SCIENCE

7 September 1973

Vol. 181, No. 4103

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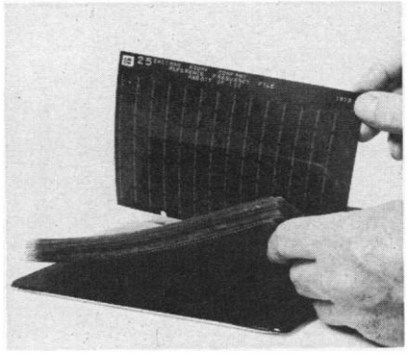
Papers on liquid crystals are appearing at such a rate that our private bibliography in its various arrangements for convenient reference occupies a whole reel of microfilm. If enough interest turns up, we might consider selling copies.

Well, interest did turn up.

Except that even in the months since that hint was dropped in a 1972 Kodak ad, microfiche reading devices have become so common and convenient that instead of "a whole reel of microfilm" it seems best to offer the bibliography in this form:



This is a good way to publish any mass of information, particularly one organized by computer for consultation by widely dispersed users with varying needs and interests.

This particular bibliography concerns liquid crystals because that is a field where we think we can make useful contributions both by our own work and as a supplier of liquid-crystal preparations to others. The bibliography contains 3281 references to mesomorphic substances—their preparation, properties, applications, and other information. For the time span from September, 1888 to May, 1973, it tabulates journal articles, patents, reviews, earlier bibliographies, government reports, conference reports. Inadvertent omissions have doubtless occurred.

Here are samples of the author and subject indexes, respectively:

```
GLAMANN RW
 X-RAY STUDY OF AZOXY ANISOLE LIQUID_CRYSTALS.
   **GLAMANN,RW **HERRMANN,K **KRUMMACHER,AH * Z
   KRISTALLOG 74, 73-94 (1930)                    1930   1394

GLARUM SH
 ESR OF THE PERI NAPHTHENYL RADICAL IN A
   LIQUID_CRYSTAL.     **GLARUM,SH **MARSHALL,JH * J
   CHEM PHYS 43 (10), 3442-54 (1965)              1965   0758
 ESR OF THE PERI NAPHTHENYL RADICAL IN A
   LIQUID_CRYSTAL.     **GLARUM,SH **MARSHALL,JH * J
   CHEM PHYS 44 (8),2884-90 (1966)                1966   0012
 PARAMAGNETIC RELAXATION IN LIQUID_CRYSTAL SOLVENTS.
     **GLARUM,SH **MARSHALL,JH * J CHEM PHYS 46
   (1),55-62 (1967)                               1967   0349

GLASSER ML
 MOSSBAUER EFFECT IN THE SMECTIC MESOPHASE.
   **KAPLAN,JI **GLASSER,ML * MOL CRYST LIQ CRYST 11
   (1) 103 (1970)                                 1970   0969

GLAZOV VM
 BOOK: LIQUID_CRYSTALS, SEMICONDUCTORS.
   **GLAZOV,VM **CHIZHEWSKAYA,SM * PLENUM PUBLISHERS
   (1969)                                         1969   0750

GO Y
 EXPERIMENTS ON NEMATIC ORIENTATION OF
   LIQUID_CRYSTALS OF POLY_GAMMA BENZYL L GLUTAMATE.
     **IIZUKA,E **GO,Y * J PHYS SOC JAP 31, 1205-9
   (1971)                                         1971   2282
 MAGNETIC ALIGNMENT OF CHOLESTERIC POLY_GAMMA ETHYL
   GLUTAMATE.     **MIYATA,N **TOMIYAMA,R **GO,Y * J
   PHYS SOC JAP 33, 1180 (1972)                   1972   2859
```

```
IODINE
  PATENT:  METHOD OF CHANGING COLOR PLAY RANGE OF A
    LIQUID_CRYSTAL MATERIAL (DIRECT_READING OF X-RAY
    RADIATION ENHANCEMENT BY IODINE COMPOUNDS) .
    **FERGASON,JL **GOLDBERG,NN
    **WESTINGHOUSE_ELECTRIC_CO * US 3663390 (1972)  1972   2511

IODO
  MESOMORPHIC TRANSITION TEMPERATURE OF 3 IODO 4
    OCTYLOXY BIPHENYL CARBOXYLIC_ACIDS.     **GRAY,GW
    **HORRALL,BH * J CHEM SOC, 1545-50 (1959)      1959   1694
  MESOMORPHIC TRANSITION TEMPERATURE OF 3 IODO 4
    OCTYLOXY BIPHENYL CARBOXYLIC ACID.      **GRAY,GW
    **HORRALL,BH * J CHEM SOC 1545-50 (1969)       1969   1694
  MOLECULAR STRUCTURE AND BARRIER TO METHYL ROTATION
    IN BROMO TOLUENE AND IODO TOLUENE PARTIALLY
    ORIENTED IN NEMATIC PHASE.     **DIEHL,P
    **HEMRICHS,PM **HIEDERBERGER,W **VOGT,J * MOL PHYS
    21, 377-80 (1971)                              1971   2003

ION
  GOVT_REPT: SOLID_STATE MECHANICS OF ION TRANSPORT
    IN BIOLOGICAL SYSTEMS.     **COPE,FW * AD-631544
    (1966)                                         1965   0789
  BIOPHYSICAL PROPERTIES OF PHOSPHO LIPIDS.
    PERMEABILITY OF PHOSPHATIDYL SERINE LIQUID_CRYSTAL
    TO A UNIVALENT ION.     **PAPAHADJOPOULOS,D
    **BANGHAM,AD * BIOCHIM BIOPHYS ACTA 126(1), 185-8
    (1966)                                         1966   0017
  SOLID_STATE MECHANISM IN ION TRANSPORT IN
    BIOLOGICAL SYSTEMS.     **COLE,FW * MOL CRYST 2
    (1),45-54 (1966)                               1966   0221
  SURFACE PROPERTIES OF ACID PHOSPHO LIPIDS.
    INTERACTION OF MONOLAYERS AND HYDRATED
    LIQUID_CRYSTALS WITH UNIVALENT OR BIVALENT METAL
    ION.     **PAPAHADJOPOULOS,D * BIOCHIM BIOPHYS ACTA
    163, 240-5 (1968)                              1968   0028
```

