13 April 1979 • Vol. 204 • No. 4389 $1.50

SCIENCE

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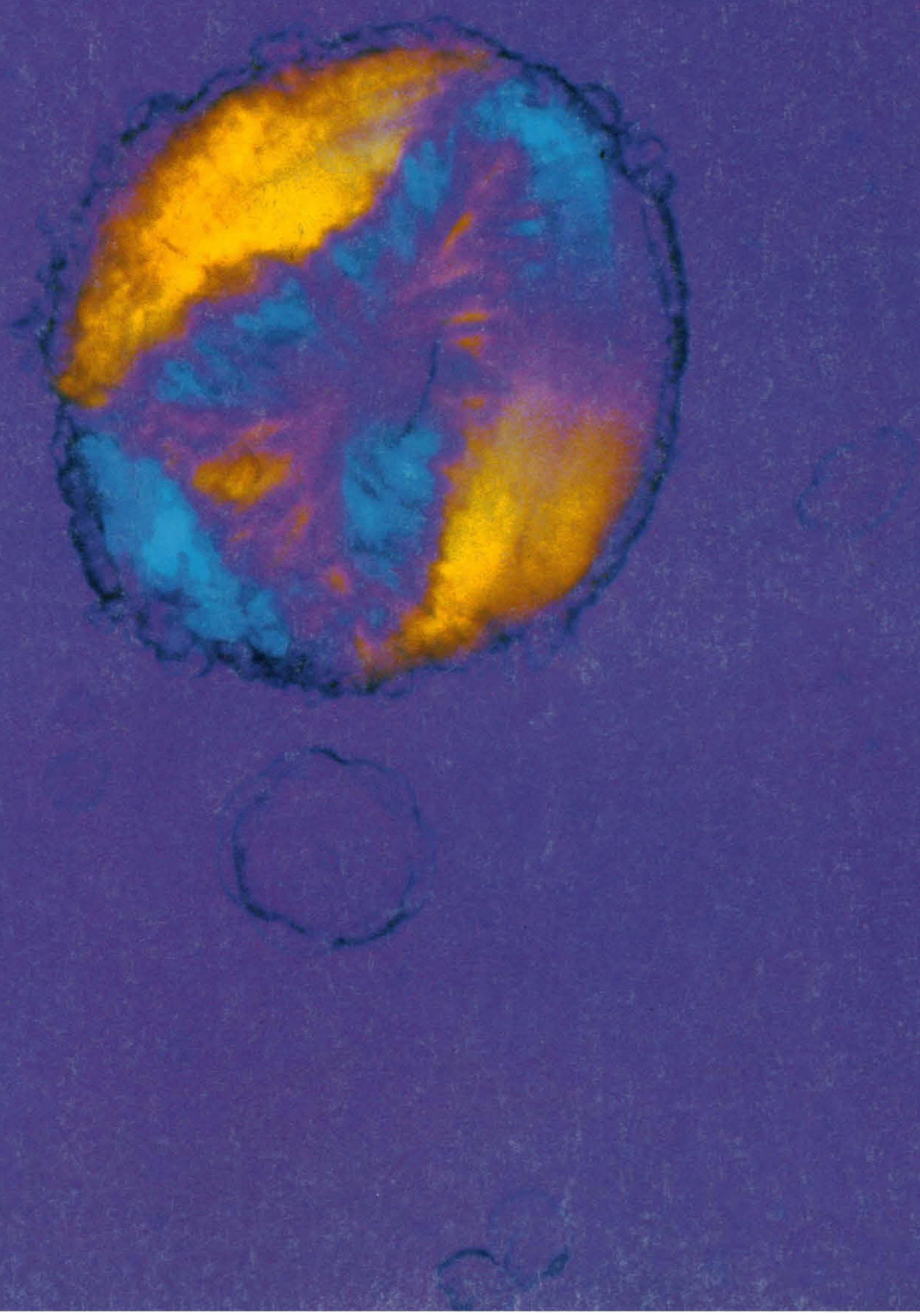


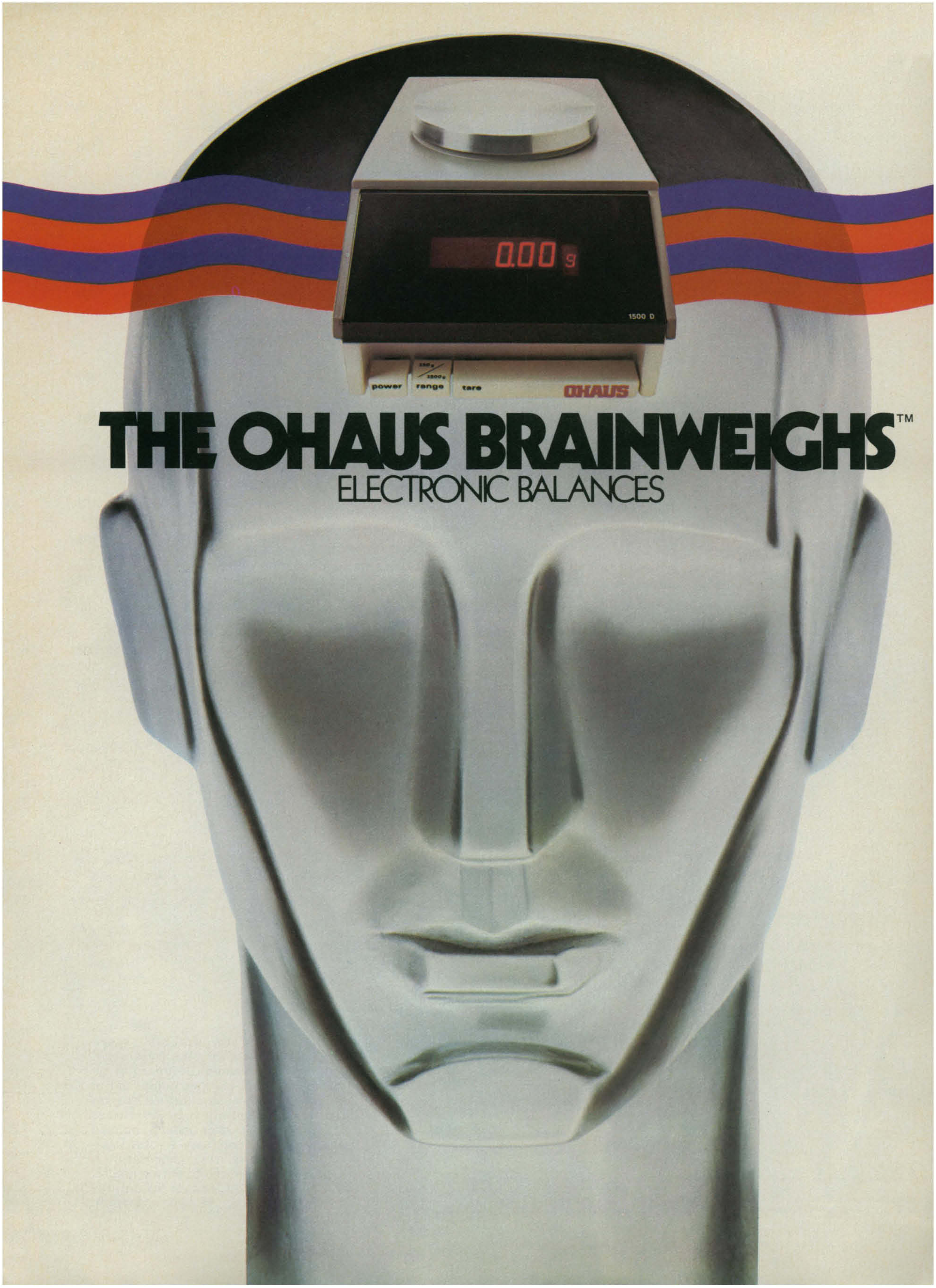
ISSN 0036-8075
13 April 1979
Volume 204, No. 4389

