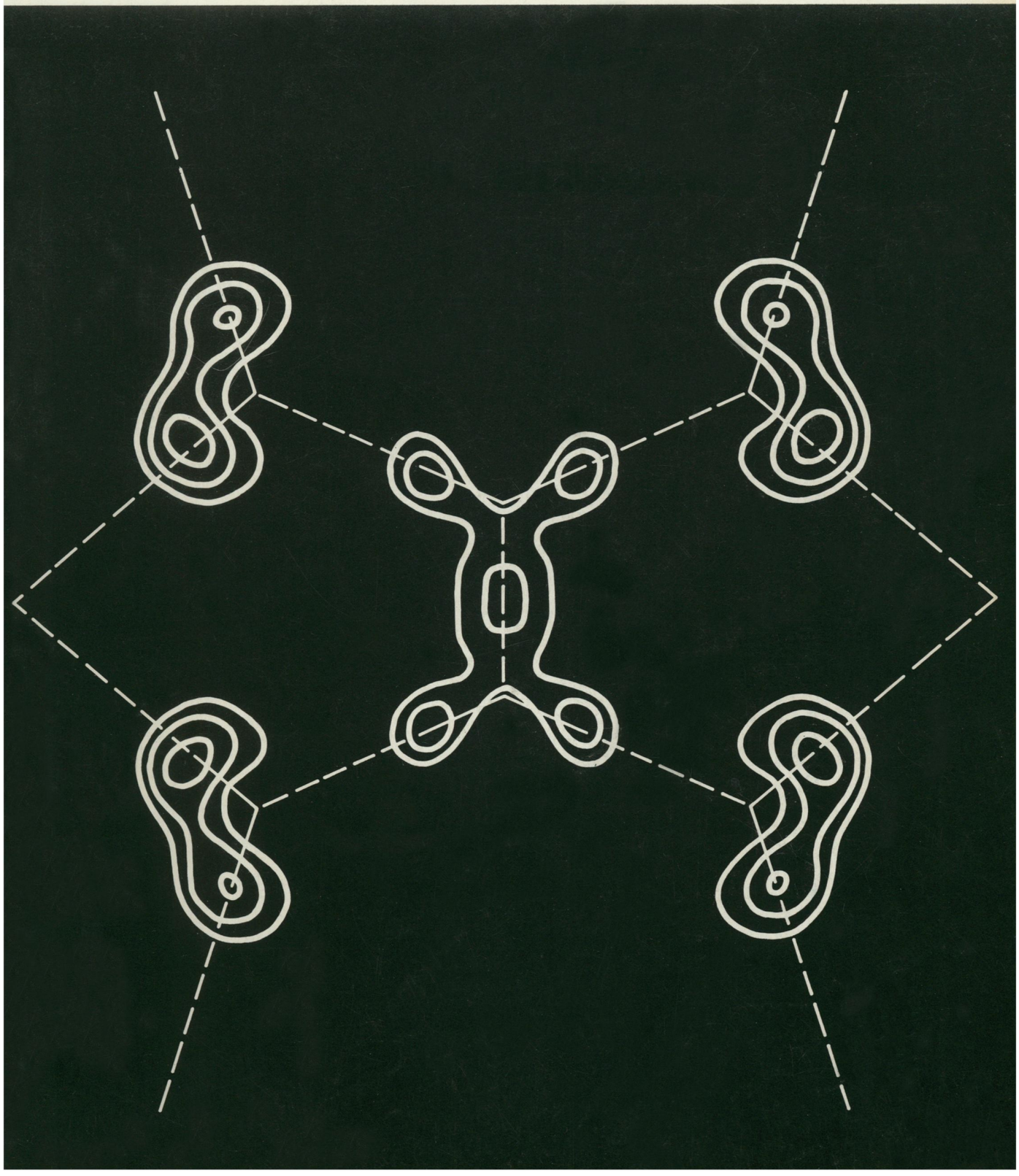
# SCIENCE

10 October 1975

Volume 190, No. 4210

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

# *Announcing...* Technicon Research Grants for Biomedical and Industrial Instrumentation

Technicon Instruments Corporation announces its second annual competition for grants in support of research in biomedical and industrial instrumentation. Initiated last year in North America, the program is now being expanded to include researchers in Western European and Mediterranean nations.