The Numerical-Sequence File, for searching by year of publication, starts like this:

```
1888  1138   TOWARDS THE UNDERSTANDING OF CHOLESTEROL.
               **REINITZER,F * MONATSH 9, 421 (1888)
1889  1139   LIQUID_CRYSTALS.     **LEHMANN,O * Z PHYSIK CHEM
               4, 462 (1889)
1890  1136   AZOXY PHENYL ETHER LIQUID_CRYSTALS.
               **GATTERMANN,L **RITSCHKE,A * BER 23, 1738
               (1890)
1890  1137   LIQUID_CRYSTALS (AZOXY COMPOUNDS) .
               **LEHMANN,O * ANN PHYSIK (3) 40, 401 (1890)
1890  2116   STRUCTURE OF CRYSTALLINE_LIQUIDS.     **LEHMANN,O
               * Z PHYSIK CHEM 6, 427 (1890)
1894  1147   LIQUID_CRYSTALS.     **QUINCKE,F * ANNALEN PHYSIK
               UND CHEMIE 53, 613-6 (1894)
1898  1140   INVESTIGATION OF CRYSTALLINE_LIQUIDS (CHOLESTERYL
               BENZOATE: AZOXY ANISOLE) .     **SCHENCK,R * Z
               PHYSIK CHEM 27, 167-71 (1898); Z PHYSIK CHEM
               25, 337-52 (1898)
1899  1141   ISOMORPHIC LIQUID_CRYSTAL MIXTURE.     **SCHENCK,R
               **SCHNEIDER,F * Z PHYSIK CHEM 29, 546-57 (1899)
1899  1142   TRANSITION OF LIQUID_CRYSTALS.     **HULLETT,GA *
               Z PHYSIK CHEM 28, 629-72 (1899)
```

A sample from the tabulation of how many times an author's name appears:

```
BROCHARD F                    7
BROG KC                       2
BRONNIKOVA AA                 1
BROOKS SA                     1
BROOME FK                     1
BROUTMAN LJ                   1
BROWN AJ                      1
BROWN CW                      1
BROWN GH                     31
BROWN R                       1
BROWN SP                      6
BROWN ZL                      1
BROWN BOVERI  CIE             1
BROWN BOVERI UND CIE          1
BROWN BOVERIE UND CIE         1
```

And a sample from the tabulation of the frequency of key words in the titles:

```
FLAW                          2
FLAWS                         5
FLEXIBLE                      3
FLICKER FREE                  3
FLICKERING                    2
FLIGHT                        1
FLOW                         32
FLUCTUATION                   9
FLUCTUATIONS                 11
FLUID                         9
FLUIDITY                      1
FLUIDS                        6
FLUORENE                      2
FLUORENONE                    2
FLUORESCENCE                  5
```