SCIENCE

SCIENCE is published weekly on Friday, except the last week in December, by the American Association for the Advancement of Science, 1515 Massachusetts Avenue, NW, Washington, D.C. 20005. Second-class postage (publication No. 484460) paid at Washington, D.C., and at an additional entry. Now combined with **The Scientific Monthly®**. Domestic individual membership and subscription (51 issues): $34. Domestic institutional subscription (51 issues): $70. Foreign postage extra: Canada $12, other (surface mail) $15, air-surface via Amsterdam $40. First class, airmail, school-year, and student rates on request. Single copies $1.50 ($2 by mail); back issues $2.50 ($3 by mail); classroom rates on request. **Change of address:** allow 6 weeks, giving old and new addresses and seven-digit account number. **Postmaster:** Send Form 3579 to *Science*, 1515 Massachusetts Avenue, NW, Washington, D.C. 20005. *Science* is indexed in the *Reader's Guide to Periodical Literature* and in several specialized indexes.

COVER

Microscopy of the earliest physiochemical events during the digestion of fat. Interference colors produced by birefringent liquid crystals composed of fatty acids and calcium formed by pancreatic lipase hydrolysis on the surface of an olive oil droplet under simulated physiological conditions (crossed polars, first order quartz compensator, × 870). See page 145. [J. S. Patton and M. C. Carey, Harvard Medical School, Peter Bent Brigham Hospital, Boston, Mass.]



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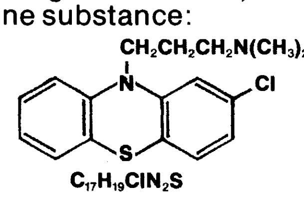

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Do you need to look up 100 names for Chlorpromazine to avoid missing literature on this drug? Not if you use the CAS Indexes to CHEMICAL ABSTRACTS (CA).

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Three Steps Toward Efficient Literature Searching

A study of Chlorpromazine involves checking three CAS publications. You can find references on many chemical substances by following essentially the same steps:

concerns chemical it should Abstracts Indexes.

1. Find the CA Index Name

First, looking up Chlorpromazine in the CA INDEX GUIDE, you find the following entry:

Chlorpromazine
See *10H-Phenothiazine-10-propanamine, 2-chloro-N,N-dimethyl-* [50-53-3]

This is the fully systematic CA Index Name. It designates the unique molecular structure and eliminates the ambiguity arising from trade names and "common language" terms applied to this drug. The five-digit number in brackets is the CAS Registry Number; it has no structural significance but provides a concise identification (somewhat like a social security number) for the substance.

2. Go to the CA Indexes

Now that you have the CA Index Name, it's a simple matter to find literature references. Assuming that studies published after 1961 are of primary interest in this case, you go to the CA Seventh, Eighth, and Ninth Collective Indexes. Each covers five years (ten volumes) of CA: together, the three collectives provide access to all chemically-significant literature referenced in CA between 1962 and 1976. For more recent studies, check the semiannual CA Volume Indexes published since 1976.

No matter what term was used for this drug in the literature, any study concerning Chlorpromazine is listed under the CA Index Name:

10*H*-Phenothiazine-10-propanamine
•
•
•
—, **2-chloro-*N*,*N*-dimethyl-** *(chlorpromazine)* *[50-53-3]*
10*H*-Phenothiazine-10-propanamine, 2-chloro-*N*,*N*-dimethyl- *[50-53-3]*, **analysis**
detection of, by gas chromatog., 128228u
detn. of
in blood, 111152s
in blood and urine, by gas chromatog., 128222n
in blood and urine, in overdosage, 47872x
•
•
•
10*H*-Phenothiazine-10-propanamine, 2-chloro-*N*,*N*-dimethyl- *[50-53-3]*, **biological studies**
absorption of, by cassava powder, in simulated stomach conditions, 178750d
acetylcholine metab. by brain response to, 145828g
acetylcholine of brain striatum response to, dibutyryl cyclic AMP in relation to, 127222a
•
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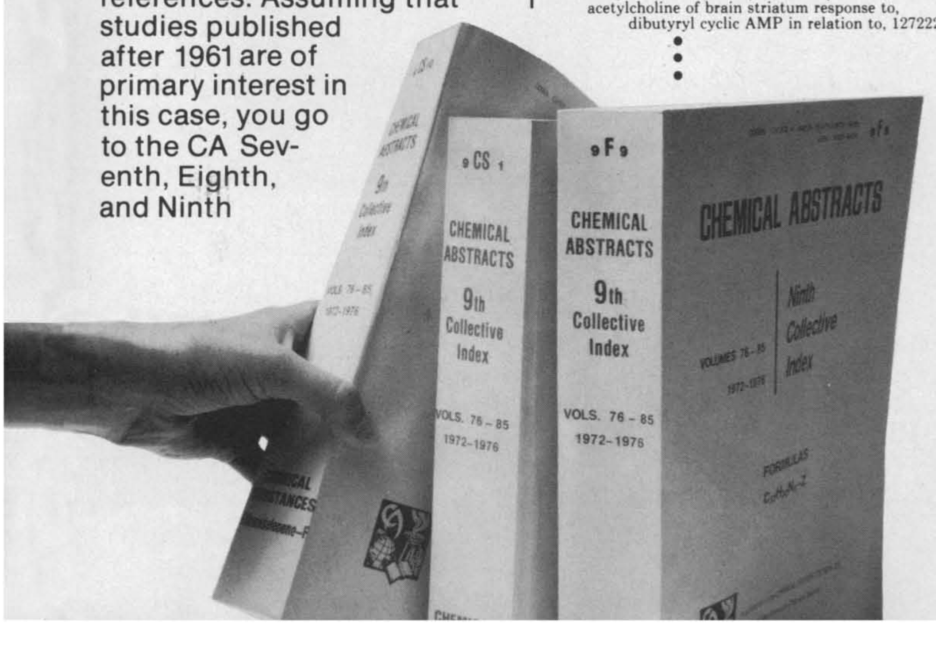

