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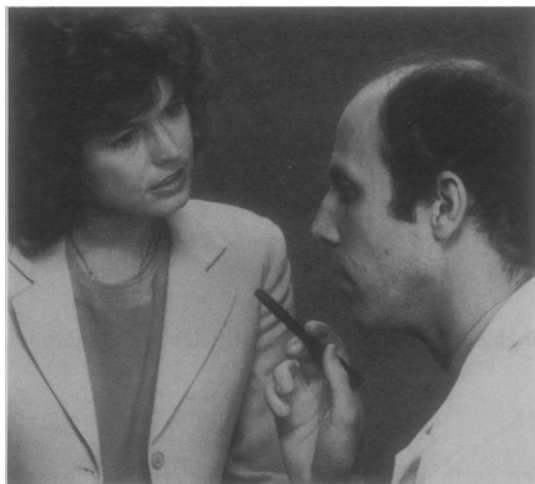
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COVER

The deployment of Pershing II and cruise missiles in Europe has created some painful and potentially lasting military and political problems for the United States and its Western allies (see page 371). This photo shows a platoon of three Pershing II missiles erected for a test at Fort Sill, Oklahoma, in mid-1983. The missiles declared operational on 31 December 1983, in Mutlangen, West Germany, are identical except that they lack the red and yellow stripes. [Martin Marietta Aerospace]

