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Now you can choose from two series of Beckman ultracentrifuges.

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The results of six years of intensive research, the Model L8's are so remarkable, so advanced that they introduce a new era in preparative ultracentrifugation.

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Norepinephrine, *levo*-[7,8-^{3}H(N)]-

β-Adrenergic
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Epinephrine, *levo*-[*N-methyl*-^{3}H]-
Hydroxybenzylisoproterenol, *p*-[7-^{3}H]-
Iodohydroxybenzylpindolol, [^{125}I]-
Isoproterenol, DL-[7-^{3}H(N)]-
Norepinephrine, *levo*-[7,8-^{3}H(N)]-
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Aspartic acid, D-[2,3-^{3}H]-
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Methyl-D-aspartic acid, *N*-[*methyl*-^{3}H]-

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Flunitrazepam, [*methyl*-^{3}H]-

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Muscarinic
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Choline chloride, [*methyl*-^{3}H]-
Pilocarpine, [^{3}H(G)]-
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Acetylcholine chloride, [*N-methyl*-^{3}H]-
α-Bungarotoxin, [^{125}I]-
Choline chloride, [*methyl*-^{3}H]-
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Nipecotic acid, [*ring*-^{3}H]-

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Glutamic acid, L-[3,4-^{3}H]-

Glycine
Glycine, [2-^{3}H]-

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Histamine, [^{3}H(G)]-
Pyrilamine, [*pyridinyl*-5-^{3}H]- (Mepyramine)

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Morphine, [6-^{3}H(N)]-

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ISSN 0036-8075

26 October 1979

Volume 206, No. 4417

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.

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COVER

North ridge of Mount Charles, Enderby Land, Antarctica. Pyroxene granulites are cut by charnockitic pegmatites dated at 2.5 billion years. See page 443. [E. S. Grew, University of California, Los Angeles]

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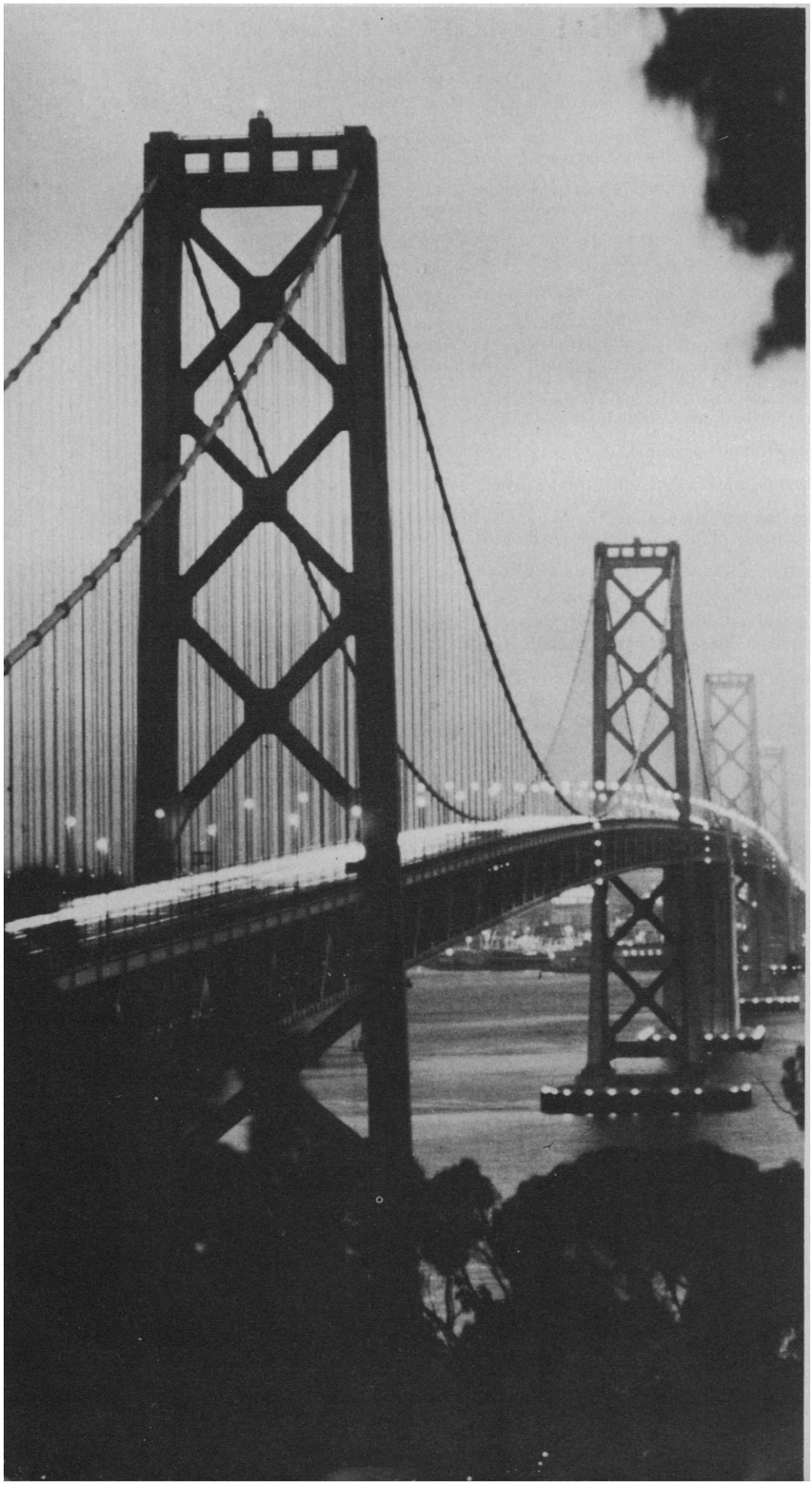