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To identify and support research on novel concepts or technologies in biomedical and industrial instrumentation with a view toward commercial application of the results of the research.

**AWARDS**
Meritorious proposals will be considered for grants covering direct and indirect costs for one year, to a maximum of $100,000 for each grant. In most cases grantees will be eligible for renewal of their grants for a second year, and in exceptional circumstances support for a third year may be considered.

**ELIGIBILITY**
Open to faculty members and scientists from colleges, universities, medical centers, and nonprofit research institutes.

**SCOPE**
Basic and applied research proposals will be considered, including those for a new concept or support for development of a process or device. Each submission will be judged for scientific merit as well as for its potential for practical utilization.

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In the biomedical and diagnostic area:

New and improved diagnostic procedures of broad utility adaptable to automation for the determination of the chemical constituents of body fluids (e.g., blood and urine), for measurement of enzyme activities, for the differentiation of cells and viruses, and for other common and important medical laboratory tests.

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In the industrial area:

Automated instrumentation and methods for the analysis and characterization of a wide variety of materials, including agricultural products, drug preparations, minerals, and other industrial products.

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**INVENTIONS AND PATENTS**
Ownership of inventions will be determined by the policies of the institutions. However, Technicon will be granted an option to acquire an exclusive license to inventions, the terms of which will be negotiated at the time of the grant award.

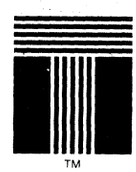
**EVALUATION**
Proposals will be reviewed by distinguished academic scientists outside of Technicon. Those proposals recommended by these reviewers will then be evaluated with respect to their importance to the medical and industrial communities served by Technicon.

**DEADLINE**
Final proposals must be submitted by December 15, 1975.

**FURTHER INFORMATION**
Interested investigators are advised to obtain full details, including a short-form "preproposal" application prior to submission.

In North America, write Technicon Research Grant Program, c/o Dr. Morris H. Shamos, Technicon Instruments Corporation, Tarrytown, New York 10591.

In Western Europe and the Mediterranean area, write Technicon Research Grants Program, c/o Dr. Harry W. Holy, Technicon International Division S.A., 12-14 Chemin Rieu, 1208 Geneva, Switzerland.



**Technicon**
Instruments Corporation,
Tarrytown, N.Y. 10591

10 October 1975

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# SCIENCE





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**COVER**

Portions of a difference map for the $H_{13}O_6^+$ ion and the surrounding $C_l^-$ ions showing the electron density associated with the hydrogen atoms. Contours are drawn at 0.2, 0.3, and 0.4 electron/Å$^3$. See page 151. [R. A. Bell *et al.*, California Institute of Technology, Pasadena, California]

# Pictures you see in seconds can save you hours.

## In scientific detection.

When photography is used for scientific detection, special lighting and filtration is often required. Just coming up with the right combination using conventional methods (shooting, developing, adjusting light and filters, and reshooting) can take hours, even days.

Fortunately, there's a faster, more economical way—by using Polaroid's Type 105 or Type 55 positive/negative films on standard view cameras. With Type 105 (3¼ x 4¼ inch pack format) and Type 55 (4 x 5 inch sheet format), seconds after the picture has been taken you can evaluate the results, make adjustments and reshoot. Until it's just right.

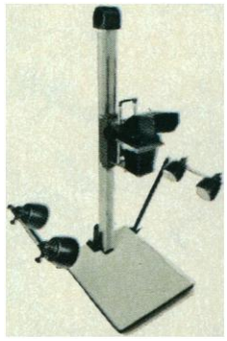
And since both films provide a high-resolution negative along with the positive print, enlargements can be made for closer scrutiny, or multiple copies for distribution.

The picture on the left is an ultraviolet reflectogram that tells the art conservationist that the painting in question has badly deteriorated be-

neath the surface. The deterioration took decades. The proof took seconds.

