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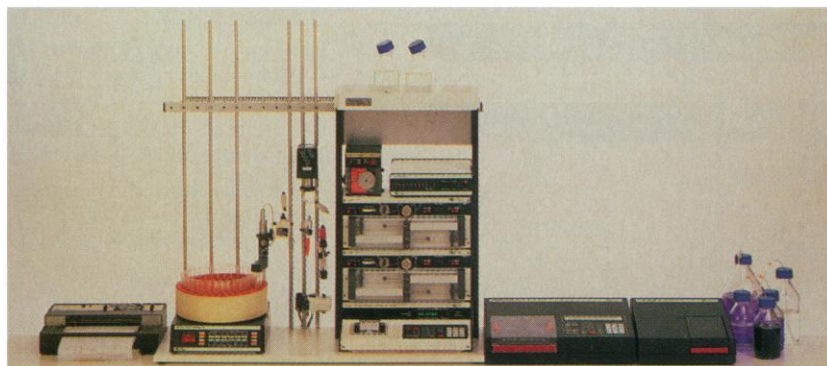
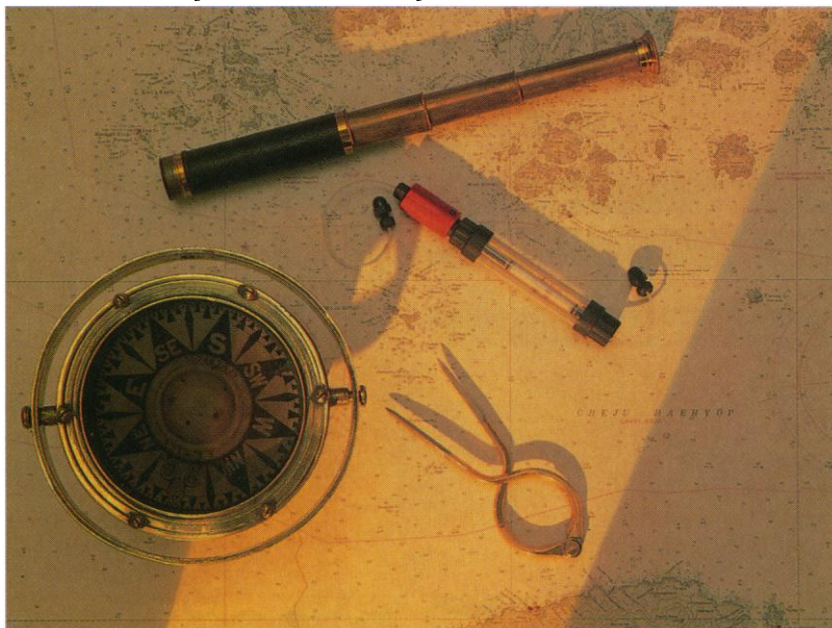


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COVER The bat *Pteronotus parnellii* detects, identifies, and catches flying insects by hearing variations in the echoes of the ultrasonic sounds that it emits. Auditory pathways to frontal cortex may play a role in this mammal's ability to use hearing as the chief sensory basis for spatial navigation. See page 824. [The photograph was taken in the laboratory of O. W. Henson, Jr., at the University of North Carolina, Chapel Hill, by Russell Hansen. The moth was tethered to a string for the purpose of the photograph]

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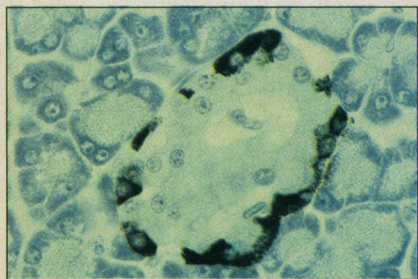
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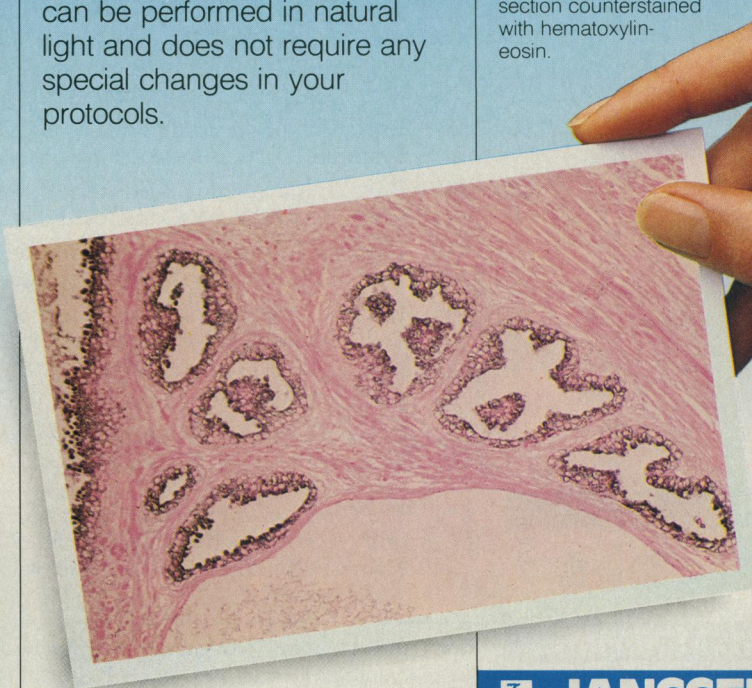
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This Week in SCIENCE

Cloning large DNA segments

THE mapping of the human genome or other complex chromosomes would be greatly facilitated if large pieces of DNA could be easily cloned (page 806). Burke *et al.* have now developed techniques that increase tenfold (to 500 kilobases or more) the size of clonable pieces of DNA. Linear molecules of DNA were generated in vitro and ligated into a yeast vector; these were inserted into yeast cells in which they were maintained as linear artificial chromosomes. In the prototype experiments, pieces of yeast DNA with 40 to 130 kilobases and pieces of human DNA with more than 400 kilobases were successfully cloned. The sizes of the cloned segments were verified by pulsed-field gel electrophoresis. Manageable DNA libraries may now be generated from complex chromosomes and large DNA sequences whose specific functions are of interest may be cloned. Both mapping efficiency and fidelity are expected to be improved by this new cloning strategy.

