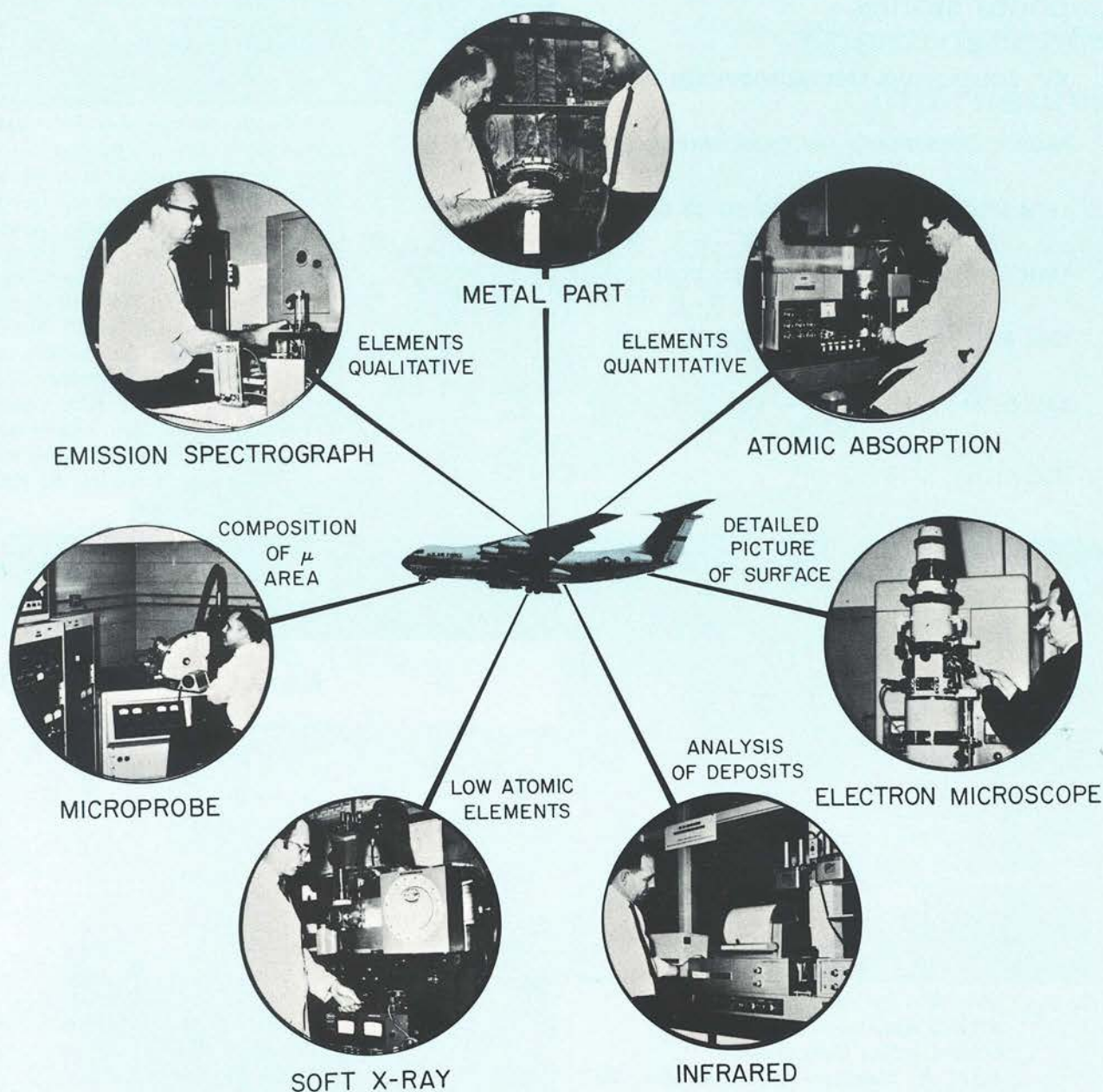


ANALYSIS AND CHARACTERIZATION OF MATERIALS



Feature:

**U.S. Air Force Materials Laboratory
Wright Patterson AFB, Ohio**

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Ronald A. Bujalski



Ronald A. Bujalski

The recent promotion of Ronald A. Bujalski to Superintendent of Machining for Ultra Carbon Corporation, Bay City, Michigan, is announced by Del Hughes, Exec. V.P. and General Manager.

Mr. Bujalski joined Ultra in 1956 as a machinist. His first job was in the spectrographic department producing electrodes on the then used hand lathe. Like most Ultra employees he soon began his four year apprenticeship working toward his Masters Machinist Certificate. During this four years of on-the-job training and outside classroom work Ron worked in every department of manufacturing, becoming familiar with all operations in machining graphite. During the years new methods and machines have been developed for the manufacture of graphite parts and Ron moved on to these more delicate precision machining instruments. Appointed Assistant Superintendent of Machining four years ago, Ron rounded out his experience by administration work in every department from raw materials to shipping the finished product.

Arcs & Sparks is published by Ultra Carbon Corporation, P.O. Box 747, Bay City, Michigan 48706, for the advancement of the profession of spectroscopy. News stories, changes of address and other pertinent correspondence should be directed to the Editor.

Do You Want Your SAS News Published

If you have news items, awards or photos which pertain to the SAS and would be of interest to its members, we will endeavor to include them in future issues. Photos should be glossy, no smaller than 3 1/4 x 4 1/4, persons in photo should be clearly identified, the event, location and date should be included, please type or print. Photos cannot be returned and the publishers cannot be responsible for incorrect spelling or identification of any item submitted.