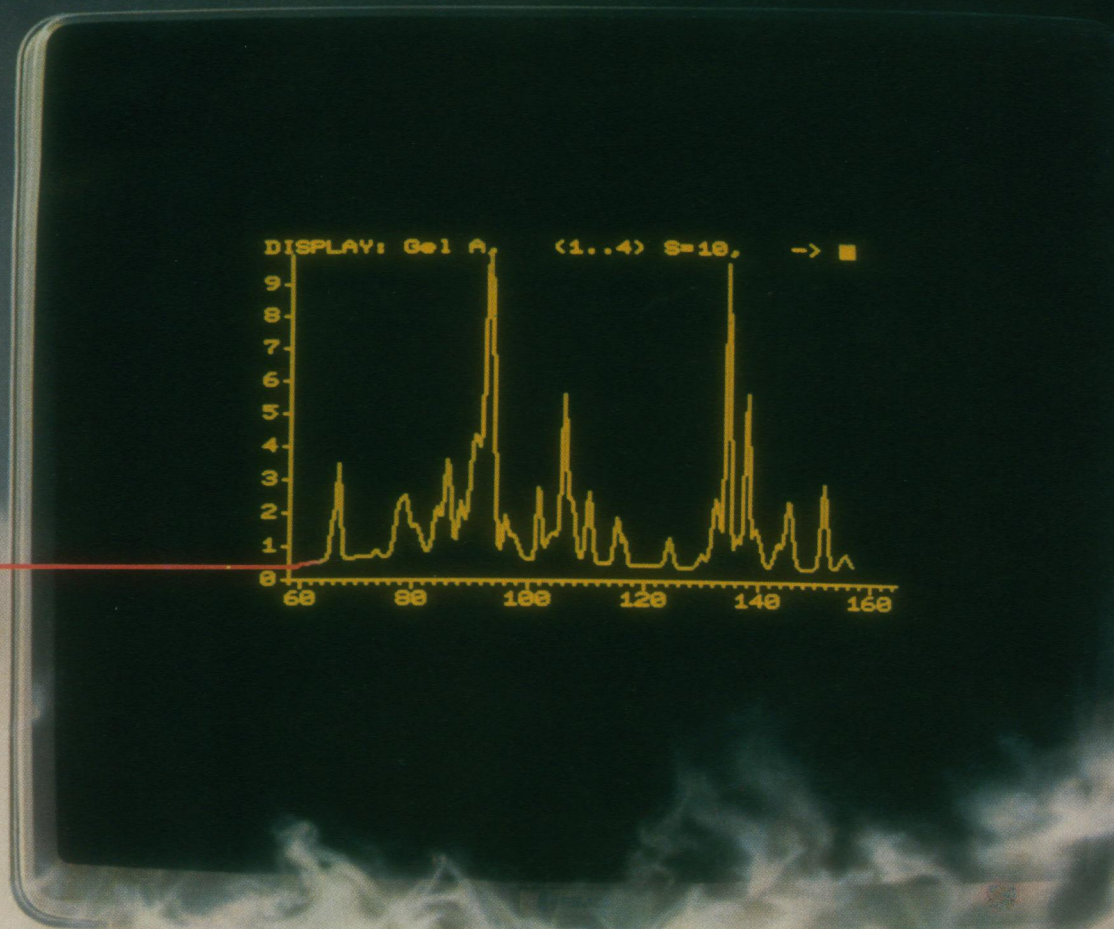


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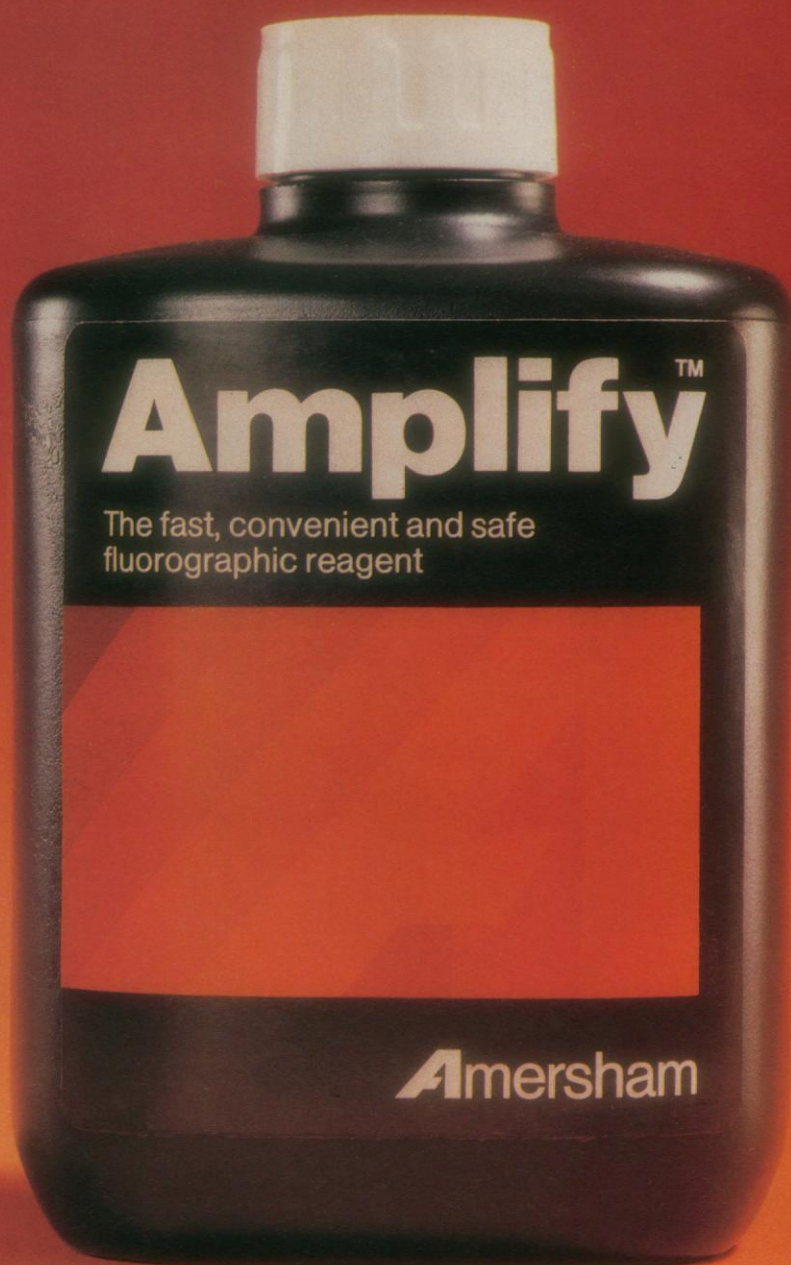
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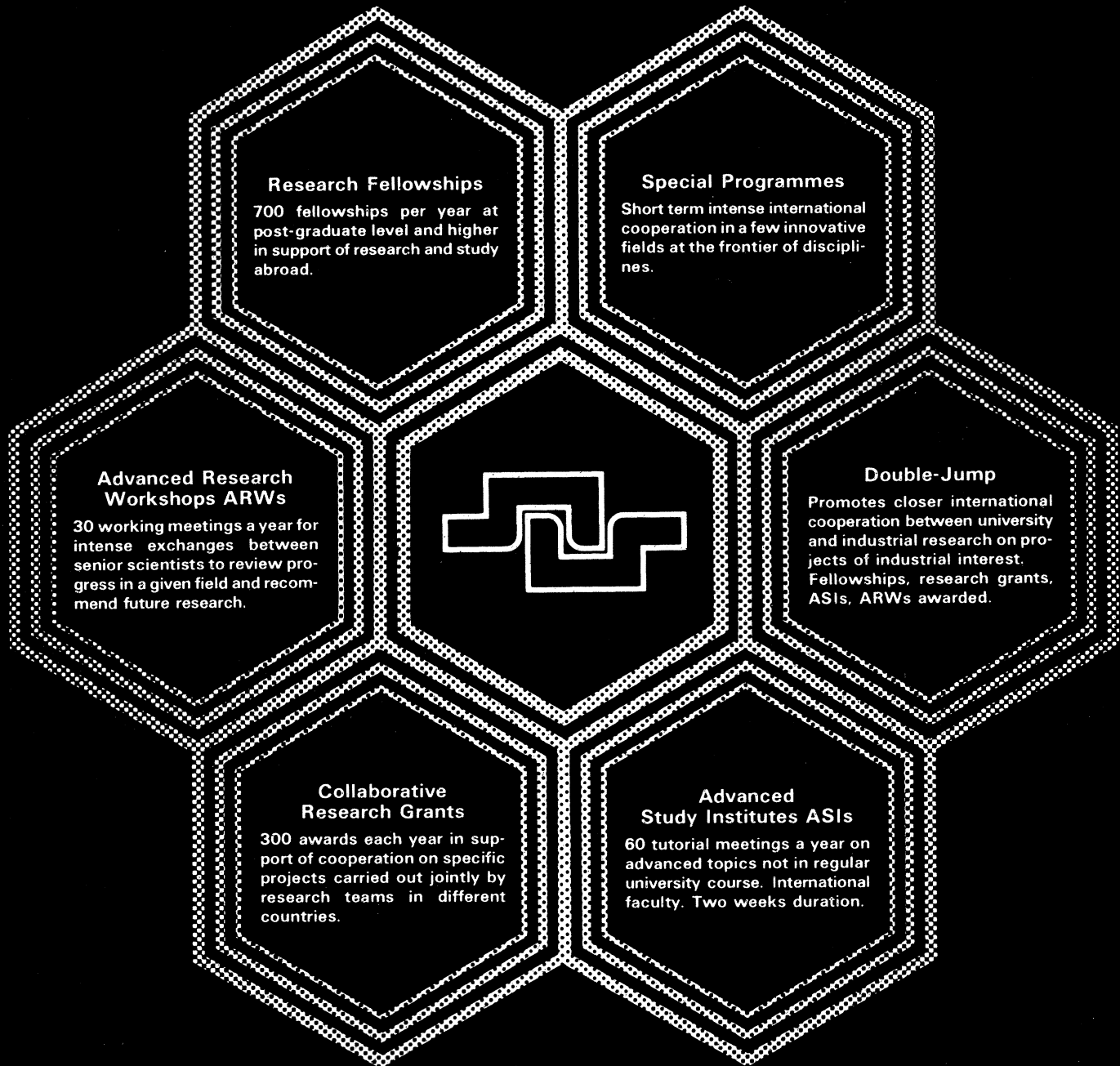
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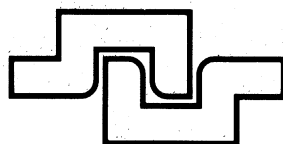
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F.L. BAUER, *Inst. Inform., Techn. Univ., Arcisstr. 21, Postfach 20 2420, D-8000 München 2, Germany*
 31 July-12 August 1984 : Marktobderdorf (Nr. Munich) Germany 685/83