## In record keeping.

How can a laboratory assure that it has accurate visual records of thousands of experimental results? One way is to use a central photo lab,



MP-4 MULTIPURPOSE CAMERA

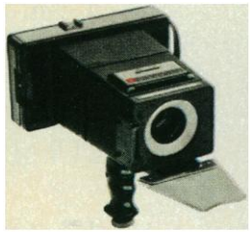
which is costly, time consuming and sometimes impossible.

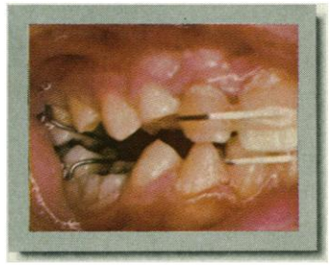
A better way is to take pictures with a centrally-located Polaroid MP-4 Multipurpose Land camera. It can be operated by just about anyone with a little training. No darkroom is required. And there are 15 different Polaroid self-developing films (from black and white slides to 4x5 color prints) to choose from. Best of all, the pictures are available instantly — to clip into a lab notebook, to be routed, or to be filed.

The picture above, for example, was one of a series taken on our brilliant new Polacolor 2 film. It illustrates the effect of a specific amount of ozone on a tobacco cultivar.

## In making a diagnosis.

This is Jeffrey's malocclusion. A year from now, it will be considerably improved. And pic-





CU-5 CLOSE-UP CAMERA

tures taken at every stage will tell just how the treatment is progressing.

Many dentists now make such pictures on the spot to study, then to show at consultation meetings and later to file for reference — using Polaroid's hand-held CU-5 Close-up Land camera. It requires virtually no experience to operate and there's little or no guesswork involved.

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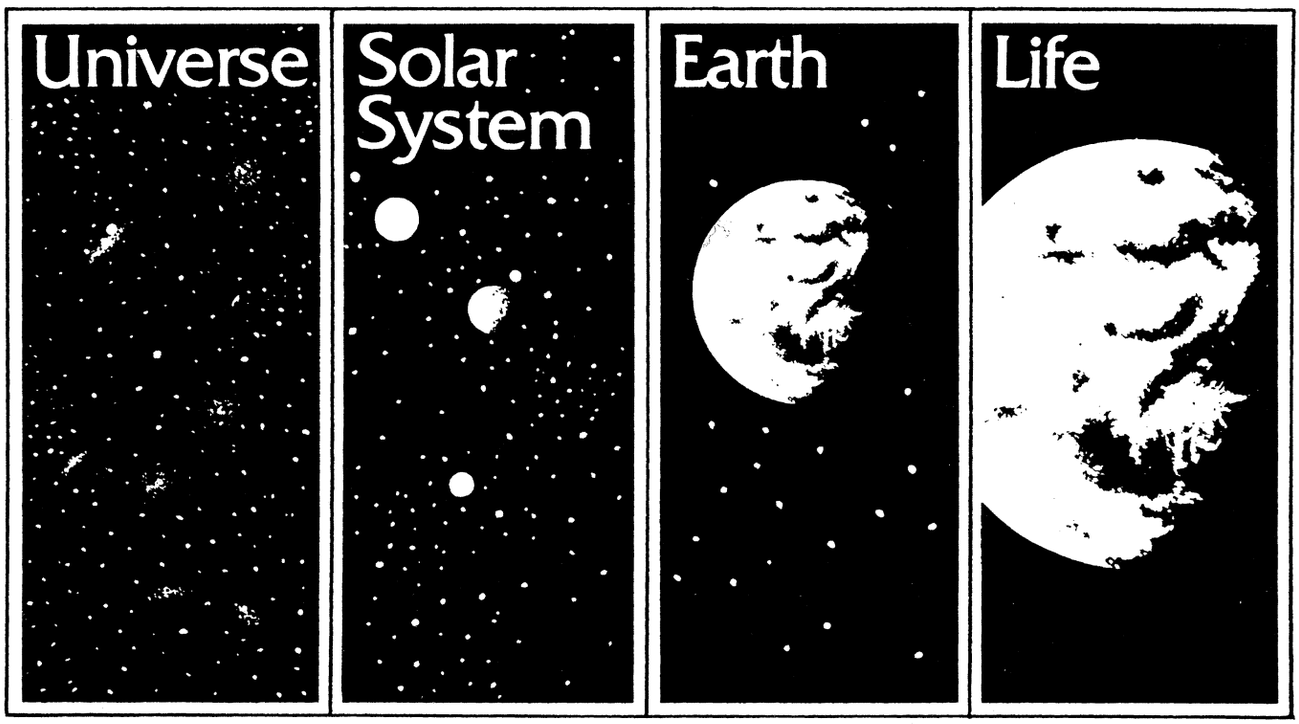
# Origins:

Speculations and facts on the sources of planets, Earth, and life by Robert Jastrow, Philip Morrison, Cyril Ponnamperuma, George Wald.