Address: Miss Marion M. Tamblyn, Editor
Arcs & Sparks
Ultra Carbon Corporation
1310 N. Madison Ave., P.O. Box 747
Bay City, Michigan 48706

New Catalog Available

Ultra Carbon Corporation, Bay City, Michigan announces their new Analytical Laboratory Catalog. Completely new and revised, this 48 page catalog is divided into three sections. The first section gives the physical properties of Ultra's carbon and graphite grades, the carbon concentrations of the four Ultra purity levels, packaging and color-coding information and a photo-story of Ultra facilities. The second section is devoted to spectroscopic preformed electrodes, rods and powders. Over 150 preforms are available and drawn in detail with all dimensions given. Rods in a wide variety of lengths and diam-

(Continued on Page 15)

XV Colloquium



Spectroscopicum Internationale



Madrid, Spain
May 26-30, 1969



(additional photos will appear in next issue)

11th ANNUAL EASTERN ANALYTICAL SYMPOSIUM

November 19-21, 1969

Statler Hilton Hotel, New York City

THE A. A. BENEDETTI-PICHLER AWARD for outstanding achievement in microchemical techniques was awarded to PROF. BURRIS B. CUNNINGHAM, University of California, Berkeley, California. Prof. Michael Cefola of Fordham University, a colleague and former co-worker accepted the plaque for Professor Cunningham. Shown below is Erik R. Hoffman, Ethicon, Inc. making the presentation.

Burris Cunningham was born in Springer, New Mexico. His academic degrees in biochemistry and his career center about the University of California. In 1942 he went to Chicago to work on the Manhattan Project, where he remained until 1946. He then returned

to California where he was appointed to full professor in 1953.

He has been a consultant to Los Alamos Scientific Laboratory since 1957. Professor Cunningham has now contributed 27 years to the practice and teaching of micro techniques, especially for the study of transuranium elements. While at the Lawrence Radiation Laboratory he provided, in many cases, the first measurements or determinations of the bulk physical and chemical properties of the actinide elements and their compounds. This was done years before the elements were available in quantities suitable for property determinations by more classical techniques.

Dr. Cunningham has authored or co-

authored more than 76 research papers. He is a fellow of the New York Academy of Science, The British Chemical Society, and the American Association for the Advancement of Science.



The Awards Committee, American Microchemical Society. L. to R. Erik Hoffman, Ethicon, Inc., Louis M. Broncone, American Cyanamid Co., Michael Cefola, Professor, Fordham University, Richard N. Boos, Merck, Sharp & Dohme.



L. to R. Mr. Erik R. Hoffmann, Ethicon, Inc. Prof. Michael Cefola, Fordham University.

Presentation of the MEDAL of the SOCIETY for APPLIED SPECTROSCOPY, New York Section, was made to DR. ROBERT H. BELL for outstanding achievements in spectroscopy. Shown above and to the right, George Peterson, Perkin Elmer Corp., Dr. Robert H. Bell, and making the presentation, Charles L. Guettel, Driver Harris Co.

Dr. Bell is president of Lucius Pitkin, Inc., an independent laboratory specializing in analysis, testing, measurement, research, development and consultation, in the field of metals and alloys, ores and concentrates, and related materials. He received his degree in Chemical Engineering at the University of Cincinnati in 1935 and, followed by his Masters of Science in Chemical Engineering degree from the University of Cincinnati in 1937, he obtained his Ph.D. in Chemical Engineering and Physics in 1947, from the same institution.

He served as Laboratory Assistant and Instructor in the Department of Chemistry and Chemical Engineering at the University of Cincinnati, as Assistant Professor at New York University from 1941 to 1944 in the subjects of



L. to R. George Peterson, Perkin-Elmer Corp., Dr. Robert H. Bell, Lucius Pitkin, Inc., Charles L. Guettel, Driver Harris Co.

Spectroscopy and Physical Optics, as Adjunct Professor at the Polytechnics Institute of Brooklyn from 1945 to 1955 in the fields of Applied Spectroscopy and Physics.

Dr. Bell has had extensive experience in the science of spectroscopy and instrumental methods of analysis and testing. He has supervised various research projects involving the development of methods of analysis for uranium materials dating back to the days of the Manhattan Project.

Dr. Bell was one of the founding members of the Society for Applied Spectroscopy—the 1946 New York version which predated the national group of that name by a considerable time—and served as its president during 1947-48. He served as the Business Manager of the "Bulletin"—later becoming "Applied Spectroscopy"—from 1954 to 1960. He has been continuously active in various subcommittees of ASTM Committee E-2 on Emission Spectroscopy since the early forties, including the chairmanship of its Subcommittee X, and served as liaison between Committee E-2 and Committee E-3 on Chemical Analysis of Metals.



L. to R. Chas. Bell, Westinghouse, M. F. Wilson, Allied Chemical Research, Edward Withers, Celanese Research.



L. to R. M. Kornbalm, GT&E Labs., J. W. Colby, Bell Tel. Labs., W. Singer, ARL, W. L. Baun, WPAFB, Paul Lublin, GT&E Labs, Cris Anderson, ARL.



L. to R. Victor F. San Miguel, Chas. Pfizer & Co., Mrs. H. J. Pazdera, H. J. Pazdera, Abbott Labs., Dr. C. W. Pifer, Hoffman LaRoche, David A. Green, Western Electric, Anne R. Donnell, Sun Oil Co.



