29 January 1982 • Vol. 215 • No. 4532 $2.50

SCIENCE

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

NATO ADVANCED STUDY INSTITUTES AND WORKSHOPS 1982

COURS D'ETE ET TABLES RONDES DE L'OTAN

ADVANCED STUDY INSTITUTES (ASIs) are tutorial courses of two weeks' duration on new, important topics for up to 100 scientists and research students. They aim at the dissemination of advanced scientific knowledge and promotion of international contacts among scientists. No tuition fees are requested from participants; some may obtain small grants to assist with travel and living expenses.

ADVANCED RESEARCH WORKSHOPS (ARWs) are working meetings which enable leading researchers, scientists and engineers to review the state-of-the-art in specific topics in fast moving fields and to formulate recommendations for the future. They are of about five days' duration and attendance is usually by invitation only.

Each meeting is held under the responsibility of its Director, to whom all requests for attendance or support should be addressed. Attendance at meetings marked ● is, however, by invitation only. A number of the meetings are being held under the sponsorship of the Special Programmes on Air-Sea Interaction (A-S), Eco-Sciences (ES), Human Factors (HF), Marine Sciences (Mar.S), Materials Science (Mat.S) and Systems Science (SS).

Locations and dates may change. Titles and addresses have been abridged. Many meetings are of an interdisciplinary nature : please check all subject areas.

PUBLICATIONS : Proceedings of meetings are published in the NATO ASI and Conference Series by : **Plenum –Reidel – Nijhoff – Springer Verlag.**

I LIFE SCIENCES

ASIs

BIOMASS UTILIZATION
Prof. W. COTÉ, College of Env. Sciences, State Univ. Syracuse, New York 13210, USA
September 20 - 30, 1982 : Berkeley Springs, W. Virginia, USA

STRUCTURE AND FUNCTION OF PLANT GENOME
Prof. O. CIFERRI, Istituto di Microbiologia, via Sant'Epifanio 14, 27100 Pavia, Italy
September 1 - 11, 1982 : Erice, Italy

ORGANIZING PRINCIPLES FOR NEURAL DEVELOPMENT
Prof. S.C. SHARMA, New York Medical College, Dept. of Ophthalmology, Valhalla, N.Y. 10595, USA
June 1 - 12, 1982 : Povoa do Varzim, Portugal

REGULATION OF GENE EXPRESSION IN PROKARYOTES AND EUKARYOTES
Prof. M. GRUNBERG-MANAGO, Institut de Biologie, 13, rue P. et M. Curie, 75005 Paris, France
August 30 - September 11, 1982 : Spetsai, Greece

GENETIC ENGINEERING IN EUKARYOTES
Dr. P.F. LURQUIN, Biology Dept., Washington State Univ., Pullman, Wa. 99164, USA
July 26 - August 6, 1982 : Pullman, USA

NUMERICAL TAXONOMY
Prof. R.R. SOKAL, Dept. of Ecology, State University of New York, Stony Brook, NY 11794, USA
July 4 - 16, 1982 : Bad Windsheim, Germany

GENE EXPRESSION IN NORMAL AND TRANSFORMED CELLS
Dr. J.E. CELIS, Institute of Chemistry, University of Aarhus, 8000 Aarhus C, Denmark
May 25 - June 4, 1982 : Sintra Estoril, Portugal

NEW DEVELOP. AND METHODS IN MEMBRANE RESEARCH AND BIOL. ENERGY TRANSDUCTION
Prof. K. WIRTZ, Biochemistry, University, Trans 3, Padualaan 8, 3508 TB Utrecht, The Netherlands
August 16 - 29, 1982 : Spetsai, Greece

THE IMMUNE SYSTEM : GENES, RECEPTORS AND REGULATION
Prof. M. PAPAMICHAIL, Anti-Cancer Institute, 171 Alexandras Ave., Athens 603, Greece
August 25 - September 5, 1982 : Spetsai, Greece

PINEAL GLAND AND ITS ENDOCRINE ROLE
Prof. F. FRASCHINI, Dept. of Chemiotherapy, University, via Vanvitelli 32, 20120 Milan, Italy
June 21 - July 2, 1982 : Erice, Italy

RELATED SOCIO-TECHNICAL APPROACHES TO THE MANAGEMENT OF UNCERTAINTY
Dr. L. WILKIN, U.L.B., Centre E. Bernheim, 28 av. F.D. Roosevelt, 1050 Brussels, Belgium
July 4 - 17, 1982 : Maratea, Italy

MOLECULAR MODELS OF PHOTORESPONSIVENESS
Prof. G. MONTAGNOLI, CNR, Institute of Biophysics, via S. Lorenzo 26, 56100 Pisa, Italy
August 29 - September 10, 1982 : San Miniato, Italy

MICROVASC. RHEOLOGICAL, METABOLIC & HEAT TRANSFER ASPECTS OF THE HEART ●
Dr. L. DINTENFASS, Haemorheol. & Bior. Dept., Med. Research Kanematsu Mem. Inst. Hosp., Sydney 2000, Austr.
July 4 - 11, 1982 : Bonas, France

UNDERSTANDING AND AIDING HUMAN DECISION MAKING (HF/SS) ●
Prof. J. McKENNEY, Harvard Univ., Grad. Sch. Business Admin., Soldiers Field, Boston, MA 02163, USA
Prof. C. STABELL, Norwegian Sch. Economics & Business Admin., Helleveien 30, 5000 Bergen, Norway
March 28 - April 2, 1982 : Williamsburg, Virginia, USA

