SCIENCE

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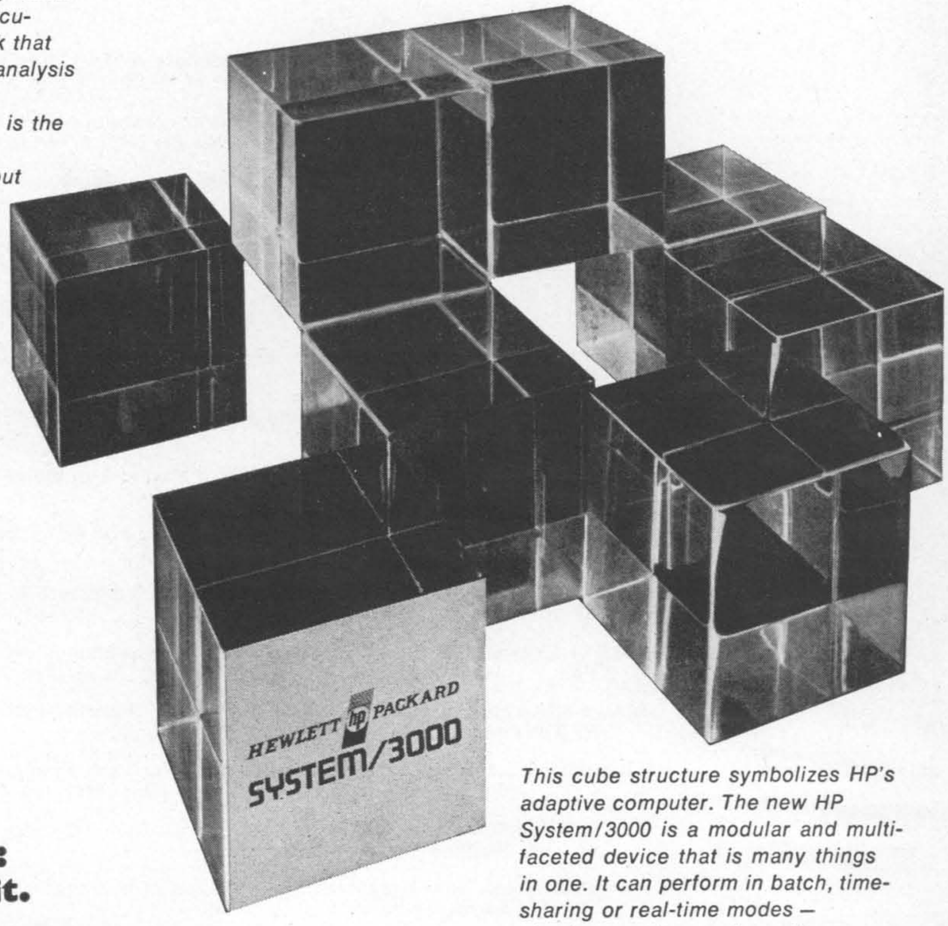
AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

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 ×1.7). See page 988. [R. E. Henshaw, Pennsylvania State University, University Park]

Some things are changing for the better.

Many people know us as an instrument manufacturer: we make more than 2,000 products for measurement, test and analysis. Others know us as a computer company: more than 10,000 own our programmable calculators and computers. We prefer to think that our business is to serve measurement, analysis and computation needs . . . in science, industry, medicine and education. This is the rationale behind every new instrument, computer or system that we tell you about in these ads. This month:



This cube structure symbolizes HP's adaptive computer. The new HP System/3000 is a modular and multi-faceted device that is many things in one. It can perform in batch, time-sharing or real-time modes — simultaneously — and use three different computer languages at the same time.

Computer proliferation: a better way to control it.

Until now many computer users in high-technology areas faced a puzzling fork in the road. With several computers already in use, they had to decide either to continue the proliferation of dedicated systems or turn to a large-scale system costing at least a half-million dollars.

Now there is a third and happier choice: HP's new adaptive computer System/3000. It is the first small-scale computer that handles batch, real-time and time-sharing all at once, each in more than one computer language — at half the price of a good alternative.

For time-shared tasks, it handles up to 64 users. For real-time processing, it allows several programs to be active simultaneously, completely protected one from the other. In batch processing, it permits execution of a variety of programs at extremely high speed.

