Mass Spectrometry: Time-of-Flight Patents

Up until the mid 1940s, mass spectrometers were based on single magnetic or magnetic and electrostatic sectors. During the Manhattan Project, several scientists worked on a design in which ions of different mass would be separated on the basis of the different times it would take them to traverse a fixed distance given that they were all accelerated to a constant energy. Due to secrecy issues, knowledge of this concept was not widely disseminated in the scientific and patent literature until after World War II. Shown at right are the patent drawings from two patents, one by W. E. Stephens of the University of Pennsylvania, and the other by W. Wiley of Bendix Aviation Corporation. While the Stephens patent drawing portrays an arrangement not unlike a modern instrument, Wiley's patent drawing would tend to mislead a person without a good understanding of the concept.

Time-of-Flight instruments had several potential advantages. Their mass range was unlimited (in principle) and they could acquire spectra from extremely short-lived events. Bendix Aviation Corporation elected to build and sell time-of-flight instruments and created a successful niche market for them. While the Bendix mass spectrometer never dominated the market, it did show that mass analysis technologies other than those based on the tried and true magnetic sector could find application in analytical chemistry.





Contemporary Instrumentation

Prior to the 1st Conference, there were a handful of commercial instruments on the market. Consolidated Engineering Corporation (CEC) had two instruments for sale, the 21-103C for hydrocarbon analyses and the Consolidated Nier for isotope ratio analyses. Westinghouse had an instrument based on the Nier 60 degree magnetic sector and General Electric also had a magnetic sector instrument. By 1953, Westinghouse had withdrawn its mass spectrometer from the market. European and Japanese instrument companies were poised to manufacture and market instruments at this time period.

MASS SPECTROMETRY

1886 Eugen Goldstein observes *Kanalstrahlen*, positive rays of electricity.

1897 J.J. Thomson discovers the electron.

1898 Wilhelm Wien studies canal rays deflecting them with electric and magnetic fields.

1943 Consolidated Engineering Corporation (CEC) installs its first commercial mass spectrometer (Model 21-101) at Atlantic Refining Company in Philadelphia.

E. O. Lawrence leads development of the "Calutron" preparative scale mass spectrometer for the separation of uranium isotopes.

1944 A CEC 21-101 users group forms in Pasadena, California.

The U.S. National Bureau of Standards makes fifteen hydrocarbons available as calibration standards for mass spectrometers.

1945 CEC introduces the Model 30-103 analog computer for analysis of mass spectra of hydrocarbon mixtures.

1946 The first description of the time-of-flight mass spectrometer is published in the *Physical Review*.

Metropolitan Vickers produces the first MS-1 mass spectrometer.

1947 CEC introduces its "Consolidated-Nier" isotope ratio mass spectrometer

The U.S. National Bureau of Standards and the American Petroleum Institute initiate the distribution of reference mass spectra and the creation of a library of mass spectra.

1948 Researchers at the University of Minnesota design a dual inlet with a changeover valve for rapid sample switching in high-precision isotope ratio mass spectrometry.

Ion cyclotron resonance mass spectrometry (Omegatron) is developed.

Harland Wood investigates the synthesis of liver glycogen in rats using isotopically labeled compounds.

1950 The first high-precision gas isotope ratio mass spectrometer is put into operation at the University of Chicago.

Consolidated Engineering Corporation (CEC) introduces its Model 21-103 mass spectrometer. Heated inlet systems for gas-liquid sample introduction are subsequently developed for this instrument.

An improved isotope ratio mass spectrometer permits measurement of ^{13}C and ^{18}O abundance to plus or minus 0.01 percent.

1952 A. O. Nier and E. G. Johnson design a double-focusing mass spectrometer that focuses ions onto a single point.

A. J. Martin and R. L. Synge receive the Nobel Prize in chemistry for their invention of partition chromatography.

The American Society for Testing ad Materials (ASTM) Committee E-14 on Mass Spectometry is organized.

Victor Talrose discovers that elementary ion-molecule reactions of organic compounds have no activation barrier.

CEC introduces SpectroSADIC, an analog-to-digital converter for the acquisition of up to forty selected peaks in the mass range of 12 to 150 daltons.

1953 Field ionization phenomena are observed at the University of Chicago.

Wolfgang Paul publishes early papers on quadrupole mass spectrometers and ion-trap detectors.

HISTORY

1895 X-rays are discovered by Wilhelm Roentgen.

1898 Westinghouse Electric installs the first alternating current generators for the production of electricity at Niagara Falls, New York

Marie and Pierre Curie discover radium.

1899 Guglielmo Marconi sends the first radio transmission across the English

1941 Orson Welles directs and stars in *Citizen Kane*, considered by many to be the best film of all time.

The United States enters World War II after the Japanese attack on Pearl Harbor.

1942 Enrico Fermi conducts the first controlled nuclear chain reaction at the University of Chicago.

1943 The Nazis are defeated by the Soviets at the horrific Battle of Stalingrad, turning the tide of war on the Eastern Front.

Rodgers & Hammerstein's *Oklahoma!* opens on Broadway.

Scuba (self-contained underwater breathing apparatus) is invented byJacques Cousteau and Emil Gagnan.

1944 Allied armies invade Normandy on D-Day.

Oswald Theodore Avery shows that DNA carries genetic information.

1945 Franklin Roosevelt, Winston Churchill, and Joseph Stalin meet Yalta in the Soviet Union to determine the fate of postwar Europe.

World War II ends.

A patent is issued for the first microwave oven.

1947 Jean-Paul Sartre heralds many existentialist ideas in his brochure *Existentialism and Humanitarianism*.

Presper Eckert and John Mauchly build ENIAC, the world's first all-electronic computer.

India and Pakistan gain independence from Britain as a result of a long nonviolent campaign led by Mohandas Gandhi.

Willard Frank Libby develops radio-carbon dating as a method of determining the age of remains of living organisms.

1948 The transistor is invented by William Shockley, Walter Brittain, and John Bardeen at Bell Telephone Laboratories.

The state of Israel is founded.

Mohandas Gandhi is assassinated for his calls for peace between India's Hindus and Muslims.

1949 The Soviet Union explodes its first atomic bomb

Linus Pauling determines that a genetic hemoglobin abnormality is the cause of sickle-cell anemia.

The North Atlantic Treaty Organization (NATO) is founded.

1950 The Korean War begins.

Charles Schulz begins writing his comic strip *Peanuts*.

1951 The first oral contraceptive is developed.

Libya gains independence from Italy.

1952 The first hydrogen bomb is exploded by the United States at Bikini Atoll.

The first commercial jet airliner, the DeHavilland Comet, enters service.

Jonas Salk introduces a polio vaccine.

1953 James Watson and Francis Crick, working with the help of data obtained by Rosalind Franklin and Maurice Wilkins, determine the double-helical structure of DNA.