II PHYSICS

ASIs

NEW DIRECTIONS IN GUIDED WAVE AND COHERENT OPTICS
Prof. D.B. OSTROWSKY, Lab. d'Electrooptique, Université, Parc Valrose, 06034 Nice, France
July 5 - 16, 1982 : Cargèse, France

TECHNIQUES AND CONCEPTS OF HIGH ENERGY PHYSICS
Prof. T. FERBEL, Dept. of Physics, University, Rochester, N.Y. 14627, USA
July 1 - 12, 1982 : Adirondacks, USA

PROGRESS IN NUCLEAR DYNAMICS
Prof. D. BOAL, Dept. of Physics, Simon Fraser University, Burnaby, BC, Canada V5A 1S6
August 23 - September 3, 1982 : Vancouver, B.C., Canada

COHESIVE PROPERTIES OF SEMICONDUCTORS UNDER LASER IRRADIATION
Prof. L.D. LAUDE, Université de l'Etat, 23, Av. Maistriau, 7000 Mons, Belgium
July 19 - 31, 1982 : Cargèse, France

METHODS IN COMPUTATIONAL MOLECULAR PHYSICS
Prof. G.H.F. DIERCKSEN, Institut für Astrophysik, Karl Schwarzschild Str. 1, 8046 Garching, FRG
August 9 - 22, 1982 : Bad Windsheim, Germany

FUNDAMENTAL PROCESSES IN ENERGETIC ATOMIC COLLISIONS
Prof. H.O. LUTZ, Physics Dept., University of Bielefeld, 4800 Bielefeld 1, Germany
September 20 - October 1, 1982 : Maratea, Italy

LASER PHYSICS, SYSTEMS AND TECHNIQUES
Prof. S.D. SMITH, Heriot-Watt University, Riccarton, Edinburgh EH14 4AS, Scotland
August 8 - 28, 1982 : Edinburgh, Scotland

GRAVITATIONAL RADIATION
Dr. M.T. BÉAL-MONOD, Physique des Solides, Université de Paris Sud, 91405 Orsay, France
June 2 - 21, 1982 : Les Houches, France

ATOMIC & MOLECULAR PROCESSES IN CONTROLLED THERMONUCLEAR FUSION
Prof. C.J. JOACHAIN, U.L.B., Campus Plaine CP 227, Bd. du Triomphe, 1050 Bruxelles, Belgium
July 19 - 30, 1982 : Palermo, Italy

COMPOSITION AND ORIGIN OF COSMIC RAYS
Prof. M.M. SHAPIRO, Code 4020, Naval Research, 4555 Overlook Ave S.W., Washington DC 20375, USA
June 20 - 30, 1982 : Erice, Italy

III CHEMISTRY, EARTH SC., MATHEMATICS

ASIs

POLYMER COLLOIDS III
Dr. G.W. POEHLEIN, School of Chemical Engineering, Inst. of Technology, Atlanta, Ga. 30332, USA
June 29 - July 8, 1982 : Bristol, UK

AIR-SEA EXCHANGE OF GASES AND PARTICLES
Dr. P.S. LISS, School of Environmental Sciences, University of East Anglia, Norwich NR4 7TJ, UK
July 19 - 30, 1982 : Durham, N.H., USA

THE MULTINUCLEAR APPROACH TO MAGNETIC RESONANCE
Prof. J.B. LAMBERT, Dept. of Chemistry, Northwestern University, Evanston, Illinois 60201, USA
August 23 - September 3, 1982 : Stirling, Scotland

SYSTEMS OF NONLINEAR PARTIAL DIFFERENTIAL EQUATIONS
Prof. J.M. BALL, Dept. of Mathematics, Heriot-Watt University, Edinburgh EH14 4AS, Scotland
July 25 - August 7, 1982 : Oxford, UK

NONLINEAR STOCHASTIC PROBLEMS
Prof. J.M.F. MOURA, Caps Complexo, Instituto Superio Tecnico, Av. R. Pais, 1000 Lisbon, Portugal
May 16 - 28, 1982 : Algarve Portugal

COMPUTATIONAL ASPECTS OF COMPLEX ANALYSIS
Prof. H. WERNER, Institut für Angewandte Mathematik, Wegelerstr. 6, 5300 Bonn 1, Germany
July 26 - August 6, 1982 : Braunlage, Germany

SYSTEMATICS AND THE PROPERTIES OF THE LANTHANIDES
Prof. S.F. SINHA, Hann Meitner Institute, Glienicker Str. 100, 1000 Berlin 39, Germany
July 11 - 25, 1982 : Braunlage, Germany

MESOSCALE METEOROLOGY OBSERVATIONS, THEORIES AND MODELS
Dr. D.K. LILLY, National Center for Atmospheric Research, PO Box 3000, Boulder, Col 80307, USA
July 13 - 31, 1982 : Bonas, France

SURFACE PROPERTIES & CATALYSIS BY NON METALS
Prof. J.P. BONNELLE, Univ. Sciences et Techn., Lab. de Catalyse, Bât. C-3, F-59655 Villeneuve d'Ascq Cedex, France
June 28 - July 9, 1982 : Namur, Belgium

REMOTE SENSING APPLICATIONS IN MARINE SCIENCE AND TECHNOLOGY
Prof. A.P. CRACKNELL, Carnegie Laboratory of Physics, University, Dundee DD1 4HN, Scotland
August 1 - 21, 1982 : Dundee, Scotland

THERMOCHEMISTRY OF MOLECULES, IONIC SPECIES AND FREE RADICALS
Prof. M. RIBEIRO DA SILVA, Chemistry Department, University of Oporto, 4000 Porto, Portugal
July 4 - 17, 1982 : Vimeiro, Portugal