3. Read the Abstracts in CA

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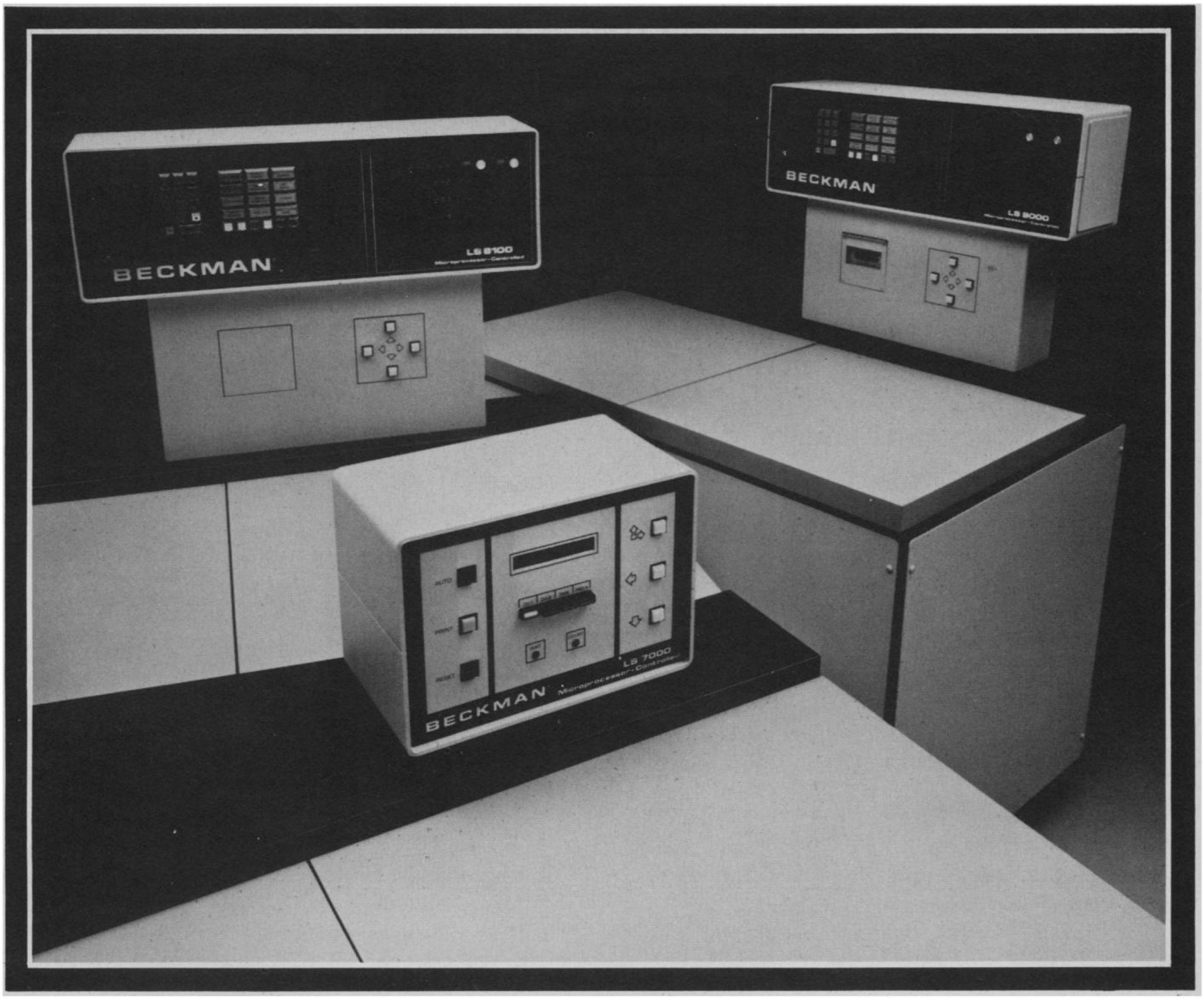

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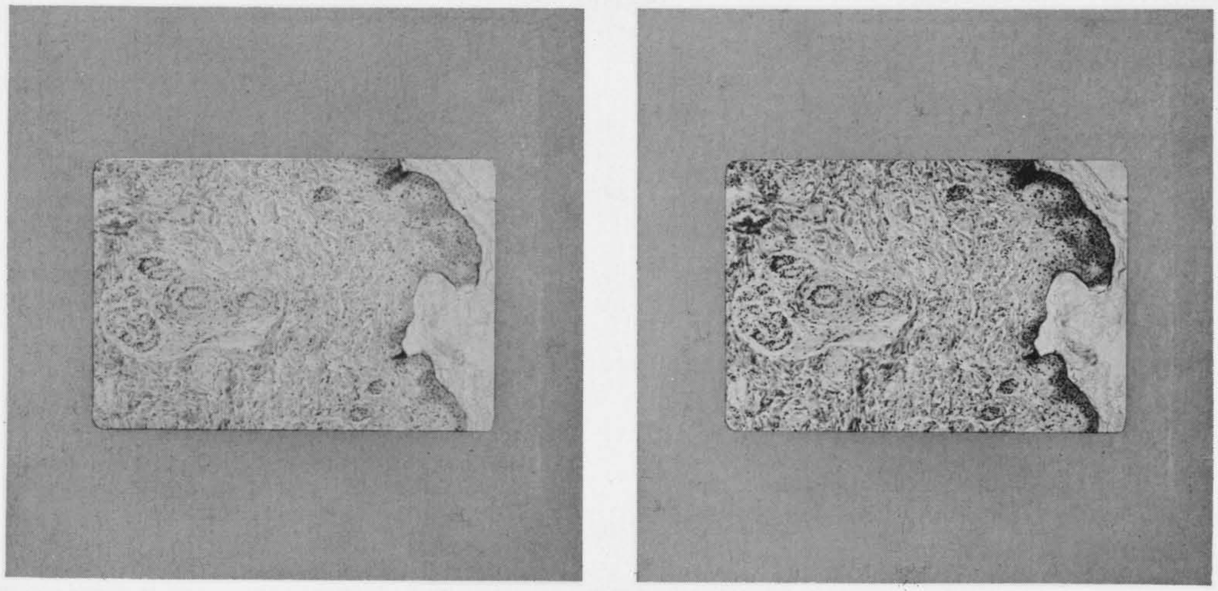

