

CONFERENCE TIME TABLE

All meeting rooms are in Fawcett Center for Tomorrow, except on Monday, May 17 between 8:00 a.m. and 5:40 p.m. all activities are at Battelle.

SUNDAY, MAY 16 (Center for Tomorrow)

Registration and Refreshments—6:00-8:00 p.m.

MONDAY, MAY 17 (Battelle)

Busses leave Center for Tomorrow and Holiday Inn for Battelle 7:40 and 8:00 a.m.

Registration 8:00 a.m., Auditorium/Lobby
 Opening Session 8:30 a.m., Auditorium
 Sessions 1, 2 9:10 a.m., Lecture Hall/Auditorium
 Morning Break 10:30 a.m., Auditorium/Lobby
 Sessions 3, 4 11:00 a.m., Lecture Hall/Auditorium
 Luncheon 12:30-2:00 p.m., Battelle Dining Room
 Sessions 5, 6 2:00 p.m., Lecture Hall/Auditorium
 Afternoon Break 3:30-4:00 p.m., Auditorium/Lobby
 Sessions 7, 8 4:00 p.m., Lecture Hall/Auditorium
 Busses leave Battelle for Hotels: 5:20 and 5:40 p.m.
 Reception 6:30-7:30 p.m., Center for Tomorrow
 Dinner 7:30-9:30 p.m., Center for Tomorrow

TUESDAY, MAY 18 (Center for Tomorrow)

Meeting Rooms will be Posted in the Lobby
 Registration 8:00 a.m.
 Sessions 9, 10 8:30 a.m.
 Morning Break 10:00-10:30 a.m.
 Sessions 11, 12 10:30 a.m.
 Lunch 12:00-1:30 p.m.
 Sessions 13, 14 1:30 p.m.
 Afternoon Break 3:00-3:30 p.m.
 Sessions 15, 16 3:30 p.m.
 Evening Free

WEDNESDAY, MAY 19 (Center for Tomorrow)

Meeting Rooms will be Posted in the Lobby
 Registration 8:00 a.m.
 Sessions 17, 18 8:30 a.m.
 Morning Break 10:00-10:30 a.m.
 Sessions 19, 20 10:30 a.m.
 Program Concludes 12:00 Noon

PROCEEDINGS

A 500 page hard-cover bound copy of the PROCEEDINGS (8 1/2 x 11 inches) will be given to each full-paid registrant attending the Conference. Additional copies may be purchased at the time of registration for \$35.00. After May 19, 1976, the PROCEEDINGS will be available at a cost of \$40.00 from Public Relations Department, Battelle's Columbus Laboratories, 505 King Avenue, Columbus, Ohio 43201 (limited number), or from SME's Publication Sales Department, 20501 Ford Road, Dearborn, Michigan 48128.

FOURTH NORTH AMERICAN METALWORKING RESEARCH CONFERENCE NAMRC-IV
MAY 17-19, 1976, COLUMBUS, OHIO
.. SITE OF THE ..
OHIO STATE UNIVERSITY
BATTELLE'S COLUMBUS LABORATORIES AND

AACIS



With the participation of:

NAMRC-II

Fourth North American Metalworking Research Conference
 May 17-19, 1976, Battelle's Columbus Laboratories
 505 King Avenue, Columbus, Ohio 43201

Scientific, Engineering and Research Personnel in the Field of Metalworking Please take note: An International Conference on Metalworking and Manufacturing

REGISTRATION TIME AND LOCATION
SUNDAY, MAY 16, 1976—6:00-8:00 p.m.

Fawcett Center for Tomorrow
 2400 Olentangy River Road, Columbus, Ohio 43210
MONDAY, MAY 17, 1976—8:00 a.m.
 Battelle's Columbus Laboratories
 Auditorium Lobby
 505 King Avenue, Columbus, Ohio 43201
TUESDAY/WEDNESDAY, MAY 18-19, 1976—8:00 a.m.
 Fawcett Center for Tomorrow

ADVANCED REGISTRATION

Registration by mail before May 5 is strongly recommended to avoid congestion at the time of the Conference and to assure attendance and accommodations. Blocks of rooms are reserved at Fawcett Center for Tomorrow and at Holiday Inn, OSU area, 328 West Lane Avenue, which is only two blocks from Conference locations.

Please give your complete mailing address on the registration card. The registration fee is \$150. A check in this amount, payable to "Battelle-Columbus/NAMRC-IV", should accompany the registration card.