SIMULATION & MODEL BASED METHODOLOGIES: AN INTEGRATIVE VIEW
Dr. T.I. OREN, Dept. of Computer Science, Ottawa University, 375 Nicholas, Ottawa, Canada K1N 9B4
July 26 - August 6, 1982 : University of Ottawa Campus, Canada

CHEMISTRY OF IONS IN THE GAS PHASE
Prof. M.A. FERREIRA, Chemistry Dept., Univ. of Lisbon, R. Escola Politecnicà, 1294 Lisbon Codex, Portugal
September 6 - 17, 1982 : Vimeiro, Portugal

PHYSICAL METHODS IN BIOLOGICAL MEMBRANES AND THEIR MODEL SYSTEMS
Prof. F. CONTI, Istituto di Chimica Fisica, Piazzale A. Moro 5, 00185 Rome, Italy
September 20 - October 2, 1982 : Altavilla Milicia, Italy

PHOTORECEPTION & VISION IN INVERTEBRATES
Prof. M.A. ALI, Biology Dept., University of Montreal, C.P. 6128, Succ A, Montreal, Que H3C 3J7, Canada
July 11 - 24, 1982 : Lennoxville, Canada

BIOMAGNETISM: AN INTERDISCIPLINARY APPROACH
Prof. S.J. WILLIAMSON, Dept. of Physics, New York University, 4 Washington Pl., New York, NY 10003, USA
September 1 - 12, 1982 : Frascati, Italy

DYSLEXIA - A GLOBAL ISSUE
Prof. R.N. MALATESHA, School of Education, Oregon State University, Corvallis, Oregon 97331, USA
August 15 - 27, 1982 : Algarve, Portugal

THE APPLICATION OF LASER LIGHT SCATTERING TO THE STUDY OF BIOLOGICAL MOTION
Prof. J.C. EARNSHAW, Dept. of Pure & Applied Physics, Queen's University, Belfast BT7 1NN., N. Ireland
June 20 - July 3, 1982 : Maratea, Italy

PRINCIPLES AND METHODS IN RECEPTOR BINDING
Prof. F. CATTABENI, Inst. of Pharmacology, University of Urbino, Urbino, Italy
September 8 - 18, 1982 : Urbino, Italy

IMMUNOTOXICOLOGY
Dr. P.W. MULLEN, Kemic Bioresearch Labs. Ltd., P.O. Box 878, Kentville, NS, Canada B4N 4H8
July 14 - 24, 1982 : Wolfville, N.S. Canada

CHILD ABUSE AND NEGLECT
Dr. J.E. LEAVITT, School of Education, California State University, Fresno, Calif. 93740, USA
June 1 - 12, 1982 : Europe

TECHNICAL ADVANCES IN BIOMEDICAL PHYSICS
Dr. P.P. DENDY, Biomedical Physics Dept. Aberdeen University, Foresterhill, Aberdeen AB9 2ZD, Scotland
September 14 - 28, 1982 : Istanbul, Turkey

BIOLOGICAL BASES OF ANTISOCIAL BEHAVIOUR (HF)
Dr. S.A. MEDNICK, Ctre f. Longitudinal Res., Social Sc. Res. Inst., Univ. of Sthn. Calif., Los Ang., CA 90007, USA
August 25 - 30, 1982 : Skiathos, Greece

ARWs

GENETICAL AND ENVIRONMENTAL FACTORS DURING THE GROWTH PERIOD ●
Prof. Ch. SUSANNE, Vrije Universiteit Brussel, Pleinlaan 2, 1050 Brussel, Belgium
August 1982

WORLD PRIORITIES FOR SEABIRD CONSERVATION ●
Dr. J. TEMPLE LANG, Av. P. Hymans, 113, Bte 19, 1200 Bruxelles
August 3 - 5, 1982 : Cambridge, UK

ANALYTICAL LASER SPECTROSCOPY
Prof. S. MARTELLUCCI, Institute of Physics, Piazza V. Tecchio 80, 80125 Naples, Italy
September 23 - October 3, 1982 : Erice, Italy

ATOMIC PHYSICS OF HIGHLY IONIZED ATOMS
Prof. R. MARRUS, Physics Dept., University of California, Berkeley, CA 94720, USA
June 7 - 18, 1982 : Cargèse, France

NEW TRENDS IN ATOMIC PHYSICS
Prof. R. STORA, Division Théorique, CERN, CH 1211, Genève 23, Suisse
June 28 - July 29, 1982 : Les Houches, France

DIFFUSE MATTER IN GALAXIES
Prof. M. LEVY, Lab. de Physique Théorique, Université P. & M. Curie, 4 Place Jussieu, 75230 Paris, France
July 19 - 31, 1982 : Cargèse, France

LASER APPLICATIONS TO CHEMISTRY
Prof. F.T. ARECCHI, Istituto Nazionale di Ottica, Largo E. Fermi 6, 50125 Firenze, Italy
June 27 - July 9, 1982 : San Miniato, Italy

NUCLEAR STRUCTURE - SYMMETRIES AND BROKEN SYMMETRIES
Prof. P.J. BRUSSAARD, Physics Dept., Utrecht Univ., P.O. Box 80,000, 3508 TA Utrecht, Netherlands
August 16 - 28, 1982 : Dronten, The Netherlands

PHOTOCHEMISTRY AND PHOTOPHYSICS IN THE VACUUM ULTRAVIOLET
Prof. S.P. McGLYNN, Dept. of Chemistry, Louisiana State University, Baton Rouge, LA 70803, USA
August 15 - 29, 1982 : Wisconsin, USA

ADVANCES IN SUPERCONDUCTIVITY
Prof. J. RUVALDS, Physics Dept., University of Virginia, Charlottesville, VA 22901, USA
July 3 - 15, 1982 : Erice, Italy

