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**Dr. Suzanne Forqia, University of Texas Health Science Center at San Antonio.
Materials Science

In this week’s issue of Science we present one of our special issues on materials. A unifying theme of the articles is interfaces: how various materials associate with and relate to other materials. Much of the science and engineering of materials relates to interfaces within the material itself, as well as interfaces with other matter. In many cases, intrinsic properties of a material, such as its resistance to failure under working conditions or its optical properties, depend on how internal interfaces are engineering into a material or are prevented from forming. Similarly, the ways in which a material interacts with its surroundings, such as its resistance to wear or its biocompatibility, can determine its value. We present four articles, three perspectives, and a selection of research reports on materials science. In a special news section, we have three reports that examine how new materials can perform as devices.

In his article, Fréchet examines modern functional polymers. The functional groups in polymers—such as double bonds, amides, or esters—in the polymer chain or pendant to it, determine the reactivity, molecular architecture, and interfacial energy of the polymer. These reactive groups can participate in useful chemical processes without degrading the polymer chain and hence play a critical role in the interface between polymers and other surfaces. Design of new materials and new architectures depend importantly on our understanding of these interactions. In addition, the author discusses three-dimensional polymers—den- trimers—in which the reactive interfaces can be tightly controlled.

Peppas and Langer discuss creation and characterization of new biomaterials. Biomaterials are a particular challenge because critical interfaces between living tissue, including blood, can lead to rejection. Foreign materials, replacement for soft and hard tissue, adhesives, and dental materials all present interesting problems. Many conventional characterization methods, for instance, require high vacuum, yet biomaterials must be studied in a hydrated environment. Success in meeting these challenges will lead to advances in biosensor technology, surgical procedures, and drug delivery.

The interaction of bulk surfaces gives rise to adhesion. Kendall examines molecules and mechanics in adhesion at the molecular level and adhesion in engineering objects. He reminds us that macroscopic notions of glue and keyed joints need to be abandoned in the world of nanometer structures. Instead, theories should be based on reversible work and adhesion energy, including the extra energy required to restructure the interface as surfaces move. In thinking about adhesion, one must consider how surfaces jump into contact, undergo adhesive hysteresis, and then exhibit formation of adhesive strings and clusters at the surface.

The ultimate in interfaces is a monolayer film. Zasadzinski et al. discuss molecular order and organization in Langmuir-Blodgett (LB) films. Transfer of engineered monolayers from an air-water interface to another substrate affords a high level of control. As the authors discuss, many questions about LB films can be answered with scanning probe microscopy. Such probes reveal that thin organic films of fatty acid salts can exhibit liquid, hexatic, and crystalline order and van der Waals and strained layer epitaxy on various substrates. Sixty years after LB films were first developed, it now seems that this wide variety of structures will increasingly be used in the design of organic thin film devices.

In our Perspectives, we get views of three additional aspects of interfaces and materials. Lynden-Bell tells about fracture in computer simulations at the atomic level; in numerically “pulling apart” computer-simulated metals, for instance, we can learn much about the microscopic details of how materials fail. Marder and Perry discuss nonlinear optical materials and, in part, how their synthesis depends on the interaction with their environments; dramatic increases in our understanding of these substances open the possibility of real optical devices. Finally, Newman and Sieradzki discuss metallic corrosion, a phenomenon that erodes any industrialized national economy; as the authors report, new interfacial probes enable progress in characterizing and halting its effects.

New developments in materials increasingly involve conceptual scientific insights coupled with important engineering advances. This interplay between fundamental and applied science gives rise to important progress that profoundly affects our lives. It is important that the current public concern regarding the value of research be informed about the remarkably close coupling between much of fundamental science and its ultimate application.