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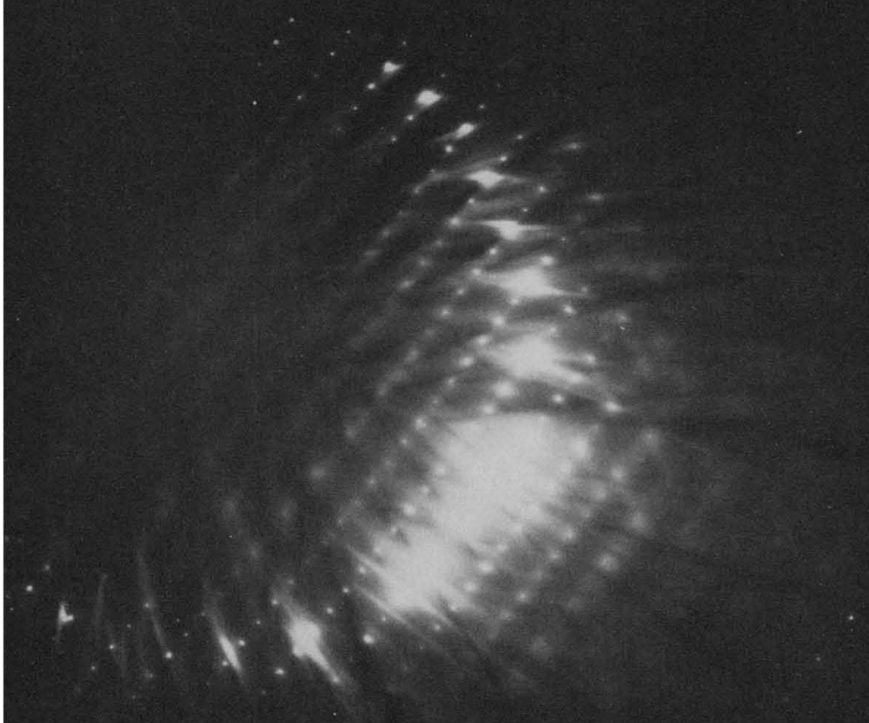

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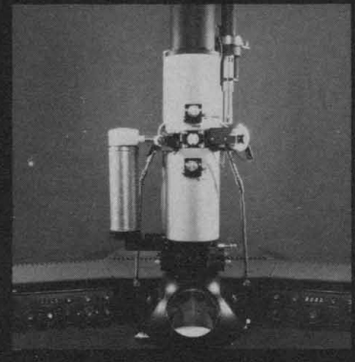

Electron Diffraction pattern of CdS from a single grain in a solar cell. Courtesy of Dr. J.W. Edington, Dept. of Aeronautical Engineering, Univ. of Del.

