

## Foreword

The inaugural meeting in the distinguished series of International Conferences on Photochemistry took place in Brussels, Belgium, in 1961 and meetings have since followed biennially in Rochester, U.S.A.; Tokyo, Japan; Munich, West Germany; Tarrytown, U.S.A.; Bordeaux, France; and Jerusalem, Israel. It was an honour to host the eighth meeting in Edmonton, Canada August 7 - 13, 1975.

Over the past fourteen years the Conferences have expanded in scope, grown in size and scientific content, as well as in stature, culminating in a record attendance at the Edmonton Conference of approximately 500 delegates from 20 countries. Traditionally, these Conferences have provided a cross-sectional view of progress in various photochemical disciplines, a state-of-the-art presentation of contemporary issues and have opened up vistas of the future. The Edmonton Conference represented a special effort to bring together the various scattered domains of photochemistry in order to promote personal interchange among workers in diverse areas, to stimulate new thoughts and approaches, and also to effectively disseminate progress in methodology and technique.

In addition to general physical, organic and inorganic photochemistry, special symposia were held on theoretical chemistry, air pollution, atmospheric and extra-terrestrial photochemistry, photobiology, industrial photochemistry, solar energy utilization and energy storage, and macromolecular photochemistry. Plenary lectures were presented by Melvin Calvin, Gerhard Herzberg, Sir George Porter and Lionel Salem.

The Edmonton Conference also provided a forum for the foundation of the Inter-American Photochemical Society. To this end a Steering Committee was set up to formulate a charter. Perhaps the day is not so distant when the European Photochemical Association, the new Inter-American Photochemistry Society and their Far-Eastern counterpart currently also under organization may unite to form a World Union of Photochemists.

This foreword would not be complete without expressing heartfelt gratitude towards the sponsors of the VIIIth International Conference on Photochemistry; the National Research Council of Canada, the Chemical Institute of Canada and the University of Alberta, and without acknowledging the generous financial support provided by the following donors: The National Research Council of Canada; Department of the Environment, and Department of Mines and Minerals, Government of the Province of Alberta; the University of Alberta; Chemical Institute of Canada; Imperial Oil Enterprises Limited; Weiller and Williams Company Limited (Edmonton); Kodak (Canada) Limited; Gulf Oil Corporation; Texaco Canada Limited. Special thanks are due to the Province of Alberta and the City of Edmonton for providing hospitality grants for some of the social events.

O. P. Strausz

## Programme

FRIDAY, 8th August

### Welcoming Address

Plenary Lecture (Chairman I. G. Csizmadia)

The electronic theory of photochemical reactions (L. Salem, Orsay, France)

### Session A

Molecular Orbital Symposium (Chairmen R. Hoffmann, R. S. Mulliken)

- A1. *Invited Lecture*: A review of recent developments in MO theory of photochemical reactivity of large molecules (Josef Michl, Salt Lake City, Utah, U.S.A.)
- A2. *Invited Lecture: ab initio* MO studies of the 3-electron bond; energetics and reactivity of photochemical intermediates (N. C. Baird, London, Ontario, Canada)
- A3. *Invited Lecture*: A theoretical analysis of exciplex chemistry (I. G. Csizmadia, Toronto, Ontario, Canada)
- A4. Application of the "direct open shell scf method" to photochemistry (Richard Eade and Michael A. Robb, London, U.K.)

### Session B

Physical Photochemistry

Welcoming Address to the Physical Photochemistry Session (Chairman W. A. Noyes, Jr.)

- B1. Flash photolysis of ketene: reactions of methylene radicals (M. J. Pilling and J. A. Robertson, Oxford, U.K.)
- B2. Electronic states of methylene from ketene photolysis between 200 nm and 313 nm (Vaclav P. Zabransky and Robert W. Carr, Jr., Minneapolis, Minn., U.S.A.)
- B3. Flash photolytic studies of  $\text{NH}_2$  reaction kinetics (R. Lesclaux, P. Van Khê, J. C. Soullignac, J. Joussot-Dubien, Talence, France)
- B4. Kinetic isotope effects in the quenching of  $\text{NH}(\text{b}^1 \Sigma^+)$  and of  $\text{ND}(\text{b}^1 \Sigma^+)$  by some deuterated compounds (C. Zetzsch and F. Stuhl, Bochum, Germany)
- B5. Primary steps in the photolysis of 1,1,2,2-tetrachloroethane (T. Yuan and M. H. J. Wijnen, New York, N.Y., U.S.A.)
- B6. Cadmium photosensitized emissions of ammonia, amines, and some other molecules (Shunzo Yamamoto and Shin Sato, Tokyo, Japan)
- B7. Energy transfer from  $\text{Hg}(6^3 \text{P}_0)$  metastables to the OH and OD radicals (A. C. Vikis and D. J. Le Roy, Ontario, Canada)
- B8. Mercury sensitization and molecular modulation spectroscopy for the study of the kinetics of transient gas phase species (Alan B. Harker and C. S. Burton, Thousand Oaks, Calif., U.S.A.)
- B9. Some interactions of species produced by controlled-energy electron excitation in  $\text{H}_2$ , Hg,  $\text{N}_2$ , Ar, He systems (L. B. Thomas, Y. H. Wachman, and D. N. Lyon, Columbia, Mo., U.S.A.)
- B10. Some reactions of  $\text{C}_2 \text{O}$  (H. M. Frey, Reading, U.K.)

### Session C

Physical Photochemistry

Welcoming Address to the Physical Photochemistry Session (Chairmen B. A. Thrush and R. A. Back)

- C1. Excited state electronic structure and dynamics of NSF, in the vapor and in 8 K matrices (J. R. McDonald, R. R. Smardzewski and R. A. DeMarco, Washington, D.C., U.S.A.)
- C2. Fluorescence and resonance Raman emission in the  $\tilde{\text{A}} \rightarrow \tilde{\text{X}}$  system of  $\text{ND}_3$  (P. A. Hackett, S. Koda and R. A. Back, Ottawa, Canada)
- C3. *Invited Lecture*: Some recent high resolution spectroscopic studies (D. A. Ramsay, Ottawa, Canada)
- C4. The perturbation of molecular Rydberg states (Larry R. Wilson and Sanford Lipsky, Minneapolis, Minn., U.S.A.)
- C5. Excited electronic states of  $\alpha$ -,  $\beta$ -, and  $\gamma$ -dicarbonyls (P. Brint and S. P. McGlynn, Baton Rouge, La., U.S.A.)
- C6. Phosphorescence spectrum of *p*-chlorobenzaldehyde: An example of closely spaced state interaction (Omar S. Khalil and Lionel Goodman, New Brunswick, U.S.A.)