John I. Brauman
This is a powerful, expandable and comprehensive molecular biology package for the Mac, with the best protein analysis and restriction mapping software available. I recommend DNASTAR to any lab requiring this level of power and expandability. DNASTAR is currently unique in its support for networking as well.
Renovating Italian Science

We can only be sympathetic to Vittorio Sgarra (Letters, 21 Jan., p. 305), who discusses Italy’s role in Europe. We agree that Italy should be better represented within the European Molecular Biology Laboratory (EMBL). We do not agree with those who hope that, by withdrawing from EMBL, things might improve (“Italy throws EMBL into turmoil,” News & Comment, 21 Jan., p. 315). Not only would such a decision discredit Italy’s already weakened image, but it would make futile the financial investments of two decades in support of the EMBL. It would undermine ongoing efforts of Italian institutions that are directed at improving the quality and stature of scientific research in Italy.

For this embarrassing situation there is only one responsible: Italy itself. It is unrealistic to expect that EMBL would solve Italy’s problems, and the notion that a few more regional labs in Italy (supervised by EMBL) would improve the quality of our provincial research is misleading. To the contrary, it would create more dependency on the European partners.

For this new spurt of provincialism, however, Italian scientists should be granted the benefits of the doubt, since more aggressive “euro-skeptical” partners are already guilty of expanding their own regional domains. Nonetheless, because we live in a fast-paced, competitive world, leading countries are reluctant to wait for less-aggressive ones, and concepts such as Euro-panization and internationalization seem to be of secondary concern. The National Institutes of Health in the United States should be an illuminating example to European scientists. Through the concentration of a “critical mass” of scientists, this institution has been able to remain at the forefront of research, not through a rainy political dispensation of precious funds.

For its own good, the Italian scientific community should enforce vigorous standards of scientific research in place of short-sighted political convenience and claim its intellectual independence from a falling-apart, “paritocratic” system that has no long-term future. The real problem is that the vast majority of the Italian scientific establishment has learned through the years, for reasons of mere survival or opportunistic convenience, that tactics maneuvering and receiving timely blessings from friendly political leaders represent the only guaranteed tickets to life-time tenured positions and well-secured funding. Peer review of grant proposals and competitive research training programs are not the tradition in Italy. Bitterly, scientific excellence and meritocracy have been slashed by political interferences which, given the current political system, would engulfl any new regional initiative.

Italian scientists can perform outstanding research in molecular biology or other disciplines. It is up to them to resolve their internal struggles. The ongoing Italian political revolution should be looked on by the Italian scientific community as a historical occurrence for renovating itself and creating opportunities for new generations.

**Donato Romagnolo* 

*Ornella Selmin* 

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message comes from 18th-century Oxford, data on the career histories of all of the 20 men to hold chairs of mathematics or astronomy at Cambridge or Oxford Universities at some time during that century (1). Of these 20, 18 (or 90%) held their chair until death; one (5%) was banished for heresy; and one (5%) actually retired. The retiree was Robert Smith of Cambridge, who retired with dignity at age 71 after holding the Lucasian Chair for 44 years. These 18th-century professors were not fragile specimens: their median age at death was 71, and their median number of years in the chair was 27.5. It is, of course, risky to draw a conclusion from these data, but they suggest that in the years ahead the number of university faculty retiring will be approximately equal to the number banished for heresy.

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References


Corrections and Clarifications

In Jean Marx’s Research News article “Learning how to suppress cancer” (10 Sept., p. 1385), a team led by Stephen Friend at Massachusetts General Hospital in Boston was credited with finding that p53 is the gene at fault in Li-Fraumeni syndrome. This work was published in Science in 1990 (vol. 250, p. 1233). Similar work was published in Nature in the issue of 20/27 December 1990 (vol. 348, p. 747) by the group of Esther H. Chang at the Uniformed Services University for the Health Sciences in Bethesda, MD.