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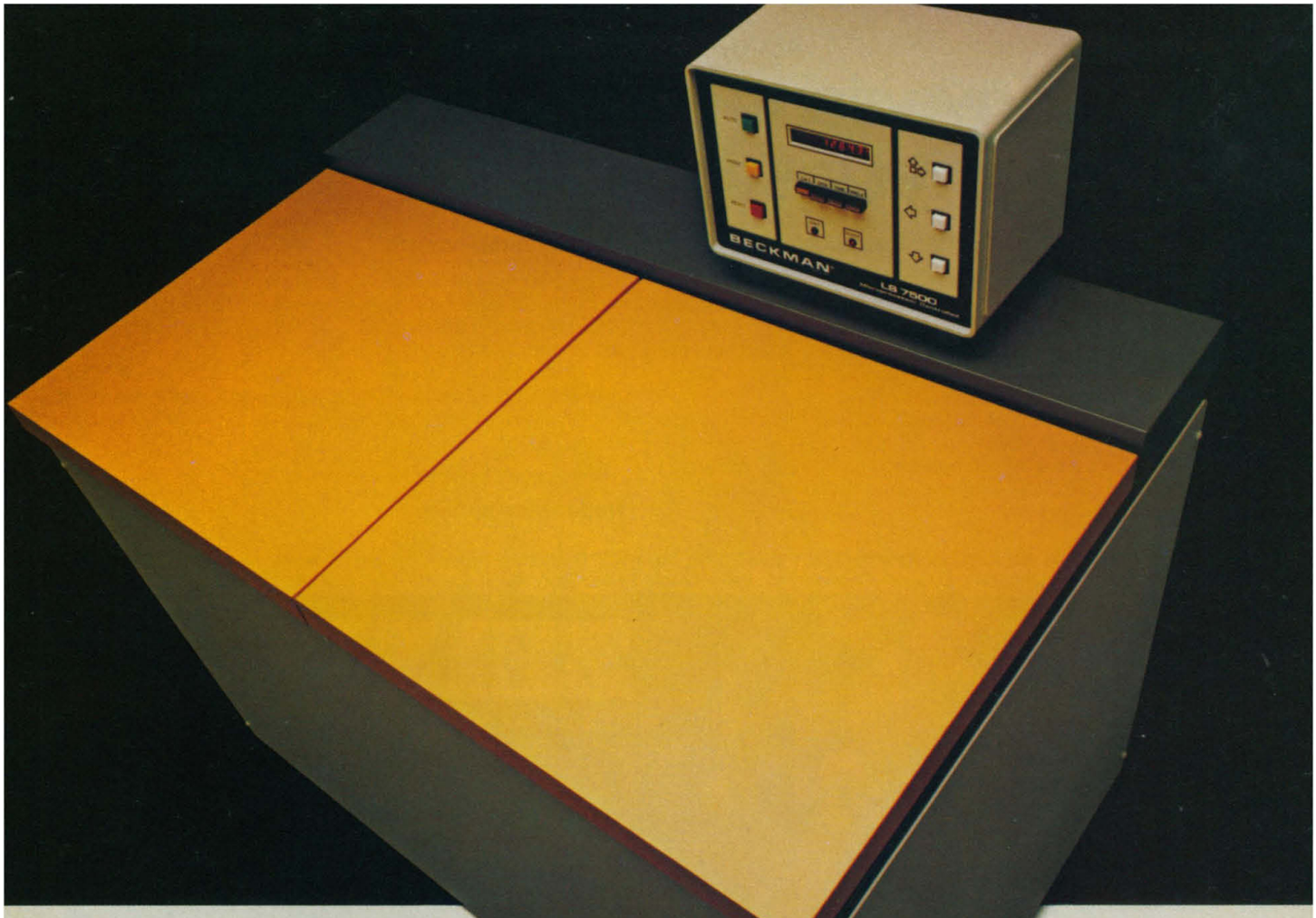

