

International Conference on

SPECTROSCOPY

1962

A Review by *Hugh Howerton*

THE International Conference on Spectroscopy was held at the University of Maryland, College Park, Md., from Monday, June 18, through Friday, June 22, 1962. It was the Xth Colloquium Spectroscopicum Internationale; other colloquia were held previously in Amsterdam, Liège, Lucerne, and Lyons. Sponsors were the Society for Applied Spectroscopy (SAS), the International Union of Pure and Applied Chemistry (IUPAC), and the University of Maryland chemistry department. Nearly 1000 scientists attended. Chemists¹ and physicists were well represented. The Conference provided communication between spectroscopists of various countries throughout the world and made known the most recent advances in research in both fundamental and applied spectroscopy.

Practically all disciplines² of spectroscopy were covered by more than 160 papers presented in 27 sessions. Speakers came from Argentina, Australia, Belgium, Canada, Colombia, Czechoslovakia, France, Germany, Great Britain, Hungary, India, Israel, Italy, Japan, the Netherlands, Poland, the Soviet Union, Spain, and the USA. Three scientists attended from the Soviet Union's Academy of Sciences, Moscow: N. N. Sobolev, A. R. Striganov, and K. V. Vladimirov; they presented postdeadline papers on the broadening of hydrogen lines in the plasma of arcs and shock tubes, isotope shifts in the spectra of dysprosium and samarium, the state of gases behind a shock wave, and unsteady modes of the spin generator.

Abstracts of the 160 papers appeared in *Applied Spectroscopy*, 16, 44 (1962)—the April issue. Most of the invited papers and a few selected contributed papers will be published in the Conference *Proceedings*.³

Thirty-four exhibitors displayed their spectroscopic instruments and accessories. Social events, conducted

tours, ladies' activities, a "fire",⁴ and recreational facilities occupied the participants when not attending the scientific sessions. Meetings were held of the Coblenz Society, SAS, IUPAC, and two committees of the American Society for Testing and Materials.

The Conference was opened with remarks by Bourdon Scribner, general chairman; John Hansen, president of SAS; C. E. White, head, department of chemistry, University of Maryland; A. C. Menzies, chairman, Commission on Spectrochemical and other Optical Procedures, IUPAC; and W. H. Elkins, President of the University of Maryland.

IN the first technical session, Jesse L. Greenstein, of Caltech and Mt. Wilson and Palomar Observatories, presented an invited paper on "The Role of Spectroscopy in Astrophysics." He reviewed the problems and progress of astrophysical research and pointed out that further progress in quantitative determination of stellar abundances requires laboratory and theoretical data, transition probabilities, together with ionization and collision cross sections. Eight papers on astrophysics and related topics followed—UV and x radiation from above the atmosphere, molecules of astrophysical interest, forbidden lines of O and N, newly observed 1-O band of the quadrupole spectrum of the hydrogen molecule, satellites of spectral lines, third spectra, emission spectra in the IR by interference spectroscopy, and recent developments in IR atomic emission in the 1- to 4- μ region. Orbiting astronomical observatories (OAO's) may furnish needed astrophysical data.

Ultraviolet was introduced by Boris Vodar of the Centre National de la Recherche Scientifique (CNRS), Bellevue, S-et-O, France. He presented an invited paper on extreme UV spectra, presided over the UV session and gave two contributed papers there. One he co-authored and the other he read. Vodar discussed the region between 100 and 2000 Å. Other papers dealt with analytical applications, pulsed light sources, automatic comparators for spectrogram measurement, and diffraction gratings.

¹ "The chymists are a strange class of mortals impelled by an almost insane impulse to seek their pleasure among smoke and vapour, soot and flame, poisons and poverty, yet among all these evils I seem to live so sweetly, that I may die if I would change places with the Persian King." Johann Joachim Becher, *Acta Laboratorii Chymica Monacensis, seu Physica Subterranea* (1669)—The Creed of the Chemist.

² Articles concerning some aspect of spectroscopy, or its application, may be expected to appear in almost any scientific journal.

³ It is expected that this volume will appear in early fall, 1962. All inquiries should be addressed to the publisher, Spartan Books, 6411 Chillum Place, N.W., Washington 12, D.C.