The photo credit for the cover of the Women in Science 1994 cover (11 Mar., p. 1351) was incorrect. It should have read, “Tom Van Sant/Geosphere Project, Santa Monica, CA/Photo Researchers.”
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Our Competitors' Enzymes Can't Pass The Quality Testing Performed On Gibco BRL Restriction Endonucleases

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<th>Assay Performed</th>
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<th>Company A</th>
<th>Company B</th>
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Summary: Seven out of ten restriction endonucleases from each competitor failed one or more of our quality tests.

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33. Mature thymocytes from 8- to 12-week-old normal C57BL/6 or mutant mice were enriched by J11d.2 (anti-HSA) and complement killing, to eliminate CD4+CD8+ and most immature CD4−CD8− thymocytes, with centrifugation on a density gradient (lymphocyte M). After Fc receptor blocking with 2.4G2 antibody, the thymocytes were stained with H1.29 anti-CD4-RED-613 or 53.6.7 anti-CD8-RED-613 (Gibco-BRL), IM78 anti-CD4-FITC, and biotinylated PK136 anti-NK1.1 or F13 anti-β2m RR4-7 anti-Vα6, B20.6 anti-Vα2, TR310 anti-Vγ7 (Pharminiag, San Diego, CA), followed by Streptavidine-PE (Caltag) and analyzed with a FACSCAN cytometer. Homozygous Aβ−/− (Genpharm International), Bβ−/−, CD8−, and CD4− null mutant H-2b mice were in their fourth to eighth backcross to C57BL/6. Antibody-treated mice were 5-week-old C57BL/6 mice treated with birth with H1.29 anti-CD4 or 53.6.7 anti-CD8, and CD8+ transgenic mice were 5 weeks old. Controls included nontransgenic littermates or age- and sex-matched C57BL/6 (for transgenics beyond the sixth backcross to C57BL/6) or littermates injected from birth with phosphate-buffered saline or an isotype-matched control antibody (SPF3-DRS) at the same dose and frequency as those of the experimental littermates (0.5 mg the first week and then 1 mg every 2 days intraperitoneally for 3 weeks). CD8+ transgenic mice were H-2d in their eighth backcross to B10.BR (the B10.BR background does not affect any of the parameters measured on the C57BL/6 background: percent of Vγ6, Vγ7, Vγ2, and Vδ6 were 56, 14, 5, and 4%, respectively, among CD4+CD8− thymocytes).

34. Mice 14 to 16 weeks old of the ββ−/−H-2d strain (backcrossed eight times to C57BL/6), and ββ−/− mice (C57BL/6) received two intraperitoneal injections of 0.5 mg of PK136 antibody to NK1.1 on day −1 and day 0 of whole body gamma irradiation (1000 rads) and were reconstituted 6 hours after irradiation with 1 × 107 fetal liver cells from 15-day-old ββ−/−H-2d (backcrossed eight times to C57BL/6) or C57BL/6 fetuses. At days 42, 49, and 74 after reconstitution, thymocytes from individual mice were processed and stained as in Fig. 1. At least five mice were analyzed for each type of chimera.

35. Mature (HSAbb) thymocytes were obtained from pools of five to 10 C57BL/6 mice at weeks 1, 2, 3, 7, and 18 of age and stained as described in Fig. 1. The absolute numbers of TCR Vγ8+ cells per thymus in each subset was computed from the frequency of these cells in the HSAbb preparation and the frequency of HSAαβ cells in the whole thymus, as determined by staining with M1/6-9PE anti-HSA (Pharminiag).

36. Thymic organ cultures were set up as described (11) from day 14 fetal thymuses. Mature (HSAαβ) thymocytes were obtained as in Fig. 1, at day 22 of culture, and NK1.1+ cells were first stained with PK136 followed by goat anti-mouse IgG-PE (Southern Biotechnology, Birmingham, AL), then anti-CD4-FLC or a cocktail of FITC-conjugated anti-CD4, anti-CD8, and anti-νγTCR (to gate for CD4− or CD4−8−γγTCR− cells, respectively) and biotinylated antibodies to Vγ6, Vγ7, or panTCR Vγ were added, followed by streptavidin-RED-613 (Gibco-BRL).