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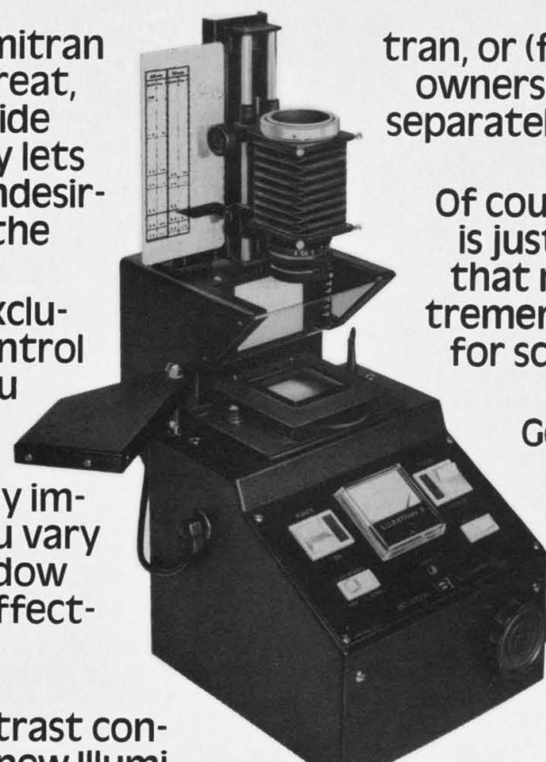

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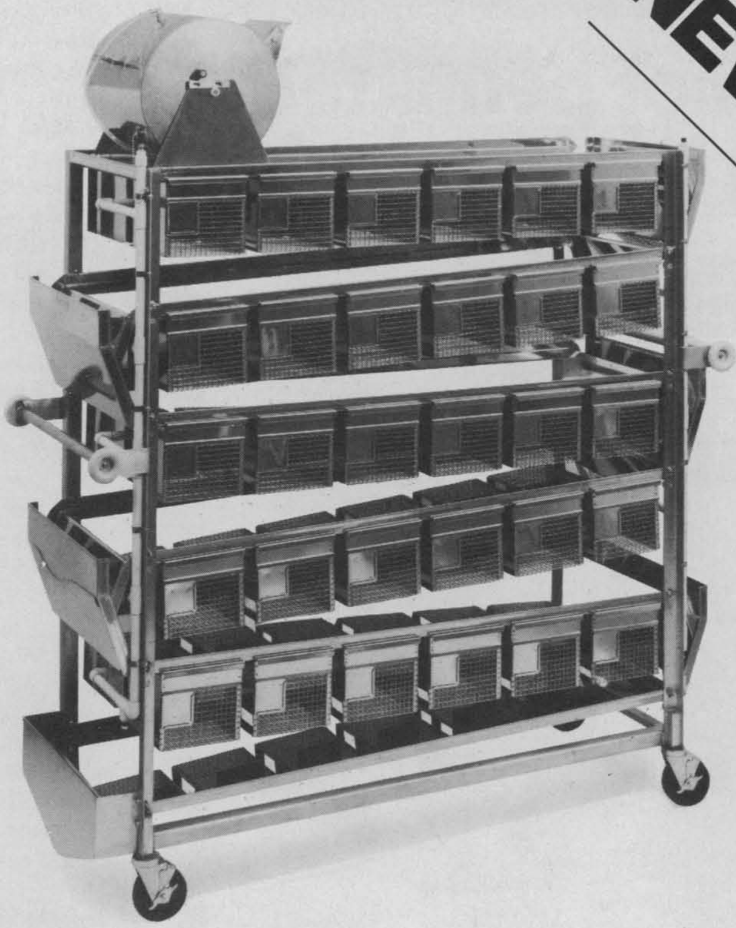

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grossly suboptimal. It used a packaged rather than a field-erected collector—roughly doubling the cost per square meter (7); was about seven times oversized (8); and required backup even though 100 percent solar heating is cheaper for a house to which cost-effective heat-conserving measures have been applied first (9). Seeking the best buy for each technology, I relied on Bechtel data in Bechtel's area of expertise—hard technologies—but, outside it, preferred other data sources (2) that were more detailed and technically sound and included all the other soft technologies I wished to analyze. (The ESPM included no others.) Contrary to Gallagher's implication, I normalized all cost data to the same accounting conventions for all technologies.

The ESPM was intended, as Gallagher states, to calculate only total capital costs, not fuel or operating costs (10). For a complete accounting I therefore had to add non-Bechtel auxiliary assumptions (1, 2). Seeking to show that my results "are often dominated more" by those than by the ESPM capital costs, Gallagher compares my first published capital-cost calculation (11)—"\$3179 to \$5000" (12) per kilowatt electric (kWe) delivered for nuclear and \$2476/kWe delivered for coal—with the ESPM's total capital cost of "approximately \$1100/kW installed capacity for both coal and nuclear systems (in 1974 dollars, including transmission and distribution)." Of course they differ—like comparing apples with horned toads. Gallagher's costs are per kilowatt electric installed, not delivered; using the capacity factors from (13) and the ESPM's transmission and distribution (T & D) losses [16.4 percent (1)] and capital costs (\$489/kWe installed), the ESPM's actual 1974-dollar capital costs of \$1074 and \$964/kWe *installed* for nuclear and coal, respectively, would become \$1976 and \$2306/kWe *delivered*. Gallagher has also omitted (1, 2, 11) the ESPM's marginal fuel-cycle investments and my initial core cost and compared his 1974 dollars with my 1976 dollars. The discrepancies he cites arise solely from these sources, which result from his arbitrary omissions, not my "arbitrary assumptions"; and my non-ESPM assumptions are not "arbitrary" but based on the best available statistical fits to the historic data. Further, substituting Bechtel's capacity factor and T & D losses for mine as above does not, as Gallagher implies, "strongly influence" the nuclear capital cost per delivered kilowatt electric that he cites (11) but reduces it by a mere 0.6 percent to

$3158—and *increases* the coal-system cost 32 percent to $3278 (all in 1976 dollars).