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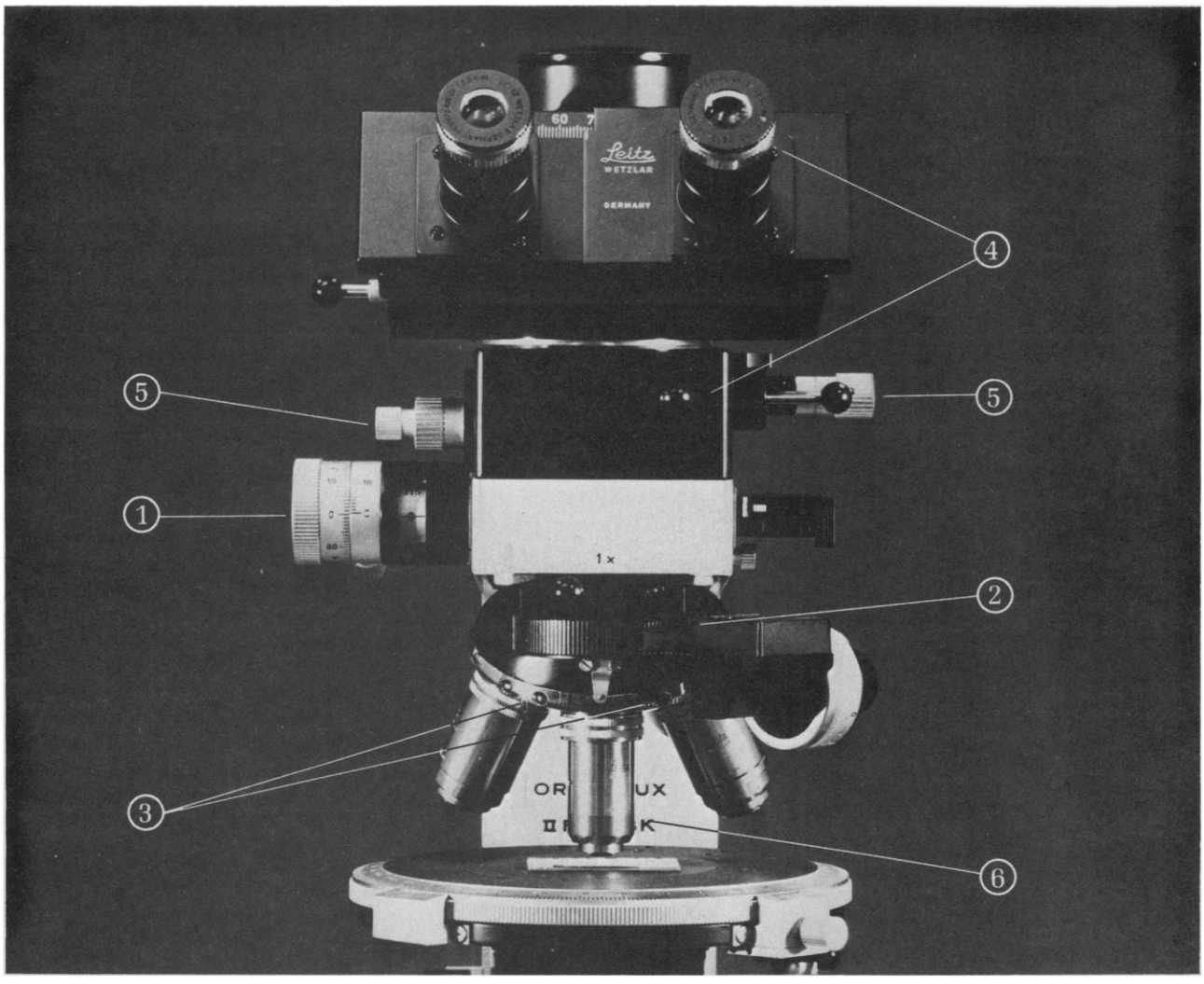


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By **Claude A. Villee**, Harvard University; and **Vincent G. Dethier**, University of Massachusetts. About 925 pp., 500 ill. (in two colors). Ready March 1976.