37. We thank B. J. Fowlkes, O. Lantz, and P. Matzinger for discussions; L. D'Adamo, B. J. Fowlkes, O. Lantz, P. Matzinger, D. Margelies, and W. Paul for reviewing the manuscript; T. Mat, C. Timms, E. Robey, and R. Jaenisch for mice; A. Barnes, S. Brust, and P. Golway for managing the specific pathogen-free mouse colonies; and T. Tran for excellent technical assistance.

20 October 1993; accepted 13 January 1994

AAAS–Newcomb Cleveland Prize

To Be Awarded for a Report, Research Article, or an Article Published in Science

The AAAS–Newcomb Cleveland Prize is awarded to the author of an outstanding paper published in Science. The value of the prize is $5000; the winner also receives a bronze medal. The current competition period began with the 4 June 1993 issue and ends with the issue of 27 May 1994.

Reports, Research Articles, and Articles that include original research data, theories, or syntheses and are fundamental contributions to basic knowledge or technical achievements of far-reaching consequence are eligible for consideration for the prize. The paper must be a first-time publication of the author's own work. Reference to pertinent earlier work by the author may be included to give perspective.

Throughout the competition period, readers are

invited to nominate papers appearing in the Reports, Research Articles, or Articles sections. Nominations must be typed, and the following information provided: the title of the paper, issue in which it was published, author's name, and a brief statement of justification for nomination. Nominations should be submitted to the AAAS–Newcomb Cleveland Prize, AAAS, Room 924, 1333 H Street, NW, Washington, DC 20005, and must be received on or before 30 June 1994. Final selection will rest with a panel of distinguished scientists appointed by the editor of Science.

The award will be presented at the 1995 AAAS annual meeting. In cases of multiple authorship, the prize will be divided equally between or among the authors.
a goal function. For animals, the utility or cost of a particular behavior is defined by its contribution to the animal's fitness, that is, the animal's subsequent survival and reproductive success. McFarland and Bösser argue that for robots, on the other hand, these notions should be defined in terms of the robot's commercial success in the marketplace. For example, in order to proliferate, a dishwashing robot must successfully compete with human dishwashers and existing automatic dishwashers in terms of cost, reliability, and quality of work. The book goes on to develop this similarity between commercial success and reproductive success into a formal analogy. Along the way, a number of other issues, such as the roles of motivation, goals, and learning in animals and robots, are also discussed.

A highlight of the book is a detailed illustration of the application of this general economic framework to the overall design of a housekeeping robot. Here the authors assume that a particular behavioral repertoire is given (for example, collecting dishes, mopping the floor, and so on) and the essential problem is to optimally deploy these behaviors in time while simultaneously considering issues of stability, reliability, and customer appeal. In general, the book tends to treat behaviors at a fairly high level, abstracting from details of the underlying mechanisms. In addition, the problem of selecting from a set of mutually incompatible alternatives is emphasized over the problem of fine-tuning ongoing behavior, though both are presumably crucial to an agent's success. Nevertheless, this simple example does clearly demonstrate the kind of analysis that the economic framework for intelligent behavior makes possible and illustrates how the results of such analysis can be used to guide the overall design of an autonomous robot.

Indeed, this book is at its best when drawing out the many strong analogies between animal and robot behavior and when presenting and illustrating the economic framework that is its central contribution. However, I think the book would have benefited from a clearer outline of its principal goals and overall plan at the outset. As it stands, the reader is left to sort through a number of seemingly tangential discussions and sometimes confusing terminology in order to grasp the essential ideas, a situation that the overly long lists of "points to remember" that end each chapter do little to alleviate. In addition, the minimal discussion of the large body of existing work on computer simulations of adaptive behavior and biologically inspired robotics is inadequate for this book to serve as a general introduction to the study of autonomous agents. Nevertheless, Intelligent Behavior in Animals and Robots stands as an important first attempt at laying the groundwork for a unified treatment of the behavior of animals and robots. It sets the standard against which any future discussion of these issues must be judged.

