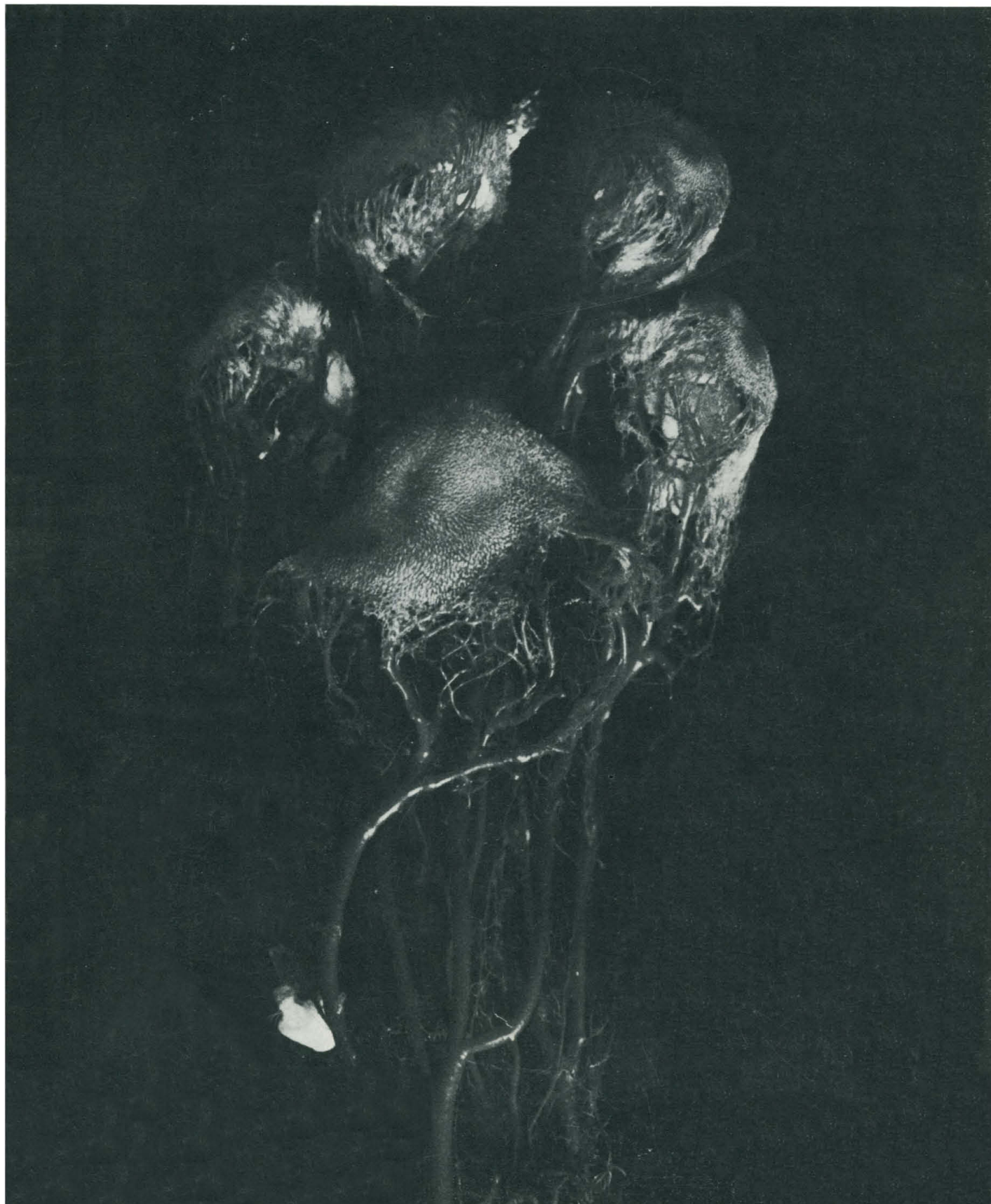


# SCIENCE

3 March 1972

Vol. 175, No. 4025

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<b>LETTERS</b>	Defense Research: <i>J. J. Stone</i> ; Cost of the Space Shuttle: <i>R. E. Lapp</i> ; AAAS Meeting: <i>M. E. Clutter</i> and <i>V. Walbot</i> ; <i>F. H. Babers</i> ; <i>R. J. Arthur</i> ; Social Responsibility: <i>M. McClintock</i> ; <i>B. R. Stein</i> ; Shape and Structure: <i>C. Kopala</i> ; Dyslexia: A Personal View: <i>A. Peterson</i> ; Erroneous Reference: <i>T. E. Reed</i> .....	944
----------------	---	-----