NEW SYSTEMS & ARCHITECTURES FOR AUTOMATIC SPEECH RECOGNITION & SYNTHESIS

R. DE MORI, *Comp. Sc., 1455 De Maisonneuve Blvd West, Rm H961-22, Montreal, Quebec, Canada H3G 1M8*
 2-14 July 1984 : Bonas, France 712/83

RELATIONAL DATA BASE SYSTEMS DESIGN AND IMPLEMENTATION

C.J. ROGERS, *Software & Inform. Syst. Div., TRW Def. Syst. Gp., 1145 Arques Av., Sunnyvale, CA 94086, USA*
 17 June-29 July 1984 : Bad Windsheim, Germany 992/83

LOGICS FOR VERIFICATION AND SPECIFICATION OF PROGRAMS

K.R. APT, *L.I.T.P., Univ. de Paris VII, 2 Place Jussieu, F-75251 Paris, France*
 15-19 October 1984 : France 995/83

APPLIED SCIENCES & ENGINEERING**GLASS CURRENT ISSUES**

J. DUPUY, *Dép. Physique des Matériaux, 43 Bd. du 11 Nov. 1918, 69622 Villeurbanne, Cedex France*
 2-13 April 1984 : Tenerife, Spain 10/83

INDUSTRIAL ROBOTIC VISION

A. OOSTERLINCK, *Centrum Menselijke Erfelijkheid, Minderbroedersstraat 12, B-3000, Leuven*
 6-17 August 1984 : Leuven, Belgium 135/83

PHYSICS & ENGINEERING OF MEDICAL IMAGING

R. GUZZARDI, *Nuclear Measurements Unit, C.N.R., Inst. Clin. Phys., Via Savi, 8, I-56100 Pisa, Italy*
 23 September-5 October 1984 : Maratea, Italy 139/83

THERMODYNAMICS & FLUID MECHANICS OF TURBOMACHINERY

A.S. ÜÇER, *Mechanical Engineering Dept., Middle East Techn. Univ., Ankara, Turkey*
 17-28 September 1984 : Izmir-Çesme, Turkey 435/83

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H. URBAN, *Fried. Krupp GmbH, Krupp Atlas-Elektronik, PO. Box 44 85 45, D-2800 Bremen 44, Germany*
 30 July-10 August 1984 : Lüneburg, Germany 439/83

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W.G. GENSLER, *Dept. of Electrical Engineering, Univ. Arizona, Tucson, AZ 85721, USA*
 27 May-9 June 1984 : Italy 736/83

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Z.M. DOĞAN, *Mining Engineering Department, Middle East Technical Univ., (METU) Ankara, Turkey*
 6-17 August 1984 : Ankara, Turkey 772/83

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O.D.D. SOARES, *Lab. de Física, Faculdade de Ciências, 4000 Porto, Portugal*
 6-17 August 1984 : Povoá de Varzim, Portugal 945/83

MICROARCHITECTURE OF VLSI COMPUTERS

P. ANTIGNETTI, *Istituto di Elettrotecnica, Univ. of Genova, Viale Cause 13, 16145 Genova, Italy*
 July 1984 : Urbino, Italy 970/83

APPLICATIONS OF THE MATERIAL SCIENCES TO THE PRACTICE OF ORTHOPEDIC SURGERY

M. DUJOVNY, *Dept. Neurological Surgery, Henry Ford Hospital, 2799 W. Grand Blvd., Detroit, MI 48202, USA*
 15-28 July 1984 : Marbella, Spain 972/83

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Dr. A. PARMEGGIANI, Laboratoire de Biochimie, Ecole Polytechnique, F-91128 Palaiseau Cedex, France
16-20 July 1984 : Thiverval-Grignon, France 743/83

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Dr. G. DE CARO, Inst. of Pharmacology, Univ. of Camerino, 62032 Camerino, Italy
11-21 July 1984 : Camerino, Italy 767/83

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Prof. D.H. WARREN, College Humanities & Social Sciences, Univ. of California, Riverside, CA 92521, USA
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2-6 July 1984 : Paris, France 788/83