The complete Kodak liquid-crystal bibliography on 4 x 6-inch microfiche, 98 frames to the fiche, each with its individual index to grid location on the fiche, is sold by Eastman Kodak Company, Dept. 454, Rochester, N.Y. 14650 at $25, subject to change without notice. Provision is made for indicating interest in future updatings. Of course, if you don't need an 85-year bibliography but merely want lots of data about the Eastman liquid-crystal products, you can ask Organic Chemical Sales, Kodak, Rochester, N.Y. 14650 for the 24-page Kodak Publication No. JJ-14. It's on paper in the old-fashioned way.

But if you are interested less in liquid crystals than in microfiche readers, computer-output microfilming, and publication by microfilm, ask Dept. 240 B (not 454).

Kodak

Mesomorphs, microfilm, and other things

7 September 1973

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SCIENCE

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AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

COVER

Laysan albatross (*Diomedea immutabilis*), first identified by Rothschild in 1893. Award of the American Miscellaneous Society, presented to Roger Revelle in Mexico City, June 1973. See page 926. [Dan Dugan, photographer, Boston, for the Harvard Center for Population Studies, Cambridge, Massachusetts]

These calculators have such special significance for scientists and engineers that we devoted this space to describe them in some detail. Other new instruments and systems stemming from our measurement/computation technologies are being developed: look for them in the coming months.

Three alternatives (two of them brand new) to the drudgery of paper-and-pencil mathematics.

Almost 300 years ago, Gottfried Wilhelm Leibniz wrote, "It is unworthy of excellent men to lose hours like slaves in the labor of calculation." He was right, but how could anyone avoid it then?

Today, in any field of science or engineering, tedious manual calculation is neither wise nor necessary because things have changed significantly for the better, even in the last few months. We're convinced you should never again labor with slide rule, tables, scratch pads and adding machines . . . wasting your creative time getting answers that aren't as accurate as you'd like.

Any of the economical calculators that we describe in this month's message is as easy to operate as an adding machine but incomparably more powerful. All are pre-programmed to perform not only the basic arithmetic operations but also transcendental and statistical functions. All calculate positive and negative numbers throughout a 200-decade range. All automatically keep track of the decimal point and can display answers to the tenth significant digit.

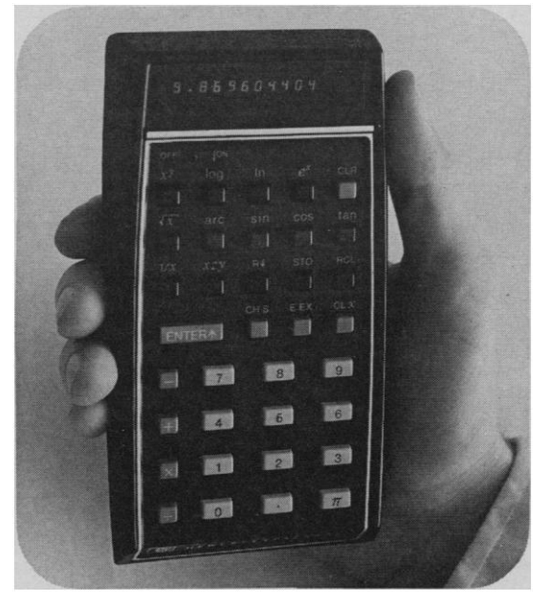
One of the traits that sets them apart from the recent flood of electronic calculators is a four-register operational stack that is solidly based on computer theory. The stack automatically stores intermediate results obtained during your calculations — whether they be serial, chain or mixed chain — and brings them back to the working register when they are needed to complete the calculations. In plain English, the stack relieves you of the necessity to make scratch notes and re-enter intermediate values: it does it for you, automatically and without error.

HP-35.
The electronic slide rule

Small enough so that you can easily carry it around in your shirt pocket — it weighs only 9 ounces including rechargeable battery — the HP-35 is the original electronic slide rule introduced a little over a year ago. It has since become the constant companion of more than 75,000 scientists and engineers around the world.

Due to the economies realized in this long production run, the price of the popular HP-35 has been reduced to $295.*

HP-35



The HP-35 is easier to use, 10 times faster and significantly more accurate than the slide rule. With a single keystroke and in less than a second, it performs trigonometric (sin, cos, tan), logarithmic (log x, ln x, e^x) and other commonly used functions (x^y, $1/x$, $\sqrt{x}$, π) as well as the four arithmetic operations. It also calculates inverse trig functions.