REGISTRATION ON ARRIVAL

The registration desk will be in operation on Sunday evening, May 16, from 6:00-8:00 p.m., and will be open during the sessions at Battelle and at Center for Tomorrow. If you do not register in advance by mail, please bring the completed registration card and the registration fee when you register on arrival.

CONFERENCE LOCATION

On Monday, May 17, all the sessions will be held at Battelle, 505 King Avenue. In the morning, busses will leave Center for Tomorrow and Holiday Inn for Battelle at 7:40 and 8:00 a.m. In the afternoon, busses will leave Battelle at 5:20 and 5:40 p.m. for the hotels.

On Tuesday, May 18, and Wednesday, May 19, all sessions will be held in Fawcett Center for Tomorrow, 2400 Olentangy Road, which is within walking distance from Holiday Inn. Free parking is available on both Conference locations.

TRANSPORTATION/ARRIVAL

Columbus is served by many of the nation's major airlines. The Airport is located about 10 miles East of Battelle and Center for Tomorrow. Limousine service is available from the airport to the Center for Tomorrow and to Holiday Inn, OSU Area. It is best to inquire at the Airport, near the baggage lobby, for limousine service. The cab fare from the Airport to Conference locations is approximately \$7.00.

PARKING FACILITIES

Parking will be reserved at Battelle in the Auditorium Parking Lot at the corner of Perry Street and King Avenue. Free parking is available for visitors at the Center for Tomorrow and Holiday Inn—OSU.

REGISTRATION FEES

Participant	Ladies Program
Full Conference	\$40
Monday or Tuesday Only	\$20
Wednesday Only	—
	\$80

The fees include participation at sessions, refreshment breaks, lunches, conference dinner, bus transportation, and one copy of the NAMRC-IV PROCEEDINGS. Additional copies of the NAMRC-IV PROCEEDINGS will be available at the Conference for \$35.00 per copy. The fees do not include accommodations, breakfasts, lunch on Wednesday, or dinner on Tuesday.

Your registration should be received no later than May 5. Registrations after this deadline should be made by telephone or wire. Your registration should be confirmed prior to attending the program. Early registration is advised. Space may be reserved by individuals required to obtain employer authorization. Companies may place reservations and send names at a later date.

TAX DEDUCTION OF EXPENSES: An income tax deduction is allowed for expenses of education (including registration fees, travel, meals, lodging) undertaken to maintain and improve professional skills (see Treas. Reg. 1.162-5).

LADIES PROGRAM

An interesting program is being planned for those not participating in the technical sessions. This will provide an opportunity of visiting points of general interest in the Columbus Area. The program is being organized for Monday and Tuesday. The ladies will be free on Wednesday morning to do as they wish. Since bus and other facilities must be booked in advance of the meeting, we will greatly appreciate early registration so that we may properly plan these events. If you will be accompanied by someone interested in this program, please check the appropriate box on the registration form.

CONFERENCE SPONSORS



Columbus Laboratories



Department of Engineering and Manufacturing Technology of Battelle's Columbus Laboratories in conjunction with

- American Society of Mechanical Engineers
- Canadian Society of Mechanical Engineers
- National Science Foundation, RANN Program
- Ohio State University, Industrial & Systems Engineering Department
- Society of Manufacturing Engineers
- Association of American CIRP Industrial Sponsors

CONFERENCE PROSPECTUS

The Fourth North American Metalworking Research Conference (NAMRC-IV) has as its purpose and scope the presentation and discussion of basic and applied metalworking research. The format of the Conference is similar to NAMRC-I held at McMaster University in 1973, NAMRC-II held at the University of Wisconsin in 1974, and NAMRC-III held at Carnegie-Mellon University in 1975.

The papers presented at this Conference represent both original work as well as extraordinary summary reports in the fields of metal forming, metal removal, machine tools, and manufacturing systems.

All papers, presented at the Conference, are contained in the Conference PROCEEDINGS, and represent the work conducted in many renown and established metalworking research centers in North America, Europe, and Japan.

CONFERENCE ORGANIZATION

The North American Metalworking Conferences have been created by a group in North America dedicated to furthering knowledge, its dissemination and application in the field of materials processing.

The papers presented in this Conference are selected by the Scientific Committee of NAMRC from a large number of submissions. All the other Conference arrangements were carried out by the NAMRC-IV Organizing Committee.