SYMPOSIUM ON BIOLOGY OF INVERTEBRATE AND LOWER VERTEBRATE COLLAGENS

Dr. S. BAIRATI, Dept. General Physiology & Biochemistry, Univ. of Milano, Via Celoria 26, 20133 Milano, Italy
3-6 June 1984 : Como, Italy 956/83

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Prof. E.G. BECK, Inst. of Hygiene, Justus-Liebig Univ., 63 Giessen, Germany
11-14 September 1984 : Schluchsee-Hochschwarzwald, Germany 976/83

STANDARDIZATION OF METHODOLOGY FOR THE MYCOLOGICAL EXAMINATION OF FOODS

Dr. J.E.L. CORRY, Min. of Agriculture Fisheries & Food, (Food Sc. Div.), 65 Romney Str., London SW1P 3RD, UK
July 1984 : Boston, USA 980/83

COORDINATE REGULATION OF CHOLESTEROL METABOLISM IN THE LIVER

Dr. A. SANGHVI, Dep. of Pathology, Univ. of Pittsburgh, School of Medicine, Pittsburgh, PA 15261, USA
October 1984 : Santa Fe, New Mexico, USA 990/83

ECOLOGY

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Dr. R.A. LIVINGSTON, RD-677, Res. & Dev., EPA, 401 M St SW, Washington, DC 20460, USA
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Prof. A. EGBELAND, Inst. of Physics, Univ. Oslo, P.O. Box 1048, Blindern, N-0slo 3, Norway
20-27 May 1984 : Lillehammer, Norway 434/83

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Prof. M.F.L. DE BOODT, Fakult. Landbouw, RUG, Coupure Links 533, B-9000 Gent
2-8 September 1984 : Gent, Belgium 515/83

MOLECULAR ASTROPHYSICS - STATE OF THE ART & FUTURE DIRECTIONS

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8-14 July 1984 : Bad Windsheim, Germany 741/83

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January 1984 : Santa Barbara, California, USA 768/83

CHAOS IN ASTROPHYSICS

Prof. J.R. BUCHLER, Dept. of Physics, Univ. of Florida, Gainesville, FL 32611, USA
8-11 April 1984 : Palm Coast, Florida, USA 797/83

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Prof. R. BAIER, Fakultät für Physik, Univ. Bielefeld, Postfach 8640, D-4800 Bielefeld 1, Germany
4-8 June 1984 : Bielefeld, Germany 859/83

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10-16 June 1984 : University Park, Pennsylvania, USA 861/83

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Dr. R.R. CHANCE, Corporate Technology, Allied Corporation, P.O. Box 1021R, Morristown, NJ 07960, USA
12-17 August 1984 : Stratford-upon-Avon, UK 959/83

COMPUTER SIMULATION OF CONDENSED MATTER (Mat.S)

Dr. C.R.A. CATLOW, Dep. Chemistry, Univ. College London, 20 Gordon Street, London WC1H 0AJ, UK
22-27 July 1984 : Norwich, UK 758/83

ICE IN THE SOLAR SYSTEM (Astron.)

Prof. A. DOLLFUS, Observatoire de Paris, 92190 Meudon, France
16-19 January 1984 : Nice, France 450/83

BIOGEOCHEMICAL CYCLING OF S & N IN REMOTE AREAS (GTM)

Dr. J.N. GALLOWAY, Environmental Studies Dept., Univ. Virginia, Charlottesville, VA 22903, USA
8-12 October 1984 : St. Georges, Bermuda 771/83

THE CHEMISTRY OF WEATHERING (GTM)

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Prof. E.W. SCHLAG, Inst. F. Physik und Theoret. Chemie, Lichtenbergstrasse 4, 8046 Garching, Germany
24-27 September 1984 : Bavaria, Germany 1000/83

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Dr. J.H.P. UTLEY, Dept. Organic Chem., Queen Mary Coll., Univ. of London, Mile End Road, London E1 4NS, UK
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ASYMMETRIC CATALYSIS (SAM)

Prof. B. BOSNICH, Dept. of Chemistry, Univ. Toronto, 80 St. Georges St., Toronto M5S 1A1, Canada
2-7 January 1984 : Florida, USA 756/83

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9-11 April 1984 : London, UK 701/83