⁴ At the Park University Motel, where many participants stayed. There were several fire engines, but it was only steam from the air-conditioning water tower. An earthquake excited participants at the Oct., 1961, meeting of the Optical Society of America in Los Angeles. Something exciting happens at many scientific meetings.



At the opening ceremonies, overseas visitors rise to receive an ovation from the other participants.

Infrared played a leading role and practically all of its fine details were discussed. Invited papers by R. N. Jones, J. Fahrenfort, J. H. Jaffe, and L. Bellamy reviewed, respectively, IR and Raman group frequencies and their applications, recent developments in attenuated total reflection spectroscopy, high resolution in the near IR, and factors influencing the position of group frequencies in IR spectra.

Optical masers—some applications of this “radically different light source” to spectroscopic studies—were discussed by B. P. Stoicheff of the Division of Pure Physics, NRC, Ottawa, Canada. He stated, “Clearly, there are many potential applications of optical masers in spectroscopy and new developments will be awaited with great interest. . . . the intensive search for additional maser materials has given a new impetus to spectroscopic studies of atomic and molecular energy levels, lifetime of excited states, and transition probabilities.” Papers on ruby dealt with emission-mode patterns, time-resolved spectroscopy, photoconductive measurements, and microemission. A. Learner of the Physics Department, Royal Holloway College, London, read the paper by Allen and Havens on possible laser action in cesium vapor by means of collisions of the second kind.

Time-resolved spectroscopy⁵ was reviewed by Laqua and Hagenah from Dortmund, Germany. Arpad Bardocz of the University for Technical Sciences, Budapest, Hungary, presented a postdeadline paper, “A Universal

Device⁶ for Time-resolved Spectroscopy and Some Results Achieved by It”. Other TRS papers described the variation of spark-to-arc ratio and electron number density, pulsed discharges, rf discharges, wandering of discharges, errors by changing types of discharges, hollow cathodes, and inert-atmosphere sparks.

X rays were covered in two sessions. Invited papers dealt with scanning techniques in electron-probe microanalysis, x-ray spectroscopy of radioactive elements, x-ray emission spectrography at long wavelengths, and techniques of analysis. There were contributed papers on electron probes, x-ray fluorescence, instrumentation, and thin films.

The EPR (or ESR) sessions included invited papers by Hutchison on phosphorescence of organic molecules, Hauser on high-resolution ESR, and Whiffen on oriented free radicals. Other papers dealt with sulphur-nitrogen compounds, dicobalt-peroxo complexes, metal ketyls, low-frequency to near-microwave ESR, high-temperature ESR, allyl-type free radicals, electron transfer rates in free radicals, simultaneous EPR-optical absorption, radical stability, and transient organic radicals.

NMR was introduced by an invited paper by R. Richards on applications. The other papers treated conjugated molecules, association constants, high resolution applied to chemical problems, and nuclear-nuclear double resonance (NUNDOR).

⁵ A technique whereby the continuous background and gaseous band spectra excited initially in sparks is blocked—allowing metallic lines to stand out clear of the background.

⁶ A time-resolved photo of a high-voltage spark, which Bardocz photographed by employing his electronic source and timing mechanism, appears on page 163 of *The Encyclopedia of Spectroscopy*, (Reinhold, N.Y.) George L. Clark, editor. The writer escorted Dr. Bardocz from Friendship Airport (Baltimore, Md.) to his motel near the University and noted that he carried his “device” with him from Budapest in order that he might exhibit it during the paper—which he did.



Discussion at the reception for speakers. At left facing camera, E. R. Lippincott, conference program chairman; center, with bow tie, H. C. Allen, Jr., National Bureau of Standards; right foreground, E. A. Garlock, Hazelton Laboratories.

The session on intensities and transition probabilities was opened by W. L. Wiese of the NBS, who commented that our knowledge of atomic transition probabilities is far from complete, and that satisfactory agreement between various experimental and theoretical determinations exists only for some transitions of the simpler elements. Two papers on the NBS work on experimental gf values were presented (g is the Landé factor and f the oscillator strength). Other papers were on doubly and triply ionized rare earths, the manganese and dc arc, and broadening of the resonance doublet of Ba II.

Spectra of gases included an invited paper on free radicals by D. A. Ramsay, Division of Pure Physics, NRC, Ottawa, and contributed papers on gaseous species formed at flash-heated solid surfaces, line-reversal temperatures in shocked gases, and energy transfer in inelastic collisions.