Allelic exclusion

ALLELIC exclusion is a puzzling phenomenon: in any immunoglobulin-producing cell, only one set of immunoglobulin genes (there are two sets per cell, one from each parent) will be expressed (page 816). The gene that is expressed for immunoglobulin heavy chain (in this study, the μ heavy chain of IgM molecules) is thought to prevent the expression of the other allele. Nussenzweig *et al.* used transgenic mice to study whether, in cells capable of producing only membrane-bound immunoglobulin, allelic exclusion would occur. The transgenic mice carried an altered human gene that lacked the signals for making secretory IgM; secretory molecules are normally made in immunoglobulin-producing cells along with the membrane-bound form of the molecules. In spleen cells expressing the human gene and producing only membrane-bound μ chains,

production of normal mouse IgM was inhibited; in those expressing the mouse μ chain, human μ chain was not produced. In addition, the messenger RNA molecules of only the expressed μ chains were made. That allelic exclusion pertains for a combination of human and mouse genes implies that molecular structures and signals that are crucial to this process are common to these two species.

New archaeobacteria

A third branch has been identified within the archaeobacterial kingdom: it consists of bacteria that grow well in extreme heat, derive energy from the reduction of sulfate, and contain a novel form of RNA polymerase (page 822). Stetter *et al.* isolated the distinctive bacteria from hot sediments collected at two marine hydrothermal systems off the coast of Italy. The organisms are irregular spherical motile bacteria. Their optimum growth occurred in extreme heat (83°C). It depended on the availability of sulfate, which was reduced to hydrogen sulfide and carbon dioxide; some methane was also produced. The phylogenetic uniqueness of the organisms suggests that their origins, like those of other archaeobacteria, are ancient. Although the oceans were not rich in sulfur during Archean time (early in earth history), local hydrothermal vents would have been rich in sulfate (from magma) and could have provided suitable substrates for the growth of these organisms. The discovery of organisms combining a sulfate-reducing metabolic pathway with optimum growth in high temperatures may account for the finding of hydrogen sulfide-rich "sour oil" as a contaminant of geothermally heated oil wells.

Hearing in echolocators

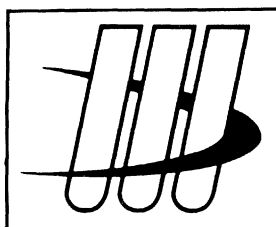
PATHWAYS in the brain by which sounds are processed have been studied in mustache bats (*Pteronotus parnellii*) which have well-developed auditory senses (cover and page 824). The bats use hearing to orient in

space, find and intercept prey, and avoid obstacles. They emit pulses of sound, scan their environment for returning sound waves, and respond with movements of pinnae (the external, cartilaginous ear flaps), head, and body. Injected tracer substances highlighted neuronal pathways for processing sounds as the tracers were transported along firing axons. The frontal lobe of the cerebral cortex was involved in the response to acoustic stimulation: signals entered it from regions of the thalamus (having entered the thalamus from the medulla); signals traveled out from the cortex to the superior colliculus, a region from which motor signals directing head and pinnae movements occur. Kobler *et al.* speculate that sensory-motor connections in the frontal cortex may develop in accordance with and reflect the sensory needs of the animal: those animals that rely heavily on hearing, therefore, would have well-developed links between auditory input and motor output regions; those relying more on sight would develop stronger connections between visual input and motor output centers.

Food for thought

EATING enhances memory (page 832). Groups of mice subjected to different feeding regimens were taught how to run a maze. The ability to remember the right route was best in those animals that ate voraciously after learning. The effect was found to be mediated by cholecystokinin, a neuropeptide that is normally secreted by the stomach during eating and is one of several peptides that sends signals to stop eating to the central nervous system. Cholecystokinin acts on vagus nerve fibers; when the vagus nerve was experimentally severed, the memory effect did not take place. Flood *et al.* speculate that the association of eating with memory may have given wild animals a survival advantage: eating caused release of gastric peptides, stimulation of the vagus nerve, and enhanced memory, perhaps of the strategy that had been used in the successful attempt to find food.

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Ice Minus and Jobs Minus

The coincidence of an actual field test of a genetically engineered organism with the arrival in Washington of Prime Minister Yasuhiro Nakasone to discuss trade imbalances generated some cerebral turbulence. The field test occurred 4 years after a committee of experts of the National Institutes of Health had declared the experiment safe. The delay was caused by lawsuits, hearings, and court appeals in various localities. As Russell Baker commented, the country is "dying of terminal jurisprudence."

To be fair, scientists are not being discriminated against selectively. Litigious delays are inflicted with magnificent sameness upon baseball teams, malpractice cases, antitrust suits, and worker injuries, to name a few other examples. Moreover, any reader of newspapers is well aware that cases usually travel by multiple appeals through ever ascending courts until the Supreme Court settles the matter, at least temporarily. The testing of the "ice minus" organisms, however, is illustrative of the special problems of scientists. Of all organisms that scientists plan to release into the environment, this is probably one of the safest. It already exists in nature in a slightly different form, and the natural form has been shown not to take over in preference to existing species. The engineering involved the removal of a protein, not the addition of one. In the interminable legal delays, not one serious scientific fact was added to the initial body presented to the NIH committee. Judges can, and indeed do, throw cases out of court for lack of merit. But in these cases, presumably public outcry generated by mediawise groups convinced judges to consider seriously issues that had little scientific substance. The question arises whether that is a good way to proceed and whether in an increasingly competitive world, the United States can afford such leisurely undertakings.