COMBINATORIAL ALGORITHMS ON WORDS

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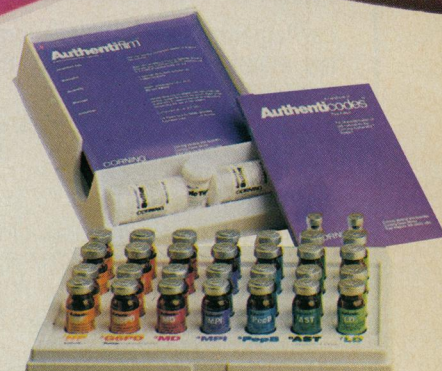
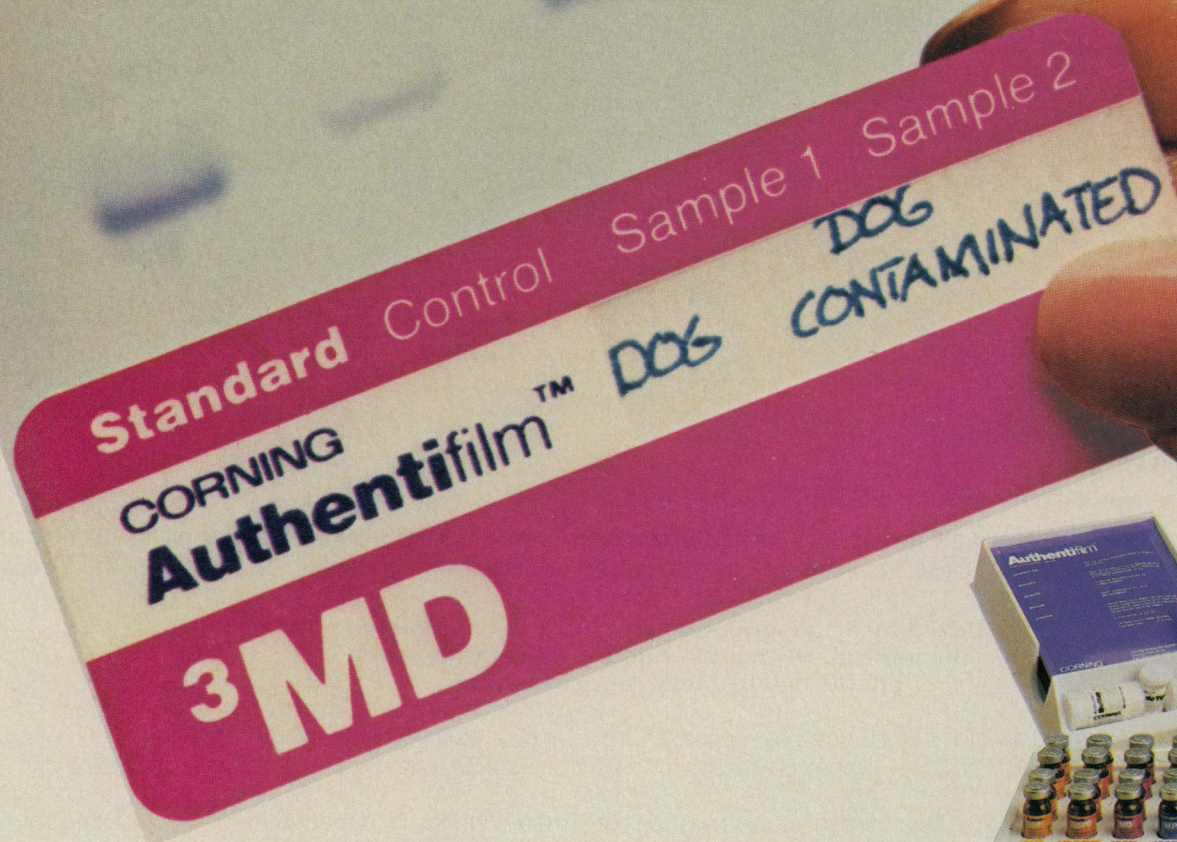
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Date & Place to be announced 534/83

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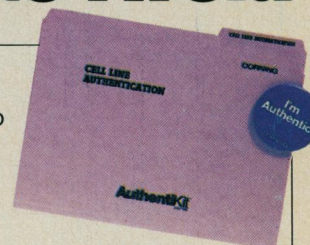
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Geneva, May 2-4

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Reproductive Medicine

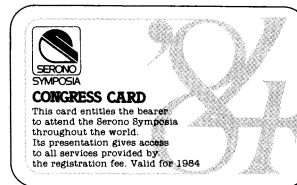
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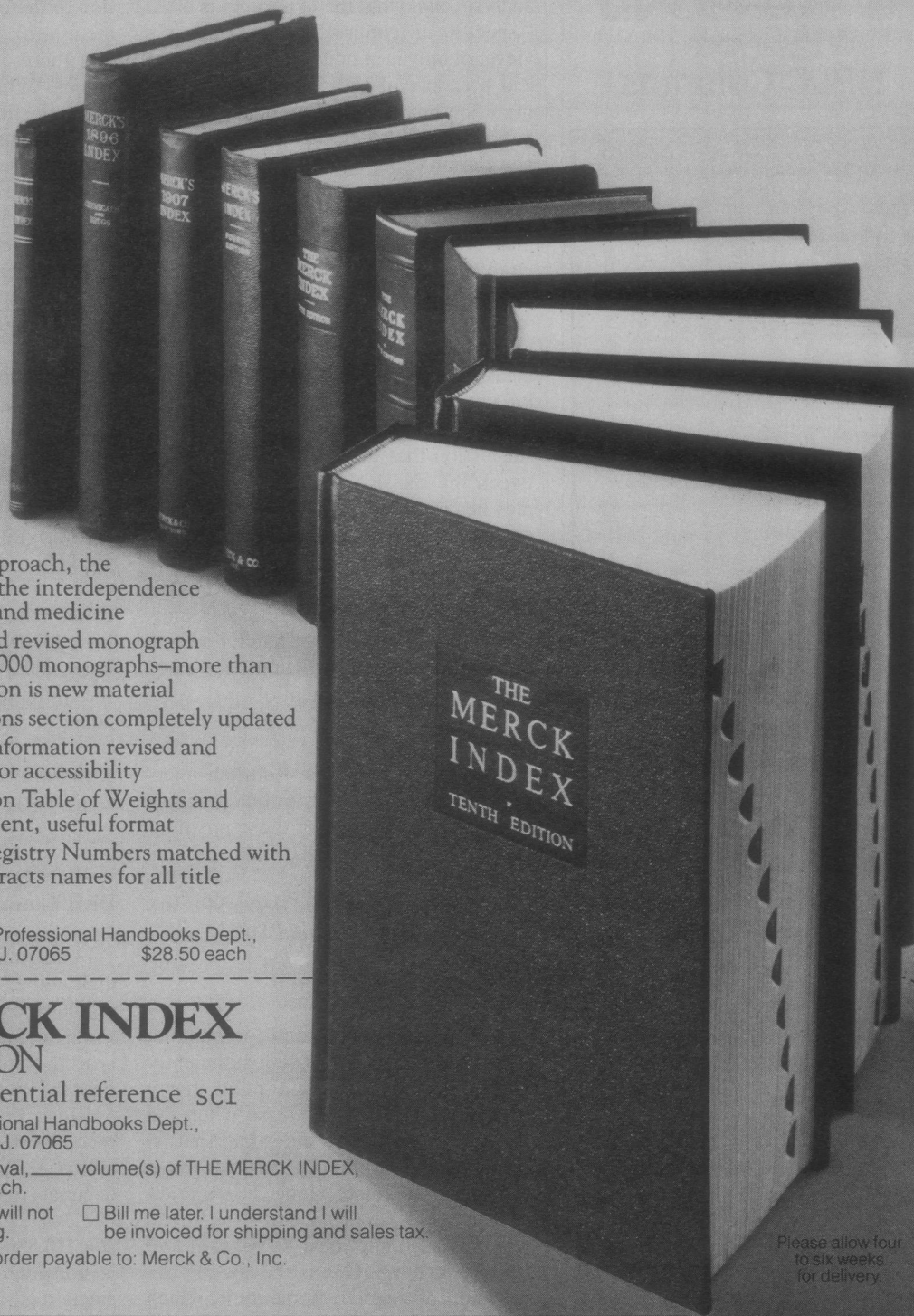
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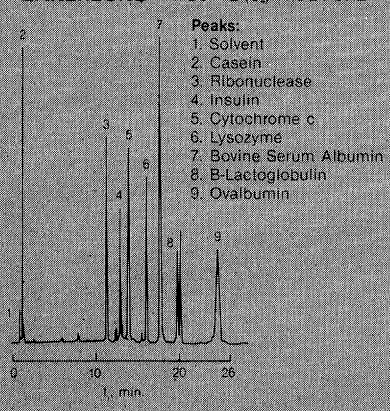
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terministic prejudices. Einstein's position was based, not on his commitment to determinism, but on a strong distaste for the "spooky actions at a distance" suggested by the quantum doctrine that $s_2(a)$ acquires its value only as a result of the faraway measurement made on particle 1.