Flames constituted a session concerned mainly with excitation techniques. C. Th. J. Alkemade, Physics Lab, State University, Utrecht, the Netherlands, gave an invited paper on excitation and related phenomena in flames and discussed various factors such as self-absorption, temperature, equipartition of energy over all degrees of freedom, ionization, collisions of the second kind, and population of the excited state. Other papers dealt with oxy-acetylene flames, methods, applications, and the old problem of calcium and magnesium.⁷

Mass spectroscopy took two sessions—structure and solids. In his invited paper, J. H. Beynon pointed out that the most important information which can generally be obtained from a mass spectrum is the formula of the molecular ion and that resolving power must be increased until even the small differences caused by different packing fractions of the elements can be distinguished. Physics crept into the solids session via Ahearn's invited paper on vacuum-spark mass spectrographic analysis of solids and liquids.

⁷ The determination of calcium in the presence of magnesium has been studied extensively due to its biological importance (body fluids). The new method of fluorescence spectroscopy for calcium (fluorescence of the calcium O Calcein complex), in the presence of magnesium, offers promise. See "A New Instrument for Automatic Colorimetric and Fluorimetric Titrations", H. K. Howerton and J. C. Wasilewski, in *Titrimetric Methods*, Plenum Press, N.Y., 1961.

Mass spectroscopy is one of the new analytical tools employed with increasing frequency to determine impurities in solids at concentrations as low as one part per billion atomic fraction. He presented information on impurities in metals and semiconductors and in insulators and powders. Other papers dealt with detectors, quantitative analysis, high-purity irons, and analysis of solid surfaces.

Microwave spectroscopy was covered by two papers, one on tertiary butyl compounds and one on normal propyl chloride, in the session on molecular-spectra structure. In this session were included experimental papers on organics and inorganics and a theoretical paper on transferability of force constants. Again, solid-state physics crept in with a paper on IR absorption in inorganic crystals, alkaline earth carbonates, sulfates and phosphates, where the site group theory of Halford and Hornig was applied to materials of known structure and found adequate to explain the major experimental absorption bands.

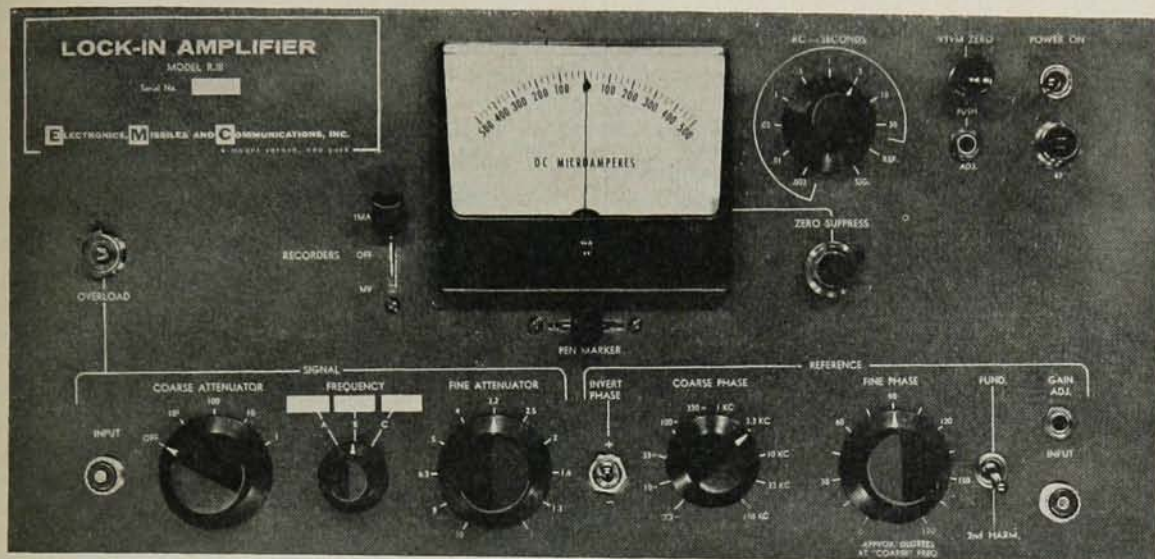
Robert L. Bowman presided at the lively session on optical molecular spectra, constituting papers on fluorescence and phosphorescence, UV absorption, optical rotary dispersion, absorption by nitrogen heterocyclics, total luminescence of compounds of petrochemical interest, and polarization of luminescence from complex molecules, the latter presented by your reviewer. McGlynn of LSU commented on practically all papers. Following the session, Dr. Bowman presided at the meeting of subcommittee 6 (fluorescence spectroscopy) of E-13 (ASTM), the best attended of any to date. The first hour was devoted to a panel discussion on world practices in fluorescence spectroscopy. Participants were Giorgio Nebbia, Italy; F. Lipsett, Canada; B. Vodar, France; C. E. White, USA; and Ross Robinson, Abbott Labs (USA), who reviewed the recent literature of the Soviet Union. The second hour was devoted to reports by task group leaders.