<b>EDITORIAL</b>	Federal Support of Graduate Education .....	947
------------------	---	-----

<b>ARTICLES</b>	Gene Therapy for Human Genetic Disease?: <i>T. Friedmann</i> and <i>R. Roblin</i> .....	949
	Protein Synthesis: Its Control in Erythropoiesis: <i>P. A. Marks</i> and <i>R. A. Rifkind</i> ....	955
	Information for a Changing Society: <i>E. L. Brady</i> and <i>L. M. Branscomb</i> .....	961

<b>NEWS AND COMMENT</b>	Division of Biologics Standards: Scientific Management Under Question .....	966
	The News about Stockholm Isn't All Bad, State Officials Say .....	969
	Office of Technology Assessment: Congress Smiles, Scientists Wince .....	970
	Carlsberg Laboratory: Ferment over Future of Copenhagen Lab. ....	972

<b>BOOK REVIEWS</b>	Scientific Methods in Medieval Archaeology, Science and Archaeology, and The Impact of the Natural Sciences on Archaeology, reviewed by <i>J. E. Fitting</i> ; Environment, <i>P. A. Jordan</i> ; The Radiation Chemistry of Water, <i>M. S. Matheson</i> ; Lignins, <i>J. M. Harkin</i> ; Colloque sur la Paléoécologie des Ostracodes, <i>R. V. Kesling</i> ; Comparative Physiology of Respiratory Mechanisms, <i>D. C. Jackson</i> and <i>R. E. Forster</i> ; Chemical Mutagens and Chemical Mutagenesis in Mammals and Man, <i>W. G. Flamm</i> and <i>L. Fishbein</i> ; Lectures on Developmental Physiology, <i>J. Oppenheimer</i> .....	976
---------------------	--	-----

<b>REPORTS</b>	Extinct Superheavy Element in Meteorites: Attempted Characterization: <i>E. Anders</i> and <i>J. W. Larimer</i> .....	981
	Infrared Spectral Emittance in Geological Mapping: Airborne Spectrometer Data from Pisgah Crater, California: <i>R. J. P. Lyon</i> .....	983
	Rock-Type Discrimination from Ratioed Infrared Scanner Images of Pisgah Crater, California: <i>R. K. Vincent</i> and <i>F. J. Thomson</i> .....	986

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# AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