- C7. *Invited Lecture: Time-independent interactions between electronic states* (J. C. D. Brand, London, Ontario, Canada)

#### Session D

**Photobiology** (Chairmen R. K. Clayton and L. I. Grossweiner)

- D1. A new facet in rhodopsin photochemistry (C. van der Meer, J. J. C. Mulder and J. Lugtenburg, Leiden, The Netherlands)
- D3. *Invited Lecture: Spectroscopy and photochemistry of visual pigments* (E. W. Abrahamson, Guelph, Ontario, Canada)
- D4. Excited states and electron transfer for porphyrin and chlorophyll molecules (Martin Gouterman, Dewey Holten, William W. Parson, Seattle, Wash. and Maurice W. Windsor, Pullman, Wash., U.S.A.)
- D5. Radiationless deactivation of the triplet states of chlorophylls (R. H. Clarke, R. E. Connors and R. H. Hofeldt, Boston, Mass., U.S.A.)
- D6. Investigation of the origin of the positive and neutral radicals formed in the flash photolysis of *N*-acetyltryptophanamide (Richard F. Evans, W. A. Volkert, and C. A. Ghiron, Columbia, Mo., U.S.A.)
- D7. Photochemical studies of *N*-acetyltryptophanamide (R. D. Smith, C. A. Ghiron, and W. A. Volkert, Columbia, Mo., U.S.A.)
- D8. The mechanism of the photohydroxylation of lumichrome (R. R. Duren, R. H. Dekker, J. Verbeek, and H. C. A. van Beek, Delft, The Netherlands)

#### Session E

**Organic Photochemistry** (Chairmen: G. S. Hammond and H. E. Zimmermann)

*Organic Photochemistry Session Introductory Lecture:*

- E1. Problems and prospects in organic and organometallic photochemistry (G. S. Hammond, Santa Cruz, Calif., U.S.A.)
- E2. *Invited Lecture: Mechanistic and exploratory organic photochemistry* (Howard E. Zimmerman, Madison, Wisc., U.S.A.)
- E3. Steric limitations in photochemical  $\{2\pi+2\pi\}$  and  $\{2\pi+2\sigma\}$  cycloaddition reactions (H. Prinzbach, Freiburg, F.R.G.)
- E4. Regiospecificity and stereoselectivity of the light-induced (2+2) cycloaddition reactions of compounds containing the C=S chromophore (Hans Gotthardt, München, F.R.G.)
- E5. *Invited Lecture: Photochemical ring expansion of cyclic ketones* (Peter Yates, Toronto, Ont., Canada)
- E6. The photochemistry of  $\beta$ ,  $\gamma$ -epoxy cyclic ketones (Roger K. Murray, Jr., Thomas K. Morgan Jr., Judith A. S. Polley, Chester A. Andruskiewicz, Jr., and David L. Goff, Newark, Del., U.S.A.)
- E7. Reactivity of carbonyl  $1n\pi^*$  states toward alkyl amines (J. Christopher Dalton, John J. Snyder and Margaret C. Geiger, Rochester, N.Y., U.S.A.)
- E8. On the chemistry of cyclic ketones containing photochemically generated twisted double bonds (Harold Hart and Mikio Suzuki, East Lansing, Mich., U.S.A.)

#### Session F

**Physical Photochemistry** (Chairmen: R. J. Cvetanovic and C. Steel)

- F1. Mercury photosensitized reactions of silyl radicals (E. R. Austin and F. W. Lampe, University Park, Pa., U.S.A.)
- F2. Vacuum-ultraviolet photolysis of  $C_2(CH_3)_6$ ,  $Si_2(CH_3)_6$ , and  $(CH_3)_3CSi(CH_3)_3$ . Evidence for production of an unsaturated Si-C linkage (P. Boudjouk and R. D. Koob, Fargo, N.D., U.S.A.)
- F3. The disproportionation and metathetical reactions of the trimethylsilyl radical (L. Gammie, I. Safarik and O. P. Strausz, Edmonton, Alb., Canada)
- F4. Emission spectra in the photolysis of methyl nitrite and ethyl nitrite (K. Ohbayashi, I. Tanaka, Tokyo and H. Akimoto, Ibaraki, Japan)
- F5. Vacuum U.V. photoisomerisation of *cis*-2-butene in the presence of  $SF_6$  (Hélène Gagnon and Guy Collin, Chicoutimi, Québec, Canada)
- F6. Resonance fluorescence studies of sulphur atom reactions (M. A. A. Clyne and L. W. Townsend, London, U.K.)
- F7. The chemiluminescent reaction of luminol with singlet oxygen (I. B. C. Matheson and John Lee, Athens, Ga., U.S.A.)

- F8. Role of  $O_2(^1\Sigma_g^+, ^1\Delta_g)$  in the photosensitized oxidation of diphenylamine (W. R. Bansal and K. S. Sidhu, Patiala, India)
- F9. Dynamics of the electronically chemiluminescent reactions of  $O_2(^1\Delta_g)$  with vinyl ethers (D. J. Bogan, R. S. Sheinson and F. W. Williams, Washington, D.C., U.S.A.)
- F10. Electronic energy transfer in small molecules in the gas phase (E. W. Abrahamson and K. Kear, Guelph, Ont., Canada)
- F11. Excitation of singlet molecular oxygen by energy transfer from  $NO_2$  and  $HO_2$  (D. J. Giachardi, G. W. Harris and R. P. Wayne, Oxford, U.K.)
- F12. Diffusion displacements of molecular  $O_2(^1\Delta)$  in solution (B. Stevens and R. R. Williams, Tampa, Fla., U.S.A.)

#### Session G

##### Physical Photochemistry (Chairmen: J. C. D. Brand and R. Srinivasan)

- G1. High resolution lifetimes in excited states (E. W. Schlag, Munich, FRG)
- G2. Delayed fluorescence from higher excited singlet states of aromatic hydrocarbons in solution (Bernhard Nickel, Göttingen, FRG)
- G3. Polarization effects of fluorescence measurements (Edwin D. Cehelnik and Klaus D. Mielenz, Washington, D.C., U.S.A.)
- G4. Excited state relaxation: Laser pumped fluorescence studies (Kenneth G. Spears, Evanston, Ill., U.S.A.)
- G5. The fluorescence processes of the excited benzyl and methyl-substituted benzyl radicals (T. Okamura, K. Obi and I. Tanaka, Tokyo, Japan)
- G6. Phosphorescence emission and polarization of hydroxypyridines (A. C. Testa and S. Hotchandani, Jamaica, N.Y., U.S.A.)
- G7. Energy transfer from single vibronic levels of benzene ( $^1B_{2u}$ ) and fluorobenzene ( $^1B_1$ ), (P. H. Chereson, D. R. Worsnop, and F. S. Wettack, Holland, Mich., U.S.A.)
- G8. Phosphorescent benzene: triplet sublevel origins of decays (N. G. Kilmer and A. H. Kalantar, Edmonton, Alb., Canada)
- N7. *Invited Lecture*: Photochemical evolution of hydrogen (Gabriel Stein, Jerusalem, Israel)