In addition to its computer-like operational stack, the HP-35 has a constant storage register which lets you store any number and recall it as often as you want for repeat operations, without ever having to re-enter it.

The HP-35 comes with owner's handbook, battery pack, AC adapter/recharger, carrying case and travel case.

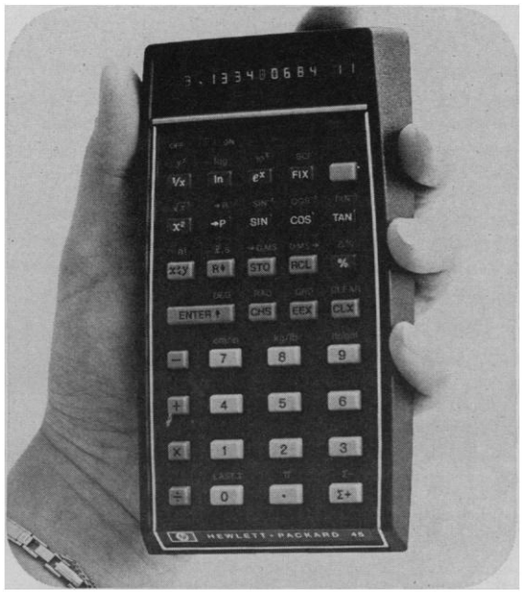
HP-45.
The scientific pocket calculator

A direct descendant of the "electronic slide rule," the new HP-45 packs nearly twice the computational power into the same package. The trick is that it has a unique gold-colored "shift" key that doubles the function of 24 of its 35 keys. Hence it does all that the HP-35 does . . . and then some.

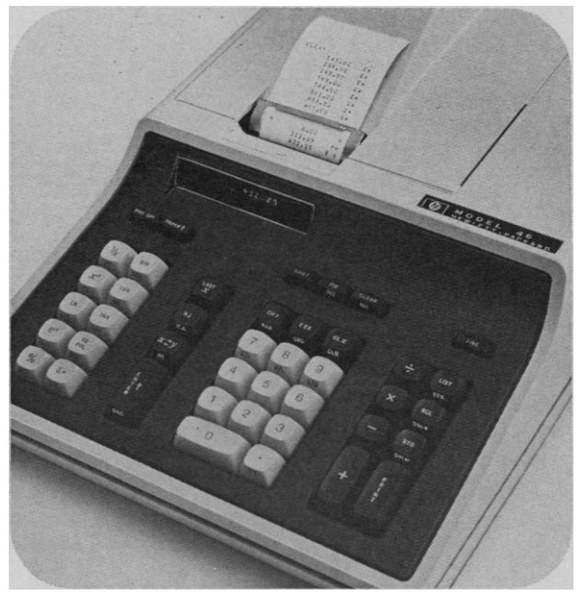
The HP-45 is the first pocket calculator with *nine* addressable memory registers besides its operational stack. You can store data in each one — any number that appears on the display — and recall it to the working register whenever you want. (Let your imagination picture the calculating horsepower of this feature for register arithmetic, conversions, continued products, payrolls . . .)

The HP-45 also has a 14th register, called "Last X" in which the last input argument is auto-

HP-45



HP-46



matically stored. You can recall this number by pushing the "Last X" key . . . then proceed to correct it or to perform calculations with it.

There's more. The HP-45 lets you do trig calculations in any of three angular modes (degrees, radians or grads) and converts angles in any mode to degrees/minutes/seconds instantly, and vice-versa. It lets you convert polar coordinates to rectangular and vice-versa, at a single keystroke. Add or subtract vector components in polar or rectangular coordinates. Perform two dimensional accumulations for vector calculations. And convert U.S. units of length, weight or volume to metric, and vice-versa . . . to 10-digit accuracy.

The HP-45 costs $395* including owner's handbook, quick reference guide, battery pack, AC adapter/recharger, carrying case and travel case.

HP-46.
The scientific printing calculator

If you need a permanent record of your calculations and don't insist on the size and portability of our two shirt-pocket wizards, the HP-46 was designed especially for you.

It has all the computational ability of the HP-45 with the important addition of a printer. The printer's extended set of alphanumeric symbols lets it "talk back" to you as you perform your calculations. The HP-46 prints easy-to-read symbols with all operations you perform, and clearly labels the results. Its printout thus constitutes a complete permanent record.