SCIENTIFIC COMMITTEE

J. G. Bollinger
 University of Wisconsin

L. V. Colwell
 University of Michigan

N. H. Cook
 Massachusetts Institute of Technology

D. French
 University of Waterloo

S. Kobayashi
 University of California

I. LalMay (on leave)
 University of Saskatchewan

S. Ramalingam (on leave)
 State University of New York

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 University of Vermont

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 University of Wisconsin

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BATTELLE'S COLUMBUS LABORATORIES
OHIO STATE UNIVERSITY

SUNDAY, MAY 16, 1976

6:00-8:00 p.m. Registration, Fawcett Center for Tomorrow

MONDAY, MAY 17, 1976

7:40 and 8:00 a.m. Busses leave Hotels for Battelle

8:00 a.m. Registration, Battelle Lobby

OPENING SESSION 8:30 a.m. Battelle Auditorium

CHAIRMAN

William B. Rice, Chairman, Scientific Committee, NAMRC-IV and Head, Mechanical Engineering Department, Queen's University, Kingston, Ontario

SPEAKERS

Words of Welcome, John M. Batch, Director of Battelle's Columbus Laboratories
Words of Welcome, Harold A. Bolz, Dean, College of Engineering, OSU

Introductory Remarks, William B. Rice

Announcements, Taylan Altan, Research Leader, Battelle-Columbus

SESSION 1 9:10 a.m., Lecture Hall

CO-CHAIRMAN

F. W. Boulinger, Battelle's Columbus Laboratories, Ohio

K. Lange, Technical University, Stuttgart, Germany

AUTHORS

"An Analysis of Wire Making in Antiquity", E. G. Thomsen, H. H. Thomsen, University of California, Berkeley, California.

"The Effect of Work Hardening on Drawing Stresses in Multi-Pass Wire Drawing", J. S. Larragubel, Catholic University, Santiago, Chile, and S. Kobayashi, University of California, Berkeley, California.

"Analytical Study of Drawing of Composite Tubes", G. S. Hartley and H.A.J. Chin, University of Florida, Gainesville, Florida.

SESSION 2 9:10 a.m., Auditorium

CO-CHAIRMAN

N. H. Cook, Massachusetts Institute of Technology, Cambridge, Massachusetts

J. B. Watson, WABCO, Ltd., Hamilton, Ontario, Canada

AUTHORS

"Improvement of Machining Efficiency by Broadnose Turning", H. K. Tonshoff, Ch. NedeB, Technical University, Hannover, Germany.

"A General Graphic Method for the Selection of Optimum Machining Conditions", G. L. Ravignani, Consulting Engineer, Milan, Italy.

"Unsymmetrical Multi-Edge Cutting Tools in Deep-Hole Machining—Design Concept and Analysis", V. Latnovic, M.O.M. Osman, Concordia University, Montreal, Canada.

COFFEE BREAK 10:30-11:00 a.m.

SESSION 3 11:00 a.m., Lecture Hall

CO-CHAIRMAN

H. Conrad, University of Kentucky, Lexington, Kentucky

H. Gegel, Air Force Materials Laboratory, Wright-Patterson Air Force Base, Ohio

AUTHORS

"Tearing of Scored Sheet Materials", S. Kaipakjian, J. Lehti, E. A. Monaco, F. Suzda, J. E. Torres, Illinois Institute of Technology, Chicago, Illinois.

"A Study of the Isothermal Forming or Creep Forming of a Titanium Alloy", J.W.H. Price, J. M. Alexander, Imperial College of Science and Technology, London, U.K.

"Superplastic Forging of Disks with Bulging", S. Tang, Grumman Aerospace Corporation, Bethpage, New York.

SESSION 4 11:00 a.m., Auditorium

CO-CHAIRMAN

R. S. Hann, Cincinnati Milacron-Heald Division, Worcester, Massachusetts

M. C. Shaw, Carnegie-Mellon University, Pittsburgh, Pennsylvania

AUTHORS

"An Application of the Method of Simulation to Machining Economics", R. G. Fenton, N. D. Joseph, University of Toronto, Toronto, Ontario, Canada.

"Determination of Machining Conditions by a Self-Adaptive Procedure", M. P. Groover, A. M. Gunda, Lehigh University, Bethlehem, Pennsylvania, R. J. Johnson, Warner and Swasey Company, King of Prussia, Pennsylvania.