E. J. Rosenbaum presided at the session on history and education. Two papers dealt with forgotten topics from the history of the theory of spectra and the teaching of spectroscopy. During the panel discussion on education in spectroscopy, it was pointed out that spectroscopy means different things to people with differing backgrounds, such as theoretical physicists and analytical chemists. It was generally agreed that it was better to present good courses in physics and chemistry in which spectroscopy was brought in incidentally than to have specialized courses on some aspects of spectroscopy.

Atomic-absorption and atomic-emission sessions were on Monday and Friday, respectively. Due to the analytical chemist's interest in these fields, they were very well attended. Atomic absorption was reviewed by A. Walsh, from Melbourne, Australia. He said that the problem of making the atomic-absorption measurements required in analytical work can now be regarded as solved. Since physicists shy away from solved problems, it is left to the chemist to bring the loose ends

At last you can **BUY** a **LOCK-IN**!

for frequencies from 3 cps to 100 kc — time constants .003 sec. to 30 sec.



The **NEW MC** LOCK-IN AMPLIFIER

Includes all the features that make it the truly universal coherent detector.

The EMC Model RJB Lock-In provides the user with a regularly manufactured laboratory instrument. Based on the widely accepted design of R. J. Blume, this equipment provides *all* the required functions of a complete narrow banding system; including: selective amplifiers—phase detector—filter—meter—recorder driver circuits.

TECHNICAL FEATURES

SIGNAL CHANNEL

- Approx. 20 microvolts full scale
- Internal notch rejection filtering of an unwanted input signal
- Overload indicator
- Precision step attenuators, decade and log interpolation
- Three switch—selected plug-in tuning networks. $Q \approx 20$
- Reference pick-off permits gain calibration

REFERENCE CHANNEL

- Accepts any input waveform—sinusoidal or non-sinusoidal
- Phase shift with approximate calibration on front panel
- Fundamental or 2nd harmonic ("2nd derivative") operation selectable by front panel switch

OUTPUT CIRCUIT

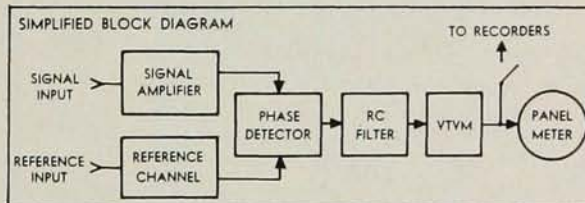
- Internal time constants—.003 sec. to 30 sec.
- Outputs for all standard recorders including sep-

arate zero for non-adjustable potentiometric types

- Servo output
- Zero suppression up to 5 times full scale
- Pen marker circuit activated by momentary front panel switch
- On-off switch for recorders

ALSO FOR OPERATING CONVENIENCE & MAXIMUM TROUBLE-FREE OPERATION

- Premium tubes, including low drift dc amplifier types
- Regulated dc on all critical heaters
- Full monitoring of signal and reference
- Self-contained regulated power supply
- Conservative design and construction everywhere



For complete model RJB data sheet write to:

ELECTRONICS,

MISSILES AND

COMMUNICATIONS, INC.

MEASUREMENT AND CONTROL DIVISION

262 EAST THIRD STREET, DEPT. P, MT. VERNON, N.Y., MO 8-3012

CREATIVE

RESEARCH POSITIONS WITH THE NAVY

on the

Beautiful Southern California Coast

RESEARCH CHEMIST (PHYSICAL)

Salary \$10,635 (plus "extra" benefits worth up to \$2,550). Prefer Ph.D. in physical chemistry, but also interested in M.S., plus experience in corrosion research or related surface or kinetic studies. Will investigate corrosion mechanics, surface chemistry of inhibitors and factors causing coating deterioration.