Gallagher objects to my use of the ESPM data base as it stood at October 1976 (*4*), saying it is outdated. Of course, I could not have used post-1976 data in a 1976 analysis, and in defending that analysis subsequently it would be confusing to substitute new data rather than reexplain the old. But I emphasized in my letter that newer data are available, such as the Mooz (*14*) and Komanoff-Taylor (*15*) regressions for light-water reactor capital cost, and that using them results in *higher* nuclear costs—hardly congenial to Gallagher's case. I retained the 1975 ESPM data as a deliberate conservatism, and said so (*16*).

For example, I convert the ESPM reactor cost, $585/kWe installed in 1974 dollars, to $929 in 1976 dollars using the Bupp & Treitel index (*1, 2, 11*), which shows r^2 of 0.71 on a 35-plant sample. The newer Mooz and Komanoff-Taylor regressions, with respective r^2's of 0.76 on 39 plants and 0.83 on 42 plants, would have yielded corresponding costs (in 1976 steam-plant dollars) of $1474 and $1330 (*17*). Other recent studies (*18*), including two by Bechtel (*19, 20*), are also consistent with or higher than my $929/kWe. Using all Gallagher's latest 1977 costs *and* his other assumptions (*21*), then deflating by his 7 percent to 1976 dollars, yields $1037/kWe installed for the reactor and $2905/kWe delivered for the whole-system nuclear capital cost, compared to my $929 and $3495. Thus his latest data, far from confuting or "substantial[ly] reworking" my findings, broadly confirm them.

His final quotation, about the relevance of economic calculations, referred in its original context (*1, 11*) to the importance of sensitivities, externalities, and the two-orders-of-magnitude lower price of the costliest industrial energy relative to the cheapest human labor. But I agree that economic calculations, which are worth doing for an audience that considers them important, should be "based on consistent and current information," conservative, scrutable, thoroughly documented, and widely published for protracted peer review. That is just what my cost calculations are. May I therefore hope this will be the last time I ask in these columns that we stop inventing tedious new misreadings and start getting on with better energy policies?

AMORY B. LOVINS
International Project for Soft Energy Paths, 124 Spear Street, San Francisco, California 94105

References and Notes

1. A. B. Lovins, *Soft Energy Paths: Toward a Durable Peace* (Harper Colophon, New York, 1979; originally Friends of the Earth and Ballinger, Cambridge, Mass. 1977, and Pelican, 1977), especially pp. 105-115.
2. ——, *Annu. Rev. Energy* **3**, 477 (1978).
3. M. Carasso, J. M. Gallagher, K. J. Sharma, J. R. Gayle, R. Barany, *The Energy Supply Planning Model* (final report to the National Science Foundation, Bechtel Corp., San Francisco, August 1975; available from the National Technical Information Service, Springfield, Va.).
4. As updated to October 1976. I stated (*1*) that Gallagher and Carasso had kindly given me the results of Bechtel's data-base update to October 1976; Gallagher states in his letter that this update had not changed the original 1974-1975 cost estimates for the systems I considered; both statements are correct. Our autumn 1976 communications did, however, confirm earlier cost figures, and resolved several errors and ambiguities in other relevant data (such as the definitions of transmission-line modal splits) used in the original ESPM report (*3*). The 1975 base costs are still not updated today (*16*).
5. In this letter, capital costs mean direct construction costs plus owner's costs (mainly for interest during construction)—given, respectively, in the ESPM's tables D-3 and D-2 (*3*, vol. 2)—and all coal-electric plants (called simply "coal" for short) include scrubbers.
6. The ESPM nominal solar heating system, about which I could obtain no further details, was described only as a 500-square-foot, single-house, active system with 1000-gallon storage and an auxiliary boiler, supplying 70 million Btu's per heating season. In 1974 dollars, it cost $10,350 (−20 percent, +40 percent) per house, or $20.7 per square foot [(*3*, table D-3) gives the specific cost correctly as $129,000 per 10^9 Btu's per year and incorrectly as $129 per 10^6 Btu's per day; the former figure is 13 percent *higher* than that shown for solar space cooling. The 1977 update (*20*) reduces the heating-system cost to $20.4 per square foot in 1977 dollars]. After normalizing to my accounting conventions (*2*), the capital cost alone for the ESPM system is 4.8 times the maximum total cost of my better-optimized solar system of the costliest kind.
7. A. B. Lovins, *Energy Policy* **6**, 171 (1978), p. 175; *Proceedings of the 1st New England Site-Built Solar Collector Conference* (Mechanical Engineering Department, Worchester Polytechnic Institute, Worchester, Mass., 1978).
8. A. B. Lovins, in U.S. House of Representatives, Committee on Government Operations, Subcommittee on Environment, Energy and Natural Resources, *Nuclear Power Costs* (Government Printing Office, Washington, D.C., 1978), part 2, p. 1106. See also H. Nash, Ed., *The Energy Controversy: Soft Path Questions and Answers* (Friends of the Earth, San Francisco, in press).
9. A. B. Lovins, *Soft Energy Notes*, in press.
10. The ESPM does, however, assess many approximate operating factor inputs by two-digit Standard Industrial Classification category for use in interfacing with input-output models.
11. A. B. Lovins, in *Future Strategies for Energy Development* (Oak Ridge Associated Universities, Oak Ridge, Tenn., 1977), pp. 109-113. This calculation is the precursor of chapter 6.1 of (*1*).
12. This misrepresents (*11*), in which I use the deliberately conservative figure $3179/kWe delivered. The figure $3496 [later adopted in (*2*)] is mentioned (*11*, p. 112n) as better fitting the historical cost data, and ~ $5000 is mentioned (*11*, p. 114) as a more realistic estimate, but neither is used in the analysis in (*11*), and the latter figure does not underlie any of my conclusions.
13. J. M. Gallagher, M. Carasso, R. Barany, R. G. J. Zimmerman, "Direct requirements of capital, manpower, materials, and equipment for selected energy futures" (Bechtel Corp., San Francisco, April 1976; available from the National Technical Information Service, Springfield, Va.). These capacity factors, from the Energy Research and Development Administration and Brookhaven National Laboratory, were 0.65 for nuclear and 0.50 for coal, compared with my 0.55 for nuclear and 0.62 for coal (*1*). The ESPM leaves capacity factors to be chosen by its user.
14. W. E. Mooz, "Cost analysis of light water reactor power plants" (Report R-2304-DOE, Rand Corp., Santa Monica, Calif., 1978).
15. C. Komanoff, "A comparison of nuclear and coal costs" (testimony to the New Jersey Board of Public Utilities, Docket 762-194, Phase III, 9 October 1978).
16. See (*11*), pp. 109n and 112n; (*1*), p. 106, note 4;