For example, when you calculate the mean and standard deviation of a series of numbers, the printer lists each entry with a $\Sigma+$ symbol. Then, after you push the $\bar{x}$, s key, it prints the results, in order: the number of entries, the calculated standard deviation and the mean . . . each clearly labeled.

On command, the printer will also record the contents of the operational stack or the 9 addressable memory registers, each also clearly labeled. Should you make a logical error in data entry or call for an improper calculation, the printer will make an error note with a reference to an explanation contained in the operating manual.

A 15-digit LED display is available as an option.

The HP-46 costs $695* including owner's handbook, printer paper, and carrying case.

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00310

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abandoned, has been bisected by a power line clearing and faces another bisecting by a highway). Friends in Malaya have stated that, within a decade, the lowland rain forests in Malaya will have disappeared, with the exception of a few sites (hill forests are in less imminent danger).

It is a tragedy for mankind that such potentially valuable areas of forest are being destroyed before we have the knowledge to manage them effectively and economically. For a mere pittance, a few, usually foreign, businessmen (representing industries in so-called "advanced" countries) and several local government employees accumulate wealth, a few local people have temporary jobs, and the land is ravaged. And this in a region where population pressure is not severe.

LESTER L. SHORT
American Museum of Natural History, New York 10024

The article by Gómez-Pompa, Vázquez-Yanes, and Guevara has aroused much interest. For well over 20 years, tropical botanists and scientists in other disciplines from a number of countries have been sounding the alarm over the increasingly rapid rate of destruction of one of man's great but little studied heritages—the tropical rain forests. The Association for Tropical Biology, with an international membership and a broad outlook, has done a good job of developing and spreading information on this subject, but no means are at hand nor foreseen to slow down or stop the ever-increasing rate of destruction or to guarantee the preservation and availability of any appreciable areas for future research.

It seems safe to predict that unless present policies and population pressures can be changed soon, few tropical American rain forests of any size will escape the wasteful treatment that has already been accorded many hundreds of thousands of square kilometers in the last three decades. Governments apparently see no value in these forests and, in fact, follow policies which actively promote their destruction.

One way to reserve some areas for future study might be for botanists to join forces with other interests. If a strip 25 kilometers wide (or preferably wider) of untouched forest extending completely across the Isthmus of Panama could be reserved now and protected against agricultural activity, it could serve as a barrier to the northward movement of certain plant and animal diseases (for example, foot-and-mouth disease in livestock and *Monilia* pod rot in cacao). Costs of reserving and maintaining the barrier might logically be borne by benefiting nations.

Here may be an opportunity for livestock interests, quarantine officers, botanists, and others to join forces. If this barrier is to be established, no time should be lost in employing the necessary scientific statesmanship needed to delineate, fence, and guard the strip before it is invaded by the cut-and-burn farmers and squatters with their livestock, if indeed they are not already in the area.

Once reserved, the strip could serve researchers for years to come. It would give man a better chance to discover some of the valuable information which these highly evolved, biologically efficient, beautiful rain forest communities are believed to contain.

ERNEST P. IMLE
10802 Bornedale Drive, Adelphi, Maryland 20783

My first impulse on reading "The tropical rain forest: A nonrenewable resource" was to request a translation in Spanish from the authors for distribution here. But on second thought it seems completely futile: the resource is not only nonrenewable, it is within a few years of being nonexistent. Conservation is an occupation of a well-educated society, conscious of its heritage and the errors it has already committed. What can one hope to achieve in the face of a majority of professional foresters, politicians, and lumbermen whose only interest is to obtain the greatest gain in the shortest possible time from the resource and then embark on costly projects of reforestation with exotic species? The concience should come from the general public, but in the developing countries the common man is poorly educated, and his response is all too frequently not only a complete lack of understanding, but a frank "Para qué?"; he is dependent on the rapid destruction of the forest for his only income, either for the lumber or for new land for crops to feed an undernourished, exploding population.

In my opinion the only hope *lay* in a massive educational program in the primary schools, where one can create the necessary conscience and long-term economic vision; but by the time the present generation becomes adult it will be too late. Meanwhile the taxonomic

botanist attempts to preserve a meager portion of the rain forest as a record for posterity, but on a budget which is also almost nonexistent.