#### Session H

##### Photochemistry of Macromolecules (Chairmen: J. Guillet and J. L. R. Williams)

- H1. Energy migration in polymer systems (A. M. North, D. A. Ross and M. F. Treadway, Glasgow, Scotland)
- H2. Photophysical and photoelectric properties of a series of vinyl carbazole polymers (D. G. Marsh, W. W. Limburg and J. M. Pearson, Webster, N.Y., U.S.A.)
- H3. Photopolymerization initiated by type II-derived biradicals (Mauricio Hamity and Juan C. Scaiano, Rio Cuarto, Cordoba, Argentina)
- H4. Chemiluminescence from the degradation of unsaturated elastomers (G. David Mendenhall and Richard A. Nathan, Columbus, Ohio, U.S.A. and Morton A. Golub, Moffett Field, Calif., U.S.A.)
- H5. Studies of energy transfer in polymer photochemistry (James Guillet, Toronto, Canada)

#### Session I

##### Organic Photochemistry (Chairmen: P. de Mayo and J. Michl)

- I1. Photochemistry of oxiranes; synthetic applications (G. W. Griffin, N. E. Brightwell, K. Ishikawa, I. Lev, and S. Satra, New Orleans, La., U.S.A.)
- I2. The photochemistry of  $\alpha$ -aryl carboxylic anhydrides (A. A. M. Roof, H. F. van Woerden, and H. Cerfontain, Amsterdam, The Netherlands)
- I3. The photorearrangement of dimethoxytritycene (E. Alabi, R. O. Day, V. W. Day, S. J. Fuerniss, J. R. Hohman and D. M. S. Wheeler, Lincoln, Neb., U.S.A.)
- I4. *Invited Lecture*: Photochemistry at low temperature (O. L. Chapman, Los Angeles, Calif., U.S.A.)
- I5. Photochemistry of  $\beta$ ,  $\gamma$ ,  $\delta$ ,  $\epsilon$ -unsaturated carbonyl compounds (Benzion Fuchs and Gad Scharf, Tel-Aviv, Israel)
- I6. The photochemistry of 3,5-cycloheptadienones (Jens Eriksen and David I. Schuster, New York, N.Y., U.S.A.)
- I7. Conformational restrictions in the photoenolization of *ortho*-alkyl ketones (P. J. Wagner and C. P. Chen, East Lansing, Mich., U.S.A.)

**Plenary Lecture and Introduction to Session on Solar Energy Utilization (Chairman: B. A. Thrush)**

Concentration quenching with particular reference to photosynthesis (Sir George Porter, F. R. S. and Godfrey S. Beddard, London, U.K.)

**Session J**

**Energy Storage-Utilization of Solar Energy (Chairmen: E. K. C. Lee and N. N. Lichtin)**

- J1. Photoelectrolysis of water on semiconducting surfaces (D. I. Tchernev, Lexington, Mass., U.S.A.)
- J2. The thermodynamics of photochemical energy conversion and its relevance to photochemical solar energy conversion (M. D. Archer, London, U.K.)
- J3. *Invited Lecture:* Optimization of the iron thionine photogalvanic cell (Norman N. Lichtin, Boston, Mass., U.S.A.)
- J4. Photochemical storage of solar energy by the dye sensitized photolysis of water (James R. Bolton, London, Ont., Canada)
- J5. The uses of membranes to prevent recombination in photochemical reactions (S. J. Valenty, Schenectady, N.Y., U.S.A.)
- J6. The dye sensitized photo-currents of electrochemical cells with semiconductor electrodes (H. Tsubomura, Y. Nakato, M. Matsumura, K. Nakatani, and K. Yamamoto, Osaka, Japan)
- J7. V/U.V. energy storage in molecules by photoelectron spectroscopy (J. E. Collin, Liège, Belgium)

**Session K**

**Physical Photochemistry (Chairmen: I. Tanaka and J. Heicklen)**

- K1. Product vibrational distribution from photo-induced dissociation processes (Karl F. Freed, Chicago, Ill., U.S.A.)
- K2. Energy distribution in the photodissociation of acrolein (R. G. Shortridge, M. E. Umstead and M. C. Lin, Washington, D.C., U.S.A.)
- K3. The dynamics of the  $O(^1D_2) + CO$  reaction (R. G. Shortridge and M. C. Lin, Washington, D.C., U.S.A.)
- K4. *Invited Lecture:* Infrared laser enhanced reaction dynamics (Walter Braun, Washington, D.C., U.S.A.)
- K5. Lips studies of primary processes in the photodissociation of  $C_2N_2$  and  $C_4N_2$  (M. J. Sabety-Dzvonik, R. J. Cody, Greenbelt, Md., U.S.A., and W. M. Jackson, Washington, D.C., U.S.A.)
- K6. Collision-induced electronic relaxation in polyatomic vapors (Alan E. W. Knight and Charles Parmenter, Bloomington, Ind., U.S.A.)
- K7. The photodissociation, with pulsed synchrotron radiation, of  $H_2$  and  $D_2$  near 750 Å (Peter Borrell, Keele, Staffs., U.K., P. M. Guyon, Orsay, France, and M. Glass-Maujean, Paris, France)
- K9. Reaction of  $O(2^1D_2)$  atoms with Freons (H. M. Gillespie and R. J. Donovan, Edinburgh, U.K.)
- η5. A direct determination of absolute quenching cross-sections of excited  $mg(^3P_J)$  using pulsed tunable dye laser excitation (R. P. Blickensderser, W. H. Breckenridge and D. S. Moore)
- O12. Excited state formation in *p*-dioxane (Ajit Singh, S. P. Vaish, and M. J. Quinn, Manitoba, Canada)

**Session L**

**Inorganic Photochemistry (Chairmen: A. W. Adamson and J. Nasielski)**

- L1. Photophysical evidence for electron transfer to solvent in the luminescence of the tris(2,2'-bipyridyl) ruthenium(II) ion (J. Van Houten and Richard J. Watts, Santa Barbara, Calif., U.S.A.)
- L2. Modifications of photochemical reactivity - amine complexes of ruthenium(II) (Peter C. Ford, George Malouf and Vincent A. Durante, Santa Barbara, Calif., U.S.A.)
- L3. *Invited Lecture:* Quenching processes involving coordination compounds (L. Moggi, V. Balzani and F. Bolletta, Bologna, Italy)
- L4. Laser excitation of ligand field states: cobalt(III) (Cooper H. Langford, and Carol P. J. Vuik, Ottawa, Canada)
- L5. Contrasts in the photochemical behavior of azido, thiocyanato and isothiocyanato complexes of cobalt(III) and rhodium(III) (John F. Endicott, Guillermo J. Ferraudi and Tomoaki Inoue, Detroit, Mich., U.S.A.)