Peripheral Thermoregulation: Foot Temperature in Two Arctic Canines: <i>R. E. Henshaw, L. S. Underwood, T. M. Casey</i> .....	988
Osmiophilic Polymer Generation: Catalysis by Transition Metal Compounds in Ultrastructural Cytochemistry: <i>J. S. Harker, W. A. Anderson, F. E. Bloom</i> .....	991
Thyroid Hormone Influence upon Lung Surfactant Metabolism: <i>R. A. Redding, W. H. J. Douglas, M. Stein</i> .....	994
Tolerance to Sheep Red Cells: Breakage with Thymocytes and Horse Red Cells: <i>R. K. Gershon and K. Kondo</i> .....	996
Loss of a Parathyroid Hormone-Sensitive Component of Phosphate Transport in X-Linked Hypophosphatemia: <i>F. Glorieux and C. R. Scriver</i> .....	997
Ultrathin Carbon Support Films for Electron Microscopy: <i>R. C. Williams and R. M. Glaeser</i> .....	1000
Human Phosphoglycerate Kinase and Inactivation of the X Chromosome: <i>B. F. Deys et al.</i> .....	1002
Sexual Receptivity: Facilitation by Medial Preoptic Lesions in Female Rats: <i>B. Powers and E. S. Valenstein</i> .....	1003
H-2 Antigen on Cell Membranes: An Explanation for the Alteration of Distribution by Indirect Labeling Techniques: <i>W. C. Davis</i> .....	1006
Lateral Interactions at Inner Plexiform Layer of Vertebrate Retina: Antagonistic Responses to Change: <i>F. S. Werblin</i> .....	1008
Lack of Enhanced Oxygen Consumption by Polymorphonuclear Leukocytes on Phagocytosis of Virulent <i>Salmonella typhi</i> : <i>R. M. Miller, J. Garbus, R. B. Hornick</i> ....	1010
Mast Cells from Human Respiratory Tissue and Their in vitro Reactivity: <i>R. Patterson et al.</i> .....	1012
Phosphodiesterase in <i>Dictyostelium discoideum</i> and the Chemotactic Response to Cyclic Adenosine Monophosphate: <i>R. G. Pannbacker and L. J. Bravard</i> .....	1014
Cyclic Nucleotide Phosphodiesterase in <i>Dictyostelium discoideum</i> : Interconversion of Two Enzyme Forms: <i>B. M. Chassy</i> .....	1016
Uricotelism and Low Evaporative Water Loss in a South American Frog: <i>V. H. Shoemaker et al.</i> .....	1018
Mapping of Interactions in the Pitch Memory Store: <i>D. Deutsch</i> .....	1020
$\Delta^9$ -Tetrahydrocannabinol and Ethyl Alcohol: Evidence for Cross-Tolerance in the Rat: <i>L. M. Newman et al.</i> .....	1022
<b>MEETINGS</b> Intelligent Verbal Behavior: <i>D. A. Norman and R. P. Abelson</i> ; Prospects of Gene Therapy: <i>E. Freese</i> .....	1024

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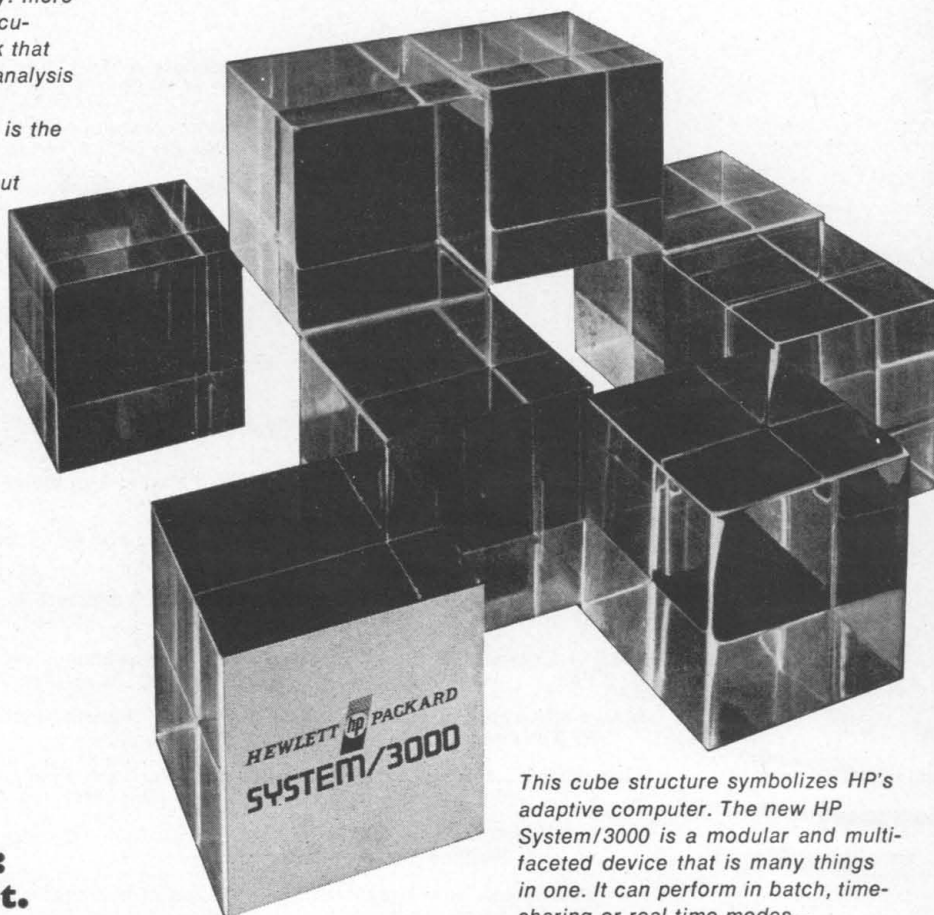
## COVER