(*2*), p. 501, note e; (*14*); and notes 7 and 8 of my letter. Further, with the apparent exception of electric distribution costs (*21*), the newer studies Gallagher cites update only escalation and indirect costs; the 1975 base costs and schedules will not be updated until the spring of 1979.

17. I assume a 1.1-gigawatt dual unit with a cooling tower, built outside the Northeast, as the architect-engineer's 25th unit and the country's 124th commercial construction-permit issuance (134, including 16 under turnkey contracts, had been issued by 31 August 1976). The *empirical* cost [smoothed as in (*15*)] of plant 58, commissioned in December 1977, was \$920/kWe in 1976 steam-plant dollars, confirming the conservatism of my \$929 for 1976 *ordering* and zero real escalation.
18. See, for example, note 8 of my letter and, in terms of total cost per kilowatt-hour sent out, C. L. Rudasill, "Coal and nuclear generating costs." [Report No. PS-455-SR, Electric Power Research Institute (EPRI), Palo Alto, Calif., April 1977)].
19. EPRI's average coal cost (*18*), derived from a special Bechtel study, is \$595 to \$721 per kilowatt electric, comparing well with my \$607. Komanoff has shown [(*15*), "Responses to PSE & G Requests 31 & 35," 27 December 1978] that the average U.S. historical ratio of nuclear-to-coal capital costs per kilowatt electric installed is 1.51 (1.72 without an industry-derived 16 percent addition for coal plants without scrubbers). My own nuclear-to-coal ratio, 1.53, is consistent with this historical 1.51 and exceeds the ESPM's unrealistically low 1.23 because of 2 years' differential escalation at 13 percent per year in the Bupp & Treitel conversion from 1974 to 1976 dollars (*1, 2*). If we assume zero differential escalation after 1976, the EPRI-Bechtel 1977 coal cost of \$595 to \$721/kWe and the historical nuclear-to-coal ratio of 1.51 together imply a nuclear cost of \$898 to \$1089/kWe, averaging 7 percent above my \$929/kWe. Thus in order to achieve a nuclear cost of only \$929/kWe, coal would have to escalate *faster* than nuclear from 1977 to 1985 in order to reduce their ratio below historical levels. This implausible requirement indirectly confirms the conservatism of my reactor cost figure.
20. J. M. Gallagher, R. Barany, P. F. Paskert, R. G. J. Zimmerman, "Resource requirements, impacts, and potential constraints associated with various energy futures" (annual report to the Department of Energy, Bechtel National, Inc., San Francisco, August 1978; available from the National Technical Information Service, Springfield, Va.). The nuclear cost given, using the 7 percent and 9 percent annual escalation and interest rates that the authors assume, is \$1110/kWe installed in March 1977 dollars. The ratio of this cost to their average coal cost (weighting high- and low-Btu-coal plants according to the ESPM's table 7-7) is 1.51, precisely the historical average and consistent with my argument (*19*).
21. This assumes costs (including escalation and interest) as given in (*20*) for all facilities; Bechtel's 0.65 capacity factor (*13*); the ESPM's 16.4 percent T & D losses (*1*); my fuel-cycle parameters (*1*) and initial core costs (*1*) (\$100/kWe installed, inflated 7 percent to 1977 dollars); and the T & D modal splits (*1*) supplied by Gallagher on 4 October 1976. Per kilowatt electric of installed generating capacity, (*20*) then yields 1977 dollar costs for the reactor, marginal fuel-cycle facilities, transmission, and distribution of, respectively, \$1110 (12 percent up from my value), \$79 (3 percent down), \$97 (5 percent up), and \$290 (48 percent down). The updated costs thus agree quite well with those I obtained by escalating the ESPM's costs from 1974 to 1976 dollars with appropriate indices (*1, 2*)—except for distribution, whose base cost the update has inexplicably halved (*16, 20*) from a value Bechtel described in May 1976 as "based on quite detailed information, with both quantities and prices listed, [so] we are confident based on a thorough review . . . that the estimate is reasonable, given the assumptions used." ["Review of electric distribution costs" (memorandum to Brookhaven National Laboratory, Bechtel Corp.)]. Because the other capital costs agree so well, combining Gallagher's latest costs (*20*) with *my* 0.55 capacity factor and 10.7 percent T & D losses changes the whole-system nuclear cost from \$2905/kWe delivered to \$3204, only 8 percent below my \$3495 (all in 1976 dollars, deflating the Bechtel values 7 percent); this difference arises from the changed distribution base cost. Thus *neither* substituting Bechtel's latest costs *nor* their ancillary assumptions for mine significantly changes my results, as Gallagher suggests.

Carcinogenicity of Phenacetin

The article (*1*) that Pedro Cuatrecasas quotes in his letter to *Science* (5 Jan., p. 6) is a summary of the activities carried out from 1971 to 1977 under the Programme on the Evaluation of the Carcinogenic Risk of Chemicals to Humans of the IARC (International Agency for Research on Cancer). The program is focused on the preparation of monographs in which all available experimental and epidemiological data, as well as data on use, production, and occurrence of individual chemicals are critically analyzed and summarized. The monographs end with an evaluation of the carcinogenicity of the chemical in animals and humans. Faced with a very large number of chemicals in our environment, we used certain criteria in our selection of those to be considered in the monograph program. It seemed reasonable to give precedence to chemicals for which (i) there is evidence of human exposure and (ii) there is some evidence of carcinogenicity in experimental animals or some evidence or suspicion of human risk.