L. to R. William Grossman, Hunter College, Ronald A. Majors, Celanese Research, Peter Neddermeyer, Eastman Kodak, Bernard Buckin, Hunter College, Robert G. Belmer, Celanese Research.



L. to R. Boyd Fagan, Thiokol Chemical Corp., Wm. F. Pickup, Carol W. Townley, Sandra Jeffers, all of Alpha Metals, Inc.



L. to R. Ed Lanning, GT&E Labs., Maurice Slater, McDonnell Douglas, Sol Weisberger, Peter Aker, Jim Cosgrove, Helen Hada, Mike Ames, Dan Oblas, Dick Weberling, Carmine Persiani, all of GT&E Labs.



L. to R. Howard Bedell, McPherson Inst., Mabel Wilson, Allied Chemical Co., R. Knauer, Armco Steel Co., Bill Wilson, Charles Bell, Westinghouse.



L. to R. C. L. Grant, Univ. of New Hampshire, Jeanette G. Grasselli, Sohio Research Dept.



SOCIETY FOR APPLIED SPECTROSCOPY

8th National Meeting, Pacific Conference

October 6-10, 1969

Disneyland Hotel, Anaheim, California



L. to R. Ted Lyon, Idaho Nuclear Corp., Idaho Falls, Idaho, Frank Tindall, Duval Corp., Tucson, Ariz., Clarence Hodge, Duval Corp., Mrs. Hodge, Tucson, Arizona.



L. to R. Geo. Uman, L. A. Dept. of Water & Power, Herm Zwart, Aminco, Don Finn, Aminco, Jim Winefordner, U. of Florida, Mike Parsons, Arizona State University, Paul Langwen, Aminco, Don Frankel, Aminco.



L. to R. Mrs. Vogel, Mrs. Mossotti, Dr. Mossotti, Univ. of Illinois, Mrs. Fassel.



L. to R. Robert Brennan, U.S.G.S., Mrs. Robert Brennan, Dave Conway, Marathon Oil, Mrs. Dave Conway.



L. to R. John Norris, Baird Atomic, Bedford, Mass., George Matz, Fisher Scientific, Pittsburgh, Penn., Paul Kehres, A. O. Smith Co., Milwaukee, Wisc., Phil Kane, Texas Instruments, Dallas, Texas, Ray Baney, Ultra Carbon Corp.



L. to R. Anna Yoakum, Stewart Labs, Knoxville, Tenn., Joe Guidry, Freeport Sulfur, Belle Chase, La., Ivan Glaze, American Cast Iron Pipe, Mrs. Glaze, Birmingham, Ala., Carl Leistner, Ultra Carbon Corp., Peggy L. Stewart, Stewart Labs, Knoxville, Tenn., Walt Barnes, General Dynamics, Pomona, California.



L. to R. Philip Kane, Texas Instruments, Mrs. Kane, Dallas, Texas, Ray Baney, Ultra Carbon Corp., Mrs. Baney, Mrs. Alexander, George Alexander, Univ. of Calif., Lab of Nuclear Medicine, Los Angeles, Calif.



16th SPECTROSCOPY SYMPOSIUM OF CANADA

October 20-23, 1969

Holiday Inn Hotel — Montreal, Quebec



L. to R. Mr. Stan Smith, representative of the Society for Applied Spectroscopy; Mrs. and Mr. A. W. Pross, chairman of the 16th Symposium; Mrs. and Mr. Wm. Sollars, Agrico Division of the Continental Oil Co.



L. to R. Dr. J. G. Sen Gupta, Geological Survey of Canada, Ottawa; Mr. C. A. Waggoner, Defense Research Board, Esquimalt, B. C.; Dr. S. R. Koirtzmann, invited speaker, University of Missouri, Dr. C. L. Chakrabarti, Carleton University, Ottawa.



Symposium Committee:

L. to R. Dr. T. Theophanides, program committee, Mr. R. Dunn, Secretary-Treasurer, Mr. A. W. Pross, Symposium Chairman, Mr. P. J. Skerry, Publicity and Registration, Mr. R. Burley, Program Chairman, Mr. G. R. Wollerton, Tours Chairman, and Mr. A. P. Manzo, Exhibition Chairman.



L. to R. D. S. Russell, NRC—President Spectroscopy Society of Canada, Campbell Whitelow, Philips of Canada, Campbell Whitelow accepted for Ron Jenkins the award for the best paper published in "Canadian Spectroscopy" during 1968.



L. to R. Mr. R. Lauzon, National Research Council, Ottawa, Dr. and Mrs. P. A. Giguere, invited speaker, University of Laval, Quebec.



L. to R. Mr. C. Salama, Technical Editor of "Canadian Spectroscopy"; Dr. and Mrs. T. Theophanides, University of Montreal, Dr. P. Krueger, University of Calgary.