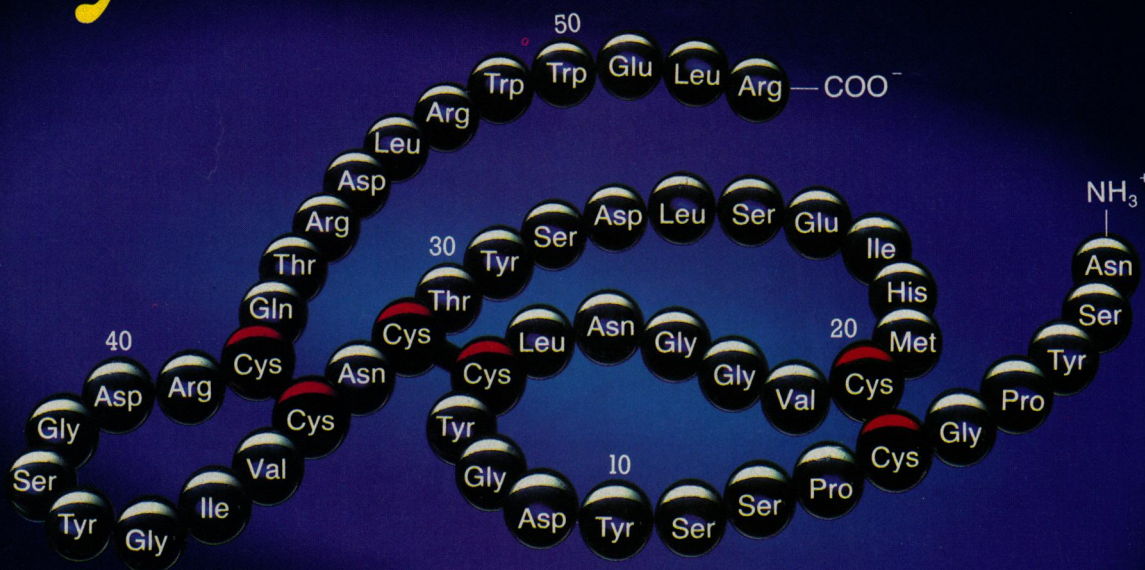
Scientists have an obligation to inform the public, particularly when a new and mysterious technology is introduced. But the public also has some responsibility to make minimal efforts to learn. In some of the media accounts it was implied that local groups knew nothing about what was going to happen because the scientists had not come and personally explained the experiment. Yet, newspapers these days contain stories explaining the uses of recombinant DNA in a variety of medical, scientific, and agricultural advances. The need for the federal government to avoid multiple considerations of the same subject was discussed (Editorial, 2 May 1986, p. 561) and to a large extent Washington has done just that. The next question is whether the post-Washington period can be streamlined not just for recombinant DNA, but also for other complex scientific subjects.

The time may have arrived when specialized judges with scientific training are a necessity. We are living in an increasingly technological society, and increasing numbers of lawsuits involve matters in which a rudimentary knowledge of science is essential. Lawyers specialize in areas such as commercial law, family law, tax law, and patent law, and in certain cases judges with specialized knowledge can be requested by mutual consent of the litigants. The concept of a judiciary some of whom are trained in scientific methods and to whom cases are routinely assigned is even more appropriate to our times. The administration could have many forms, from a deliberate introduction of a certain fraction of scientifically oriented judges per state to a few central locations in which a scientifically trained judiciary was used as a referral service for scientific cases.

The argument that local conditions will require local hearings is reasonable if there are local specifics relevant to the case. The arguments made on television and in the newspapers by opponents of the "ice minus" tests were the usual ones of "this experiment represents the first step in biological warfare," "the chance of an Andromeda strain," and "danger of an uncontrolled spread in the environment." The particular environmental conditions of Monterey versus Napa Valley versus Contra Costa County were not factors and yet each locality required hearings. Public forums are desirable in all cases, but new legal actions are not a necessary concomitant of better education.

The introduction of new organisms into the environment is a serious matter, and some future ones will require much more serious deliberation than the "ice minus" debate. The NIH committee by law contains both experts and public representatives. But repetition of the same arguments at ever lower levels of sophistication cannot ensure additional safety. These litigious delays can only lead scientific industries to select more future-oriented countries. The hazards will go but so will the jobs.—DANIEL E. KOSHLAND, JR.

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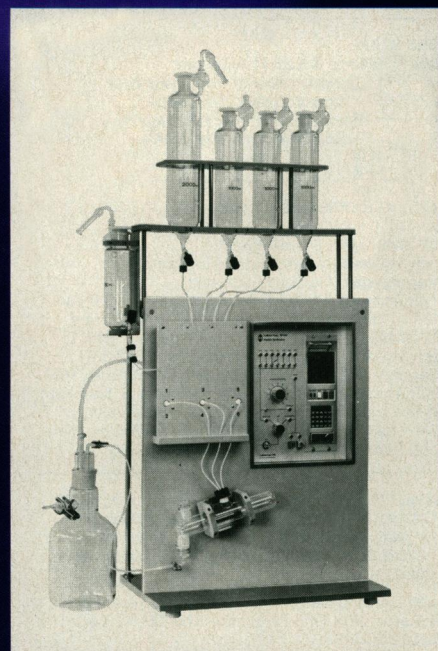
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As exciting and revealing as these new technologies are, they still involve considerable uncertainties, which I believe probably conceal significant resources. Furthermore, as we and others go back into known oil fields, we continue to discover areas that were overlooked and horizons that were drilled through without noting significant accumulations of oil.