STEPHEN S. TILLETT
Herbario, Universidad de los Andes, Merida, Venezuela

We do not know what should be done in order to prevent the destruction of the rain forests of the world, but we are convinced that they do not regenerate under present land-use practices. The solution of this problem (if any) lies in the fields of social science, especially economics and, unfortunately, also politics (both national and international). It is obvious that a change in present policies and in population growth (as Imle suggests) could solve the problem. But, unless some profound social changes can be made, there is no chance for preservation. It is sad to think that the preservation of rain forests has aroused more interest in the scientific community than the poverty, ignorance, and hunger that is commonplace in the same areas. The overexploitation of the tropics by a few individuals is one of the causes of the problem. We agree fully with Tillett's suggestion that massive educational programs in the primary schools may be one solution. But one ugly question is always in our minds—Why has this problem been left until now? Also, education is a word of many meanings. What kind of education will solve the socioeconomic problems of these areas?

We cannot solve a problem as complex and general as this one by simple actions. It is not a matter of chance that the problem is worldwide, and for this reason we think that it requires a worldwide approach (perhaps a United Nations program). We cannot cure a headache produced by cancer by prescribing aspirin. We cannot preserve the rain forests by protecting them from people who need the land for survival.

A worldwide revolution in land-use planning should be undertaken, taking into account the people living in the area, environmental deterioration, development, conservation of culture, exploitation, imperialism, population growth, improvement of living conditions, and education. New ways of planning the use of the world for all mankind are now in order.

A. GÓMEZ-POMPA
C. VÁZQUEZ-YANES, S. GUEVARA
Institute of Biology, National University of Mexico, Mexico 20, D.F.

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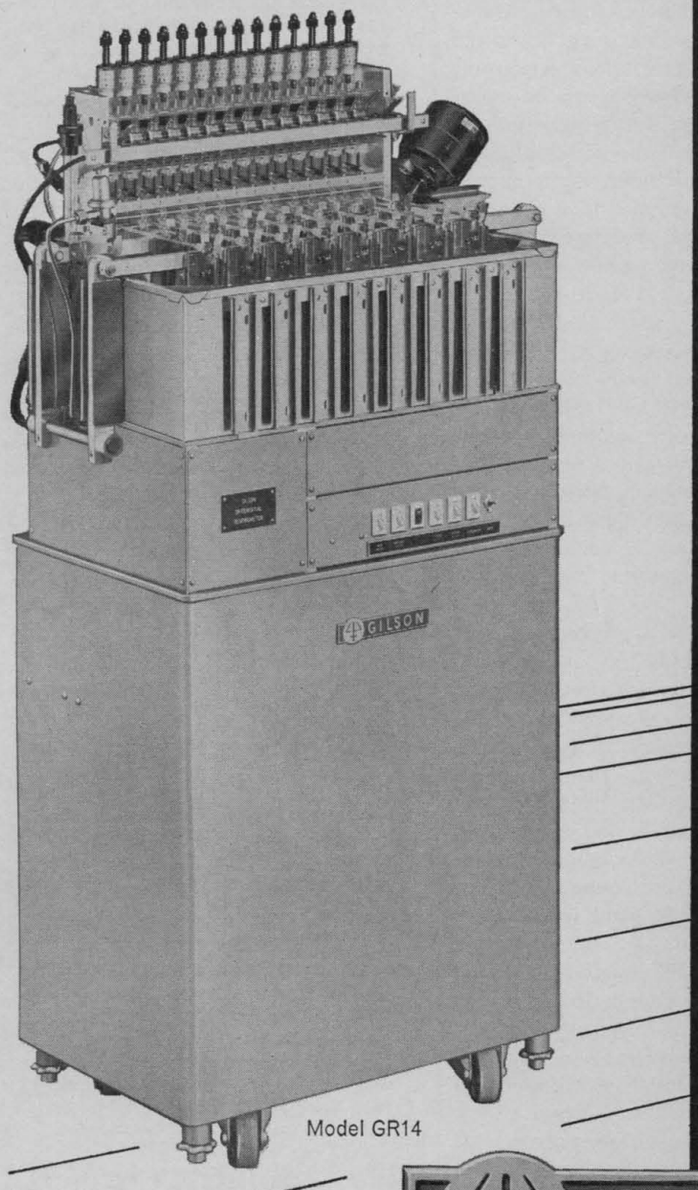

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7 September 1973, Volume 181, Number 4103

SCIENCE

University or Knowledge Factory?

There is tempting heresy loose in the land. Very simply, it is the dangerous notion that state universities are simply another agency of state government, a unit to be policed, regulated, and whipped into a bureaucratic mold.

In this view, the university is simply a production unit in the knowledge industry, a kind of specialized factory processing human beings for strictly utilitarian ends.