- L6. Multiple luminescence decays in  $[\text{Cr}(\text{urea})_6]\text{X}_3$  crystals (Francesco Castelli and Leslie S. Forster, Tucson, Ariz., U.S.A.)
- L7. Photochemistry of Ru(II) complexes in non aqueous solvents (G. B. Porter and P. E. Hoggard, Vancouver, B.C., Canada)

#### Session M

**Molecular Orbital Symposium** (Chairmen: L. Salem and N. C. Baird)

- M1. *Invited Lecture*: Geometry changes in excited states of molecules (Roald Hoffmann, Ithaca, N.Y., U.S.A.)
- M2. Electronic transition properties by the LCAO- $\alpha$  method (A. Rauk, Calgary, Alb., Canada)
- M3. Some theoretical aspects of oxacarbene chemistry (J. A. Altmann, I. G. Csizmadia, K. Yates and P. Yates, Toronto, Ont., Canada)
- M4. *Invited Lecture*: The role of the spin density in the understanding and prediction of the chemistry of triplet systems (R. F. W. Bader, Hamilton, Ont., Canada)
- M5. *Ab initio* molecular orbital study on the oxirene molecule, its isomers and decomposition products (R. K. Gosavi and O. P. Strausz, Edmonton, Alb., Canada, and I. G. Csizmadia, Toronto, Ont., Canada)
- M6. Simple perturbation treatment of the excited states of conjugated cyclopropyl systems (M. Shanshal, Adamiya, Baghdad, Iraq)

#### Session N

**Energy Storage and the Utilization of Solar Energy** (Chairmen: Sir George Porter and D. Tschernev)

- N1. *Invited Lecture*: Cyclic photochemistry (Anthony M. Trozzolo, Murray Hill, N.J., U.S.A.)
- N2. Photochemical storage of solar energy through valence isomerization of organic molecules (Guilford Jones, II, Boston, Mass., U.S.A.)
- N3. Singlet-singlet electronic energy transfer: dipole-dipole and exchange contributions, (Gary L. Loper and Edward K. C. Lee, Irvine, Calif., U.S.A.)
- N4. Ruby laser photolysis of  $N,N,N',N'$ -tetramethylbenzidine (TMB) in organic solvents and micellar solution (S. A. Alkaitis and M. Grätzel, Berlin, FRG)
- N6. Laser photolysis studies of light induced redox reactions in alcoholic and aqueous micellar solution (M. Grätzel and S. Alkaitis, Berlin, FRG)
- N5. Chemiluminescence studies of ternary flame systems for chemical laser potential (Menachem Luria, Donald J. Eckstrom, and Sidney W. Benson, Menlo Park, Calif., U.S.A.)
- N7. *Invited Lecture*: Photosynthesis as a resource for energy and materials (Melvin Calvin, Berkeley, Calif., U.S.A.)

#### Session O

**Physical Photochemistry** (Chairmen: H. M. Frey and R. P. Wayne)

- O1. *Invited Lecture*: Exciplex photophysics: the quenching of anthracene by  $N,N$ -dimethyl aniline in non-polar solvents (Man-Him Hui and William R. Ware, London, Ont., Canada)
- O2. Intramolecular excimers (Wolfgang Kühnle and Klaas Zachariasse, Göttingen, FRG)
- O3. Photophysics of diphenylpolyenes (J. B. Birks and D. J. S. Birch, Manchester, U.K.)
- O4. The interaction of intramolecular exciplexes with polar molecules (Godfrey S. Beddard, Sheena Carlin, and Colin Lewis, London, U.K.)
- O5. Kinetics and thermodynamics of saturated amine excimers (intermolecular and intramolecular) (Arthur M. Halpern, Boston, Mass., U.S.A.)
- O6. Formation of the excited triplet, the excited singlet and the excimer of octafluoronaphthalene in solution (Ajit Singh, and M. J. Quinn, Pinawa, Manitoba, Canada)
- O7. Exciplexes and E.D.A. complexes in oxadiazoles-dimethylaniline systems (C. Rulliere and P. C. Roberge, Québec, P. Q., Canada)
- O8. Comparative study of electron abstraction properties of excited singlet and triplet dyes in aqueous solution (R. Bonneau, J. Joussot-Dubien and J. Pereyre, Talence, France)
- O9. Direct determination of the triplet quantum yields of acridine in polar and non-polar solvents (Alette Kellmann, Orsay, France)
- O10. The temperature and viscosity dependence of energy transfer from triplet aromatic molecules (E. J. Marshall, N. A. Philipson, M. J. Pilling, Stephen A. Rice, and P. Spencer, Oxford, U.K.)

- O11. Intersystem crossing quantum yield measurements by intermolecular energy transfer (G. Perichet and B. Pouyet, Villeurbanne, France)

#### Session P

**Physical Photochemistry** (Chairmen: D. A. Ramsay and M. Szwarc)

- P1. *Invited Lecture*: The activation energy of bimolecular reactions (Sidney W. Benson, Menlo Park, Calif., U.S.A.)
- P2. Chemiluminescence for the determination of activation energies of hydrocarbon oxidation (Richard A. Nathan and Gerald W. Lundeen, Columbus, Ohio, U.S.A.)
- P3. *Invited Lecture*: The study of free radicals in the gas phase using magnetic resonance (B. A. Thrush, Cambridge, U.K.)
- P4. The study of free radicals in a discharge flow system using a tunable dye laser (I. Stuart McDermid, Michael A. A. Clyne and Alan H. Curran, London, U.K.)
- P5. Photodetachment spectra of dissolved species in liquids (as obtained by photoelectron spectroscopy) (Paul Delahay, New York, N.Y., U.S.A.)
- G10. Photophysics of bound and dissociative guest molecular states in rare gas lattices (L. E. Brus, Murray Hill, N.J., U.S.A.)
- P6. Photochemically induced dynamic magnetic polarization (J. K. S. Wan, Kingston, Ont., Canada)
- P7. Modulated excitation ESR spectra of hydroxy-phenoxy radicals (K. Loth, F. Graf and Hs. H. Günthard, Zurich, Switzerland)
72. Two photon Doppler free spectroscopy of gas phase molecules (J. Gelbwachs, P. F. Jones and J. Wessel, Los Angeles, Calif., U.S.A.)