And System/3000 is multi-lingual in all modes, including FORTRAN, BASIC and the new SPL/3000, a high-level systems programming language that combines the power of a Compiler with the efficiency of an Assembler.

How System/3000 accomplishes all this is a long story. Part of it involves advanced computer architecture, virtual memory that assures available core for every program in any mode, a huge micro-programmed instruction set, and a multiprogramming executive that insures dynamic allocation of system resources. For the rest of the story on the adaptive computer write for our brochure on System/3000.

Computer proliferation: a better way to do it.

For users who need to access a large data bank and also require ease of I/O interface, computer proliferation isn't always a problem. It often can be the solution.

To perform these tasks at a new low price, HP now offers a family of small disc-based computer systems dedicated to time-sharing, real-time or batch processing. Each system uses HP's versatile 2100 digital computer, and each is available with an impressive amount of storage. A choice of mass storage devices provides 5 to 47 million bytes of disc storage.

An HP disc-based system can be tailored to your specific needs, with more than a dozen peripherals and general-purpose interfaces for a variety of instruments. The new systems also use all of HP's existing software of over 500 library programs and applications packages.

The dedicated batch system is priced from $33,000. Time-share and real-time systems start at about $50,000. For more information, write for our brochure on dedicated disc-based computer systems.

Q.E.D. There are computation problems in every business that Hewlett-Packard can solve.

Instrumentation quality tape recording at a bargain price.

Most scientists would use portable instrumentation tape recorders for analog recording if only they performed as well as the big expensive laboratory machines. Unfortunately, their small size usually meant reduced performance.

Then came the HP 3960. Truly portable in size (50 pounds) and low in price ($4,270 for a fully-equipped four-channel instrument), the 3960 actually outperforms most laboratory machines costing five times more.

If this sounds too good to be true, listen to some of the 3960's capabilities. At 15/16 ips, its FM signal-to-noise ratio of better than 200:1 lets you play back signals that would be buried in noise (ECG's for example) on many lab machines as well as on any other portable.

The 3960 lets you mix and interchange four FM direct record/reproduce channels at will. You have a choice of three electrically-switched speeds, for a time-base expansion of 16:1 or 10:1 . . . without signal degradation. Tape drive is bidirectional so that you don't have to rewind either to continue recording or to play back.

Built-in facilities let you calibrate the 3960's FM electronics without external equipment. And an integral peak-reading meter lets you optimize record level without using a scope. Options include a 5 to 30 foot loop adaptor, an interrupting voice channel, and an inverter for 12 or 28 VDC . . . all integrally mounted.

Write for Application Note 89, a tape recording handbook useful to scientists interested in tape recording techniques for vibration and test analysis, research and clinical medicine, acoustics, oceanography and other environmentally difficult research projects.

For more complete information, write Hewlett-Packard, 1507 Page Mill Road, Palo Alto, California 94304. In Europe: 1217 Meyrin-Geneva, Switzerland.

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HEWLETT PACKARD

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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.

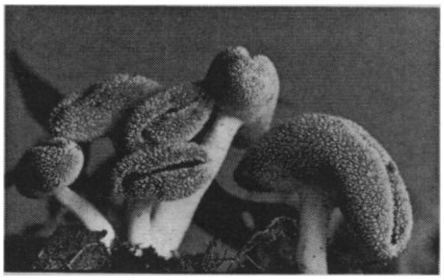
One of the excuses recently offered for continued withholding of graduate fellowships has been unemployment among scientists. Most of the best schools report that they have been able to place their science Ph.D.'s. The big drop in recruitment has occurred at the lower-ranked schools.

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 toad-stool-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 opticists 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.

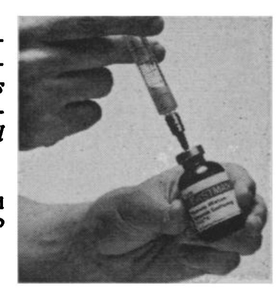
The art rests on molecules which exhibit a mesomorphic phase intermediate between liquid randomness and three-dimensional crystallinity. One out of every 200 or so organic compounds is said to do so. This would open the choice pretty wide were it not for additional constraints on dipole moment and other 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 12μm thickness of it, subjected in a NESA-coated cell to more than 4 volts dc (at 25 C), turns turbid from μm-scale turbulent centers of continuously varying refractive 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 6×10^9 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_2. 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!

Kodak

Science for pleasure or profit