Why have we come to this strange new vision of the university? For many reasons: because many believe that our business affairs are poorly managed, that we are guilty of competitive, self-serving expansion, that the faculty have become a protected featherbedding elite, and finally, that reform is paralyzed by internal quarrels. It is a harsh indictment, and it is being pursued with varying degrees of fervor and favor in many of the 50 states.

The remedy is equally harsh. If self-regulation has failed, if the state universities are "out of control," then by all means impose the classic remedy of strong, external regulation.

The power of decision on matters large and small has moved upward from individual institutions into the hands of strong state systems—with consequences we have only begun to grasp. In shared innocence, trustees and the American Association of University Professors hassle the president on matters that are now largely in the hands of the state system.

To the new managers the university is just another large system. It has raw material (students), a labor force (faculty and support personnel), instruments of production (classrooms, laboratories, libraries), a production schedule (academic requirements, classes admitted, and classes graduated), management (the trustees and central administration), and a production index (the cost of producing a student credit-hour).

The managerial revolution creates the exact reverse of the goals that are sought. The impact of multiple sources of regulation on the university is to discourage flexibility, cripple initiative, dilute responsibility, and ultimately to destroy true accountability.

The university which is regulated by everyone becomes, by the most bitter of ironies, accountable to no one. The invasion of external authority makes it virtually impossible to fix responsibility on anyone for educational results. With everyone in the act, who is finally accountable?

Everyone has a stake in the work of the university—parents, students, faculty, governors, legislators, business, the professions, taxpayers, trustees, even presidents. Slowly, clumsily, we in the universities have evolved our own special forms of "participatory management." It will do no good for any of us to rail against external intervention. Instead, our challenge and opportunity is to devise wider and deeper networks of consultation. If consultation with faculty is necessary and desirable, so by the same token is university consultation with governors, legislators, and state coordinating boards.

The universities are a very special kind of place. They are fragile as truth itself is fragile. They exist by public sufferance, and it is a marvel that the public at large supports with its dollars an institution that is independent, free-standing, openly critical of the conventional wisdom, friendly to disputation, enchanted with controversy, and hospitable to those who "think otherwise." May it always be so.—HAROLD L. ENARSON, *President, Ohio State University, Columbus 43210*

Adapted from a commencement address, University of New Mexico, May 1973.

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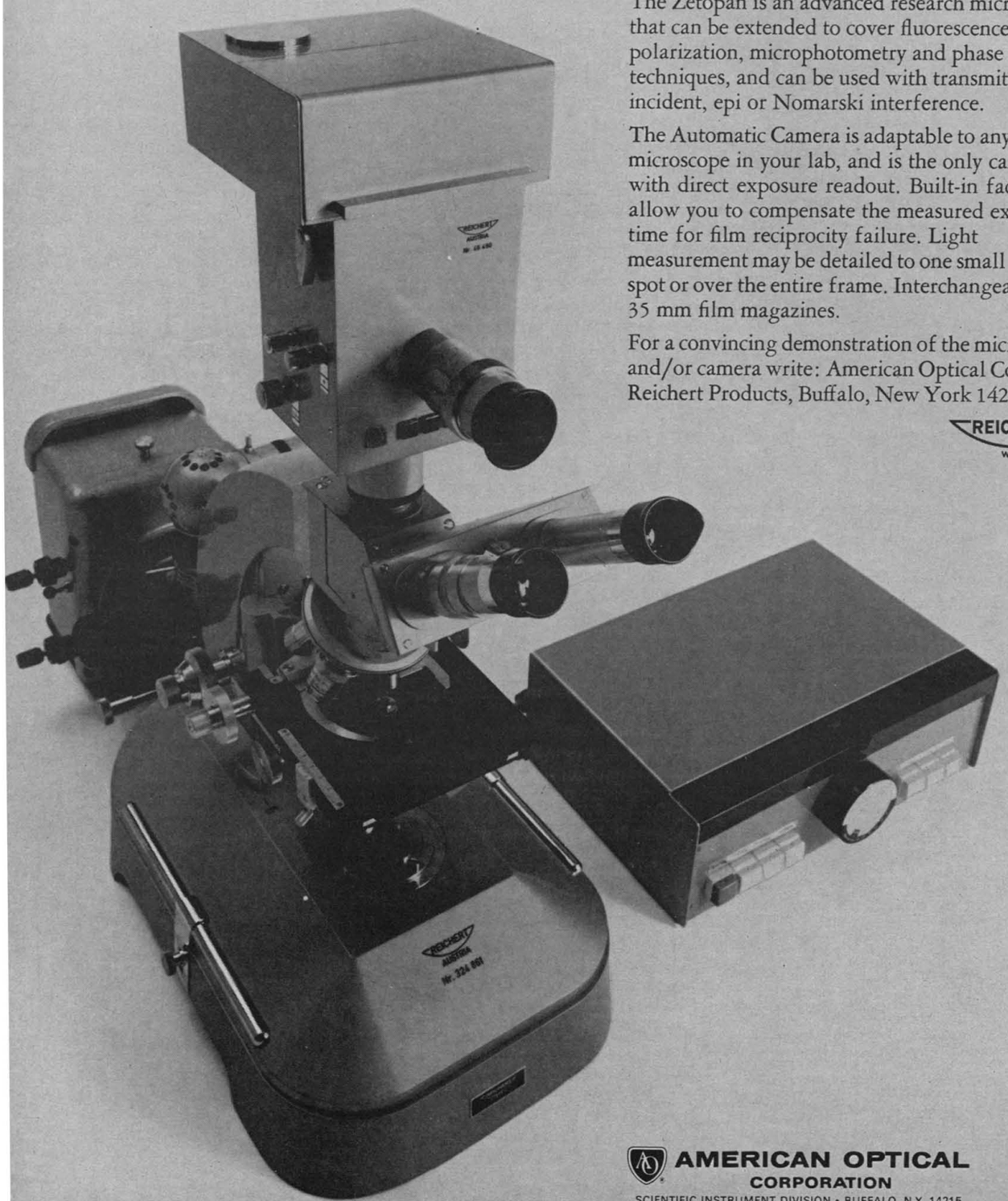