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By **W. Holt Harner**, Broward Community College. About 200 pp. Soft cover. Ready March 1976.

## McCormick & Thiruvathukal: ELEMENTS OF OCEANOGRAPHY

Readable and highly graphic, this survey text for non-science majors paints a vivid picture of the sea and oceanographic phenomena. The authors discuss the physical, chemical and biological factors that combine to make the ocean a functioning ecological system. Coverage includes *food webs, marine ecology, human use and abuse of the oceans,* and *tsunamis*. Plate tectonics are central to discussions of ocean geology. An interesting chapter on "political oceanography" touches on international, diplomatic and political issues including marine resources and navigation. Throughout the book, oceanographic discoveries are presented in historical context.

By **J. Michael McCormick** and **John V. Thiruvathukal,** both of Montclair State College. About 350 pp., illustd. Ready March 1976.

## DeWitt: BIOLOGY OF THE CELL: An Evolutionary Approach

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By **William DeWitt,** Williams College. About 450 pp., 200 ill. Ready April 1976.

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Designed to complement the DeWitt text, this innovative lab manual follows the book's evolutionary approach and features experiments never before adapted for undergraduates. Several interesting experiments relating to theories on the chemical origin of life are included. Extensively class-tested, experiments can easily be adapted by departments lacking sophisticated equipment. Valuable instructor's notes fully explain the procedures used.

By **William DeWitt** and **Eleanor R. Brown,** both of Williams College. About 200 pp., illustd. (with report sheets). Soft cover. Ready April 1976.

## Norstog & Long: PLANT BIOLOGY

This compact introductory text stresses the economic and cultural aspects of plants, within the context of an informative evolutionary survey of the plant kingdom. Data on the physiology and ecological significance of botanical species is integrated into chapters on morphology. Botanical jargon and Latin terminology are kept to a minimum. Superbly detailed plates by Priscilla Fawcett of Fairchild Tropical Gardens are included. A **Teacher's Guide** is available.

By **Knut Norstog,** Northern Illinois University; and **Robert W. Long,** University of South Florida. About 448 pp., 360 ill. Ready January 1976.

## Long & Norstog: PLANT BIOLOGY: A Laboratory Manual for Elementary Botany

Versatility is the hallmark of this lab manual. Experiments involve a number of different organisms and approaches and the authors outline demonstrations which are instructive, yet easy to set up and run. Although designed as a lab companion to the authors' text, the manual will complement any standard botany text. Appendices include suggested student research projects, lists of needed materials, and a list of equipment vendors.

By **Robert W. Long,** University of South Florida; and **Knut Norstog,** Northern Illinois University. About 200 pp., illustd. Soft cover. Ready March 1976.

## LETTERS

### Organic Farming Methods

The *Science* article by Nicholas Wade, "Boost for credit rating of organic farmers" (5 Sept., p. 777), accurately reflects the content of the report (*1*) of the Center for the Biology of Natural Systems (CBNS) of Washington University, St. Louis. However, because of the way the report is presented, I would expect a high proportion of readers to misinterpret it with respect to the most fundamental points. All of the comparisons between organic and conventional farms are on a *per acre basis*. The only valid comparison is on a whole-farm basis, inasmuch as the researchers report that the quality of soil and numbers of livestock are similar. I note that the organic farms had 14 more total acres (476 versus 462) but harvested 92 fewer acres of cropland (266 versus 358). Using the report's figures on crop production returns [table 9 in (*1*), p. 40], I calculate the total for the average organic farm to be $35,644 ($134 per acre × 266 acres) compared to $46,256 ($132 × 358 acres) for conventional farms. This is about 30 percent more for conventional farms on 2 percent fewer acres per farm, which translates into slightly more than 30 percent more food being produced on conventional farms.