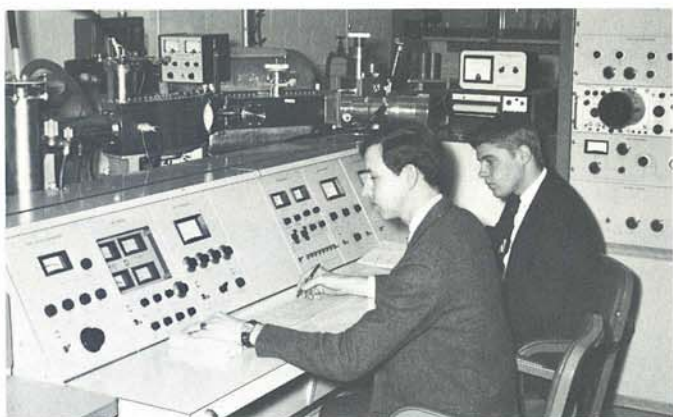


L. to R. Mr. R. Kelly, Baird Atomic Inc., Mr. L. Acs, Canadian Copper Refineries, and Dr. S. Barabas, Technicon Ltd.



L. to R. A. W. Prose, Chairman of the 16th Spectroscopy Symposium of Canada, W. A. Roemer, Fairleigh Dickinson University, R. Hart, Vice President, Spectroscopy Society of Canada, Hydro-Electric Power Commission of Canada, D. A. J. McDonald, Manager, Satellite and Ground Station Marketing of Northern Electric Co., Symposium Banquet speaker.

U.S. AIR FORCE MATERIALS LABORATORY



Mass Spectroscopist Lee Smithson, assisted by Kenneth Oakes, records readings from console of CEC-21-110B High Resolution Mass Spectrometer in the process of obtaining a mass spectrum of an organic compound.

After more than a half-century of service to the air arm of the United States military forces, the Air Force Materials Laboratory at Wright-Patterson Air Force Base, Dayton, Ohio, looks forward to the challenges of the future in research and development of materials for the aerospace age.

Beginning as a testing laboratory with a handful of people in 1917, the organization stands today as the United States Air Force center for research and development in materials. From a personnel complement of 45 people 50 years ago, the staff has increased to more than 400 today, representing a number of scientific specialties unheard of in the early years.

By today's standards, the early years presented relatively uncomplicated material problems as aircraft structures were made chiefly of wood, wire and fabric. By 1933, virtually all airplanes were made of metal, and today,



Dr. Dan Dyer, Research Chemist, adjusts controls on console of Varian A-56/60D Nuclear Magnetic Resonance Spectrometer which characterizes organic and organo-metallic materials containing protons and/or fluorine -19 nuclei.

many different kinds of metals, alloys and composites are to be found in aircraft and space vehicles.

While the work of the entire Laboratory is of general interest, the focus in this article is on the Analytical Branch of the Materials Physics Division and some of the related activities in other Divisions of the Laboratory.

Almost from the beginning of the Materials Laboratory, the desirability of having a strong in-house capability to characterize the materials undergoing research and development was recognized. In the early 1920's, the first quantitative chemical analysis laboratory was established. In the 1930's, an emission spectrographic unit was organized. In the 1940's, a capability for determining crystal structure through X-ray diffraction came into being. In the late 1940's and early 1950's a methodology of characterizing organic materials by means of infrared absorption spectroscopy and mass spectrometry was introduced. The



Freeman F. Bentley, Chief of the Analytical Branch of the Materials Physics Division, Air Force Materials Laboratory, adjusts controls on Perkin-Elmer Model 21 Recording Infrared Spectrophotometer as he attempts to identify an unknown organic compound by its long wavelength infrared spectrum. This particular spectrophotometer, built to the specifications of the AFML research chemists in 1954, is the first double beam instrument to record spectra in the 15-35u region.



Captain Ronald Lewis and Wilbert Powell, Research Chemists, check operation of F & M Corp. Model 5750 Analytical Gas Chromatograph which accomplishes the separation of organo-metallic materials and also identifies and characterizes materials.

ORY WRIGHT-PATTERSON AFB, OHIO



Dr. Robert Evers, Organic Research Chemist in the Polymer Branch, monitors recording of infrared spectrum of a high-temperature polymer on a Perkin-Elmer Model 137 Infrared "Infracord" Spectrophotometer.

instrumental capabilities in this area expanded rapidly during the 1950's. Research was supported to extend the range and performance of infrared spectrophotometers, and by 1960 few laboratories in the United States could match the infrared instrumental expertise enjoyed by the Materials Laboratory. It is internationally known for its extensive efforts to promote the analytical applications of long wavelength spectroscopy. The Laboratory's efforts in mass spectroscopy is perhaps less known, but is of even greater significance in analysis and characterization of materials. The solid source high resolution mass spectrometer emerged as a practical analytical tool during this period. The supporting efforts of the Materials Laboratory played an important role in these early developments.

In the 1960's, the capability to characterize organic materials through the use of magnetic resonance spectroscopy, Raman spectroscopy, and gas chromatography, and the capability to analyze inorganic materials through



Physicist Dave Fisher adjusts controls on Picker Soft X-Ray Spectrometer. The study of X-ray emission and absorption spectra contributes greatly to the basic research in the physics of spectra.

the use of low energy X-ray spectroscopy and elemental absorption spectroscopy constituted further expansion. A Raman spectrometer with a high intensity gas laser light source enables the chemist to determine uniquely the nature of chemical bonds in organic and inorganic molecules.

The Analytical Branch is equipped with a number of instruments which are unique in their fields, having been designed and constructed according to the specifications of Materials Laboratory scientists. One such instrument is a flat crystal spectrometer which uses a beam of electrons to excite characteristic X-rays in a high vacuum environment, and then uses crystals or soap films to disperse the X-rays. Another is a versatile high vacuum chamber using electron excitation, a soap film dispersing element and a windowless channel electron multiplier detector in which a wide variety of experiments on X-ray spectroscopy can be undertaken.