The larger question is, What production will be possible from these various sources at what oil price? At \$18 per barrel, U.S. production could continue to decrease at maybe 8% to 10% per year. At, say, \$35 per barrel, the United States could probably regain or surpass our early 1980s production and maintain it for decades. Eighteen dollars appears to be reality; \$35 does not appear likely.

Lovins makes a number of points; I will comment on two. First, he argues that continued improvements in efficient energy utilization are possible, desirable, and inadequately covered in my article. I totally agree. The DOE Energy Research Advisory Board (ERAB) has projected possible further U.S. energy efficiency gains of 20% to 30% by

the year 2000, and I believe such improvements are physically attainable. The original draft of my paper had a much longer section on conservation, quoting ERAB.

The answer to Lovins' questions about why "oil companies [aren't] spending more on exploration" is the same as to the question of why the drive for greater U.S. energy efficiency has stalled and even reversed [the 65 mile-per-hour speed limit, CAFE (Corporate Average Fuel Economy) relief, and so forth]. The problems are low oil prices and government policies.

Low oil prices severely limit the exploration that can be economically justified under the current U.S. tax structure. That tax structure was basically established during the high profit period of the late 1970s and early 1980s. It has not been revised to accommodate the new realities that followed the 1986 oil price collapse. Tax structure changes could lower effective costs and thereby stimulate a dramatic expansion of new U.S. exploration and production.

Low oil prices also severely dampen the economic driving force for additional energy conservation. The only possible counter

to that situation is government policy change, which could mandate continued energy efficiency improvements. When the stakes are as high as they are in energy, an either-or policy seems to me to be foolhardy. I believe that both increased U.S. exploration-production and increased energy efficiency are in the national interest, and I favor policies that would stimulate both.

ROBERT L. HIRSCH
ARCO Oil and Gas Company,
2300 West Plano Parkway,
Plano, TX 75075

Erratum: In Constance Holden's article "NIMH finds a case of 'serious misconduct'" (News & Comment, 27 Mar., p. 1566), the location of the Oakdale Regional Center for Developmental Disabilities was incorrectly given as Illinois. The center is in Oakdale, Michigan.

Erratum: In the 1 May AAAS News (p. 610), four paragraphs that should have appeared under the heading "Pacific Division meets in San Diego, 14-18 June," incorrectly appeared under the heading "SB&F focuses on science in the middle grades." The misplaced text (p. 611) begins, "In addition, several field trips are scheduled. . . ." and ends, "or call 415-752-1554."

Erratum: In Jean L. Marx's Research News article "Oxygen free radicals linked to many diseases" (30 Jan., p. 529), Benedict Lucchesi (whose name was misspelled) was incorrectly described as expecting to initiate clinical trials of superoxide dismutase and catalase in human heart attack patients who undergo reperfusion therapy.



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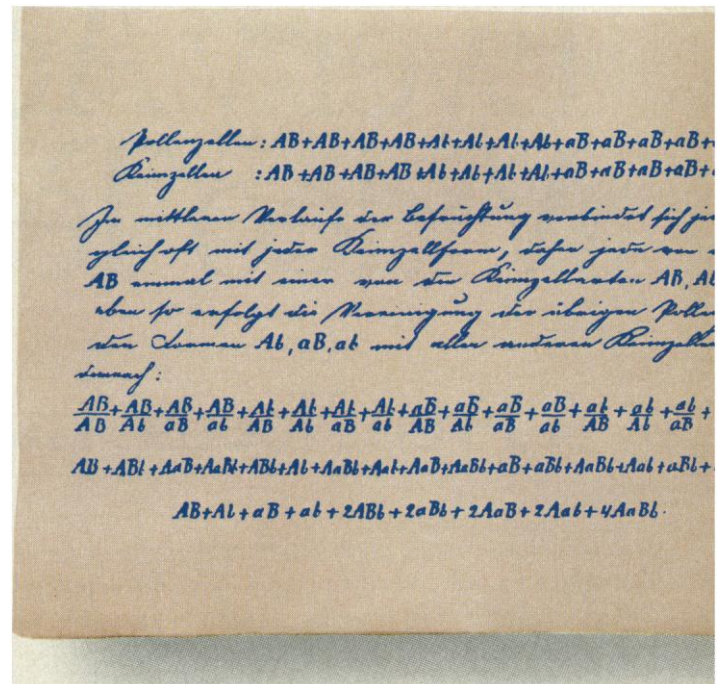
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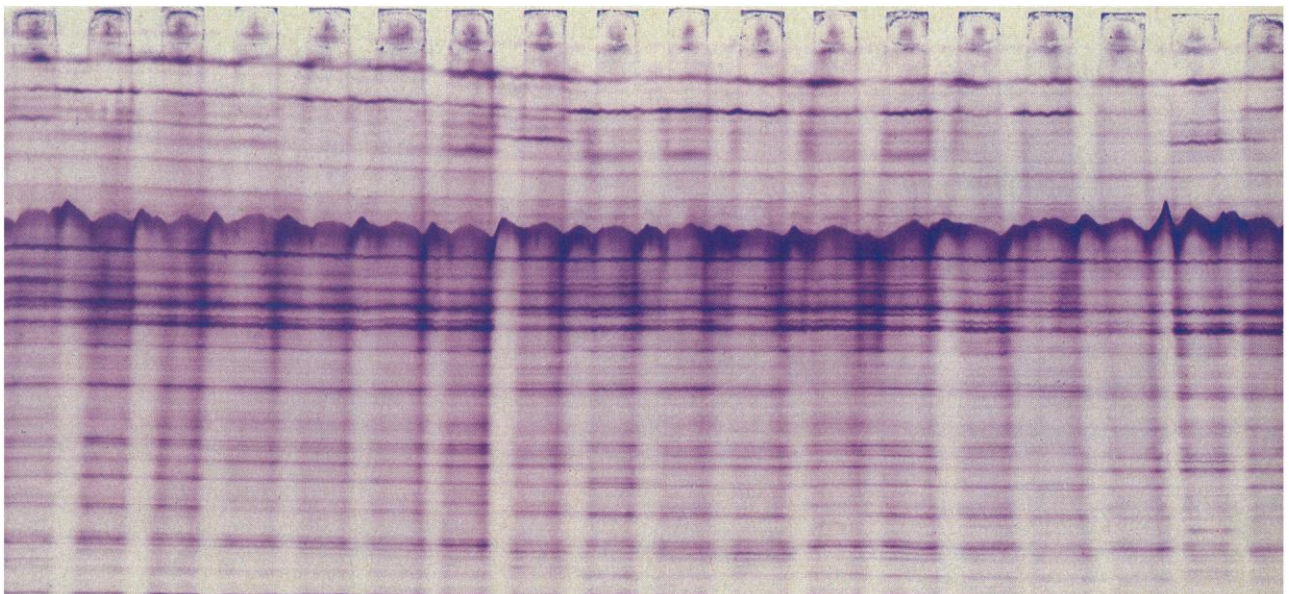
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The tools of Mendel's study were the colors, textures and shapes of plants, such as this preserved pea, *Pisum sativum*, pressed in 1853 at the Botanical Garden of the University of Uppsala, Sweden.