#### Session Q

**Organic Photochemistry** (Chairmen: G. Griffin and E. Havinga)

- Q1. Photochemical generation of triplet ethoxycarbonyl- and cyano-nitrenes from *N*-imino-pyridinium ylids (J. Streith and N. Nastasi, Mulhouse, France)
- Q2. Photochemistry of hindered nitro and nitroso aryl compounds (L. R. C. Barclay, P. Khazanie and C. E. Scott, Sackville, N.B., Canada)
- Q3. Studies in nitroaromatic photochemistry (Dietrich Döpp, Kaiserslautern, FRG)
- Q4. *Invited Lecture*: Light-induced nucleophilic aromatic substitution (J. Cornelisse and E. Havinga, Leiden, The Netherlands)
- Q5. Photooxidation of phenols (C. S. Foote, M. Thomas and T.-Y. Ching, Los Angeles, Calif., U.S.A.)
- Q6. Mechanisms for photodecomposition of aryl halides (N. J. Bunce, L. O. Ruzo, S. Safe, Guelph, Ont., Canada)
- Q7. Photolysis of aromatic *ortho*-disubstituted *S*-acyl compounds: mechanistic aspects (G. Buchholz, J. Martens, K. Praefcke, H. Simon and C. Weichsel, Berlin, FRG)
- Q8. Studies in the photochemistry of *C*-nitrosocompounds (D. Forrest, B. G. Gowenlock and J. Pfab, Edinburgh, Scotland)
- Q9. Photochemistry and electron impact induced reactions of saturated five-membered heterocyclic compounds (H. Hiraoka, San Jose, Calif., U.S.A.)
71. On the photolysis mechanism of azibenzyl (Tatiana Oncescu, M. Contineanu and O. Constantinescu, Bucuresti, Rumania)

**Plenary Lecture** (Chairman: K. H. Welge)

Free radicals and molecular ions in comets and in the interstellar medium (G. Herzberg, Ottawa, Canada)

#### Session R

**Extraterrestrial and Atmospheric Photochemistry** (Chairmen: H. J. Mastenbrook and F. S. Rowland)

- R1. *Invited Lecture*: Recent advances in the photochemistry of comets (William M. Jackson, Washington, D.C., U.S.A.)
- R2. Collisional quenching of electronically excited oxygen atoms, O(<sup>1</sup>D): temperature dependence of some rate coefficients (G. E. Streit, A. L. Schmeltekopf and D. A. Jennings, Boulder, Colo., U.S.A., J. A. Davidson, C. M. Sadowsky and H. I. Schiff, Downsview, Ont., Canada)

- R3. *Invited Lecture*: Recent measurements of absolute rate constants of O(<sup>3</sup>P) reactions by a phase shift technique (R. J. Cvetanovic, Ottawa, Ont., Canada)
- R4. Effect of vibrational energy on elementary O<sub>3</sub> reactions (Michael J. Kurylo and Walter Braun, Washington, D.C., U.S.A.)
- R5. The chemiluminescence of ozone reactions in the gas phase (Sidney Toby, New Brunswick, N.J., U.S.A.)
- R7. Laboratory kinetic studies of reactions of atmospheric interest using resonance fluorescence spectroscopy (J. J. Margitan, M. S. Zahniser, F. Kaufman and J. G. Anderson, Pittsburgh, Pa., U.S.A.)
- R8. The *in situ* measurement of atoms and radicals important to the photochemistry of the stratosphere (J. G. Anderson, Ann Arbor, Mich., U.S.A.)

#### Session S

##### Physical Photochemistry (Chairmen: W. Groth and G. von Bunau)

- S1. Photodissociation of CSCI<sub>2</sub> in the vacuum ultra violet (H. Okabe, Washington, D.C., U.S.A.)
- S2. Matrix isolation study of the vacuum ultraviolet photolysis of methyl mercaptan. Spectroscopic evidence for thioformaldehyde (Marilyn E. Jacox and Dolphus E. Milligan, Washington, D.C., U.S.A.)
- S3. Photolysis of matrix-isolated 5-membered heterocycles (A. Krantz, J. Laurenzi and R. A. Hajdu, Stony Brook, N.Y., U.S.A.)
- S4. Radiative and radiationless processes involving the second excited singlet state of thiocarbonyl compounds (T. Oka, A. R. Knight and R. P. Steer, Saskatoon, Saskatchewan, Canada)
- S5. *Invited Lecture*: Thione photochemistry and the S<sub>2</sub> state (P. de Mayo, London, Ont., Canada)
- S6. Production of excited states of I<sub>2</sub> in the picosecond pulse radiolysis of gaseous argon-iodine mixtures (R. Cooper and F. Grieser, Melbourne, Australia, M. C. Sauer Jr. and W. A. Mulac, Chicago, Ill., U.S.A.)
- S7. Mechanism for quenching of singlet state *para*-xylene vapor by nitric oxide (John McKenzie Burke, Merlyn D. Schuh, and Hamilton M. Sporborg, Davidson, N.C., U.S.A.)
- S9. Photochemical behaviour of acyclic 1,3-dienes: mechanistic implications of 1,5-hydrogen shifts in the S<sub>1</sub> state (D. Rondelez and S. G. Boué, Brussels, Belgium)

#### Session T

##### Physical Photochemistry (Chairmen: W. Braun and P. M. Rentzepis)

- T1. Energy localization in the lowest triplet state of molecules (John C. Hemminger, and William Klemperer, Cambridge, Mass., U.S.A.)
- T2. Photophysics of organic crystal surfaces (M. R. Philpott, San Jose, Calif., U.S.A., and J.-M. Turlet, Talence, France)
- T3. Temperature effects on the phosphorescence lifetimes of methyl substituted benzaldehydes dispersed in durene single crystals (A. Despres and E. Migirdicyan, Orsay, France)
- T4. *Invited Lecture*: Triplet state spin label and molecular dynamics (M. A. El-Sayed, Los Angeles, Calif., U.S.A.)
- T5. V./U.V. excitation of molecular species trapped in rigid matrices (C. Vermeil, J. Fournier, C. Lalo and L. Hellner, Paris, France)
- T6. Vibrational relaxation in condensed media (S. H. Lin, H. P. Lin and D. Knittel, Tempe, Ariz., U.S.A.)
- T7. A rapid radiationless decay process competing with the intramolecular proton transfer in the excited state (H. Shizuka and K. Matsui, Gunma, Japan)
- T8. C<sub>2</sub><sup>-</sup>-molecular ion: long range electron tunnelling and B<sup>2</sup>Σ<sub>u</sub><sup>-</sup> ↔ a<sup>4</sup>Σ<sub>u</sub><sup>-</sup> intersystem crossing in rare gas lattices (V. E. Bondybey, Murray Hill, N.J., U.S.A.)