Acrylic casting of blood vessels in paw of gray wolf. Circulation in the paw and toe pads is almost entirely in cutaneous plexuses. Flow of blood in arteries is into the center of plexuses; flow in veins is from the peripheries (about  $\times 1.7$ ). See page 988. [R. E. Henshaw, Pennsylvania State University, University Park]

The American Association for the Advancement of Science was founded in 1848 and incorporated in 1874. Its objects are to further the work of scientists, to facilitate cooperation among them, to improve the effectiveness of science in the promotion of human welfare, and to increase public understanding and appreciation of the importance and promise of the methods of science in human progress.

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## Federal Support of Graduate Education

In principle, the U.S. government has at its disposal the resources of men and money to attain great and worthy objectives. The government can recruit the services of most of the best intellects of the nation. The financial power of the Treasury towers above all other sources of funds.

Rarely, however, does the government come anywhere near achieving its potential. The failure is usually not that of parsimony or failure to employ good minds for short terms. Some of the worst failures came from an inability to pursue steady, consistent policies over the long term. When the power of government is employed capriciously, damage can result. An example is the harmful consequences of government's actions in graduate education.

In the early 1960's the government's financial power was directed toward expanding the output of graduate schools. A large number and variety of fellowships and traineeships were made available.

Fellowship winners had considerable freedom in attending the school of their choice. Students selected institutions having excellent reputations—the so-called Cartter schools. There they received good training and the stimulus of interaction with a sufficiently large group (critical mass) of their peers.

Assuming that the government would be steadfast in its avowed eagerness to foster graduate education, many universities made large capital expenditures to provide expanded facilities and entered into costly contracts for computer services. At some universities, essentially all graduate students in the sciences were supported, about half or more with federal funds. University administrations found themselves under pressure to accord to all graduate students the kind of support that students in the sciences were receiving, and at a number of schools such a policy was implemented, although it strained university resources.

When the cutback in the flow of federal funds occurred, many of the private universities, being overcommitted, were highly vulnerable, and almost all incurred large deficits. Particularly painful was the drop in fellowship and traineeship programs. In 1971, funds for such support were at about a third of the 1967 level.

As a group, the Cartter schools felt the cuts most keenly and were forced to reduce the size of the entering class in their graduate schools. In 1969, the entering class at Harvard was 840; in 1971 it was 544. Comparable decreases occurred at Yale, Princeton, and Stanford. Wisconsin, Berkeley, and the University of Washington also experienced sizable reductions. At the same time, enrollments in the non-Cartter schools have been increasing. These schools can provide teaching assistantships and other financial support. Thus, an important consequence of the cuts in federal funds has been a change in the pattern of higher education in the sciences such that fewer students are now attending centers of excellence.

One of the excuses recently offered for continued withholding of graduate fellowships has been unemployment among scientists. Most of the best schools report that they have been able to place their science Ph.D.'s. The big drop in recruitment has occurred at the lower-ranked schools.

Federal meddling in higher education has weakened many of our best universities, and capricious actions in withdrawing fellowship support can only result in a lowering of the quality of American science.

—PHILIP H. ABELSON



# We want to be useful...and even interesting

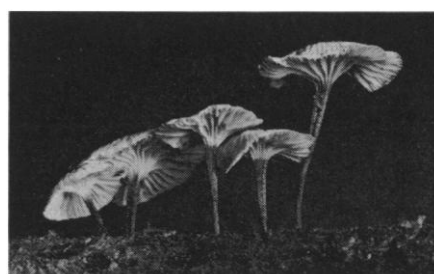
## Propaganda



*Paxina hispida*, by R. H. Runde



*Physalacria inflata*, by Mrs. R. H. Runde



*Marasmius nigripes*, by Mrs. R. H. Runde

The Rundes reside in Peoria, Ill. These pictures were made in that vicinity. Dr. Ray Runde is a medical administrator. Mrs. Runde wins prizes in toadstool-picking contests.