"Analysis of Machinability Effect on Productivity and Machining Cost", J. E. Mayer, Jr., D. G. Lee, Ford Motor Company, Dearborn, Michigan.

"Mathematically-Modeled Machining Data for Adaptive Control of End Milling Operations", V. A. Tiplis, S. C. Buescher, R. C. Garwood, Metcut Research Associates, Inc., Cincinnati, Ohio.

LUNCHEON 12:30-2:00 p.m. Battelle

SESSION 5 2:00 p.m., Lecture Hall

CO-CHAIRMAN

C. Blankenship, NASA-Lewis, Cleveland, Ohio

J. R. Douglas, Westinghouse Electric Corporation, Winston-Salem, North Carolina

AUTHORS

"A Simplified Analysis of the Lubricated Shape Extrusion Process", V. Nagpal, T. Altan, Battelle's Columbus Laboratories, Columbus, Ohio. R. Gagne, Army Materials and Mechanics Research Center, Watertown, Massachusetts.

"Metal Extrusions of Non-Circular Sections", M. Hanafy Ahmed, Ainshams University, Cairo, Egypt. M. M. Farag, American University, Cairo, Egypt.

"Metal Flow in Extrusion of Shapes", D. P. Yuen, EDS Nuclear, Inc., San Francisco, California. S. Kobayashi, J. Frisch, University of California, Berkeley, California.

"Application of Hydrodynamic Solution to the Extrusion of Circular Billets into Elliptical Shapes", Y. S. Lee, M. R. Patel, Westinghouse Electric Corporation, Pittsburgh, Pennsylvania

SESSION 6 2:00 p.m., Auditorium

CO-CHAIRMAN

J. G. Bollinger, University of Wisconsin, Madison, Wisconsin

A. F. Welch, General Motors Corporation, Detroit, Michigan

AUTHORS

"Ultrasonic Detection of Weld Strength for Dissimilar-Metal Friction Welds", K. K. Wang, S. Ahmed, Cornell University, Ithaca, New York.

"A Sensor-Based Computerized Controller for Welding Manipulators", N. Akgerman, C. Kushner, P. Tews, Battelle's Columbus Laboratories, Columbus, Ohio.

"Chatter Vibration Sensors for Adaptive Control Systems for Turning and Milling Operations", M. Weck, W. Mueller, Technical University, Aachen, Germany.

"The Dynamic Cutting Force Coefficient for Some Carbon Steels", J. Tlustý, T. Moriawaki, B. S. Goel, McMaster University, Hamilton, Ontario, Canada.

COFFEE BREAK 3:30-4:00 p.m.

SESSION 7 4:00 p.m., Lecture Hall

CO-CHAIRMAN

M. L. Devenpeck, U.S. Steel Corporation, Monroeville, Pennsylvania

A. S. Weinstein, Carnegie-Mellon University, Pittsburgh, Pennsylvania

AUTHORS

"Feasibility of Squeeze Casting Ferrous Components", K. M. Kulkar, IIT Research Institute, Chicago, Illinois. D. Stawarz, LaSalle Steel Company, Hammond, Indiana, R. B. Mielot, U.S. Army Weapons Command, Rock Island, Illinois.

"Helical Gear: A Novel Method of Manufacturing It", Shyam K. Samanta, Samanta Metal-Forming Corporation, Taylor, Michigan.

"Radial Upsetting of Flanges", B. Lengyel, A. Blass, Imperial College of Science and Technology, London, U.K.

SESSION 8 4:00 p.m., Auditorium

CO-CHAIRMAN

R. J. Andrews, Jr., Pratt & Whitney Aircraft, East Hartford, Connecticut

D. T. Koenig, General Electric Company, Latham, New York

AUTHORS

AUTHORS

"How to Find the Optimal Configuration for a Flexible Manufacturing System", G. Stute, E. Bauer, R. Wilhelm, University of Stuttgart, Stuttgart, Germany.

"Tool Replacement Strategy for Multi-Tool Machines Using a Probabilistic Model", L. A. Kendali, A. K. Shekhi, Michigan Technological University, Houghton, Michigan.

"Tool Wear Tracking in the Production Shop", L. V. Colwell, J. C. Mazur, University of Michigan, Ann Arbor, Michigan.

"Optimization of Precision Grinding Processes for Maximum Removal Rates", S. Malkin, R. W. Mayne, State University of New York, Buffalo, New York. G. Varadarajan, RCA/Electronics, Princeton, New Jersey

LUNCHEON 12:00-1:30 p.m., Center for Tomorrow

SESSION 13 1:30 p.m.