#### Session U

##### Organic Photochemistry (Chairmen: A. M. Trozzolo and Y.-L. Chow)

- U1. *Invited Lecture*: Radical ions in photochemistry. The sensitized (electron-transfer) photochemical reactions of olefins in polar, nucleophilic solvents (D. R. Arnold and Y. Shigemitsu, London, Ont., Canada)



- U2. Electron transfer mechanisms in the photosensitized dimerization and isomerization of olefins (Heinz D. Roth and Marcia L. Manion, Murray Hill, N.J., U.S.A.)
- U3. The reduction of excited triplet thiazine dyes by ferrous ion: a laser flash photolysis study (Peter D. Wildes, Norman N. Lichtin, and Morton Z. Hoffman, Boston, Mass., U.S.A.)
- U4. Excited state chemistry of indigoid dyes. IV. Evidence for the intermediacy of the triplet state in the direct photoisomerization of thioindigo dyes (Andree D. Kirsch and George M. Wyman, Chapel Hill, N.C., U.S.A.)
- U5. Carbonium ion reactions initiated by light-induced charge transfer (Edwin F. Ullman, Cheng-I Lin and Prithipal Singh, Palo Alto, Calif., U.S.A.)
- U6. The properties of some photochromic fulgides (J. Clarkson, P. Darcy, H. Gonzenbach, H. G. Heller, and R. Piggott, Aberystwyth, U.K.)
- U7. Quantitative studies of photochromic fulgides and fulgimides (R. J. Hurditch, Caswell, Towcester, Northants, U.K.)
- U8. Cocaine photochemistry (Virgil I. Stenberg, S. P. Singh and S. S. Parmar, Grand Forks, N.D., U.S.A.)
- U9. Photokinetics of hydroxyquinones (R. Paetzold and R. Werner, Jena, GDR)
- U10. Photochemistry of some pyrimidine-purine analogs of dinucleotides in aqueous solutions (S. Paszyc, B. Skaski and G. Wenska, Poznan, Poland)

#### Session V

##### Atmospheric Photochemistry (Chairmen: G. Herzberg and S. Toby)

- V1. *Invited Lecture*: Stratospheric photochemistry of halocarbons and the consequences for the ozone layer (F. S. Rowland, Irvine, Calif., U.S.A.)
- V2. Gas-phase ultraviolet absorption cross sections for nitril chloride and nitrosyl chloride (Gerald A. Takacs and Andreas J. Illies, Rochester, N.Y., U.S.A.)
- V3. Photochemistry and halogen compounds in the atmosphere (P. Harteck, P. Holmes, P. Knoot, and R. Reeves, Troy, N.Y., U.S.A.)
- V4. High resolution emission spectrum, molecular constants and Franck-Condon factors for the  $A^2\Pi - X^2\Pi$  system of ClO (J. A. Coxon, E. Skolnik and W. E. Jones, Halifax, N.S., Canada)
- V5. Photolysis of ethyl chloride at 123.6 nm (G. Kramer, A. W. Kirk and E. Tschuikow-Roux, Calgary, Alb., Canada)
- V6. The effects of collisional moderator gases on photochemically-induced reactions in nitrogen oxide-propylene mixtures (K. W. Watkins, Fort Collins, Colo., P. J. Ogren, Pella, Iowa, U.S.A. and E. R. Allen, Albany, N.Y., U.S.A.)
- V7. Experimental study of the  $NO^+ + e \rightarrow N + O$  recombination in the vacuum UV flash photolysis of nitric oxide (Dieter Kley, George M. Lawrence and Edward J. Stone, Boulder, Colo., U.S.A.)
- V8. Hydroxyl radical combination with nitric oxide.  $OH + NO + M \rightarrow HONO + M$  (Cathy Black, Ralph Overend and George Paraskevopoulos, Ottawa, Canada)
- V9. Nitric oxides in the stratosphere — A two dimensional atmospheric model (Jae H. Park, Williamsburg, Va., and Jean-Francois Louis, Boulder, Colo., U.S.A.)
- V10. Laser magnetic resonance study of the reactions of OH radicals with some halogenated hydrocarbon molecules (Carleton J. Howard, K. M. Evenson, Boulder, Colo., U.S.A.)
- V11. Chemiluminescence of HNO sensitized by  $O_2(^1\Delta_g)$  (T. Ishiwata, H. Akimoto and I. Tanaka, Ohokayama, Tokyo, Japan)

#### Session W

##### Physical Photochemistry (Chairpersons: Catherine Vermeil and D. J. Leroy)

- W1. Single vibronic level photochemistry of formaldehyde ( $H_2CO, ^1A_2$ ) (Richard G. Miller, Roger S. Lewis and E. K. C. Lee, Irvine, Calif., U.S.A.)
- W2. Single vibronic level photodissociation in glyoxal (C. G. Venkatesh and George H. Atkinson, Syracuse, N.Y., U.S.A.)
- W3. Radiationless decay of the first excited singlet state of fluorinated ketones (P. A. Hackett and K. O. Kutschke, Ottawa, Canada)
- W4. The phosphorescence of 1,1,1-trifluoroacetone (S. W. Beavan, H. Inoue and D. Phillips, Southampton, U.K., P. A. Hackett, Ottawa, Canada)
- W5. The use of photon counting, MCS, and computer processing in the study of phosphorescent lifetimes (J. Addison, Y. Kumar, G. P. Semeluk and I. Unger, Fredericton, N.B., Canada)

- W6. Correction for the variation of instrument response function with wavelength fluorescence lifetime studies (A. G. Szabo, A. E. McKinnon, D. M. Rayner and P. A. Hackett, Ottawa, Ontario, Canada)
- W8. Surface photochemistry and spectroscopy of adsorbed molecules (W. Bach and H. D. Breuer, Saarbrücken, FRG)
- W9. The condensed phase photochemistry of the fluoroethylenes (William A. Guillory and George H. Andrews, Salt Lake City, Utah, U.S.A.)
- W11. Ionic photodissociation of charge transfer complexes. Solute-solvent charge-transfer complexes (K. Kimura and Y. Achiba, Sapporo, Japan)
- W12. Photochemistry of tellurium bisacetophenone dichloride (D. G. Marsh and J. Y. Chu, Webster, N.Y., U.S.A.)

#### Session X

- Inorganic Photochemistry** (Chairmen: L. Moggi and J. F. Endicott)
- X1. *Invited Lecture*: Some chemical and physical properties of hexi states of  $d^3$  and  $d^6$  coordination compounds (Arthur W. Adamson, Los Angeles, Calif., U.S.A.)
- X2. Electron spin resonance study of free radical intermediates in the anaerobic and aerobic photolysis of some alkylcobaloximes (C. Giannotti, G. Merle, Gif sur Yvette, France, and J. R. Bolton, London, Ontario, Canada)
- X3. Polarized photochemistry and photoreorientation (J. J. Turner, J. K. Burdett, I. R. Dunkin, R. N. Perutz, M. Poliakoff, R. F. Turner, Newcastle upon Tyne, U.K.)
- X4. Flash photolysis of coordination complexes containing aromatic ligands (Morton Z. Hoffman, Boston, Mass., U.S.A.)
- X5. The photochemistry of chromium hexacarbonyl; a reexamination (J. Nasielski and A. Colas, Bruxelles, Belgium)
- X6. The photochemistry of aqueous plutonium systems (J. T. Bell, L. M. Toth and H. A. Friedman, Oak Ridge, Tenn., U.S.A.)
- X7. Physical and chemical quenching of the excited uranyl ion (M. Ahmed, A. Cox and T. J. Kemp, Coventry, U.K.)
- X8. Photodecomposition in the solid state of uranyl formate monohydrate (B. Claudel, M. Feve, J. P. Puaux and H. Sautereau, Villeurbanne, France)
- X10. Photochemistry of borazine and other boron compounds (Richard F. Porter, Ithaca, N.Y., U.S.A.)
- X11.  $CO_2$  laser-induced photochemical enrichment of boron isotopes (S. M. Freund, and J. J. Ritter, Washington, D.C., U.S.A.)