The CBNS report contains a single sentence (*1*, p. 50) which recognizes the deficiency, but few persons are likely to catch its significance: "But because the crops produced on both samples of farms are primarily livestock feeds, not food, a study of the total output (crops and livestock) of both kinds of farms would be needed to determine the actual contribution of each kind to total food production." The same concept is recognized indirectly in item 6 (*1*, p. 55): "A thorough assessment of how the total level of food production would be affected if there were an appreciable degree of adoption of organic methods." Inasmuch as the authors indicate that livestock are similar in the two systems, it seems unlikely that a study of total farm production would alter my economic analysis to any great extent. Such might not be the case if there were substantial differences in the amount of "feed purchases or sales to balance crops and livestock" (*1*, p. 13). No data on this matter are presented.

The CBNS report states that most of the additional costs on conventional farms is for fertilizers. A difference in nitrogen requirements is the only valid difference between the two systems in fertilizer costs. The authors make a gross error when they include an additional charge for phosphorus and potassium for conventional farms. An equal charge should be made against organic farms because, unless supplemented by off-farm sources of phosphorus and potassium, organic farm soils will gradually be depleted of these important elements.

The point made above also applies to the CBNS comparison of energy intensiveness. Related to the fertilizer comparison is the use of rock phosphate (energy intensiveness of 0.19 million Btu's) on organic farms versus triplesuperphosphate (energy intensiveness, 0.67 million Btu's) on conventional farms. Based upon many years of research, we expect 3 to 4 pounds of phosphorus in untreated rock to be equivalent to 1 pound in rock that has been acidulated to break the apatite bond. This is a generalized ratio that is adjusted for soil *p*H, type of crop, and soil test level. The failure to recognize the difference in utility of the phosphorus in rock versus triplesuperphosphate unfairly penalizes the conventional system.

In relation to the additional costs on conventional farms attributed by CBNS mainly to fertilizers, I think it significant that the difference would have been much less had the comparison been made in any of the previous 20 years.

SAMUEL R. ALDRICH
*Agricultural Experiment Station, College of Agriculture, University of Illinois at Urbana-Champaign, Urbana 61801*

#### References

1. W. Lockeretz, R. Klepper, B. Commoner, M. Gertler, S. Fast, D. O'Leary, R. Blobaum, "A Comparison of the Production, Economic Returns, and Energy Intensiveness of Corn Belt Farms That Do and Do Not Use Inorganic Fertilizers and Pesticides" (Center for the Biology of Natural Systems, Washington University, St. Louis, Missouri, 1975).

### Excess Bladder Cancer in Beauticians?

The scientific literature is replete with instances of misstatements and oversimplifications in secondary sources becoming accepted as fact. A recent example occurs in a review article on "Cancer of the urinary tract" (*1*), in which the following statement occurs in the course of a discussion of bladder cancer: "The Leeds, New York, and New Orleans series all noted an excess of hairdressers and beauticians, who, as indicated by Williams (1962), might have had exposure to dyestuffs" (*1*, p. 321).

In fact, this conclusion is hardly supported by reference to the three original papers.

1) The Leeds study (*2*) reports an excess in incidence of bladder cancer among "male hairdressers" (the English term


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"hairdresser" translates to "barber" in the American language)—a total of 5 cases versus an "expected" value of 1.8. For female hairdressers, the observed number was 0, the expected value, 0.6.

2) In the New York study (*3*), the 70 female bladder cancer patients included *one* beautician; there were also four male hairdressers among the 300 men. In their conclusions, the authors state "Also under suspicion are painting, hairdressing, certain textile operations, coal mining, and perhaps plumbing; there is possible exposure to dye in the first 3 occupations" (*3*, p. 1405). The statement implies that male hairdressers practice hair coloring, which is not common practice in this country.

3) The New Orleans study (*4*) does not refer to hairdressers or beauticians at all; it speaks only of barbers. It concludes that the comparatively small difference between the number of cancer patients (five) and control patients (two) may have been due to chance only.