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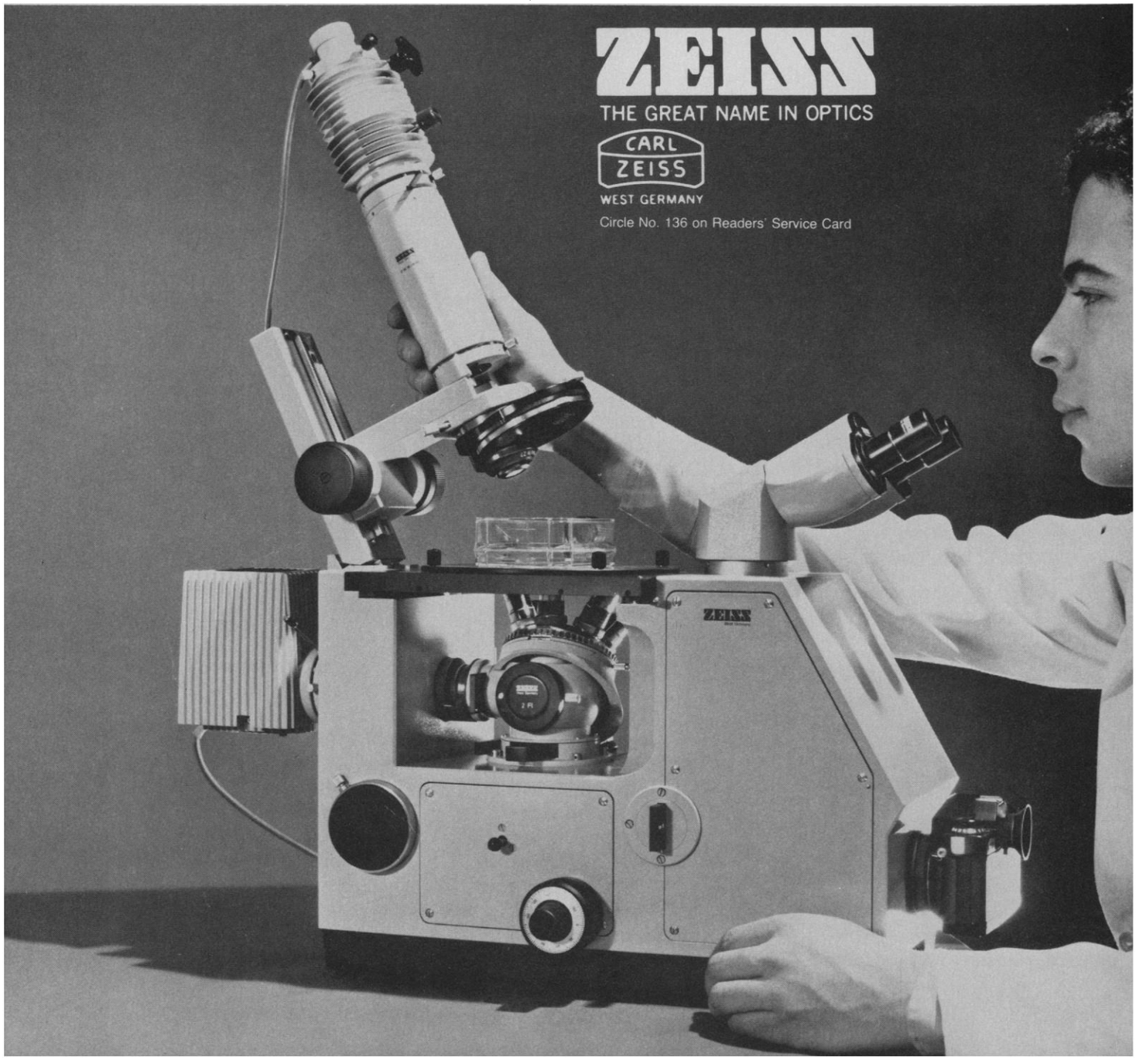

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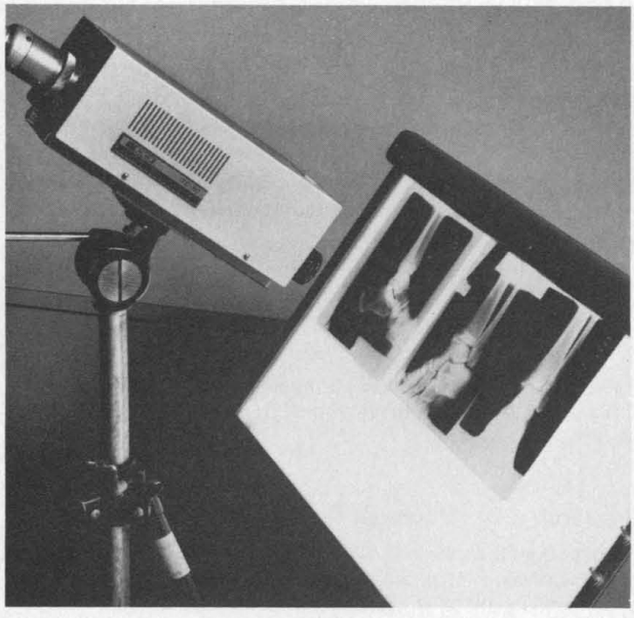

Bacterial colony counting, patient surveillance, remote x-ray inspection – all diagnostic procedures where television is invaluable. But only if the image is trustworthy. Only if the image has high acuity.

Example: In colony counting, ultra-linearity is vital. Otherwise two colonies appearing to be the same-size one at center-screen and the other at one edge, can actually differ in size.

Example: In patient surveillance, small phenomena such as eye motions require high resolution. Otherwise they can be near-indistinguishable.

Example: In remote x-ray reading, only an extended gray scale allows authoritative interpretation.