It is clearly stated in a note to the reader at the beginning of each of the IARC monographs that "inclusion of a chemical in the monographs does not imply that it is a carcinogen, only that the published data have been examined. Equally, the fact that a chemical has not yet been evaluated in a monograph does not mean that it is not carcinogenic."

If the reader consults volume 13 (*2*) of the IARC monographs, which has the subtitle "Some miscellaneous pharmaceutical substances," a few misunderstandings could perhaps be avoided with regard to the evaluation of phenacetin as being associated with the occurrence of cancer in humans. At the time phenacetin was evaluated, that is, 18 to 25 October 1976, the results of only one experimental carcinogenicity study on phenacetin (*3*) were available. No evidence of treatment-related tumors was found in this study, in which phenacetin was mixed in the diet of Berlin-Druckrey rats at a dose of 40 milligrams per animal per day. The results of another study indicated *N*-hydroxyphenacetin, a putative metabolite of phenacetin, is carcinogenic in rats, producing hepatocellular carcinomas (*4*). The evaluation of the carcinogenicity of phenacetin in experimental animals states: "In one limited study in which phenacetin was administered orally to rats, no carcinogenic effects were observed. One putative metabolite of phenacetin, *N*-hydroxyphenacetin, is carcinogenic in rats after

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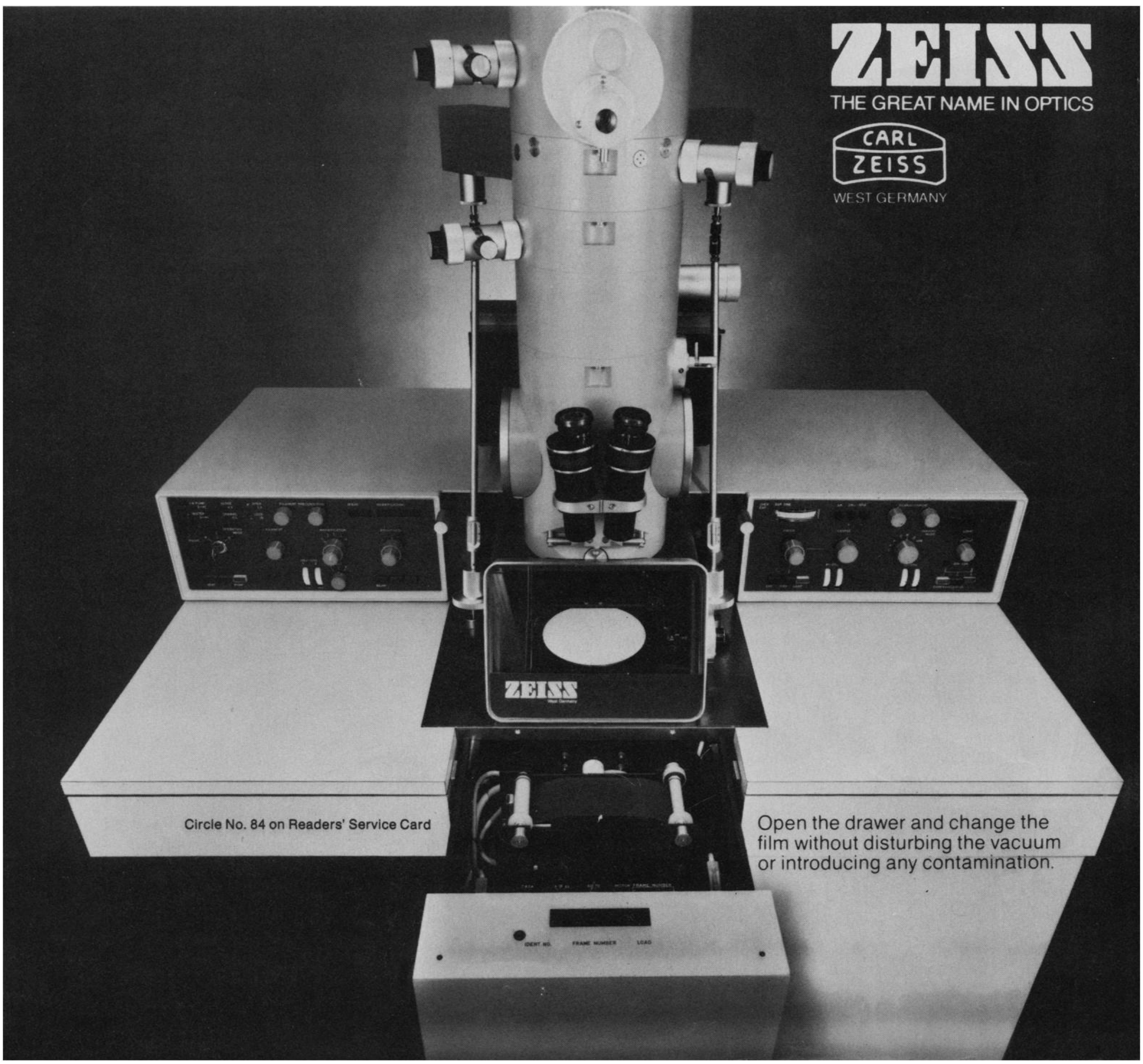

13 April 1979, Volume 204, Number 4389 **SCIENCE**

Problems of Science Faculties

During the past 2 months I have had casual conversations with about 20 professors from widely scattered universities. If their attitudes are an indication of the spirit on campus, the long-term future of science in America is in jeopardy. Not one of those 20 conveyed the impression that life is great, science is fun, and that academic research is the best possible of all activities. Rather the majority were gloomy—some were bitter. How could such individuals inspire the young and foster in them a love of knowledge and a zeal for lifelong scholarship?

Some of the factors contributing to poor morale include problems in obtaining adequate research support, the proliferation of a federally mandated inefficient bureaucracy on campus, a perception (perhaps not correct) that the public no longer values scientists, failure of salary adjustments to keep up with inflation, the scrambling for tenure, and an aging faculty.

Both private and state universities share these factors but the private schools seem somewhat less affected. They have had to retrench and are reluctant to increase tuition further, but loyal alumni have been helpful and the boards of trustees understanding. The state universities must deal with governors and legislatures that too often are capricious and quick with the meat-ax. A conspicuous example is the great University of California system, which is now in peril. Proposition 13 is only the latest blow. But California is not alone. Many other states had earlier followed destructive practices and they too now are placing further financial restrictions on their institutions. Many of them have refused to make adequate cost-of-living salary adjustments for professors so that during this decade a cumulative deterioration of personal purchasing power of 20 percent is common. This is without taking into account higher income and social security taxes. Considering the hours that assistant professors work each week, their pay per hour often is considerably less than that of many unionized blue-collar workers.