The misstatement dissected above may seem trivial. However, in the current controversy on hair dyes, it has been cited in the public press (*5*, *6*) as raising questions concerning the safety of these dyes. One of the articles (*5*) has, in fact, been dignified by double inclusion in the *Congressional Record* (*7*).

Two points in conclusion: First, a report (*8*) on a recent epidemiological study in Massachusetts concludes, "Although suggested by earlier studies [presumably those just discussed] no excess risk was found for . . . [female] hairdressers (one observed, 0.9 expected)." Second, even if beauticians had been observed to incur excess bladder cancer, there would be no justification for linking this to exposure to hair dyes. Tests in which the skin of animals was painted throughout their lifetime with dye composites (*9*) and numerous skin painting and feeding studies in which single ingredients of dyes were tested have shown no such association.

JOHN MENKART
*Clairol, 2 Blachley Road,*
*Stamford, Connecticut 06902*

**References**

1. D. B. Clayson and E. H. Cooper, *Adv. Cancer Res.* **13**, 271 (1970).
2. H. M. Anthony and G. M. Thomas, *J. Natl. Cancer Inst.* **45**, 879 (1970).
3. E. L. Wynder, J. Onderdonk, N. Mantel, *Cancer* **16**, 1388 (1963).
4. L. J. Durham, A. S. Rabson, H. L. Steward, A. S. Frank, J. L. Young, *J. Natl. Cancer Inst.* **41**, 683 (1968).
5. J. Brody, *New York Times*, 18 March 1975, p. 26.
6. P. Toynbee, *Observer (London)*, 29 June 1975, p. 1; Washington *Post*, 6 July 1975, p. E-11.
7. T. Eagleton, *Congr. Rec.*, 19 March 1975, p. S.4462; L. K. Sullivan, *ibid.*, p. E.1247.
8. P. Cole, R. Hoover, G. H. Friedell, *Cancer* **29**, 1250 (1972).
9. H. J. Kinkel and S. Holzmann, *Food Cosmetic Toxicol.* **11**, 641 (1973); C. M. Burnett, B. Lanman, R. Giovacchini, G. Wolcott, R. Scala, M. Keplinger, *ibid.* **13**, 353 (1975).



## Succulent Stalks

So, that's what does it! Robert H. White ["Occurrence of *S*-methyl thioesters in urines of humans after they have eaten asparagus" (5 Sept., p. 810)] should now guide his research to a really meaningful conclusion by attempting to establish a correlation between asparagus quality and urine odor specificity, something many an asparagus devotee can do without the benefit of laboratory facilities. (One friend goes so far as to insist that the effect is modulated by the vintage of the companion wine.)

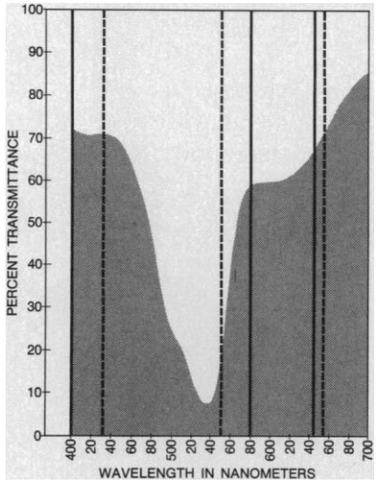
I, for one, choose to remain unconvinced. The uniqueness of the succulent stalks must be due to a certain wonderful and mysterious magic, not to some substance with a name I can't pronounce.

G. N. TSANDOULAS
*Lincoln Laboratory, Massachusetts Institute of Technology, Lexington 02173*

# Make better color photomicrographs with film that fits the job

Making photomicrographs is not like making pictures of landscapes or people. Different films are needed.

Conventional films are designed for pleasing the average "eye." But film which does well in rendering grass, sky, and flesh tones may not perform so admirably with the hues of hematoxylin and eosin. As the chart indicates, the green sensitivity of KODAK Photomicrography Color Film 2483 is a good match for the peak transmittance of the common H & E stain.




A comparison of film sensitivities with the spectral transmittance of H & E stain. Vertical lines are peak-wavelength sensitivities of KODACHROME II Professional Film (Type A [solid lines]) and KODAK Photomicrography Color Film 2483 (dashed lines). The spectral-absorption curve is from hematoxylin and eosin stain on a 5-micrometer section of adult guinea pig liver, read on a General Electric Recording Spectrophotometer.