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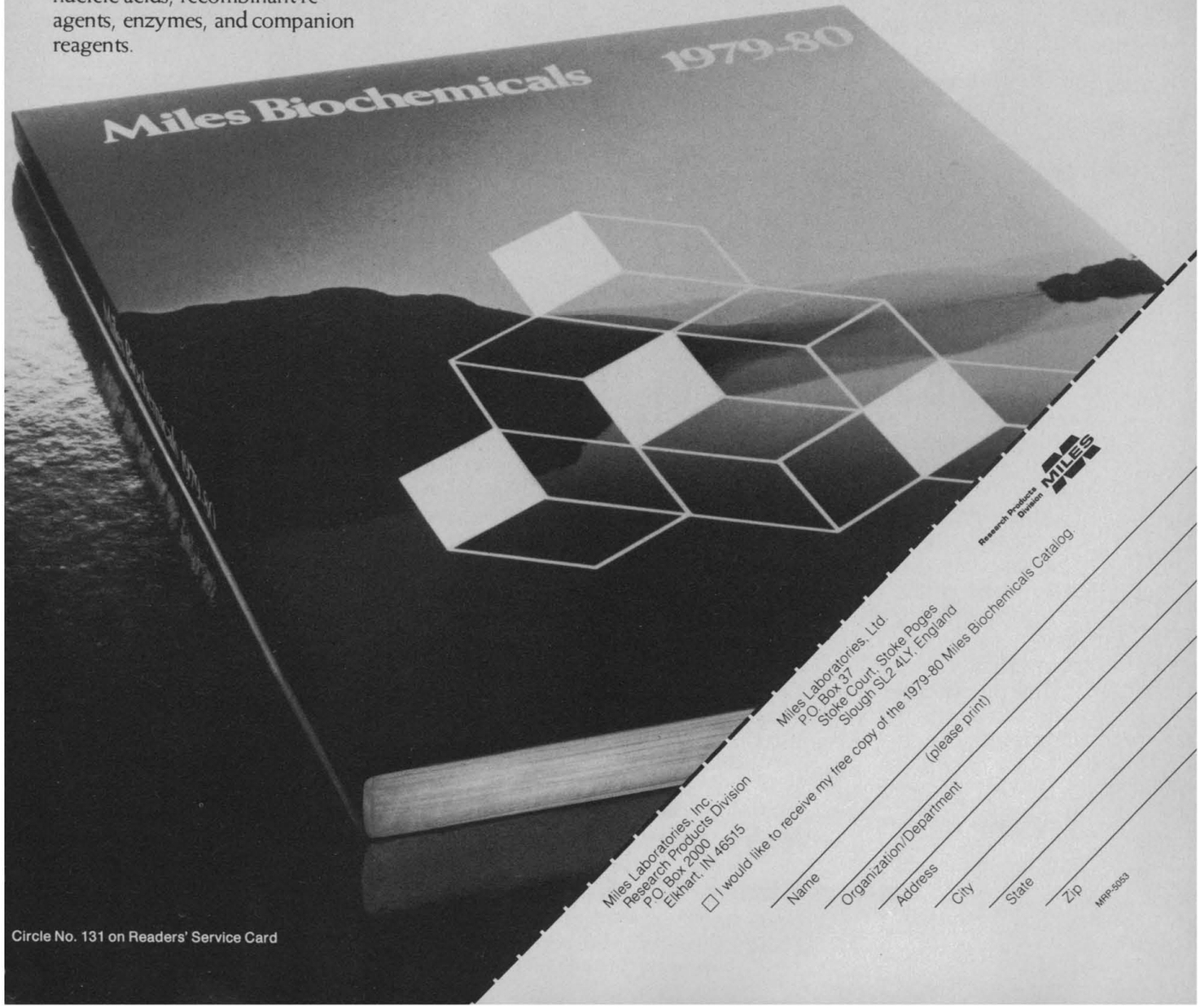