See also the good grey shell-collectors patrolling the beaches in Bermuda shorts.

Rich malacologists there may be, but they probably didn't get rich on malacology. Ditto mycology, algology, bryology, and all the other deeply fulfilling, totally absorbing slots where "natural history" academically survives. How dry and dull, how low on the scale of priorities—until the sea shells, the fungal fruit bodies, the algae and mosses grow more distinct in the mind.

A camera finder helps greatly in focusing attention on the fascinating details. There are just so many ways for Pa to photograph Ma in front of the sign marking the easternmost point in the United States. Each year some lucky people discover that their investment in camera and film can pay off spiritually in an awareness of the beauty of the world.

Naturally, Kodak preaches that doctrine. The academic specialist has even more to gain from preaching it. Keep it in mind for the coming season. It is a good doctrine.

## Wired optics

The financial seers who counsel on where to put smart money must be boning up furiously on liquid crystals. Cards are being played close to the chest. To get into the game seriously calls for optical talent, logic circuitry talent, and chemical talent.

The chemists deliver a vial of stuff. The opticians spread the stuff out into a thin layer and make an optical device out of it, an optical device that doesn't just sit there passively refracting, reflecting, dispersing, diffracting, scattering, absorbing, transmitting, or fluorescing. This optical device stays alert to the commands of circuitry.

The art rests on molecules which exhibit a mesomorphic phase intermediate between liquid randomness and three-dimensional crystallinity. One out of every 200 or so organic compounds is said to do so. This would open the choice pretty wide were it not for additional constraints on dipole moment and other properties.

So, while the chemists may try for something very special in the nematic or cholesteric line, or some multicomponent mixture of the two, or pleochroic guests among host nematic molecules, their teammates pass the time practicing and polishing their own contributions with commercially available liquid-crystal preparations. There Kodak comes in and has been coming in ever since revival of interest in liquid-crystal phenomena. That occurred in the sixties after several decades of somnolence on the subject.

We hereby announce the commercial availability of a multicomponent nematic that might suffice to call off some chemists. Name: "Nematic Mixture, Dynamic Scattering." Outstanding virtue: a nematic range all the way from 15 to 97 C. When nematic, a 12 $\mu$ m thickness of it, subjected in a NESAC-coated cell to more than 4 volts dc (at 25 C), turns turbid from  $\mu$ m-scale turbulent centers of continuously varying re-

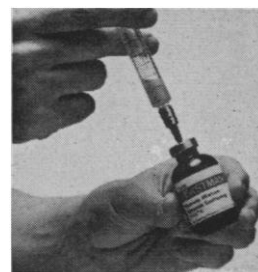
fractive index, caused by migrating ionic entities locally perturbing the parallel alignment of molecules. In ac, required voltage rises with frequency to an asymptote at 300 Hz.

At 60 Hz, 200 v peak-to-peak, scatter is such that only 0.1%\* of the flux in a parallel beam remains within the forward  $f/34$  cone of solid angle. (0.02% at 300 v.) When and where there is no field, it's 78%. Presto, graphic or digital displays with ambient light, no more internal light sources needed than in a grandfather's clock. Contrast ratio at 24 v dc, 26:1†; 39:1 at 38 v (rms), 60 Hz. Resistivity of  $6 \times 10^9$  ohm-cm (rather invariant over the usable frequency range!) keeps power requirements modest.

Order as EASTMAN Organic Chemical No. 11643 from leading lab suppliers, in 5- or 25-gram septum bottles under N<sub>2</sub>. Data quoted in this advertisement are to be regarded as typical but not stipulated.

\*90% of this degree of scatter is attained within 10 milliseconds. At break, the drop to 10% takes 400 msec.

†Look Ma, no hands on the watch!



Science for pleasure or profit