What is remarkable about J. S. Bell's analysis, and what the experiments of A. Aspect *et al.* confirm, is that Einstein's view not only is at odds with the ontological precepts of the Copenhagen interpretation but is also numerically incompatible with the results of other spin correlation experiments. It is worse than a breach of quantum metaphysics to assign a value to $s_2(a)$ before the faraway measurement on particle 1—it is demonstrably inconsistent with the observed facts.

It is tempting to say that the only property of particle 2 changed by the measurement of particle 1 is what we know about particle 2, as in Rohrlich's example of the tossed coin. But the suggestion that the major difference between the classical and quantum examples lies in the presence or absence of a detailed dynamics insufficiently emphasizes what is most peculiar about the quantum case. The state of the coin is heads or tails, whether or not we know it. Particle 2, on the other hand, does not possess a value of $s_2(a)$ until we carry out a distant measurement of $s_1(a)$. After that it does. It is this state of affairs that has given rise to some of the bizarre philosophical positions Rohrlich mentions. I share his distaste, but it should be stressed that many of those positions are hardly more peculiar than the unadorned facts.

N. DAVID MERMIN

Laboratory of Atomic and Solid State
Physics, Cornell University,
Ithaca, New York 14853

I am grateful to Mermin for pointing out that I have not been sufficiently explicit about at least one point in my article. He refers to the case when the directions a and b are the same, that is, when the two spinning particles have their spins measured along the same direction.

In this case one must distinguish two separate matters. One is the law of conservation of angular momentum, which guarantees that the spins of the two particles are always in opposite directions (no matter what direction is chosen), because the total spin of the system has been zero before the breakup into two particles. It means that no matter

what the outcome of the spin measurement of the particle that is measured first, $s_1(a)$, the spin measurement of the other particle will give the opposite result, $s_2(a) = -s_1(a)$. No action-at-a-distance scenario need be invoked here. This is simply a matter of satisfying a conservation law.

The other matter deals with the prediction of the outcome of the spin measurement $s_1(a)$. It can be one of two values, and therefore $s_2(a)$ will be one of two values. Which one it will be is just as probabilistic as $s_1(a)$. But because of the conservation law, $s_2(a)$ is determined uniquely once $s_1(a)$ is known, whether $s_2(a)$ is measured later or at the same time. In that respect the situation is the same as the toss of a coin.

The difference between the coin toss (classical mechanics) and the breakup into two spinning particles (quantum mechanics) is (i) that the coin toss has a detailed dynamics which in principle can be known and then permits one to predict the outcome from the initial conditions, while the breakup does not have such a dynamics (no hidden variables that make the outcome deterministic); and (ii) that the quantum mechanical prediction involves probability *amplitudes* while the classical prediction (when the detailed dynamics is not known) involves probabilities. It is the latter difference that is responsible for the difference between quantum mechanical and classical correlations.

F. ROHRlich

Department of Physics, Syracuse
University, Syracuse, New York 13210

Digit Counting

I congratulate *Science* on printing 23-digit and 29-digit numbers without typographical error in the item "What does it mean to factor?" by Gina Kolata (Research News, 2 Dec., p. 1000). I infrequently encounter an error of any sort in *Science*; however, I find it difficult to reconcile the claim that 2 to the 193rd minus 1 is a 58-digit number with its decimal representation 12,554,203,470,773,361,527,671,578,846,415,332,832,204,710,888,928,069,025,791. Perhaps 12 is considered indistinguishable from a single digit in this transcendent realm?