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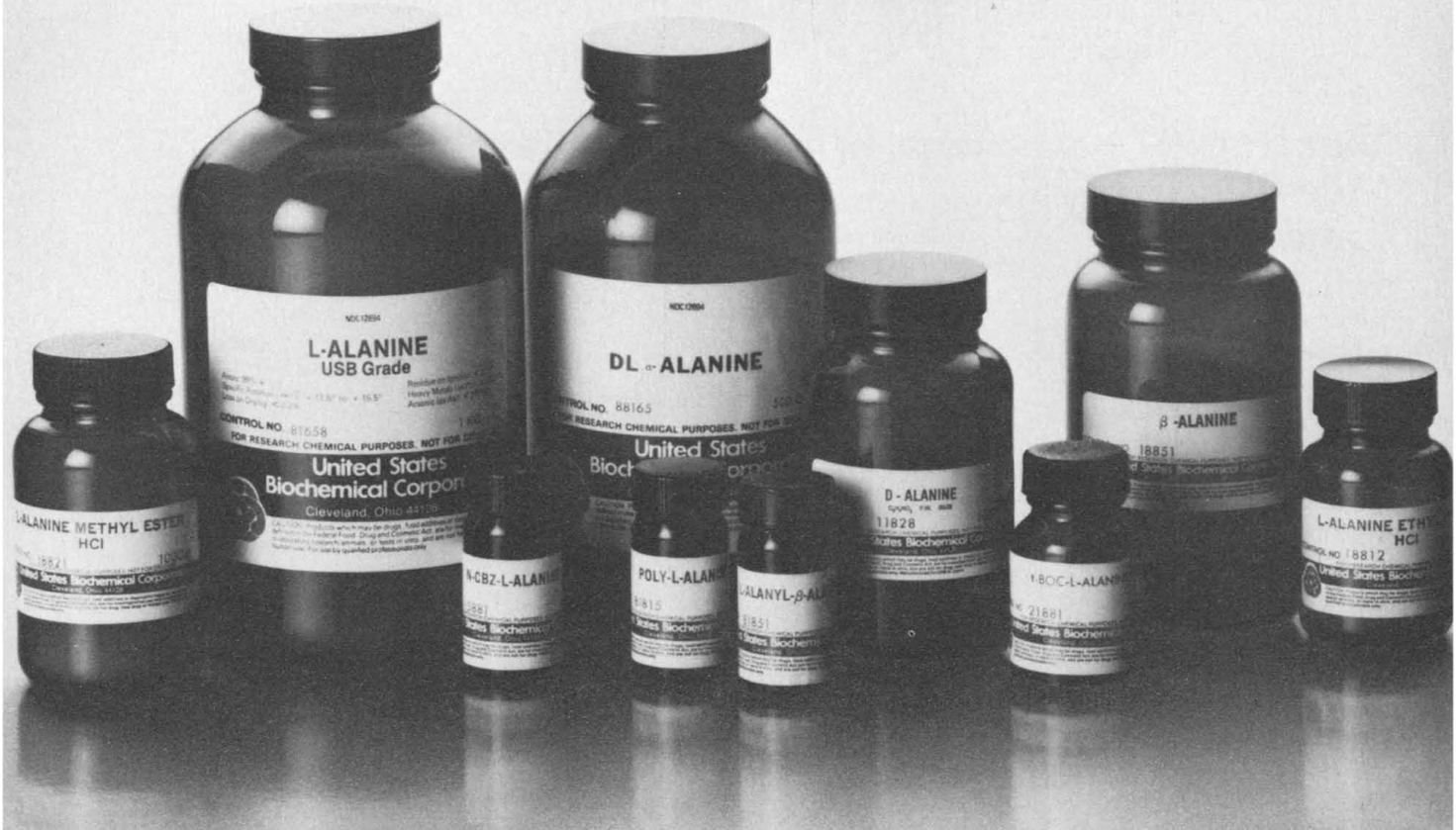

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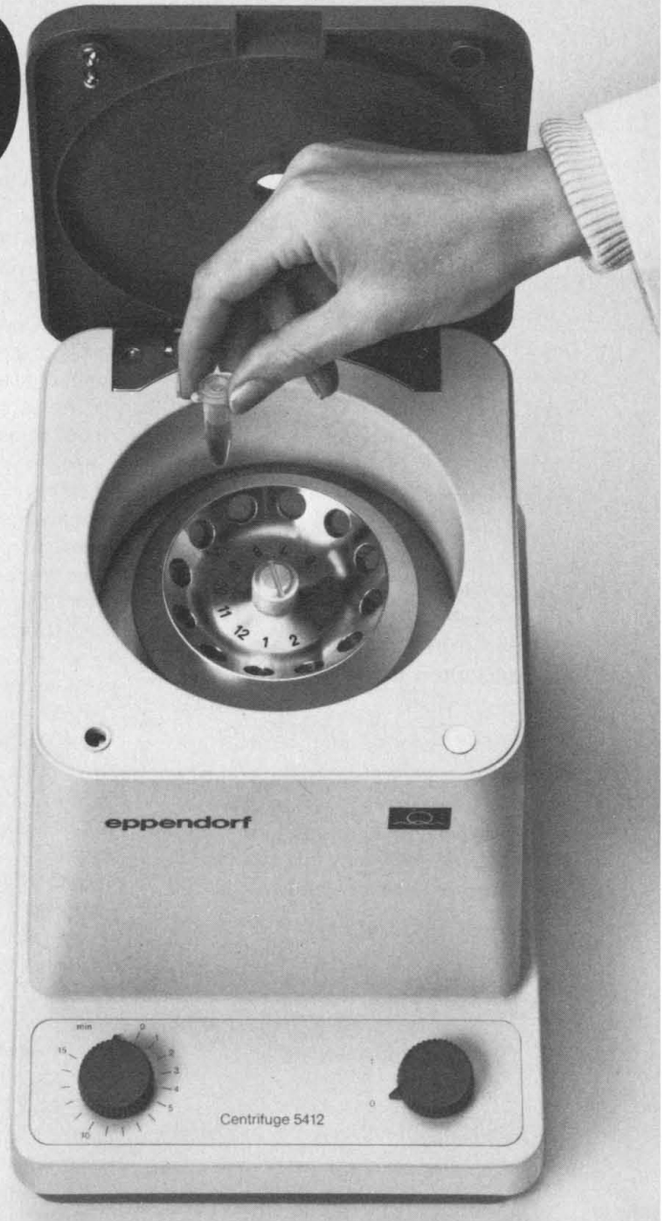