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load extension curves, and fracture toughness.

The description of deformation of an ensemble of statistically interacting particles which appears to be smooth in time and space was the topic of the session on continuum descriptions of deformation, chaired by Lee. The behavior of viscoelastic solids and solutions in extrusion, compression, and tension was discussed (Takayanagi, Zapas, Brinson, Rybicki). Anthony developed the concept of disclinations, a geometrical tool to describe certain polymer defects (for example, twist and wedge disclinations), by using the methods of continuum theory. From such continuum treatments, a relation between microstructure and the elastic and plastic behavior of polymers may be expected.

The session on fracture was chaired by M. L. Williams. Fracture propagation (Kanninen, Kobayashi) and conditions of crack stability and the relation between viscoelastic functions and crack extension parameters (Thomas, Knauss) were discussed. Knappe treated the role of fracture criteria in the fracture analysis of fiber-matrix composites. J. G. Williams took up the previously discussed problem of craze formation, subjecting it to fracture mechanical analysis. He also studied the effect of temperature and environment.

After each paper, time for direct questions was allowed. A 3-hour agenda discussion of the topic of the morning session concluded every day.

Some of the accomplishments of the colloquium have been indicated in the brief comments on the individual sessions. The presentation of the closely related papers provided a high information density, and all conceivable arguments from the three disciplinary viewpoints were advanced and discussed. In illustration, we may mention crazing. Environmental effects on craze initiation are undisputed. But what is their nature? The solubility parameter seems to be an insufficient criterion. Hydrogen bonding, sample orientation, swelling, wetting, presence of minute impurities, and diffusion all have to be considered. Gases can adsorb on carbon-carbon bonds and reduce the bond energy, and facilitate chain scission, the opening of voids, and crack initiation. The exposition and interaction of these interdisciplinary viewpoints is a major accomplishment of the colloquium; subsequent evaluation by participants (and readers) will be an even greater one.

Another illustration is the problem of crack branching and its relation to dynamic toughness. Is the energy or the shape of the stress field at the crack tip important? Is it the decoupling of stress field and crack propagation or the statistical chance that off-axis flaws will grow to sufficient size that determines deviations of crack propagation from one plane and crack branching? The arguments were presented in an elegant fashion. They are well founded, and they will be taken up again. These few examples show the breadth of the discussion, which extended from the mathematical foundations of viscoelasticity to the thermodynamic formulation of fracture and design criteria.

A summarizing discussion on critical issues that remain to be resolved, chaired by Halpin, concluded the 7-day meeting in the pleasant setting of the Schlosshotel Kronberg.

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References and Notes

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2. H. H. Kausch, J. A. Hassell, R. I. Jaffee, *Deformation and Fracture of High Polymers* (Plenum, New York, in press).