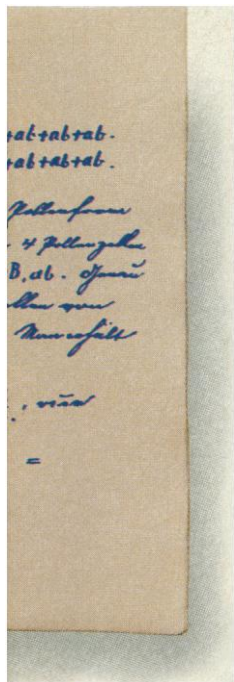


A facsimile from one of Mendel's own handwritten manuscripts, in which he sets forth the Mendelian laws.



Seed proteins of 20 different pea variants (*Pisum sativum*), focused on Immobiline DryPlate pH 4–7. The gel was rehydrated with 8M urea, 15% glycerol and 10 mM DDT. (A. Görg et al, in *Electrophoresis* '86, ed. M.J. Dunn; VCH Verlagsgesellschaft mbH, Weinheim F.R.G. 1986, 435–449.)

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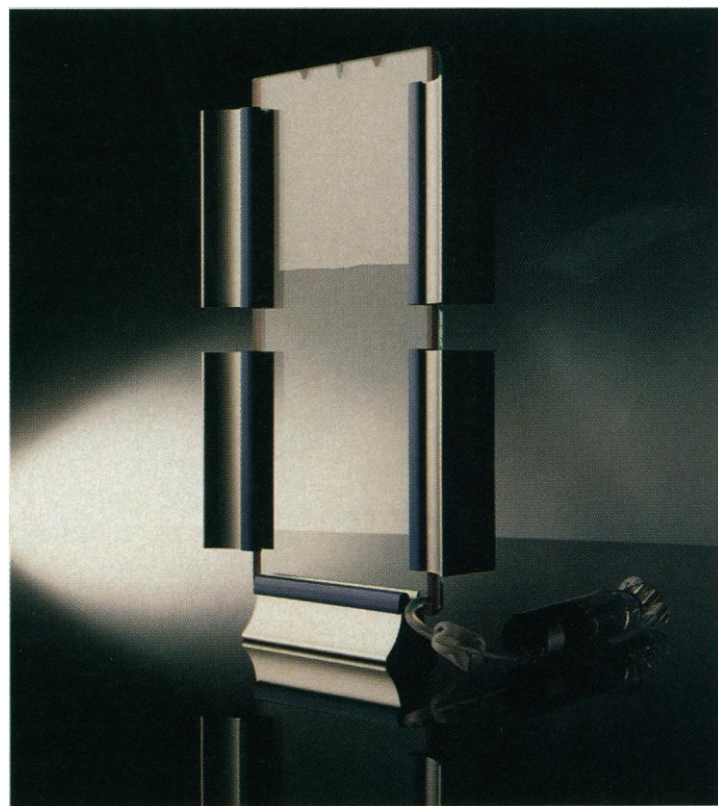
Whereas Mendel was limited to studying the colors, textures and shapes of plants, modern genetics uses high resolution electrofocusing advantageously to study minute variations on the protein level.