RESEARCH PHYSICISTS (NUCLEAR)

Salary \$8,955-\$10,635 (plus "extra" benefits worth up to \$2,550). Will conduct fundamental studies in radiation shielding, including shelter entryway configurations, neutron and gamma ray albedo and radiation streaming in ducts.

PHYSICIST (GENERAL)

Salary \$8,955 (plus "extra" benefits worth up to \$2,158). Will be concerned with problems involving metals and alloys, corrosion products and boiler scale, protective coatings and various other materials suitable to treatment by analytical methods.

MATHEMATICIAN

Salary \$8,340 (plus "extra" benefits worth up to \$2,035). Will analyze and interpret experimental data and monte carlo calculations on radiation shielding problems. Position will involve computer operations, as well as giving mathematical advice to mechanical and civil engineers.

NCEL, the research and evaluation arm of the Navy's Bureau of Yards and Docks, also offers these definite employment advantages:

- Careers in Civil Service
- Creative scientific and intellectual climate
- Opportunities for free educational advancement, including degrees
- Regularly scheduled salary increases
- Annual leave up to 26 days, sick leave up to 13 days.
- Year-around outdoor living
- Easy access to metropolitan centers, mountains, desert, beaches

Submit education and experience resume, or contact Commanding Officer and Director.

U. S. NAVAL CIVIL ENGINEERING LABORATORY

Department F
PORT HUENEME, CALIFORNIA

together by producing satisfactory atomizers to minimize chemical interference effects due to the sample not being completely atomized. Two promising approaches, according to Walsh, are cathodic sputtering and the arc furnace. Contributed papers were applied—sources, methods, instrumentation, and techniques of analysis. The session on atomic emission was chaired by C. E. White in the main lecture hall of the U. of Md. Physics Building. The room (~140 capacity) was nearly filled before the session began (1:30 PM, Friday) and, after the first paper, there was standing room only (and they were standing both inside and outside the doors). Your reviewer stood outside, keeping it quiet, helping the Spanish interpreter (she was trying to advance John Manuel Lopez de Azcona's paper), and listening to a discussion (held outside) between McGlynn (LSU) and Lippincott (U. of Md.), on assignments by IR and Raman. When he opened the session on atomic emission, Dr. White commented that it was a great compliment to the people who arranged the program⁸ that the papers were so excellent the audience remained "to the very last hour" on "the very last day" of the Conference.

SOCIAL events included a general reception and buffet, a tour of Washington at night, a concert by the US Marine Band, an old-fashioned chicken barbecue, and a cruise down the Potomac River to Mount Vernon.

Tours were conducted through the National Institutes of Health, National Bureau of Standards, Naval Research Laboratory, and the Federal Bureau of Investigation.

The Ladies' Program⁹ comprised tours to the White House, US Capitol, Supreme Court, Lincoln and Jefferson Memorials, Washington Monument, Shrine of the Immaculate Conception and Monastery, a visit to the Gem Room at the Smithsonian Institution, the National Gallery of Art, and the Japanese Embassy Teahouse. A Silver Tea was served, there was a luncheon with fashion show, and there were coffee hours in the Hospitality Room.

Recreation—swimming, tennis, and golf—was enjoyed by many.

A few hundred programs (108 pages) are still available at \$1.00 each. Inquiries regarding their purchase should be addressed to Dr. Marvin Margoshes, Conference Secretary, National Bureau of Standards, Washington 25, D. C. A list of the registrants and visitors to the exhibit with names, addresses, and affiliations is available for \$1.00. Inquiries concerning its purchase should also be addressed to Dr. Margoshes.

Acknowledgment—This review was written at Copper Honk, a farm near Leesburg, Virginia. I am grateful to Messrs. Leopold Freeman and Hyman Goldstein for the use of Copper Honk during the writing.

⁸ The Conference Program Chairman was Ellis R. Lippincott, Professor of Chemistry, University of Maryland.

⁹ Mrs. Ellis R. Lippincott was in charge of the Ladies' Program.