THE ELECTRONIC STRUCTURE OF COMPLEX SYSTEMS
Prof. P. PHARISEAU, Theoretische Vaste Stof en Lage Energie Kernfysica, Krijgslaan 271, S9, 9000 Gent, Belgium
July 12 - 23, 1982 : Gent, Belgium

NON-LINEAR RAMAN SPECTROSCOPY & ITS CHEMICAL APPLICATION
Prof. W. KIEFER, Physikalisches Inst., Postfach 3008, 8580 Bayreuth, Germany
August 22 - September 3, 1982 : Bad Windsheim, Germany

PHYSICS OF POLARONS: RECENT PROGRESS
Prof. J.T. DEVREESE, Dept. Natuurkunde, Univ. Instelling Antwerpen, Universiteitsplein 1, B-2610 Wilrijk, Belgium
July 19 - 31, 1982 : Antwerp, Belgium

ARW

STATISTICAL MECHANICS OF IONIC MATTER ●
Dr. M.T. BÉAL-MONOD, Physique des Solides, Université de Paris-Sud, 91405 Orsay, France
March 29 - April 10, 1982 : Les Houches, France

GEOLOGIC. SYNTH. OF THE APPALACHIAN-CALEDONIAN-HERCYNIAN MAURITANIDE OROGEN
Prof. P.E. SCHENK, Geology Dept., Dalhousie University, Halifax, Nova Scotia, B3H 3J5, Canada
August 8 - 21, 1982 : Fredericton, Canada

ANALYSE DE DONNEES
Prof. P. BERTHIAUME, Dept. Mathématique, Univ. Montreal, C.P. 6128, Succ. A. Montreal, Que H3C 3J7, Canada
July 26 - August 13, 1982 : Montreal, Canada

CO-ORDIN. CHEM. OF METALLOENZIMES IN HYDROLISIS & OXYG. INSERTION MECHANISMS
Prof. I. BERTINI, Ist Chimica Generale, Universita di Firenze, Via Gino Capponi 7, 50121 Firenze, Italy
May 28 - June 8, 1982 : San Miniato, Italy

ARWs

TRANSPORT IN NON-STOICHIOMETRIC COMPOUNDS ●
Dr. G. PETOT-ERVAS, C.N.R.S., Laboratoire P.M.T.M., Av. J.B. Clément, 93430 Villetaneuse, France
June 29 - July 3, 1982 : Perpignan, France

THE LAST DEGLACIATION-TIMING AND MECHANISM ●
Prof. J.C. DUPLESSY, Centre des Faibles Radioactivités, C.N.R.S., 91190 Gif-sur-Yvette, France
June 1982 (4 days) : Maine, USA

GEOLOGICAL EVOLUTION OF THE MEDITERRANEAN BASIN (Mar.S) ●
Prof. R. SELLI, Inst. di Geologica, Univ. Via Zamboni 63-67, 40127 Bologna, Italy
Prof. D.J. STANLEY, Div. Sediment, E-109 NMH, Smithsonian Inst., Washington DC 20560, USA
March 1 - 9, 1982 : Erice, Italy

FLOWS OF ENERGY AND MATERIALS IN MARINE ECOSYST. : THEORY AND PRACTICE (Mar.S) ●
Dr. M.J.R. FASHAM, Inst. of Oceanog. Sc., Brook Rd., Wormley, Godalming, Surrey GU8 5UB, UK
May 20 - 26, 1982 : Bombannes, Bordeaux, France

HYDROTHERMAL PROCESSES OF SEAFLOOR SPREADING CENTERS (Mar.S) ●
Dr. P.A. RONA, Atlantic Oceanog. & Meteorolog. Labs., 15 Rickenbacker Causeway, Miami, FL 33149, USA
March, 1982 : to be announced

MECHANISMS OF MIGRATION IN FISHES (Mar.S) ●
Dr. J.D. McCLEAVE, Migratory Fish Res. Inst., Univ. of Maine, Orono, ME 04469, USA
December 12 - 13, 1982 : to be announced

COASTAL OCEANOGRAPHY (Mar.S) ●
Prof. H.G. GADE, Dept. of Oceanog., Geophys. Inst., Univ. Bergen, 5014 Bergen, Norway
June 6 - 10, 1982 : Os (Bergen) Norway

MARSEN (Marine Remote Sensing Experiment) (A-S) ●
Prof. K. HASSELMANN, Max-Planck-Inst. f. Meteorolog. Bundesstr. 55, 2000 Hamburg 13, Germany
Summer 1982 : Hamburg, Germany

IV ENGINEERING AND APPLIED SCIENCES

ASIs

MATHEMATICAL MODELS & DESIGN METHODS IN SOLID-LIQUID SEPARATION
Dr. A. RUSHTON, UMIST, P.O. Box 88, Manchester M60 1QD, UK
January 4 - 15, 1982 : Lagos, Portugal

ELECTRONIC SYSTEM EFFECTIVENESS AND LIFE CYCLE COSTING
Mr. J.K. SKWIRZYNSKI, Marconi Res. Lab., W. Hanningfield Rd., Gt. Baddow, Chelmsford CM2 8HN, UK
July 12 - 24, 1982 : Norwich, UK

PROCESS AND DEVICE SIMULATION FOR MOS-VLSI CIRCUITS
Prof. P. ANTOGNETTI, Istituto di Elettrotecnica, Viale Cause 13, 16145 Genova, Italy
June 28 - July 9, 1982 : Urbino, Italy

MECHANICS OF FLUIDS THROUGH POROUS MEDIA
Prof. M.Y. CORAPCIOGLU, Civil Engineering, University of Delaware, Newark, DE 19711, USA
July 18 - 27, 1982 : Newark, USA