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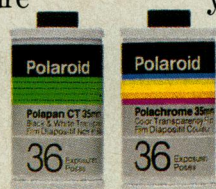
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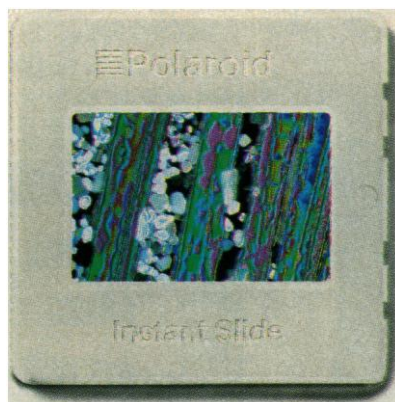
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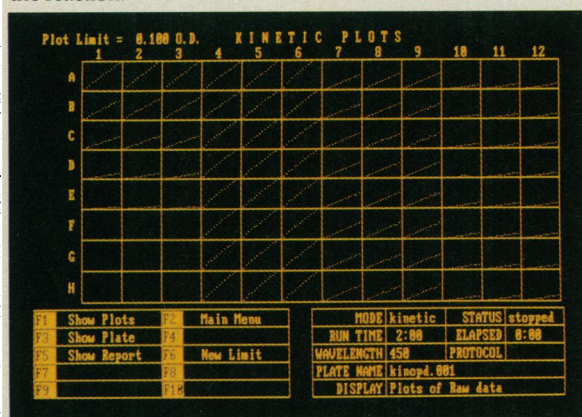
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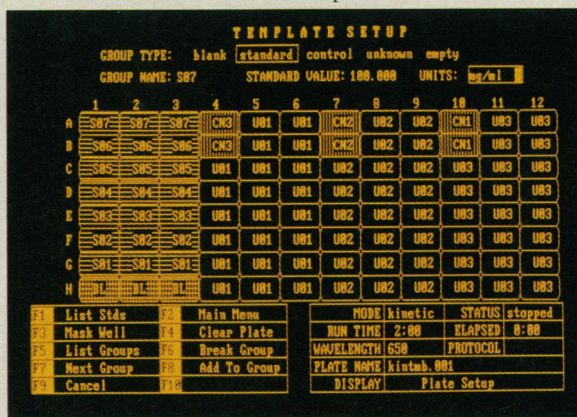
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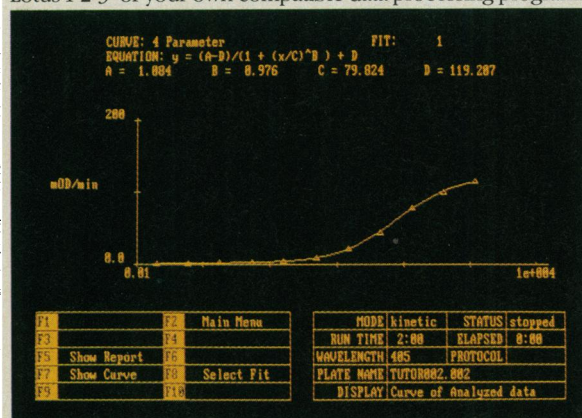
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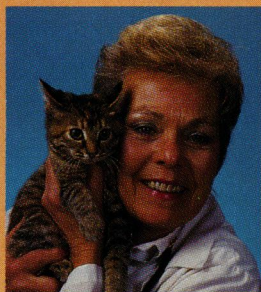