CO-CHAIRMAN

T. G. Byrer, Battelle's Columbus Laboratories, Columbus, Ohio

L. Liuzzi, Watervliet Arsenal, Watervliet, New York

AUTHORS

"Application of a New Finite Difference Method to Metal Forming", P. Gordon, Frankford Arsenal, Philadelphia, Pennsylvania. R. Karpp, U.S. Army Ballistic Research Laboratory, Aberdeen, Maryland.

"UBET Related Developments in Forging Analysis", A. S. Cramphor, Lehigh University, Bethlehem, Pennsylvania. A. N. Bramley, Leeds University, Leeds, United Kingdom. R. P. McDermott, Gulf - Western Energy Products Company, Oak Brook, Illinois.

"Radial Forging of Tubes and Rods with Compound-Angle Dies", G. D. Lahoti, T. Altan, Battelle's Columbus Laboratories, Columbus, Ohio. P. V. Dembowski, Watervliet Arsenal, Watervliet, New York.

"Force Development Capabilities of Impact-Type Forging Equipment", C. W. Frame, Chambersburg Engineering Company, Chambersburg, Pennsylvania.

SESSION 14 1:30 p.m.

CO-CHAIRMAN

G. F. Helgeson, Western Electric Company, Mesquite, Texas

B. F. von Turkovich, University of Vermont, Burlington, Vermont

AUTHORS

"The Machining State Concept as a Method for the Selection of Metal Cutting Variables", R. S. Pressman, J. E. Williams, University of Connecticut, Storrs, Connecticut.

"The Effect of Lead on Crack Behaviour of Lead-Free Machining Steel During Controlled Cutting Temperature Micro-Machining", K. Iwata, K. Ueda, Kobe University, Rokko, Nada, Kobe, Japan.

"High-Speed Production Milling of Non-Ferrous Materials", R. I. King, Lockheed Missiles and Space Company, Sunnyvale, California.

"Tool Life and Surface Finish Relationships for Milling Aluminum Alloy", K. G. Adams, C. Boer, University of Waterloo, Waterloo, Ontario, Canada.

COFFEE BREAK 3:00-3:30 p.m.

SESSION 15 3:30 p.m.

CO-CHAIRMAN

M. Geiger, Technical University, Stuttgart, Germany

A. L. Hoffmann, Battelle's Columbus Laboratories, Columbus, Ohio

AUTHORS

"Reclamation of Metallic Swarf Using High-Speed Extrusion Processes", S. Arad, Arya Mehr University of Technology, Tehran, Iran. M. Mohitpour, Iran Management and Engineering Group, Ltd., Tehran, Iran.

"One-Stroke Rim Hole Extrusion", P. Yee, Lockheed Missile and Space Company, Sunnyvale, California. S. Kobayashi, University of California, Berkeley, California.

"Forming of Radial Geometries on Pipe Products—A Case Study of Increasing Productivity by Substitutional Technology", J. M. Samuels, A. R. Bobrowsky, C. R. Beiswenger, The Pennsylvania State University, University Park, Pennsylvania.

"Design of Clamping Devices for Semi-Continuous Hydrostatic Extrusion", M. E. Said, J. M. Alexander, Imperial College of Science and Technology, London, U.K.

SESSION 16 3:30 p.m.

CO-CHAIRMAN

L. E. Samuels, Material Research Laboratories, Manlybyrnong, Victoria, Australia

R. E. Snider, Metcut Research Associates, Inc., Cincinnati, Ohio

HOUSING INFORMATION - NAMRC-IV, May 17-19, 1976
 Rooms are available at Fawcett Center for Tomorrow and Holiday Inn—OSU (2 blocks from Center for Tomorrow) at the rate of \$16/single and \$22/double. All Reservations (including those for Holiday Inn) will be handled through Reservations/Mrs. Betty J. Smith
 2400 Orentangy River Road
 Columbus, Ohio 43210
 Phone: (614) 421-2400
 If all the rooms are filled at the Center for Tomorrow, then your reservation will be made automatically at the Holiday Inn, 328 West Lane Avenue, Columbus, Ohio 43201 [phone: (614) 294-4848]. Reservations are on first-come first-served basis. Therefore, please fill in the following and return it to Fawcett Center for Tomorrow at your earliest convenience.