Charles Houston, Supervisory Chemist, Activates thermogravimetric recording instrument which measures changes in the weight of a substance as a function of temperature. This instrument supports research in the Ceramics and Graphite Branch.



Scientist Edmund Rolinski examines material preparatory to a high-temperature investigation of binary and ternary titanium alloys on the Bendix TOF Mass Spectrometer. This instrument supports research in the Thermo and Chemical Physics Branch and Advanced Metallurgical Studies Branch. *(Continued on Page 10)*

U. S. AIR FORCE MATERIALS LABORATORY (Continued)



Research Chemist Neil McDevitt places sample of material in the compartment of Perkin-Elmer Model 301 Spectrophotometer preparatory to analysis of the substance. The tank at the left contains liquid nitrogen which is necessary in the maintenance of the instrument.



Research Chemist James Muntz using the ultrasonic nebulizer for quantitative analysis of research materials on the Jarrell-Ash 3.4 meter emission spectrograph.

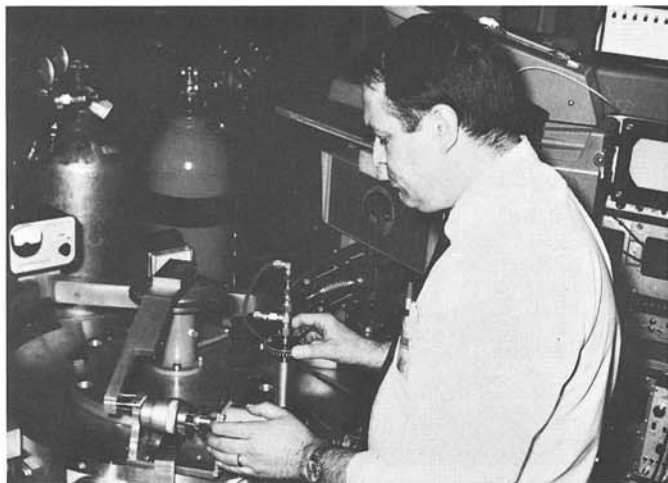
As the rapidly-changing composition and complexity of military aircraft have brought a continuous series of challenges to the Laboratory in the selection, development and evaluation of materials, so too the new space vehicles have confronted the chemist and the physicist with some entirely different materials problems such as the development of heat shield materials used to protect

The X-ray group of Analytical Branch has done extensive work using the X-ray diffraction technique in the study of the oxidation (in air and oxygen) of a group of high temperature metals and alloys which are being used in the aerospace industry.

In keeping pace with advancements in auxiliary fields, the Analytical Branch employs a computer to solve some of the more complex problems encountered in its work. Many of the products of spectroscopic investigation are

essentially mathematical in form. For example, the data obtained from an infrared spectrum can be fitted to a curve quickly with the help of the computer. In some aspects of physical chemistry, the availability of computer services to handle the necessary mathematical calculations rapidly and efficiently enhances the capability of the experimenter.

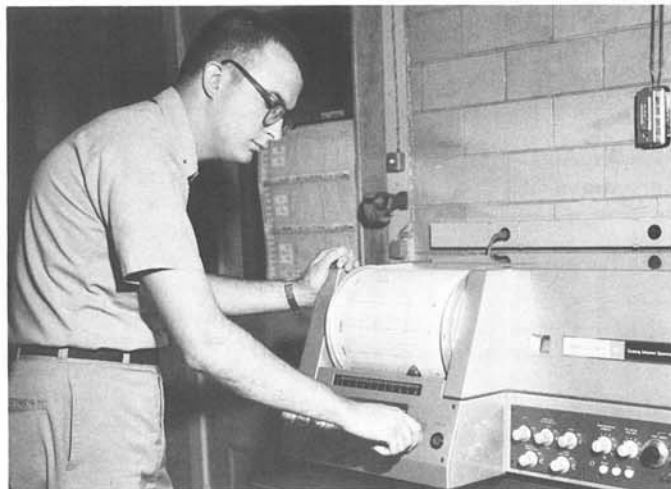
Organizationally, the Analytical Branch is divided into five groups: X-ray, Inorganic Analysis, Physical Chemistry, Microchemical Analysis, and Molecular Spectroscopy. The X-ray Group is oriented more toward research than perhaps the other groups, but all of them have the competence to conduct extensive research projects as well as to perform the required materials analysis. Contributions to the advancement of the state-of-the-art in the form of scientific papers and other publications have been numerous.



Research Chemist Bill Baun sets dials on Vacuum Soft X-Ray Spectrometer. This instrument enables the scientist to study the physics of X-ray emission spectra. This instrument was designed and constructed in the X-Ray Group.

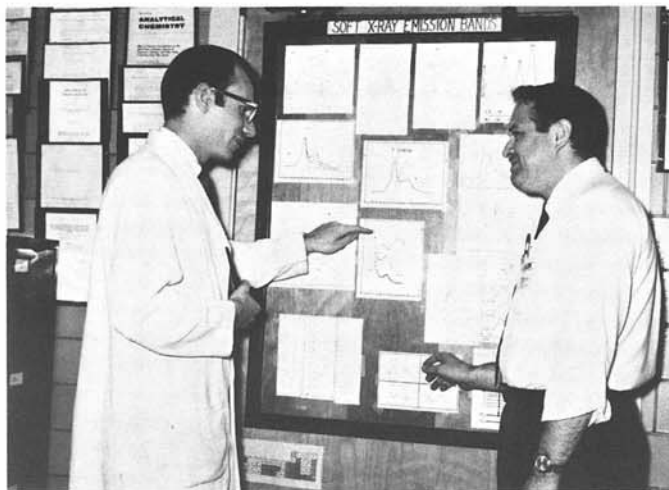


Chemist Bill Crawford observes graphic record produced on Perkin-Elmer 521 Grating Infrared Spectrophotometer. The Spectrogram provides data useful in identification of unknown materials.