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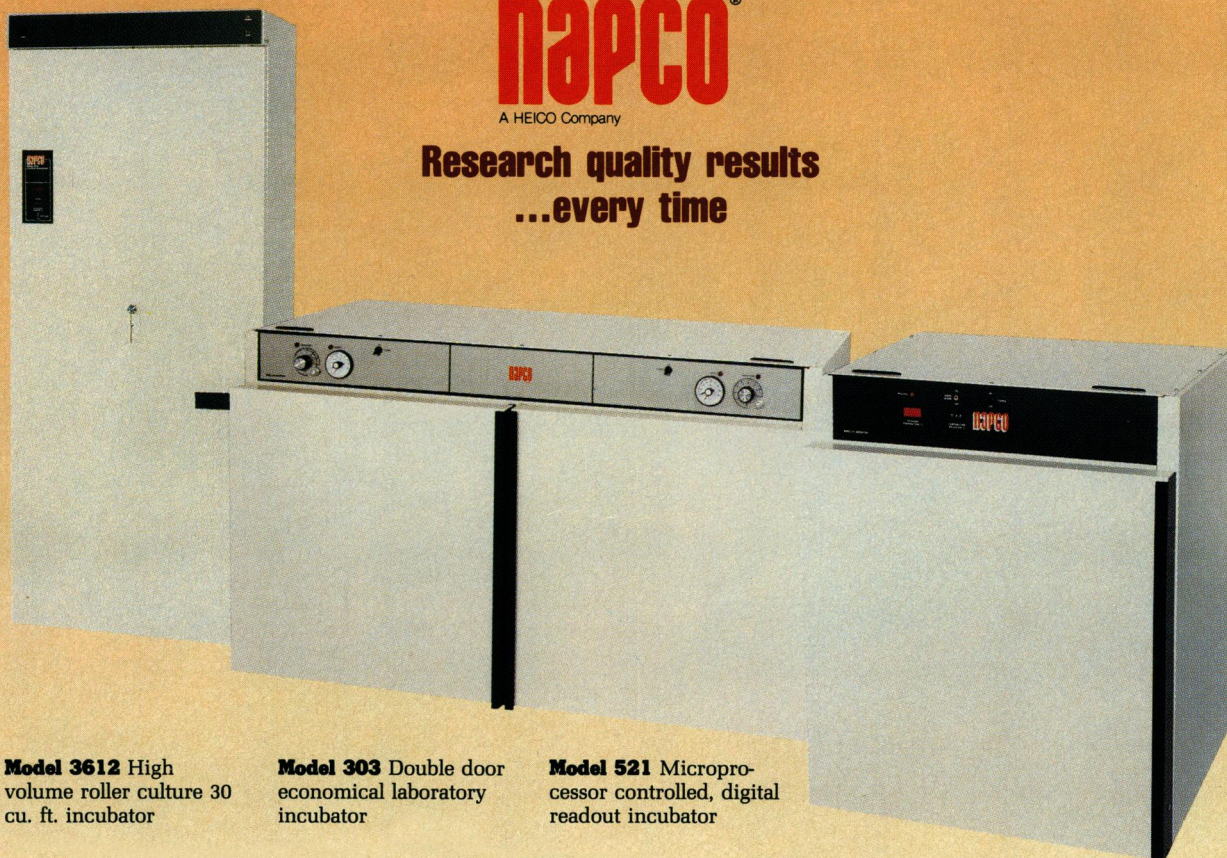
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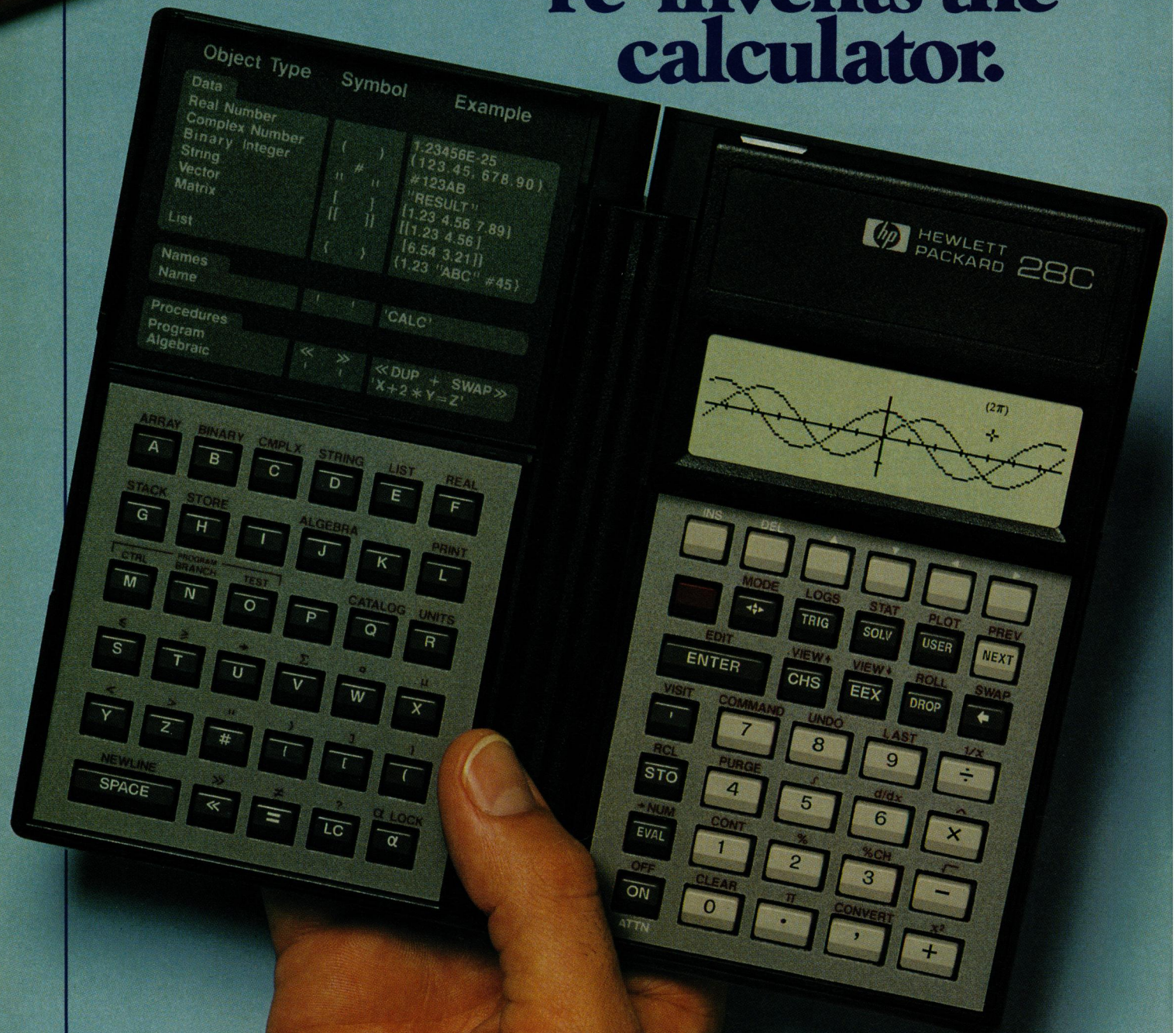
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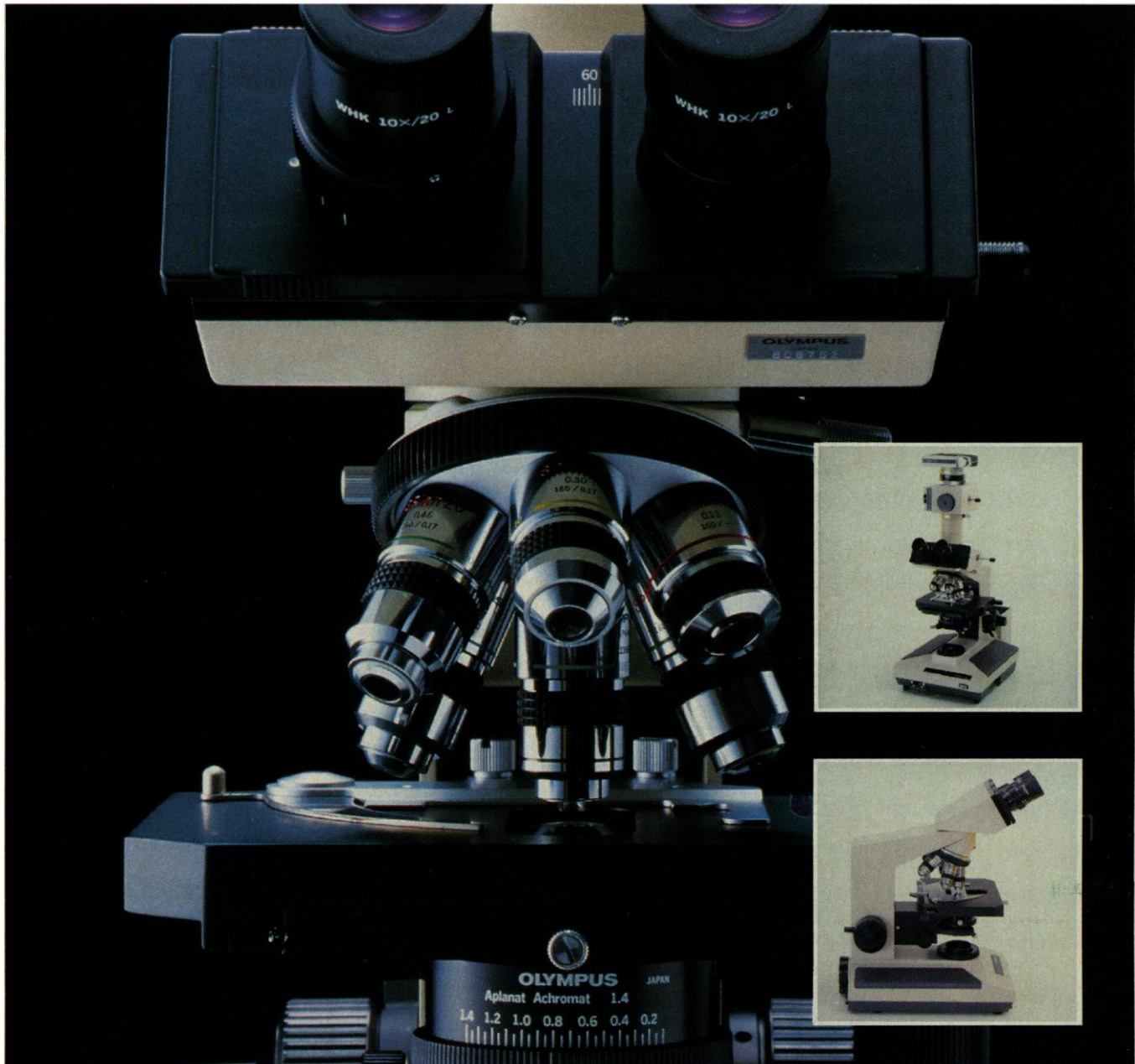
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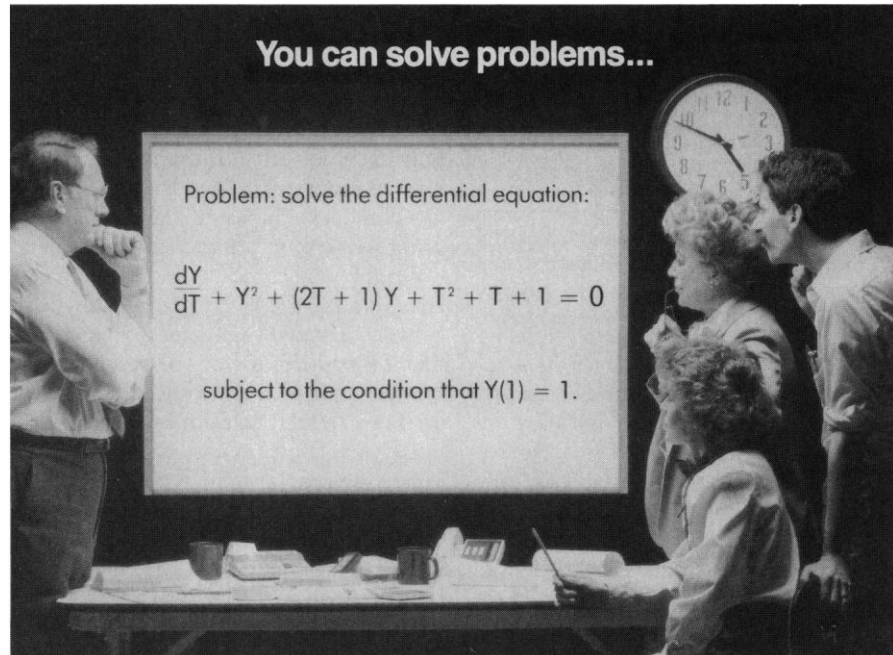
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Symbolically...

```
(C1) DEPENDS(Y,T)$
(C2) DIFF(Y,T)+Y^2+(2*T+1)*Y+T^2+T+1;
(D2) dY/dT + Y^2 + (2T + 1)Y + T^2 + T + 1
(C3) SOLN:ODE(D2,Y,T);
(D3) Y = - (%C T %E^T - T - 1) / (%C %E^T - 1)
(C4) SOLVE(SUBST([Y=1,T=1],D3),%C),NUMER;
(D4) [%C = 0.5518192]
(C5) SPECIFIC SOLN:SUBST(D4,SOLN);
(D5) Y = - 0.5518192 T %E^T - T - 1 / 0.5518192 %E^T - 1
```

and Numerically.

```
(C6) FORTRAN(D5)$
      Y = -(0.5518192*T*EXP(T) - T - 1)
      1 / (0.5518192*EXP(T) - 1)
```

electromagnetic field problems, plasma physics, atomic scattering cross sections, control theory, maximum likelihood estimation, genetic studies, and more.

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- Symbolics 3600[™] Series
- VAX & MicroVAX II
- SUN-2 & SUN-3
- Apollo
- Masscomp

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