While it is less visible than state governments in its contribution to problems at the universities, the federal government has had a greater, longer-range impact. Although few abuses or financial irregularities were ever pinpointed, the government in the name of accountability required the universities to create vast bureaucracies which produce nothing while devouring hundreds of millions of potential research dollars annually. When a scientist notes that high grant proposals are inflated by as much as a 90 percent overhead charge and then later has to deal with arrogant clerks, morale sinks.

Many years ago the government allowed universities to charge to grants part of senior investigators' salaries, including summer salaries. In addition, universities came to expect that scientists should obtain all their own research funds. A professor in the sciences who could not get a grant lost part of his salary and, more seriously, his ability to function as a scholar.

Depending on their age, scientists react differently to the deterioration of their working conditions and prospects. The elder of them are sad but not disconsolate. When they were in graduate school they thought that in pursuing knowledge they had made a Spartan choice between science and material goals. Later, when money flowed and prestige was high, they enjoyed it but the baubles did not matter that much.

In contrast, the younger people chose science after the public had been shocked by Sputnik and great efforts had been made to steer young people into scientific endeavors. After many years of struggle, they have reached the stage of experience where they could expect to obtain tenure and good research support. For many, broken expectations have brought bitterness.

Senior faculties, university administrators, and the federal government should regard the needs of these people with understanding. Remedial measures are overdue.—PHILIP H. ABELSON

PRODUCTS and MATERIALS

Spectrometer

Model 1160 AtomComp is an inductively coupled argon plasma spectrometer. It features 61 analytic channels for simultaneous determination of elemental composition. Up to 48 elements may be determined from a single sample in aqueous or organic solution. Once the operator introduces the liquid sample and types in a series of single-letter commands, the automated analysis of up to 40 elements is performed in about 1 minute and results are printed out. A radiofrequency generator provides energy to a plasma torch and creates a magnetic field. Argon is ionized in this field to form the plasma. The sample is atomized and introduced to the plasma and the sample elements are thermally excited. The optic system analyzes the light emitted by the components of the sample. Light energy is converted to electricity proportional to the intensity of the spectral lines and the composition of the sample is calculated and communicated to the operator. Jarrell-Ash Division, Fisher Scientific. Circle 750.

Analytic Balance

The AC88 is a top-loading electronic balance that offers DeltaRange to expand the scale for greater accuracy. All steps such as weight dialing, micrometer adjustment, and setting of zero points are accomplished with the touch of a single control bar. The control bar switches the balance on and off, tares, stores weight values, and recalls DeltaRange as well. The glass draft shield chamber is accessible from the top or from the sides. Mettler Instrument. Circle 755.

Newly offered instrumentation, apparatus, and laboratory materials of interest to researchers in all disciplines in academic, industrial, and government organizations are featured in this space. Emphasis is given to purpose, chief characteristics, and availability of products and materials. Endorsement by *Science* or AAAS is not implied. Additional information may be obtained from the manufacturers or suppliers named by circling the appropriate number on the Readers' Service Card (on pages 116A and 214A) and placing it in the mailbox. Postage is free.
—RICHARD G. SOMMER

ATP Photometer

LumiTran measures bioluminescent, chemiluminescent, and enzyme-coupled reactions. Energy transfer in metabolic reactions may be characterized from these measurements at many steps in a cycle or chain of events. The instrument is also useful in monitoring enzyme assays and with techniques of luminescent labeling. LumiTran is sensitive for output of cell populations as small as 10^3 cells per milliliter and can accommodate sample volumes from 10 microliters to 10 milliliters. New Brunswick Scientific. Circle 751.

Thermal Analyzer

Model 1090 incorporates a powerful microprocessor for data acquisition, storage, playback, and analysis. The system comprises an analyzer, a disk memory, and a data analyzer. Features include 12 linkable program methods, improved temperature control, increased heating rate selections, expanded sample temperature recording, linear scaling, and all alphanumeric programming and recording. Heating and cooling rates may be selected in 0.1°C increments up to 100°C per minute. Memory allows any combination of nine ramp and three step programs to be stored, linked as desired, and activated rapidly. DuPont Instruments. Circle 753.

Ion Chromatograph

Model D-12 is a biological ion chromatograph that is completely automated for ease of operation. It operates in the program mode for entry of steps to be followed and then in the auto mode for fully automated analysis. It may also be run in the manual mode for direct control during any step of analysis desired. There may be up to 13 main programs of up to 15 steps each and the controller permits execution of two subprograms during any main program. There is an additional shutdown program to regenerate and flush the system before the power is shut off between analyses. An autosampler is available to automatically load up to 99 samples for analysis. Dionex. Circle 754.

Cell Culture Reagent

Human fibronectin, isolated from fibrinogen, is a glycoprotein surface antigen that is useful in growing mammalian cells in culture. It will adsorb to surfaces of glass or plastic culture vessels and provide a suitable surface for the attachment and growth of anchorage-dependent mammalian cells. It is effective for plating fastidious cells, increases cloning efficiency, and helps minimize variability in plating efficiency associated with different serum lots. Collaborative Research. Circle 752.

Light Choppers

Miniature choppers are available in a variety of forms. Chopped frequency may be manually selected or computer programmed in the range of 3 to 2000 hertz. All models are available with light-emitting diodes to read frequency. Synchronization may be achieved with internal or external drives. Chopper blades are available with fixed or variable apertures. Rofin. Circle 756.

Literature

Clinical Reagents appear in a catalog of kits, specialty chemicals, substrates, standards, controls, and apparatus. Pierce Chemical. Circle 757.

Humidity Analysis includes instruments, definitions, formulas, applications, and techniques. EG & G Environmental Equipment. Circle 758.

Electrophoretic Separation Methods features the Multiphor line for electrofocusing, gel electrophoresis, immunoelectrophoresis, and immunodiffusion techniques. LKB Instruments. Circle 759.

Thin-Layer Separation: Photographic Documentation lists products that use ultraviolet and visible light to record results of the techniques. Separation apparatus is also cataloged. V-Tech. Circle 760.

Radioassay Chemicals and Supplies lists products for liquid scintillation and gamma counting and includes a "Sample Preparation Guide" as well. Packard Instrument. Circle 762.

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(Continued from page 167)

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