Name _____ Number in Party _____
 Address _____
 City, State, Zip Code _____
 Please Check: Single _____ Double _____
 Arrive: May _____ a.m. _____ p.m.
 Leave: May _____ a.m. _____ p.m.
 IS YOUR WIFE ATTENDING?
 Yes No

CONFERENCE REGISTRATION
NAMRC-IV, May 17-19, 1976

[Mail at least 10 days before Conference, after that please call (614) 424-6424, Extension 2155]

MAIL TO: Ms. Susan Armstrong
Battelle's Columbus Laboratories
505 King Avenue
Columbus, Ohio 43201

Please register the following for NAMRC-IV, May 17-19, 1976.

Name _____
 Name _____
 Company _____
 Address _____
 City and State _____
 Zip Code _____
 Please enclose check or money order with registrations. Make checks payable to: **Battelle-Columbus/NAMRC-IV.**
 For program information, please call Talyan Altan at (614) 424-6424, Extension 2609 or 1815.

City of Wisconsin, Madison, Wisconsin.
 "Design and Evaluation of a Quick-Stop Device for Plunge Cutting".
M. DeVries, J. Trevino-Salinas, University of Wisconsin, Madison, Wisconsin.
 "Application of a Very Rapid Quick-Stop Device to a Study of Chip Formation in Grinding". **R. H. Brown, K. S. Foo**, Monash University, Clayton, Victoria, Australia.
BUSSES LEAVE BATTLE FOR HOTELS
 5:20 and 5:40 p.m.
CONFERENCE DINNER
 Cocktails (cash bar) 6:30-7:30 p.m., Center for Tomorrow
 Dinner and Program—7:30-9:30 p.m., Center for Tomorrow
TUESDAY, MAY 18, 1976, FAWCETT CENTER FOR TOMORROW
SESSION 9 8:30 a.m.
CO-CHAIRMEN
J. T. Berry, Georgia Institute of Technology, Atlanta, Georgia
F. J. Gurney, Westinghouse Astronautical Laboratory, Wright-Patterson Air Force Base, Ohio
AUTHORS
 "Plasticity Without Yield Surfaces". **A. M. Strauss**, University of Cincinnati, Cincinnati, Ohio.
 "An Analysis of the Elevated-Temperature Working of Alloys that are Constitutionally Unstable During Deformation". **J. G. Morris**, University of Kentucky, Lexington, Kentucky.
 "Deformation Behavior and Structural Changes of WC-CO Alloys Subjected to High-Temperature Compressive Stress". **R. A. Moll**, University of Wisconsin, Madison, Wisconsin, **J. D. Wood**, Lehigh University, Bethlehem, Pennsylvania.
 "Strain Rate Effects on the Corrosion Resisting Properties of Cu/Al Alloys". **M. Mohitpour**, Iranian Management and Engineering Group, Ltd., Tehran, Iran, **Z. Ahmad**, Arya Mehr University of Technology, Tehran, Iran.

SESSION 10 8:30 a.m.
CO-CHAIRMEN
B. Chern, National Science Foundation, Washington, D.C.
E. E. Miller, Western Electric Company, Winston-Salem, North Carolina
AUTHORS
 "Replication of Anatomical and Other Irregular Surfaces". **D. G. Forsyth, G. W. Vickers, J. P. Duncan**, University of British Columbia, Vancouver, B.C., Canada.
 "Investigation into the Back Pressure-Gap Thickness Relationship in ECM". **L. Kops, M. Karina**, McGill University, Montreal, Quebec, Canada.
 "Surface Characteristics of Steel Alloys Eroded by Electrical Discharge Machining". **C.H. Kahng, A. H. Bekkala**, Michigan Technological University, Houghton, Michigan.
 "Computer Aided Manufacture of EDM Electrodes". **M. M. Tseng, R. E. DeVor, J. Glusic**, University of Illinois, Urbana-Champaign, Illinois.

COFFEE BREAK 10:00-10:30 a.m.
SESSION 11 10:30 a.m.
CO-CHAIRMEN
G. E. Dieter, Carnegie-Mellon University, Pittsburgh, Pennsylvania
A. T. Male, Westinghouse Electric Corporation, Pittsburgh, Pennsylvania
AUTHORS
 "Diminishing the Effect of Experimental Errors When Incrementally Evaluating the Effective Strain". **J. Wolak**, University of Washington, Seattle, Washington.
 "Austenite Stability and Tensile Properties of Warm Extruded TRIP Steels". **M. Azrin, B. Olson, R. A. Gagne**, Army Materials and Mechanics Research Center, Watertown, Massachusetts.
 "Analysis of Metal Flow Through Conical Converging Dies as an Adiabatic Process". **B. Avitzur**, Lehigh University, Bethlehem, Pennsylvania.
 "A Preliminary Investigation of the Visco-Elastic Extrusion of Soft Metals". **D. B. Marreco, H. A. Al-Qureshi**, Instituto Tecnológico de Aeronautics, S. Paulo, Brazil.

