

## THE NINETEENTH INTERNATIONAL SYMPOSIUM ON COMBUSTION

The 19th International Symposium on Combustion was held on August 8-13, 1982, in Haifa, Israel. This biannual conference covers an area of science in which APL has had an active interest since the early days of ramjet engine development in the 1950's. Propulsion and combustion efficiency improvements presented then a major technical challenge. In response, a combustion research program was initiated and has been supported since then to provide guidance to the development effort.

The Combustion Institute, which sponsors the symposia, has had a long and successful history of providing a worldwide forum for this diverse scientific area and publishing the results promptly in widely read *Proceedings*. A number of APL staff members have played key roles in its founding and in supporting subsequent Institute affairs. W. H. Avery was a member of the Papers Subcommittee for the 1954 Symposium, where it was decided that a permanent organization should be established. He was one of the directors of the Combustion Institute from its formation until 1982. W. G. Berl served for many years on the Combustion Institute Committee, the Institute's advisory board, was the chairman of the Papers Subcommittee in 1962, and edited two of the *Proceedings*. R. M. Fristrom chaired the Papers Subcommittee in 1980.

APL has contributed many technical papers to the Symposia over the past quarter century, and five members have been honored by the Institute. In 1966, R. M. Fristrom and A. A. Westenberg received the Institute's Silver Medal for an "outstanding paper on flame structure research," and G. L. Dugger and F. S. Billig were similarly honored in 1970 for their work on combustion in ramjets. In 1972, W. H. Avery received the Institute's Alfred C. Egerton Gold Medal.

This year's conference was held on historic Mount Carmel, above the beautiful harbor of Haifa, at the Technion-Israel Institute of Technology. The president of Technion, General A. Horev, and D. Katz, chairman of the Israel section of the Combustion Institute, hosted the meeting. The technical program was arranged by a committee chaired by J. Howard (M.I.T.). About 400 scientists were registered from Australia, Austria, Belgium, Brazil, Canada, France, Germany, Hungary, Israel, Italy, Japan, Korea, the Netherlands, Norway, Portugal, Sweden, the United Kingdom, and the United States. Representatives of the Moslem countries and of the USSR and China were absent.

A highlight of the meeting was the awards presentation, featuring a gracious and witty introduction by F. Weinberg (Imperial College, London). The Alfred C. Egerton Gold Medal, "for distinguished continuing and encouraging contributions to the field of combustion," was presented to I. Glassman of Princeton. The Bernard Lewis Gold Medal, "for outstanding research in the field of combustion, particularly in the creation of theoretical models," was awarded to B. Spalding (Imperial College, London). The Silver Medal, for an outstanding paper at the 18th Symposium, was presented to J. Warnatz (Technische Hochschule, Darmstadt).

Modern combustion studies, as exemplified by this symposium, cover a wide range of topics from the basic sciences of fluid dynamics and reaction kinetics through studies of flames and detonations to the practical problem of engines, propellants, coal combustion, and the related areas of environmental pollution and unwanted fires. More than 160 papers were presented in 36 sessions, covering 15 theme areas. With such an abundance of topics it is difficult to specify the most active and innovative areas. However, a feeling for the direction of combustion science may be had by noting the interests of the three current award winners. Glassman presented two papers on the propagation of flames over surfaces and on a study of kinetic mechanisms using his elegant turbulent flow reactor. Spalding also submitted two papers, one on two-phase flow in rocket combustion and the other on the application of his ESCIMO model for turbulent flames. This area of combustion is receiving new interest because of increased computational power and new ideas that relate flow instabilities with the mathematics of strange attractors. Warnatz, the third medal winner, described an experimental and analytical study of the detailed structure of fuel-rich acetylene flames. Our knowledge of reaction mechanisms and basic kinetics has so improved, both by new instruments and techniques and the capability of computers to handle more complex models, that the details of the structure of flames is becoming predictable despite the many interrelated and overlapping chemical and physical processes that occur within them.

Another measure of the trends of interest in combustion is provided by the topics of the invited survey papers topics. The plenary lecture by F. Kaufman (University of Pittsburgh), "Combustion Chemistry—Simple Steps and Complex Mechanisms," emphasized the vast improvements of the past decade in

detail and precision of kinetic studies that must be applied to the enormously complex interacting steps (typically 30 to 100) in combustion systems of even the simplest constituents. Other invited lectures included "Selected Topics in Reactant Turbulent Flows" by W. C. Strahle (Georgia Institute of Technology), "Combustion Rates of Coal Chars," by I. W. Smith (CSIRO, Australia), "Unsolved Problems in  $\text{SO}_x$ ,  $\text{NO}_x$  and Soot Control in Combustion" by A. Levy (Battelle Columbus Laboratories), and

"Turbulent Flame Structure and Speed in Spark Ignition Engines" by J. C. Keck (M.I.T.).

The technical program was accompanied by an equally full and enjoyable social program: an informal welcoming buffet, a barbecue held in historic Caesarea in the open-air Roman amphitheater by the sea, two concerts, including one by the Haifa Symphony Orchestra, and tours of historic and contemporary Israel. A farewell wine and cheese party closed an outstanding meeting.