#### Session Y

- Organic Photochemistry** (Chairmen: O. L. Chapman and K. Gollnick)
- Y1. *Invited Lecture*: Exciplexes and radical cations in photoaddition reactions (S. Farid, K. A. Brown, J. C. Doty, S. E. Hartman and J. L. R. Williams, Rochester, N.Y., U.S.A.)
- Y2. Exciplexes and complexed radicals in deactivating reactions of duroquinone (H. Hermann, I. Safarik, G. O. Schenck, R. Wolgast, Mulheim a.d. Ruhr, FRG)
- Y3. The charge transfer complex from benzophenone triplets and olefins (M. A. Winnik, C. K. Hsaio and D. Bichan, Toronto, Ont., Canada)
- Y4. Photochemical reactivity of some charge-transfer complexes (W. J. Sep, J. W. Verhoeven and Th. J. de Boer, Amsterdam, The Netherlands)
- Y5. The effect of structure, substitution and solvent on the fluorescence of 1,3-diphenyl-2-pyrazolines (H. Strähle, W. Seitz and H. Güsten, Karlsruhe, FRG)
- Y6. Photochemical hydrogen abstraction reactions proceeding through five membered transition states (Barry M. Jennings, John P. Louwerens, and John R. Scheffer, Vancouver, Canada)
- Y7. Two-step singlet photoreactions: kinetic criteria and experimental consequences (Gerd Kaupp, Freiburg, FRG)
- Y8. The interaction of triplet benzaldehyde with benzenes (I. F. Hung, D. F. Williams, and R. W. Yip, Ottawa, Canada)
- Y9. Some aspects of reversible photocyclisation, E. Fischer, Rehovot, Israel)
- Y10. Utilization of excited state pKs to initiate a ground state chemical reaction (F. D. Saeva and G. R. Olin, Webster, N.Y., U.S.A.)
- Y11. Photochemical reactions on insoluble polymer supported substrates: photohalogenation of polymer-bound fatty acids (J. Castells, J. Font and A. Moral, Barcelona, Spain)

- Y12. Photooxygenations with heterogeneous sensitizers (A. Paul Schaap, Arthur L. Thayer, Gary R. Faler, Krzysztof Zaklika, Erich C. Blossey, and Douglas C. Neckers, Detroit, Mich., U.S.A.)

#### Session Z

**Air Pollution** (Chairmen: J. N. Pitts, Jr. and J. G. Calvert)

- Z1. *Invited Lecture*: A test of photochemical smog mechanisms in the Los Angeles atmosphere; an analysis of the chemical aspects of the data from the Larpp operation No. 33 of November 5, 1973 (Jack G. Calvert, Columbus, Ohio, U.S.A.)
- Z2. Photochemical and free radical processes in the system sulphur dioxide-methane and sulphur dioxide-isobutane (W. G. Filby and R. D. Penzhorn, Karlsruhe, FRG)
- Z3. The reactions of photoexcited SO<sub>2</sub> with polyunsaturated olefins (Nelson Kelly, Kenneth Partymiller, James F. Meagher and Julian Heicklen, University Park, Pa., U.S.A.)
- Z4. Homogeneous photochemical aerosol formation: the SO<sub>2</sub>-alkane system (R. D. Penzhorn and H. Jordan, Karlsruhe, FRG)
- Z5. A computer simulation of the kinetics of photochemical air pollution (T. Ichimura, H. Akimoto and H. Yamazaki, Tokyo, Japan)
- Z6. *Invited Lecture*: Photochemical and kinetic processes in simulated tropospheric and stratospheric systems and their application to chemical transformations in the polluted atmosphere (James N. Pitts Jr., Arthur M. Winer, Karen R. Darnall, John M. McAfee, William P. Carter, Alan C. Lloyd, Roger Atkinson, George M. Breuer, and D. Alan Hansen, Riverside, Calif., U.S.A.)
- Z7. Meteorological factors and photochemical air pollutants over Edmonton, Alberta (H. S. Sandhu, Edmonton, Alberta, Canada)
- Z8. *Invited Lecture*: The photochemistry and kinetics of power plant plumes (D. D. Davis, College Park, Md., U.S.A.)
- Z9. Oxidant formation in the Toronto region (K. G. Anlauf, M. Lusic and H. A. Wiebe, Downsview, Ontario, Canada and R. D. S. Stevens, Toronto, Ontario, Canada)

#### Session α

**Lasers, Physical-Organic Photochemistry and Photobiology** (Chairmen: F. E. Blacet and S. W. Benson)

- α1. *Invited Lecture*: Laser photochemistry in the gas phase (K. H. Welge, Downsview, Ontario, Canada)
- α2. Picosecond continua for time resolved absorption spectroscopy (G. L. Olson, K. S. Greve, and G. E. Busch, Boulder, Colo., U.S.A.)
- α3. Modern theories of radiation-matter interactions and their photochemical consequences (G. Wilse Robinson, Parkville, Va., Australia)
- α4. Physical chemistry of laser dyes based on 7-amino coumarin (R. Srinivasan and C. S. Angadiyavar, Yorktown Heights, N.Y., U.S.A.)
- α5. Recent findings on organic dye structure as related to laser action properties (T. G. Pavlopoulos, San Diego, Calif., U.S.A.)
- α6. Isotopic enrichment by multiple absorption of intense CO<sub>2</sub> laser radiation (J. L. Lyman, R. J. Jensen, J. P. Rink, C. P. Robinson and S. D. Rockwood, Los Alamos, N.M., U.S.A.)
- α8. *Invited Lecture*: Picosecond flash photolysis and spectroscopy in photochemistry and photobiology (Maurice W. Windsor, Pullman, Wash., U.S.A.)
- α9. Picosecond resolution of intersystem crossing and measurement of quantum yields in rose bengal (M. G. Rockley and M. W. Windsor, Pullman, Wash., U.S.A.)
- α10. Laser photolysis in globular proteins (M. Cooper and J. K. Thomas, Notre Dame, Ind., U.S.A.)
- α11. *Invited Lecture*: Kinetics and photochemistry of organic and biological systems in the picosecond range (P. M. Rentzepis, Murray Hill, N.J., U.S.A.)