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Erratum: The review of *Temperature* in the issue of 6 January (p. 44) was written by Robert J. Soulen, Jr.

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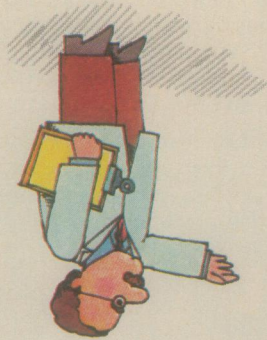
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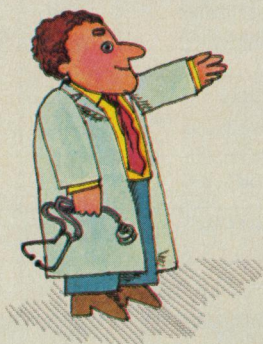
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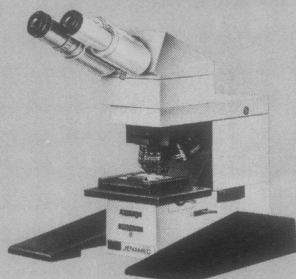
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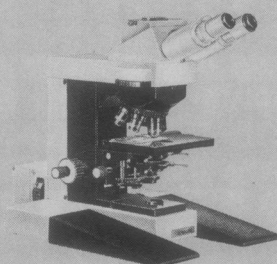
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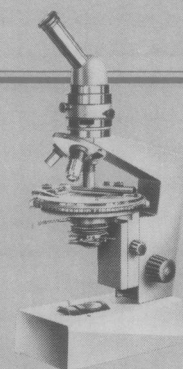
**Jenamed Laboratory
Microscope with CF
infinity 250mm optics.**



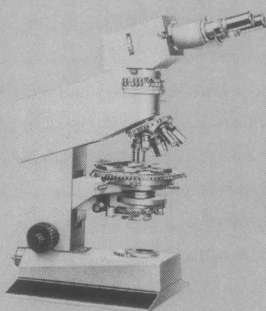
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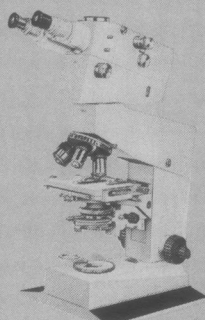
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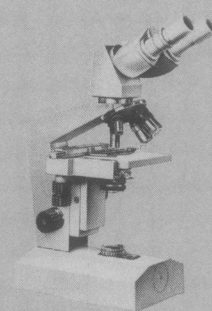
**Laboval Polarizing
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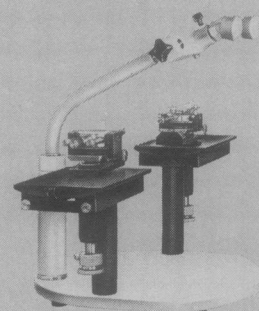
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with infinity optics.**



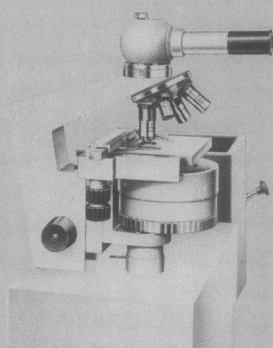
**Peraval Interference
Measuring Microscope
with infinity optics.**



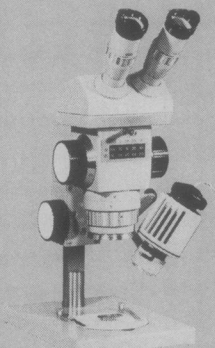
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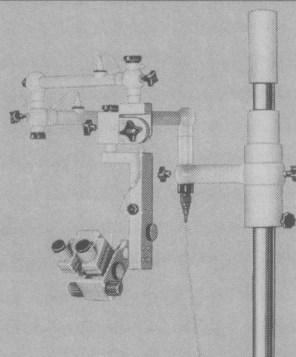
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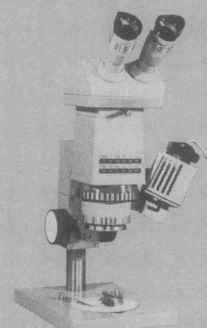
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Engineering and the National Science Foundation

In the scientific and technical communities of both the federal and private sectors, it is widely recognized that an effort to strengthen engineering at the National Science Foundation is desirable and timely. The engineering professional societies and engineering schools have been dissatisfied with NSF programs for many years. The engineering academic community has not found NSF to be an effective source of assistance as undergraduate enrollments have expanded while out-of-date laboratory facilities and inadequate research funding have decreased the ability of the schools to attract an adequate number of faculty members or full-time graduate students.

The organizational position of engineering within the NSF administration has been improving. Engineering has emerged from a division status, to part of a Directorate of Engineering and Applied Science, to its present position as a separate directorate. Presumably engineering is no longer considered as one of the sciences or simply the application of science but rather an enterprise with distinctive characteristics of its own.

One of these characteristics is the concentration of activities in industry. More than three-quarters of the engineers in the United States are employed in industry; industrial laboratories have done the outstanding research in many fields. Since much engineering research is best carried out by teams of specialists and is frequently heavily dependent on equipment, an industrial site may often be better adapted for effective engineering research than the usual academic environment.