IMPACT OF CLUSTER PHYSICS IN MATERIAL SCIENCE AND TECHNOLOGY
Dr. J. DAVENAS, Physique des Matériaux, Univ. C. Bernard Lyon 1, 69622 Villeurbanne Cedex, France
June 13 - 27, 1982 : France

THE SCIENTIFIC BASIS OF FLOTATION
Prof. K.H. IVES, Dept. of Civil Engineering, University College, Gower St., London WC1E 6BT, UK
July 5 - 16, 1982 : Cambridge, UK

HEAVY CRUDE OIL RECOVERY
Prof. E. OKANDAN, Mining & Petroleum Engineering Dept., METU, Ankara, Turkey
June 21 - July 4, 1982 : METU, Ankara, Turkey

RELIABILITY THEORY AND ITS APPLICATION IN STRUCTURAL AND SOIL MECHANICS
Prof. P. THOFT-CHRISTENSEN, Aalborg University Centre, Danmarksgade 19, 9000 Aalborg, Denmark
August 29 - September 10, 1982 : Bomholm, Denmark

MASS TRANSFER AND KINETICS IN ION EXCHANGE
Prof. L. LIBERTI, Istituto di Recerca sulle Acque, CNR, 5 Via de Blasio, 70123, Bari, Italy
May 30 - June 12, 1982 : Maratea, Italy

ANALYSIS AND DESIGN OF BRIDGES
Dr. C. YILMAZ, Faculty of Engineering, Middle East Technical University, Ankara, Turkey
June 28 - July 9, 1982 : Izmir, Turkey

IMAGE SEQUENCE PROCESSING & DYNAMIC SCENE ANALYSIS
Prof. T.S. HUANG, Coordinated Science Lab., 1101 W. Springfield Ave., Urbana, Illinois 61801, USA
June 21 - July 2, 1982 : Goslar-Hahnenklee, Germany

EVOLVING GEOGRAPHICAL STRUCTURES
Dr. D.A. GRIFFITH, Dept. of Geography, State Univ. of New York, Buffalo, N.Y. 14260, USA
July 18 - 30, 1982 : San Miniato, Italy

PICTORIAL DATA ANALYSIS
Dr. R.M. HARALICK, Dept. of Electrical Engineering, Virginia Polytechnic Inst., Blacksburg, VA 24061, USA
August 1 - 14, 1982 : Bonas, France

MAGNETIC RESONANCE TECHNIQUES IN FOSSIL ENERGY PROBLEMS
Dr. L. PETRAKIS, Gulf Science & Technology Co., P.O. Drawer 2038, Pittsburgh, PA 15230, USA
June 21 - July 2, 1982 : Patras or Corfu, Greece

LAND & ITS USES - ACTUAL & POTENTIAL : ENVIRON. APPRAISAL FOR PLANNERS (ES)
Prof. F.T. LAST, Inst. of Terrest. Ecol., Bush Estate, Penicuik, Midlothian EH26 0QB, UK
March, 1982 : Edinburgh, Scotland, UK

ARWs

TWO PHASE FLOW AND HEAT TRANSFER ●
Prof. S. KAKAC, Dept. of Mechanical Engineering, Univ. of Miami, Coral Gables, FL 33124, USA
August 30 - September 3, 1982 : Munich, Germany

ISSUES IN ACOUSTIC SIGNAL/IMAGE PROCESSING AND RECOGNITION ●
Prof. C.H. CHEN, Coll. of Engineering, Southeast. Mass. Univ., North Dartmouth, MA 02747, USA
June 2 - 6, 1982 : Sintra Estoril, Portugal

ELECTRONIC STRUCTURE AND PROPERTIES OF HYDROGEN IN METALS (Mat.S)
Prof. P. JENA, Virginia Commonwealth Univ., 901 W. Franklin Str., Richmond VA 23284, USA
March 4 - 6, 1982 : Richmond, Virginia, USA

EDUCATIONAL MODULES - 3rd NATO/EMMSE-WECC WORKSHOP (Mat.S)
Dr. J.H.W. DE WIT, Dpt. of Chem., Rijksunivers., 771 Croesestraat, Utrecht, Netherlands
September, 1982 : to be announced

HYDROMETALLURGICAL PROCESS FUNDAMENTALS (Mat.S)
Prof. R. BAUTISTA, Dept. of Chemical Eng., Iowa State Univ., Ames, Iowa 50011, USA
July 25 - August 1, 1982 : Cambridge, UK

MICROELECTRONICS - STRUCTURES & COMPLEXITIES (Mat.S)
Dr. R. DINGLE, Bell Labs., Murray Hill, NJ 07974, USA
March 14 - 20, 1982 : France

COHERENCE AND ENERGY TRANSFER IN GLASSES (Mat.S)
Dr. P.A. FLEURY, Bell Labs., Murray Hill, NJ 07974, USA
September, 1982 : Cambridge, UK or Grenoble, France

EFFICIENCY OF MANUFACTURING SYSTEMS (SS) ●
Prof. B. WILSON, Dept. of Systems, Univ. of Lancaster, Bailrigg, Lancaster KA1 4YR, UK
September, 1982 : Amsterdam, Netherlands

HEALTH SERVICE SYSTEMS (SS) ●
Dr. A. VAN DER WERFF, Minist. of Health Service, PB 439, 2260 AK Leidschendum, Netherlands
August 29 - September 3, 1982 : The Hague, Netherlands

Further information on the NATO International Scientific Exchange Programmes may be obtained from : NATO Scientific Affairs Division, B 1110 Brussels