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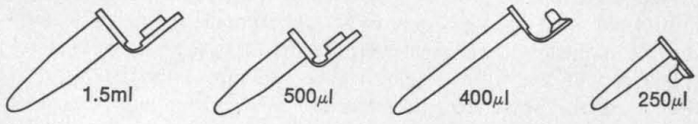

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Pontryagin's Article

In order that the readers of *Science* can assess correctly the reliability and veracity of the letter from Academician Pontryagin on page 1083 of the 14 September issue, they are invited to look at the third from the last paragraph of an autobiographical article by Pontryagin that has appeared in *Uspekhi Matematicheskikh Nauk* [**33** (No. 6), (1978)]. A translation of this article, with a disclaimer and a rebuttal, will appear in *Russian Mathematical Surveys*, published by the London Mathematical Society, in November 1979.

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Treating Mental Disorders

Gina Bari Kolata reports (Research News, 5 Jan., p. 36) on the 1976 discovery by Wurtman and others that the rate at which the brain synthesizes acetylcholine can be increased by increasing the amount of choline in the blood and on the later observations that tardive dyskinesia, a side effect of antipsychotic drugs such as the phenothiazines and the butyrophenones, can be controlled by a high intake of choline or lecithin (which contains phosphatidylcholine). This article appears to indicate that the idea that dietary constituents can influence the functioning of the brain represents a new approach, discovered by Wurtman. In fact, there had been much earlier work in this field, which in recent years has been called orthomolecular psychiatry.

Kolata states that "It was thought that as long as the brain was supplied with oxygen and glucose it would make whatever it needed, independently of the metabolic and nutritional state of the body." It has, on the contrary, been known since long before 1976 that other exogenous constituents of the brain are required for its proper functioning and that, as I stated in my 1968 article (*Science*, vol. 160, p. 265), "Varying the concentrations of substances normally present in the human body may control mental disease." The most striking early work is that on the treatment of psychiatric patients with large doses of niacin, one of the B vitamins (*1*). A dozen other nutrients that affect brain function are also discussed in my 1968 article, which includes in addition a discussion of mechanisms such as increasing the rate of formation of an important substance by increasing the concentration of a reactant. An example, not given in the article, is increasing the amount of the neurotransmitter acetylcholine by increasing the choline concentration.

I defined orthomolecular psychiatry therapy in 1968 as "the treatment of mental disease by the provision of the optimum molecular environment for the mind, especially the optimum concentrations of substances normally present in the human body." Wurtman has been quoted elsewhere as having said that the treatment of tardive dyskinesia by an increased intake of choline has nothing in common with orthomolecular psychiatry. It is clear, however, that it is a good example of orthomolecular psychiatry; especially interesting because the mechanism of its action is understood in greater detail than in the earlier examples.

LINUS PAULING
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Fetal Research Ethics

The 3 November 1978 issue of *Science* (p.540) contained another chapter in the long, unhappy history of the Philipson *et al.* fetal research study (*1*). This experiment led, at the state level, to criminal charges (eventually dismissed) of grave-robbing against the principal investigators, and, at the national level, to a scrutiny of fetal research that culminated in a research moratorium and creation of the National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research.

Throughout the debate on the Philipson *et al.* experiment, ethical questions concerning the fetal subjects of that research have preempted the attention of adversaries, advocates, and reporters like. Ethical questions concerning the *maternal* subjects of that research have not been raised but are just as important. Twenty-five of the 33 patient-subjects, 10 to 22 weeks pregnant, were aborted by hysterotomy (*1*). Hysterotomy is a major surgical procedure not normally used for abortion because it entails hospitalization, risk, discomfort, disfigurement, and because it precludes normal vaginal deliveries in future. From an investigator's point of view, however, hysterotomy as a method of

abortion has the advantage of yielding a live, intact fetus.

The doctrine of informed consent, originally put forth in the Nuremberg Code (*2*) and based on the principles of voluntariness, competence, and understanding, requires that the subject have sufficient knowledge and comprehension of the research ". . . to enable him to make an understanding and enlightened decision." This in turn requires disclosure of ". . . all inconveniences and hazards reasonably to be expected; and the effects upon his health or person which may possibly come from his participation in the experiments." Philipson *et al.* claim to have gotten informed consent from their subjects (*1*, p. 1219), but it is difficult to understand how 25 fully informed, competent people could have opted voluntarily to forego abortion by a simple, minimal risk procedure and submit instead to major surgery.

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Brackbill raises an appropriate aspect of patient informed consent in human studies. We fully agree that informed consent is essential in human studies.