Randall D. Beer
Department of Computer Engineering and Science and Department of Biology, Case Western Reserve University, Cleveland, OH 44106, USA

Quantitative Cell Biology

Receptors. Models for Binding, Trafficking, and Signaling. DOUGLAS A. LAUFFENBURGER and JENNIFER J. LINDERMANN. Oxford University Press, New York, 1993. x, 365 pp., illus. $89.95 or £50.

Curare, used for centuries by the Indians of the Amazon basin as an arrow poison, was brought to England by Sir Walter Raleigh in the 16th century. Claude Bernard began a systematic investigation of its action in 1850. But it was J. N. Langley, examining the antagonistic effect of curare on nicotine stimulation of skeletal muscle nearly a century ago, who concluded: "Since neither curare nor nicotine, even in large doses, prevents direct stimulation of muscle from causing contraction, it is obvious that the muscle substance which combines with nicotine or curare is not identical with the substance which contracts. It is convenient to have a term for the specially excitable constituent, and I have called it the receptive substance. It receives the stimulus, and by transmitting it, causes contraction" (Proc. R. Soc. London Ser. B 78, 170 [1906]). These two principles—the recognition capacity for specific ligands and the subsequent ability of the ligand–receptor complex to initiate a biological response—form the basis of our current understanding of receptor biology. In fact, the role of ligand–receptor interactions in fundamental cellular functions is one of the central themes in biology today, from bacterial chemotaxis to the mechanisms of the new anti-thrombotic agents.

The development of theoretical models of ligand–receptor interactions and their mathematical basis was initiated by A. J. Clark in 1926. Few of the basic principles have changed, but over time increased understanding has added complexity. Fortunately for those working in this area, Lauffenburger and Linderman's Receptors: Models for Binding, Trafficking, and Signaling draws on mathematical and cellular bioengineering concepts to lay a detailed foundation in three of the major conceptual areas of receptor biology: (i) cell-surface receptor–ligand binding fundamentals, (ii) receptor–ligand trafficking, and (iii) signal transduction. The extraordinary rapidity of the pace of research in all three areas, but especially signal transduction, necessarily has restricted the contents of the book to specific examples. The authors have chosen wisely. In a section on receptor–ligand trafficking they thoroughly dissect the intracellular itinerary of the epidermal growth factor receptor. The emphasis is on mathematical modeling and the theoretical and practical evaluation of biological data. For those who are not mathematically fluent, the models may be overly detailed. Yet the biological overviews provide an adequate context for them. Surprisingly, neurobiologically important ligands and receptors, such as the excitotoxic agents—which are currently generating tremendous excitement in the field of receptor biology—are not mentioned in the book. Despite this omission, given the molecular manipulations now possible for ligands, receptors, and their associated constituents, the conceptual framework in quantitative cellular biology provided here is a welcome one.

Alan L. Schwartz
Washington University School of Medicine, St. Louis, MO 63110, USA

Books Received


Ancient Technologies and Archaeological Materials. Sarah U. Wiseman and Wendell S. Williams,
The innovation, and by the Mark meeting of diagnosis, biotechnology, production, biology.

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Nominations for either price should be submitted by April 8, 1994 to the Conference of the Swiss Scientific Academies, P.O. Box 8160, 3001 Bern, Switzerland. Nominations should include a one page statement on the qualifications of the nominee and his current address.

MEMO TO MEMBERS

At its meeting in February, the AAAS Council approved a new neuroscience section. All AAAS members are invited to enroll in this new section by designating it as their primary, secondary, or tertiary electorate on the enrollment form printed below and returning the form to AAAS at the address listed.

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