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SCIENCE

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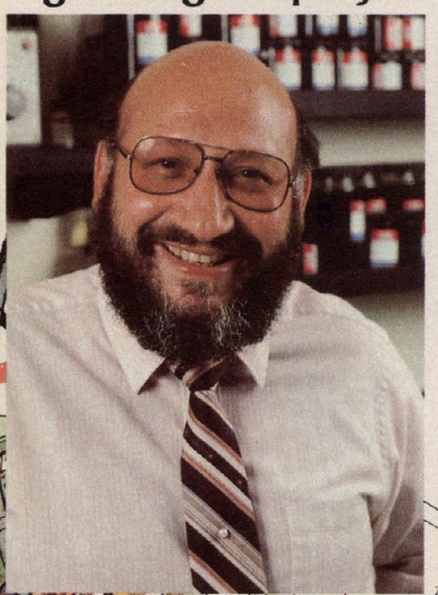
AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

COVER

Montage of Voyager photographs constructs a view over the limb of Enceladus (foreground, Voyager 2) which looks back toward the sun to observe Rhea (lower right, Voyager 1), Saturn (Voyager 1), Mimas (near Saturn, Voyager 2), and Titan (upper right, Voyager 2). Voyager 2 is currently proceeding toward flybys of Uranus (January 1986) and Neptune (August 1989). See page 499. [Montage prepared by R. W. Post, Photolab, Jet Propulsion Laboratory, Pasadena, California 91103]

A curiously tenacious that's saving millions

Hal Shaub discovered the molecule's properties at Exxon Research and Engineering Company.



Hal Shaub (Ph.D. Chemistry), Senior Research Associate in Exxon Research and Engineering Company, discovered some curious properties of a molecule in his work to develop fuel-saving motor oils. "It's a very tenacious molecule," Hal says, "sporting a pair of highly polar 'feet' that attach to positive and negative sites on metal surfaces."

Two Kinds of Friction

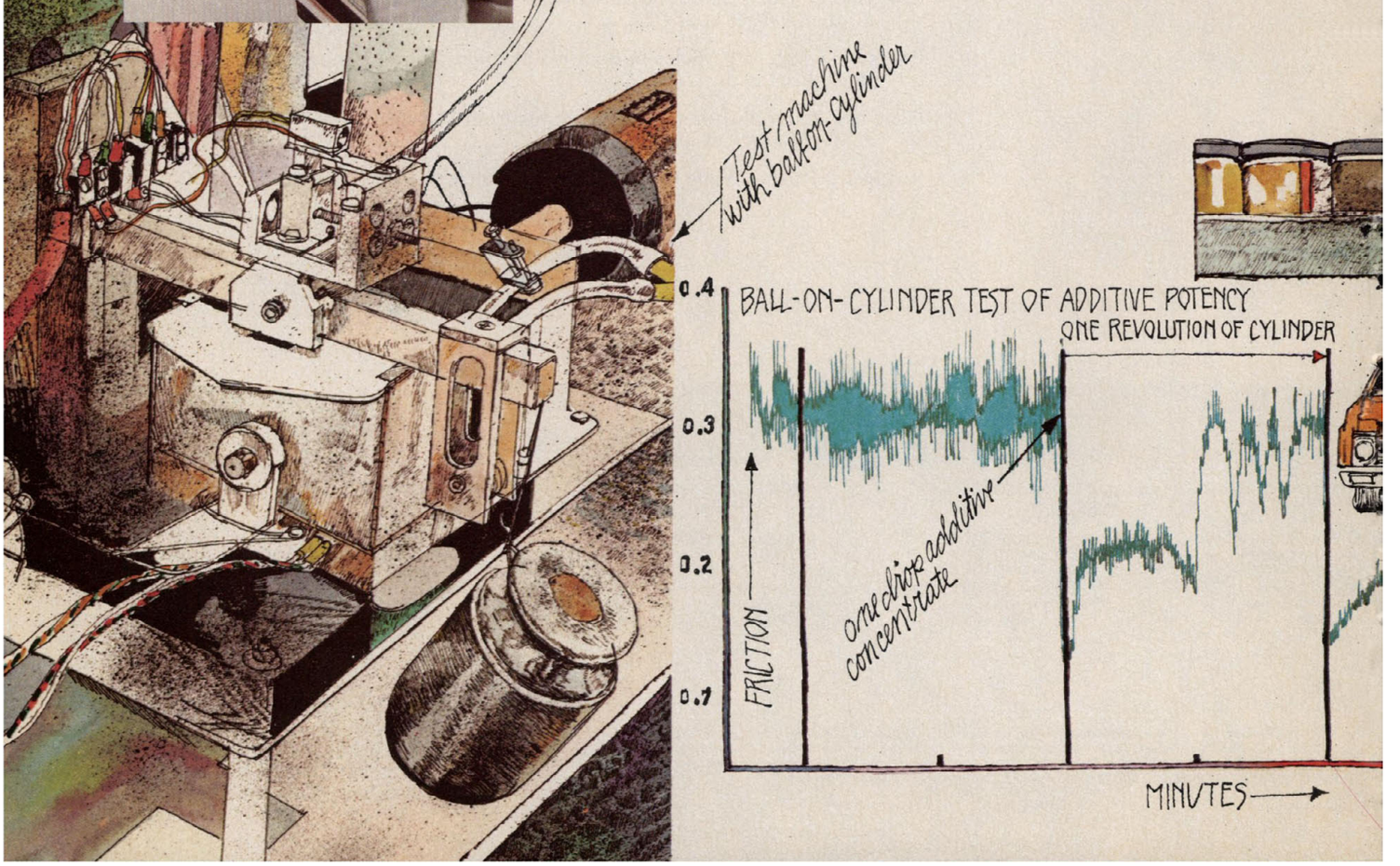
In a typical internal combustion engine, a considerable amount of fuel is consumed in overcoming friction. It has two sources: *rubbing* where lubricant film fails and metal-to-metal contact occurs, and *drag* caused by the viscosity of the lubricant itself. Friction can be reduced by lowering oil viscosity, but there is a point at which friction begins to increase due to failure of the lubricant film and resulting metallic contact. To Hal, this suggested developing sturdier lubricant films.