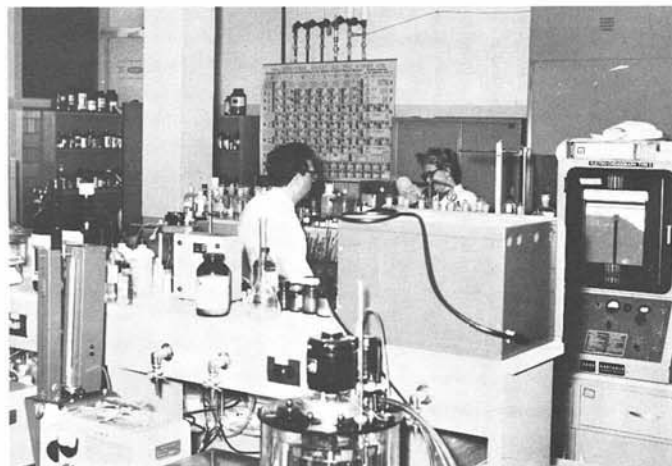
Lieutenant Henry Wells examines Perkin-Elmer 255 Grating Infrared Spectrophotometer used to identify and characterize unknown materials. The 225 Model is more sophisticated and has greater frequency range than earlier models.

Much of the work of the Branch, in fact, has been of a pioneering nature. This has centered around the analysis of low atomic number elements by long wavelength or "soft" X-ray spectroscopy and, as mentioned earlier, has involved also far infrared and mass spectroscopy. The Branch sponsored research which led to the creation of new instrumentation in the long wavelength infrared field. Other research prepared the way for the design and construction of sophisticated equipment for use in high resolution mass spectroscopy. Such developments are among the reasons for the maintenance of the outstanding capability which the Analytical Branch possesses. Moreover, these accomplishments are perhaps the most rewarding of the Analytical Branch's research efforts, in that they have made available to industrial and Government laboratories important analytical instrumentation well ahead of their time.



Physicist Dave Fischer and Research Chemist Bill Baun discuss the findings of their investigations in the field of soft X-ray spectroscopy. The Analytical Lab conducts a program of basic research in X-ray emission and absorption spectra.

The development of experimental organic and inorganic materials intended for use in aerospace systems is governed to a large extent by the Branch's capability to provide accurate and timely analyses and characterization data. The synthetic chemist, metallurgist or materials application engineer must know the composition, atomic or molecular structure of intermediate and final products of his research in order to obtain meaningful performance data and gauge the success and failure of his experiment to obtain materials of required properties. One of the functions of the Analytical Branch is, therefore, to develop new instrumental and chemical techniques and apply these to the analysis and characterization of the many new and exciting experimental materials now being produced in the AF Materials Laboratory. These techniques are essential to assure identification and selection of optimum compositions as the base material for new metallic and



Research Associate James Kerns and Research Assistant Winifred Harden check on test run in the analytical chemistry lab. The electrochemical instrument on the right is used for determining metals in organo-metallic substances. The equipment in the foreground is used for determining molecular weights and melting points.



Physicist Conrad Phillippi in communication with a computer performing an infrared dispersion analysis of a single crystal reflection spectrum.

(Continued on Page 12)

U. S. AIR FORCE MATERIALS LABORATORY (Continued)



Dr. C. T. Lynch, Senior Scientist, operates Electron Microprobe Analyzer which discerns segregation of impurities in alloys. The readout emerging at the left is recording the concentrations in yttrium.

non-metallic materials for increasing systems reliability and integrity. To avoid costly delays and permit the researcher to immediately proceed to the next stage of his experiment, accurate and reliable analysis data must be provided on a timely basis. This can be accomplished with a great measure of success only through a high level in-house analytical capability sensitive to the requirements of the materials engineer. Another function of the Analytical Branch is to provide analytical support to materials failures problems arising from weapons systems and activities in Southeast Asia and other Air Force activities throughout the world. This is depicted in the mosaic of photographs shown here. To accomplish the mentioned analyses, analytical methods such as infrared, visible and ultraviolet absorption, Raman, X-ray, emission, atomic absorption, nuclear magnetic resonance, gas chromatography, mass spectrometry, wet chemical and microelemental analyses are used as the main approach.



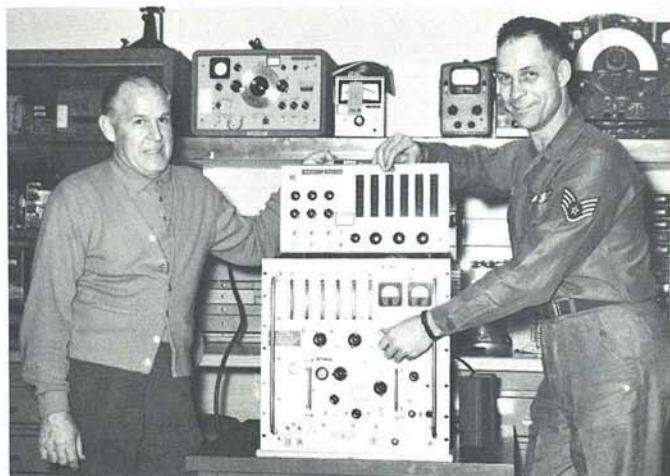
Physical Metallurgists George Yoder and Russell Henderson inspect a first-stage titanium alloy compressor disc from an aircraft to be analyzed for possible defects.