#### Session β

**Azo Symposium** (Chairmen: E. Fischer and R. J. Crawford)

- β1. *Invited Lecture*: The photochemistry of azoisopropane (Colin Steel and Laurence D. Fogel, Waltham, Mass., U.S.A.)
- β2. The photolysis of diimide and methyl diimide, and the photochemistry of simple azo compounds (C. Willis, S. K. Vidyarthi, J. Parson and R. A. Back, Ottawa, Ontario, Canada)

- β3. Photochromism of aromatic azines (R. Paetzold, K. Appenroth and M. Reichenbacher, Jena, G.D.R.)
- β5. Gas phase photochemistry of cyclic azo compounds (F. H. Dorer, Fullerton, Calif., U.S.A.)
- β6. Photochemistry of azoxybenzene. A mechanistic study (Dina Gegiou-Hadjoudis and Eugene Hadjoudis, Athens, Greece)
- β7. The photochemistry of 1-pyrazoline (R. J. Crawford, P. J. Kozak, H. E. Gunning, J. A. Quinn, A. M. Tarr, O. P. Strausz and I. Safarik, Edmonton, Alb., Canada)
- β8. Photolysis of azoalkanes in viscous and crystalline media (J. Michael McBride, New Haven, Conn., U.S.A.)

#### Session γ

**Organic Photochemistry** (Chairmen: H. Prinzbach and C. S. Foote)

- γ2. Steric and spin-orbital effects on the photodimerization of 2-bromo-thianaphthene-1,1-dioxide (Benjamin F. Plummer and William W. Schloman, Jr., San Antonio, Texas, U.S.A.)
- γ3. Photodebromination of bromothiophenes (Cyril Parkanyi and Alfred T. Jefferies, III, El Paso, Texas, U.S.A.)
- γ4. The Norrish type I photoreactions of aliphatic ketones (E. B. Abuin and E. A. Lissi, Santiago, Chile)
- γ5. Excited state properties of pyrimidyl alkyl ketones (Edward C. Alexander and Roy J. Jackson, San Diego, La Jolla, Calif., U.S.A.)
- γ6. Quenching of the Norrish type II reaction of butyrophenone by thiophenic compounds (V. Avila, S. Braslavsky, I. C. Scaiano, Cordoba, Argentina)
- γ7. Photochemical processes from the <sup>1</sup>nπ excited state of aliphatic ketones bearing "γ" hydrogens (M. V. Encina and E. A. Lissi, Santiago, Chile)
- γ8. Hydrogen abstraction by electronically excited sulfoxides (Klaus Gollnick, Hans-Jürgen Braun, Henning Hilk, and Siegfried Fries, Munich, F.R.G.)
- γ10. Photochemical reaction of 1,4-naphthoquinone epoxides with hydrogen donors (Kazuhiro Maruyama, Seiichi Arakawa, and Tetsuo Otsuki, Kyoto, Japan)

#### Session δ

**Physical Photochemistry** (Chairmen: M. A. West and G. J. Mains)

- δ1. *Invited Lecture*: Photochemistry of electron-transfer reactions (Michael Szwarc and Gideon Levi, Syracuse, N.Y., U.S.A.)
- δ3. Photoionization processes at threshold: direct and auto-ionization and Franck-Cordon factors for simple molecules (C. F. Batten, J. Ashley Taylor, and G. G. Meisels, Lincoln, Neb., U.S.A.)
- δ4. Photoionization mass spectrometry of alcohols, alcohol clusters, and carbon dioxide dimers (James W. Taylor and Gilbert G. Jones, Madison, Wisc., U.S.A.)
- δ5. Biphotonic photoionization of perylene (T. R. Evans, L. F. Hurysz, O. Jaenicke and T. H. Chen, Rochester, N.Y., U.S.A.)
- η4. Non-linear photochemical effects in laser photolysis (Michael Fisher, Bernard Beyret and Karl Weiss, Boston, Mass., U.S.A.)
- δ6. A new reaction, the cascade photobreakdown of organic compounds (François Gans, Gif/Yvette, Clement Troyanowsky and Pierre Valat, Paris, France)
- δ7. Chemiluminescence from hyponitrite (G. D. Mendenhall, Columbus, Ohio, U.S.A.)
- δ8. Transient emitting species in phosphorus chemiluminescence (Richard J. VanZee and Ahsan U. Khan, East Lansing, Mich., U.S.A.)
- δ9. Effect of pressure on fluorescent species in water (C. T. Mastrangelo and H. W. Offen, Santa Barbara, Calif., U.S.A.)
- δ10. The quantum yield of fluorescence of quinine bisulphate and azulene (B. Gelernt, A. Findeisen, A. Stein, and J. A. Poole, Philadelphia, Pa., U.S.A.)

#### Session ε

**Industrial Photochemistry** (Chairmen: S. P. Pappas and E. A. Chandross)

- ε1. *Invited Lecture*: Photochemistry and thin-film optics (E. A. Chandross, Murray Hill, N.J., U.S.A.)
- ε2. The photochemistry of benzanthrone disperse dyes (P. Bentley, J. F. McKellar and G. O. Phillips, Salford, U.K.)

- ε3. Photochemistry of cyanine dyes and their halogen substitution products (Ch. F. Hendriks and H. C. A. van Beek, Delft, Holland)
- ε4. Photochemical reactions of hexachlorobenzene (Ellis K. Fields and Seymour Meyerson, Naperville, Ill., U.S.A.)
- ε5. Photosensitization with metal oxide pigments (S. Peter Pappas, Richard M. Fischer, Jr., and Walter Kuhhirt, Fargo, N.D., U.S.A.)
- ε7. Stabilization of photochromic aziridines (Thap DoMinh, Rochester, N.Y., U.S.A.)

**Session ζ**

**Photobiology** (Chairmen: E. W. Abrahamson and M. W. Windsor)

- ζ1. *Invited Lecture*: Primary processes in bacterial photosynthesis (Roderick K. Clayton, Ithaca, N.Y., U.S.A.)
- ζ2. The oxygen-releasing partial reaction in photosynthesis (Helmut Metzner, Tübingen, F.R.G.)
- ζ4. Photochemical inactivation of enzymes (L. I. Grossweiner, Chicago, Ill., U.S.A.)
- ζ5. Photoreactions of di-iodotyrosine (S. Aditya and D. Bhattacharya, Calcutta, India)
- ζ6. Photochemistry of reduced lumiflavin (N. Lasser and J. Feitelson, Jerusalem, Israel)
- ζ7. Minimal bright mutants of luminous bacteria: an altered control of luciferase synthesis (C. A. Waters and J. W. Hastings, Cambridge, Mass., U.S.A.)