Hal uses a unique laboratory device to assess additives–Exxon's "ball on cylinder" test that simulates conditions in parts of the engine where lubricant films commonly give way. The test gives positive laboratory confirmation that the curious two-footed molecule reduces friction. But it has also raised puzzling questions about how and why.

Two Theories on How the Molecule Works

The additive that Hal discovered actually seems to chemisorb on steel surfaces, reducing metallic contact under thin lubricant film conditions.

One theory is that this chemisorption reduces adhesive wear, and low friction prevents sub-surface fatigue wear. So stresses exerted by the load cause plastic deformation of rubbing steel surfaces–resulting in smoother surfaces and less friction.



molecule from Exxon of gallons of fuel.

But Hal believes that when metallic parts contact and heat in the presence of the molecule, changes in the metal's chemistry occur. Specifically, the melting point may be lowered, causing surface irregularities to deform in a more uniform way–resulting in lower friction.

Hal adds that various additive chemicals can compete with the molecule for polar sites on the metal, can prevent it from getting to the surface, or both. So for the molecule to work its magic, special chemical techniques must be used to incorporate it into the motor oil.

Mileage Improvements Averaged over 4%

The complete additive technology, in a super premium motor oil, was assessed for overall engine performance in dynamometer and road tests, including a grueling taxi fleet test. Other special road fleet tests demonstrated improvements in fuel economy averaging over 4%, compared to conventional 10W-40 motor oils of the time.

The additive technology has been incorporated in Exxon's *Uniflo®* automotive motor oil since 1977, in heavy-duty oils for diesel engines since 1980, and is now in *Exxon Extra Motor Oil®*. The fuel savings resulting from consumer use of these fuel-efficient oils are estimated at millions of gallons per year.

Meanwhile, Hal Shaub is continuing his work. "We think we can *double* the fuel economy improvements achieved to date," says Hal.

For more information on Hal Shaub's molecule and ER & E, write Ed David, President, Exxon Research & Engineering Company, Room 603, P.O. Box 101, Florham Park, New Jersey 07932.

Exxon Research and Engineering Company

Fuel-saving engine lubricants are just one example of technological innovation going forward on many fronts at Exxon Research and Engineering Company. A wholly owned subsidiary of Exxon Corporation, ER&E employs over 2,000 scientists and engineers working on petroleum products and processing, synthetic fuels, pioneering science, and the engineering required to develop and apply new technology in the manufacture of fuels and other products.

EXXON

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The End of the Beginning

Voyager 2 journeyed 4 years from the warm sands of Florida to the icy environs of Saturn. Scientific specialists have been awed by the intricate and unexpected natural phenomena which characterize the Saturnian system, just as they were earlier bedazzled by Jupiter. Millions of others around the world have been carried along via instant global communications on this fantastic journey of the mind.

But a funny thing happened on the way to the outer planets. While the Voyagers functioned relatively smoothly in space, circumstances in their terrestrial birthplace were not so harmonious. Double-digit inflation combined with unprecedented interest rates painfully exacerbated the growing disparity between expectations and reality for middle-class Americans. NASA plans for a smooth transition to the reusable space shuttle were dashed by schedule delays and burgeoning costs. All planetary launches following the Pioneer/Venus Mission in 1978 became dependent upon timely development of the shuttle and upper stages.

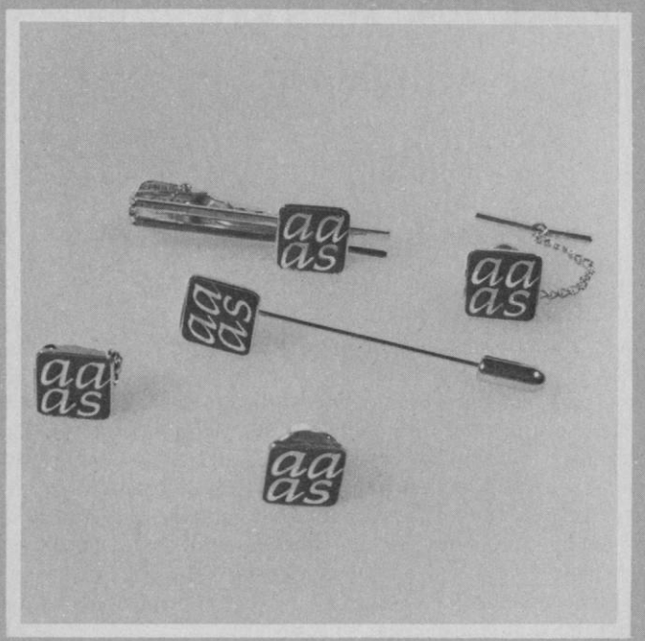
Voyager 2 began its ambitious four-planet journey in August 1977. At that time Galileo, a long-duration Jupiter orbiter also carrying a sophisticated entry probe for direct atmospheric sampling, was firmly scheduled for launch this very month aboard shuttle flight 16. Two International Solar Polar Mission (ISPM) spacecraft, one American and one European, were planned to depart by shuttle in February 1983 on exploratory passages over opposite poles of the sun. By 1984, the Venus Orbiting Imaging Radar (VOIR) spacecraft was expected to map by radar the permanently cloud-shrouded surface of Earth's closest planetary relative. And even a daring rendezvous with the nucleus of Halley's comet in 1986 was contemplated.