Mrs. Bernice Siney, Secretary to Freeman F. Bentley, Chief of the Analytical Branch, Materials Physics Division, Air Force Materials Laboratory, prepares her work plan for the day. Mrs. Siney is responsible in large part for the smooth conduct of the business end of the Branch operations.



Experimental Machinist Donald Dever operates polishing machine in the Air Force Materials Laboratory service shop as Foreman Kenneth Holdcraft looks on.



Foreman Paul Grice and Sgt. Cliff Wheeler prepare Hewlett-Packard Model 524 Electronic Counter and Measurements Model 525 Counter for recording of rapid-occurring radio and audio frequencies. The electronics shop services all of the Air Force Materials Laboratory.



11th ANNUAL ROCKY MOUNTAIN CONFERENCE

August 4-5, 1969

The Albany Hotel, Denver, Colorado



L. to R. Joe Haffty, U.S.G.S., Harlan Barton, Dow Chemical Co., Mrs. Kahan, Archie Kahan, Bureau of Reclamation.



L. to R. R. E. Miller, U.S.G.S., F. N. Ward, U.S.G.S., W. N. Jacobson, Ethyl Corp., Dr. Tim Linn, Kennecott Research Center.



L. to R. Dave Conway, Marathon Oil Co., Glen A. Shepherd, Dow Chemical Co., Francis Bonomo, Denver Research Institute.



L. to R. W. G. Schrenk, Kansas State U., Joe Haffty, U.S.G.S., F. G. Walthall, U.S.G.S.



L. to R. Mrs. Shepherd, Mrs. Barton, Mrs. Holst.



L. to R. M. W. Skougstad and Tennyson Myers, U.S.G.S.



L. to R. Mrs. Brennan, Mrs. Fishman, Marvin Fishman, U.S.G.S., Wendell Nixon, Marathon Oil.

13th CONFERENCE ON ANALYTICAL CHEMISTRY IN NUCLEAR TECHNOLOGY

September 30 — October 2, 1969

Mountain View Motor Lodge, Gatlinburg, Tennessee



L. to R. Cyrus Feldman, ORNL, Marshall H. Wakat, Savannah River Lab, Aiken, S. C., J. C. White, ORNL, J. W. Nehls, U.S.A.E.C., Oak Ridge, Tenn., R. A. Priest, Savannah River Lab, Aiken, S.C.



L. to R. W. S. Lyon, ORNL, Seymour Gold, U. S. Public Health Service, Cincinnati, Ohio, Fernando Bazan, Lawrence Radiation Lab, Livermore, Calif., H. L. Krieger, U.S.P.H.S., Cincinnati, Ohio, Bernd Kahn, U.S.P.H.S., Cincinnati, Ohio.



L. to R. Mrs. M. T. Kelley, Oak Ridge, Tenn., D. G. Boase, Atomic Energy of Canada, Pinawa, Manitoba, Canada, M. T. Kelley, Division Director, Analytical Chem. Div. ORNL.



L. to R. B. F. Scott, New England Nuclear Corp., Boston, Mass., Urpo Koskela, ORNL, O. R. Simi, Los Alamos Scientific Lab, Los Alamos, N. M.



L. to R. Mrs. S. Hanamura, Tokyo, Japan, Shigeki Hanamura, Government Chemical Industrial Research, Tokyo, Japan.



L. to R. J. S. Eldredge, ORNL, H. Houtermans, I A E A, Vienna, Austria, L. C. Nelson, Jr., USAEC, New Brunswick Lab, New Brunswick, N. J.



L. to R. W. L. Maddox, M. L. Moss, D. A. Costanzo, all of ORNL.



L. to R. S. A. Reynolds, ORNL, Mrs. S. A. Reynolds, Oak Ridge, Tenn., Mrs. W. F. Marlow, Washington, D. C., W. F. Marlow, Div. of Biology and Medicine, U.S.A.E.C., Washington, D. C., A. P. Baerg, Nuclear Research Council, Ottawa, Ontario, Canada.



L. to R. L. J. Brady, ORNL, Chairman 13th Conference on Anal. Chemistry in Nuclear Technology, David Msika, French Atomic Energy Commission, Cadarache, France, Shigeki Hanamura, Govt. Chemical Industrial Research Institute, Tokyo, Japan, Mrs. Hanamura, Hisaki Kubuta, ORNL, Mrs. M. T. Kelley, Oak Ridge, Tenn., M. T. Kelley, Division Director, Anal. Chem., ORNL.



L. to R. Enzo Ricci, ORNL, R. W. Durham, Atomic Energy of Canada Ltd., Chalk River Laboratories, Chalk River, Ontario, Canada.

ANACHEM CONFERENCE

Detroit, Statler Hilton Hotel

September 16-18, 1969



L. to R. S. Cohen, Ford Motor Co., W. R. Heilman, F.B.I., F. Totman, A.R.L., W. R. Deckor, PPG Industries.



L. to R. J. G. Hanna, Conn. Agricultural Exp. Sta., T. Morgan, G. M. Corp., Res. Lab, Sidney Siggia, U. of Mass., F. G. Reidinger, Olin Corp.