Although in-depth skills in scientific and mathematical analysis are needed by both scientists and engineers, an engineer must also be able to synthesize knowledge into products and systems. Their designs must satisfy scientific as well as nonscientific criteria such as manufacturability, maintainability, risk-minimization, and cost-effectiveness.

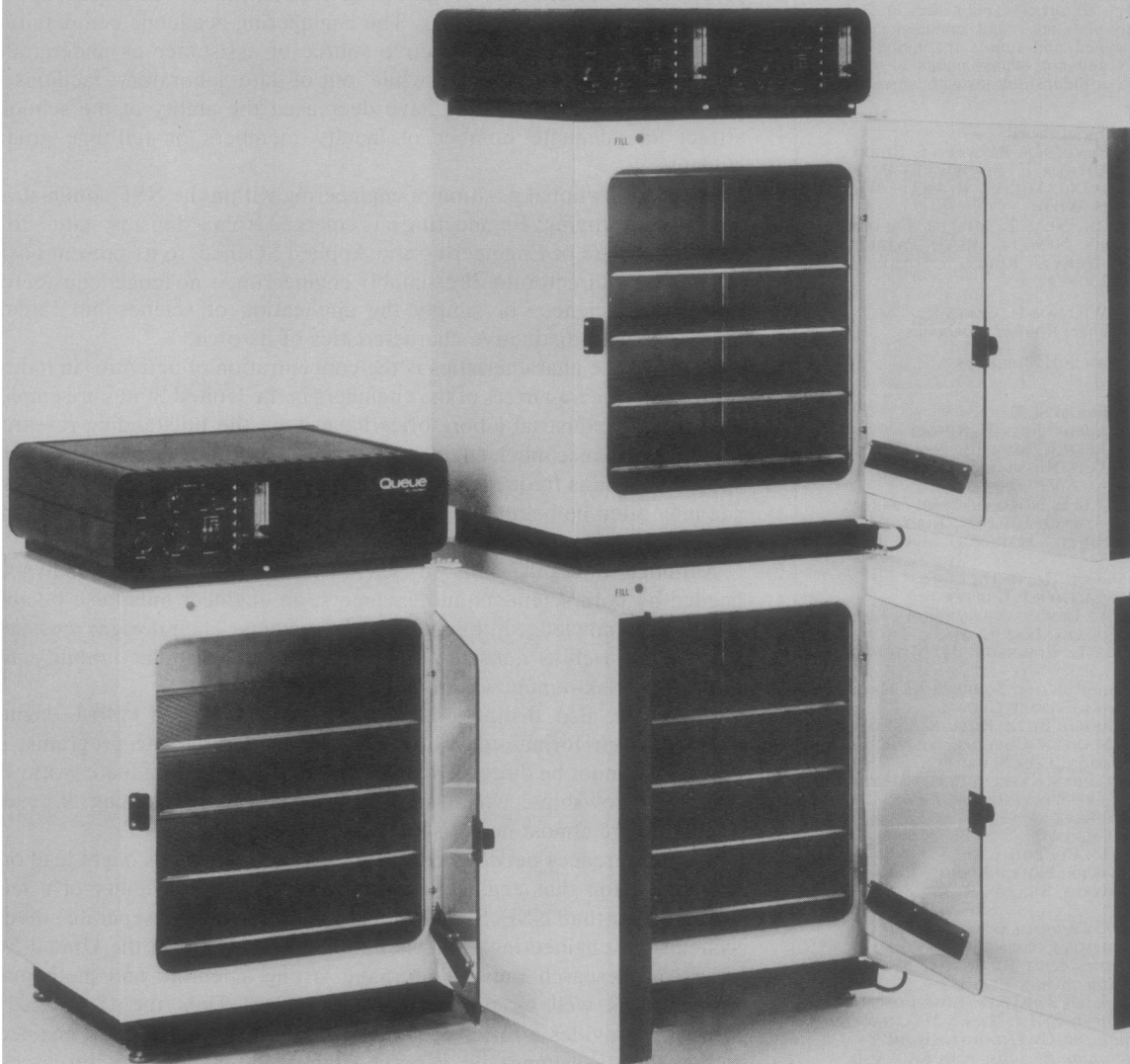
There are also distinctions in the academic world. Most engineers complete their formal education in 4-year undergraduate programs; such programs cannot be directed simply to preparation for graduate work. Post-doctoral fellowships, which are so important in the training of research scientists, are almost nonexistent among engineers.

Such differences between engineering and the sciences might lead one to the conclusion that engineering should be the responsibility of a federal agency other than NSF. Some countries have developed separate university systems for engineering and scientific education, but in the United States nearly all research universities have strong scientific and mathematical programs as well as schools of engineering. Thus the U.S. academic structure provides a rationale for expanding NSF activities in engineering rather than assigning the general support of engineering research and education to other agencies.

However, of even greater importance is the fact that the scientific and engineering enterprises operate most effectively when their borders are kept indistinct. Increases of scientific knowledge and understanding have given great impetus to engineering and technological advances. In turn, engineering and technological advances have frequently led to expansion of scientific knowledge. The interplay of science and technology, which is crucial to the rapid advance of both science and engineering, should not be hampered by institutional barriers.

If engineering in NSF is strengthened, three objectives can be simultaneously served. First, badly needed assistance to the academic engineering community can be more efficiently provided; second, the synergism between science and engineering can be reinforced; and third, the nation's technological capability can be strengthened. A dynamic engineering program at NSF is one of the most highly leveraged investments in the nation's technological future that the federal government can make.—F. KARL WILLENBROCK, *Cecil H. Green Professor of Engineering, Southern Methodist University, Dallas, Texas 75275*

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