What is the situation now? Galileo is the only remaining U.S. planetary project under development, its launch delayed until 1985. The U.S. ISPM spacecraft has been canceled outright and the launch of its European counterpart delayed until 1986. VOIR, deferred again last year until at least 1988, has come to resemble more the fading grin of a Cheshire cat than a serious national objective. Halley's comet will be investigated by spacecraft of the Soviet Union, Western Europe, and Japan—but not the United States. By these actions the United States unilaterally abandoned world leadership in planetary exploration, one of the 20th century's most uplifting and challenging technological and scientific enterprises. A brilliant burst of American imagination and energy, catalyzed by the Apollo decision, carried our senses and intellect inward to Mercury as well as outward beyond Saturn—but now has nearly run its course.

Our new challenge is to maximize the scientific and exploratory significance of the much more modest U.S. deep space activities projected for the 1980's. The Deep Space Net, which so skillfully captured Voyager's faint video signals from a distance of over 1 billion miles, steadily improves. New deep space missions still can materialize as long as they do not require increased launch-vehicle capability or strain the NASA budget. Opportunities for truly collaborative international deep space efforts may arise to replace symbolic and sometimes paternalistic arrangements of the past.

On a longer time scale, ambitious new missions to the moon and Mars can and should come about in response to the expanding capabilities and aspirations of many more peoples than just those of the United States and the Soviet Union.

During the next century, humankind's growing comprehension and utilization of our solar neighborhood are likely to make the events of the last two decades seem tiny in magnitude but large in historical import. While forgoing dominance, the United States can still make crucial contributions in a more internationalized era of space exploration. The readership of *Science*, especially, can help this uncertain nation once again look outward in space and forward in time. Perhaps our national expectations will again be rising 4 years hence when Voyager 2 reaches Uranus.—BRUCE MURRAY, *Jet Propulsion Laboratory, Pasadena, California 91109*



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behind-the-scenes interpreter of the academy's mission and activities.

Also, in the 10 days of speechmaking, there was a key sentence buried in the report by Fang Yi, lamenting the "over-concentration of power in the academy" (*17*). Such a statement is not made casually and, despite the lavish praise he heaped on the scientists, it may be assumed that the academy lost something in the course of the reorganization. It would appear that by stressing the academy's long-range tasks, primarily "in pure science and other fields of technical science," and contrasting these with the immediate and short-term scientific research in industrial departments and local scientific research institutions, Fang Yi seemed to circumscribe the academy's control over scientific activities outside its own institutes.

Given the extreme policy fluctuations, we are inclined to forget that most Chinese are realistic most of the time. Scientists may be elitist and they may have (to their own detriment) oversold their case in 1977 and 1978; at the same time it is only fair to assume that in most instances their motives were good and they sincerely believed that strong and internationally competitive science was synonymous with a strong China. While China's national interests dictate that emphasis in science be redirected toward the economy, China also is chauvinistic—she has many world-level scientists and will not deny them the opportunity to do basic research in those areas of science where there is real promise of achievement. The leaders may even adjust to the inevitability of elitism among the scientists. After all, what an individual is is not determined either by "class nature," as the Communists would have us believe, or by "human nature," as we are apt to assume, but by a combination of both. Although they may not admit it, the policy-makers must know that conversion of an elitist scientist to a proletarian scientist runs counter to both "natures." The Chinese say that "You don't cut off the feet to make the shoes fit." At this stage, Beijing is only binding the scientists' feet to force them into the tight shoes of economic readjustment.

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2. H. W. Bode, in "Basic research and national goals," National Academy of Sciences report to the Committee on Science and Astronautics, U.S. House of Representatives (March 1965), p. 76.
3. The complete texts of the major speeches at the National Science Conference are contained in appendix A of *Science in Contemporary China*, L. A. Orleans, Ed. (Stanford Univ. Press, Stanford, Calif., 1980), pp. 535–563.
4. R. F. Dernberger, in *China Under the Four Modernizations* (Government Printing Office, Washington, D.C., in press).
5. *Renmin Ribao* [*People's Daily*] (27 March 1981), in *Foreign Broadcast Inf. Serv.* (14 April 1981).
6. *Jiefang Ribao* [*Liberation Daily*] (2 June 1981), in *Foreign Broadcast Inf. Serv.* (11 June 1981).
7. Beijing Domestic Service (10 January 1981), in *Foreign Broadcast Inf. Serv.* (13 January 1981).
8. Xinhua [New China News Agency] (15 May 1981), in *Foreign Broadcast Inf. Serv.* (20 May 1981).
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10. See, for example, *Jingji Yanjiu* [*Economic Research*], No. 1 (February 1981), in *Foreign Broadcast Inf. Serv.* (17 March 1981).
11. *Jingji Yanjiu* [*Economic Research*], No. 11 (20 November 1981), in *U.S. Joint Publ. Res. Serv. Publ. 77,285* (30 January 1981).
12. Xinhua [New China News Agency] (21 May 1981), in *Foreign Broadcast Inf. Serv.* (22 May 1981).
13. For a detailed account of this meeting, see H. S. Klein, *China Exchange News* (September 1981), pp. 1–5.
14. *China Daily* (28 June 1981).
15. *Beijing Review*, No. 22 (1 June 1981).
16. *Kuangming Ribao* [*Kuangming Daily*] (14 July 1981).
17. *Ibid.* (27 May 1981).

18. I thank L. Bruno, A. DeAngeles, T. Fingar, H. Klein, P. Perrolle, and Chi Wang for reading and commenting on this article.