L. to R. James E. Kedwell, Perkin-Elmer Corp., Rodney Quentine, Wyandotte Chemical Corp.



L. to R. (standing) James A. Burns, Jr., Co-Chairman, Mitchell Kapron, Co-Chairman, John Redd, VI Registration Co-Chairman, Jim Holcomb, Arrangements Co-Chairman, (sitting) L. to R. Carol Dubovoy, Secretary, Jim Burkel, Registration Co-Chairman.



Feb. 22 to 27 — 159th National American Chemical Society Meeting, Houston, Tex. Includes Analytical Chemistry Division Sessions. Contact: J. C. White, Oak Ridge National Laboratories, Oak Ridge, Tenn. 37830.

Mar. 1 to 6 — 21st Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy, Cleveland, Ohio. Contact: Robert Mainier, Koppers Co., Inc., 440 College Park Dr., Monroeville, Pa. 15146

May 25 to 29 — Joint National Meeting: American Chemical Society and The Chemical Institute of Canada, Toronto, Ont. Contact: ACS, 1155 Sixteenth St., N. W., Washington, D. C.

May 25 to 30 — Fifth Congress of International Measurement Confederation. (IMEKOV). Versailles, France. Contact: IMEKO Secretariat, Budapest, 5, P.O.B. 457, Hungary.

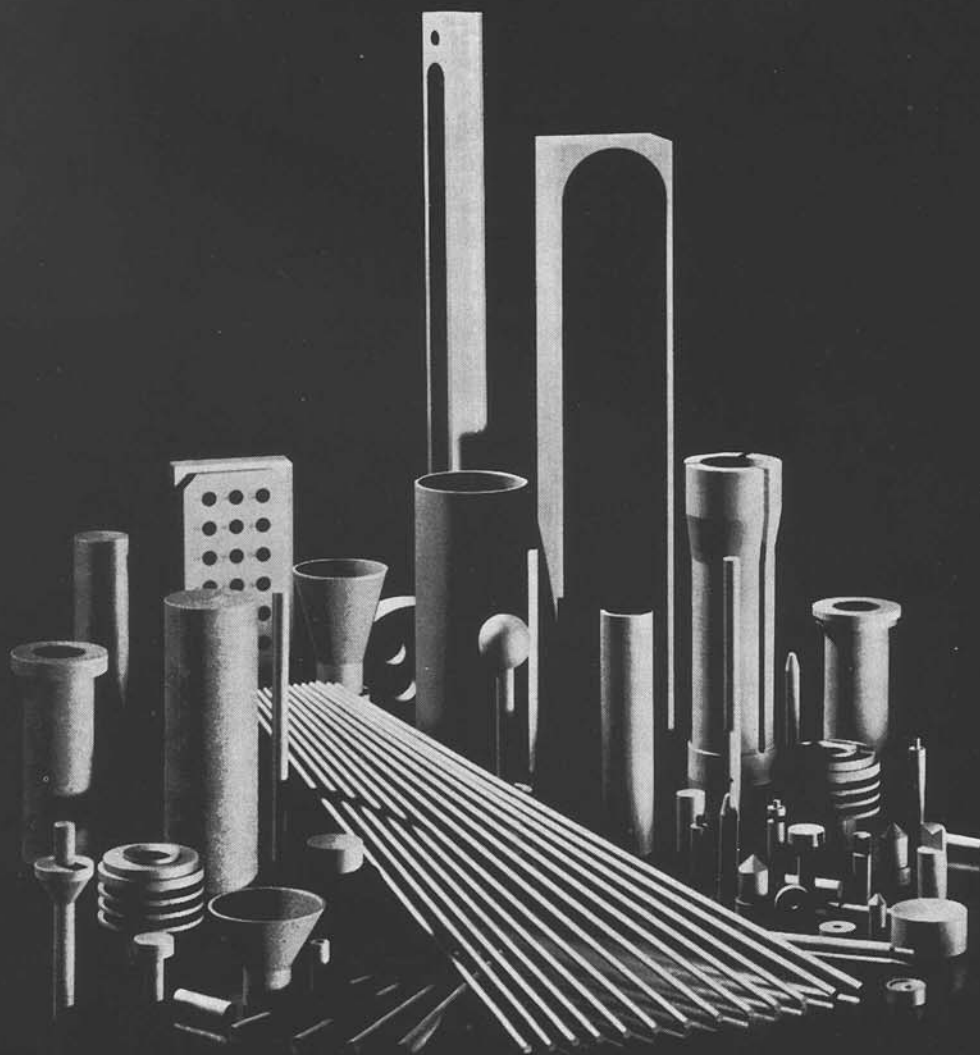
June 2 to 5 — 21st Annual Mid-America Symposium on Spectroscopy. Sheraton-Chicago Hotel, Chicago, Ill. Contact: Miss Adele Rozek, Velsicol Chemical Corp., 330 East Grand Ave., Chicago, Ill. 60611.

June 17 to 24 — European Meeting of Chemical Engineering and Acheme 1970. Frankfurt/Main, Germany. Contact: Dechema, 6000 Frankfurt (Main) 97, Postfach 9701-46, Germany.

NEW CATALOG *(Continued)*

eters and three purity levels are offered, along with powders in several mesh sizes, quantities and purity levels. The third section consists of a large selection of laboratory products crucibles, boats, funnels and shields. A complete line of graphite products for gas analysis are available including the single-use crucibles used in nitrogen determination.

All products shown are in stock and available for immediate delivery. The catalog is available on request.



a new edition for the purity-minded



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