SESSION 12 10:30 a.m.
CO-CHAIRMEN
A. B. Bishop, Ohio State University, Columbus, Ohio
G. Boothroyd, University of Massachusetts, Amherst, Massachusetts

SESSION 17 8:30 a.m.
CO-CHAIRMEN
C. F. Billhardt, Battelle's Columbus Laboratories, Columbus, Ohio
W. B. Rice, Queen's University, Kingston, Ontario, Canada
AUTHORS
 "The Validity of Friction Concepts in Deformation Processing". **J. A. Schoy**, University of Waterloo, Waterloo, Ontario, Canada.
 "Thermoviscous Behaviour of Wire Drawing Soaps". **E. Felder**, Ecole des Mines, Paris, France, **G. Breilinger**, Creusot-Loire, Imphy, France.
 "On Lubrication of Steel by the Zinc-Phosphating Technique". **V. J. Asher, K. J. Weinmann**, Michigan Technological University, Houghton, Michigan.
 "Measurement of Fractional Conditions in Lubricated Strip Drawing". **W.R.D. Wilson, P. Cazault**, University of Massachusetts, Amherst, Massachusetts.

SESSION 18 8:30 a.m.
CO-CHAIRMEN
J. T. Black, Ohio State University, Columbus, Ohio
T. L. Subramanian, Battelle's Columbus Laboratories, Columbus, Ohio
AUTHORS
 "What Use Can Be of X-Ray Diffraction Technique in Metal Cutting?". **R. Ramaswami**, Technical University, Aachen, West Germany.
 "Some Effect of CCl₄ on Tertiary Deformation in the Machining Process". **J. E. Williams**, University of Connecticut, Storrs, Connecticut.
 "Identification of Dynamic Metal-Cutting Process with Reference to Chatter". **N. Saravanja-Fabis, A. F. D'Souza**, Illinois Institute of Technology, Chicago, Illinois.

COFFEE BREAK 10:00-10:30 a.m.
SESSION 19 10:30 a.m.
CO-CHAIRMEN
J. Spretak, Ohio State University, Columbus, Ohio
A. R. Thomson, TRW, Inc., Cleveland, Ohio
AUTHORS
 "Quantitative Friction Determination Through Forging—A New Approach". **R. A. Kohser**, University of Missouri, Rolla, Missouri, **B. Avitzur**, Lehigh University, Bethlehem, Pennsylvania.
 "Lubricant Transport and Breakdown in a High-Speed Forging Operation". **W.R.D. Wilson, W. J. Farrell**, University of Massachusetts, Amherst, Massachusetts.
 "Empirical Models of Die-Contact-Surface Fracture and Center Burst in Forging". **H. A. Kuhn, S. K. Suh**, University of Pittsburgh, Pittsburgh, Pennsylvania.

SESSION 20 10:30 a.m.
CO-CHAIRMEN
M. Field, Melcut Research Associates, Inc., Cincinnati, Ohio
W. J. Sauer, Carnegie-Mellon University, Pittsburgh, Pennsylvania
AUTHORS
 "Grooving on Flank of Cemented Carbide Tools When Cutting Inconel 718". **A. E. Focke, F. E. Westerman, J. Kempthorn, W. T. Shih, M. Hock**, University of Cincinnati, Cincinnati, Ohio.
 "A Correlation of Cemented Carbide Cutting Tool Material Properties with Performance Parameters". **G. E. Kane**, Lehigh University, Bethlehem, Pennsylvania, **W. Scheithauer, Jr.**, GTE Sylvania, Inc., Towanda, Pennsylvania.
 "Cutting Performance of Experimental Hot-Pressed Alumina-Tungsten Carbide Cutting Tools". **N. G. Odey, I. Ham**, The Pennsylvania State University, University Park, Pennsylvania

CONFERENCE ADJOURNED 12:00 Noon

CONFERENCE ADJOURNED 12:00 Noon