In the particular study to which she refers, there was no need for either an intact fetus or "viable" tissue. The method of abortion was selected by a number of different surgeons, in each case on the basis of what would be best for the patient under the circumstances. Although it is correct that the different operative techniques have different risks and consequences, those matters had nothing to do with this study, since the procedure in each instance was selected entirely for the patient's benefit. In fact, the patients were not even invited to participate in the study until after the operative plan had been made.

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In accordance with the provisions of the foundation, papers are herewith invited for 1980 in conjunction with the

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The presentation of this year's prize will take place at 10.30 a.m. on 12th October, 1979 in the Adolf-von-Baeyer Lecture Hall of the University of Munich, which is located in Meiserstrasse.

26 October 1979, Volume 206, Number 4417 **SCIENCE**

Performance Evaluation of Academic Research

Congressmen and administrators are responsible for seeing to it that government R & D funds are spent effectively and that misuse does not occur. Since it is not possible for them to judge the value of the output of scientific research, they have tended to emphasize what they can understand, namely monetary accountability for funds.

Performance measurement in research, even by experts, is difficult and controversial. The difficulty in evaluating performance in federally supported R & D has led, step by step, to the present unsatisfactory state of effort reporting. Although it is easy now to see that things are not right, no consensus has developed on how to correct them.

Three classes of evaluation instruments exist for measuring the effectiveness of research, namely effort planning, indirect performance measures such as the citation index, and direct performance evaluation. For those who have not had their fill of effort reporting, the new federal regulations contained in Office of Management and Budget Circular A-110 provide a surfeit.

Effort reporting is fundamentally flawed as an instrument for measuring either the quality or the quantity of research. What reputable academic scientist would permit students to count hours spent in the classroom or used in attempts to do assignments as an indication of readiness for a degree? What scientist, when refereeing a journal paper or an NSF research proposal, cares how many hours it took to do the research or to prepare the document? Only performance should count in scientific research.

Undoubtedly, there is resistance in the research community to the concept of direct evaluation of the quality of research. Such a suggestion may raise the spectre of a corps of federal bureaucrats who evaluate research results and control funding. But this is highly unlikely. There is ample evidence that peer evaluation is a practical and effective basis for continued funding. The peer review process would permit disassembly of the costly government bureaucracy that deals with effort reporting and a reduction in the indirect cost (overhead) now added by universities to contracts.

Peer review is not only fair and in the best tradition of science, but it has several ancillary benefits. Membership on a review board serves to keep members in touch with current trends and with promising young scientists. One of the problems recognized by NSF is that investigators sometimes pay insufficient attention to final reporting requirements. If the investigators know that reports will be evaluated by a panel of their peers, with a view toward continued funding, final report quality will immediately improve.

Since this concept is an obvious extension of current best practice and apparently has few, if any, drawbacks, why has it not been tried? The answer is that it has, and it works very well. In the 1960's, the Department of Defense initiated an electronics research program with about a dozen outstanding university electrical engineering departments. Each principal investigator participated in site visits to the other grantees to evaluate progress and to recommend on renewal. On the average, four 2-day visits would take place in a year. During these visits, graduate students and postdoctorals were encouraged to make their own presentations, and the sharp grilling that followed was more challenging than many Ph.D. orals. This keen honing improved the quality of electronics research throughout the nation. The 3-year, step-funded grants and the lack of programmatic restrictions made the program very attractive, and applications for admission mounted.

Why is this program not functioning today? All parties were satisfied with its cost effectiveness, and undoubtedly it would have been expanded and utilized in other Defense Department research programs, but in 1969 the Mansfield amendment forbade the defense agencies to support basic research, and the program had to be discontinued.—JOHN E. GIBSON, *Commonwealth Professor* and *Dean, School of Engineering and Applied Science, University of Virginia, Charlottesville 22901*

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Literature

Water Purification features systems for the production of pure water for medical, electronics, research, and industrial uses. Vaponics. Circle 761.

Temperature Handbook lists instrumentation and techniques of thermal measurement with applications and specifications. Nanmac. Circle 763.

Histology describes the Tissue-Tek III Vacuum Infiltration Processor which automates complete tissue processing with a fluid-exchange principle. Lab-Tek Division, Miles Laboratories. Circle 773.

Polyaromatic Hydrocarbons is devoted to a new means of determining these substances by photoionization. HNu Systems. Circle 774.

Chromatography and Electrophoresis is a catalog of instruments, reagents, teaching aids, and much more. Shandon Southern Instruments. Circle 775.

Fluorescence UV/Visible Analytical Instrumentation describes a complete line of spectrophotometers, data processors, pressure cells, and others. American Instrument. Circle 778.

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—RICHARD G. SOMMER

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(Continued from page 442)

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