The contrast of ordinary color films is not really adequate for faintly stained or low-contrast subjects. In short, films excellent for routine photography may have serious shortcomings in the specialized world of photomicrography. But KODAK Photomicrography Color Film 2483 is a film fit for the job.

It has very high resolving power (200 lines per mm); extremely fine grain; green sensitivity which fits biological stains, as shown in the chart; and high contrast and color saturation.

Combined, these features make 2483 Film capable of producing sharp, brilliant, beautiful photomicrographs. It brings out fine detail and faint color with excellent clarity.

Of course, all high-contrast materials demand precise exposure. For best results with 2483 Film, uniform illumination of the field is essential, and bracketing exposures is recommended.

To try the film yourself, go to your usual source of Kodak products and ask for KODAK Photomicrography Color Film 2483. It comes in 36-exposure 135 magazines, 35 mm x 125-foot rolls, and 4 x 5-inch sheets. If your dealer doesn't have it on his shelf, he can order it.

He probably *will* have chemical kits for Process E-4, so you can process the film yourself in about an hour. Or you can have it done by any commercial processing laboratory that processes KODAK Ektachrome Films.

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**A better b/w film, too.**
Excellent though color photomicrographs may be, there are times when black-and-white is preferable. The use of black-and-white may provide optimum visualization of detail via contrast control and color filtration. Or it may simply reflect the economics of reproduction in journals and monographs.

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10 October 1975, Volume 190, Number 4210

SCIENCE



# Grade Inflation

College transcripts are becoming so crowded with A's and B's that chapters of Phi Beta Kappa are reported to be raising the minimum grade average required, to safeguard the honor society's traditional exclusivity. A case study of grades in one community college found that the proportion of the school's students receiving an A in the first semester rose from 9.7 percent in 1963–1964 to 12 percent in 1968–1969 and 21 percent in 1971–1972. A 1974 study of recent grading procedures in 544 colleges across the country found that a student receiving a poor grade can often take the course over. This held for any grade in 303 colleges, for D or F in 442, and for F alone in 295 out of the 544 schools. In 325 of the institutions studied, when a course was repeated, only the last grade was taken into account in computing the grade point average.

Grade inflation makes *no* sense in terms of either of the two prevalent positions toward grades, the progressive or the traditional. According to the progressive view, grades are at best unnecessary, at worst harmful. Students should study because of their interest in the subject, its value for their future career, or not study at all. Progressives argue that under the grading system students are treated like Pavlovian dogs—in need of frequent "reinforcement." Feedback, not reinforcement, is what the student needs. Teachers should write a detailed, thoughtful commentary on each paper or exam. The teacher's response to the student's work should be part of an ongoing educational process, not merely "a good grade on the final." In short, grading is degrading.

The traditional viewpoint is that to expect learning to be its own reward is to expect too much. While a student who loves a subject is likely to continue to love it and perform accordingly whether his work is assessed by a grade or through a written progress report, other students, to whom the subject matter is like a medicine that must be gotten down, or is a necessary step in a career ladder, need something extrinsic to encourage good performance. This is not just a concession to human nature; it is seen as valuable training in "life." A student who learns to work hard for a good grade is thought to gain a self-discipline that will later help him adjust to other tasks in the real world which he will dislike but must perform. A student who cannot learn to live with competition over grades, however he ranks, will find the much harsher competitiveness of adult life even more difficult to take. Finally, so long as selecting some people and rejecting others is inherent in many fields of activity, it seems preferable to base the sorting process on an explicit criterion rather than a subjective one. Grades are less subject to favoritism and paternalism than personal evaluations.

Whichever philosophy one subscribes to, neither provides a rationale for the kind of wishy-washy grading now on the increase. It has all the disadvantages of a grade hierarchy with few of its benefits. It does rank and label people, but does not give them clear performance cues. While theoretically a B– can be as clear a signal as an F or a D, and a B+ could eventually take on the meaning of a C, the various letters have just enough cultural and emotional resonance for student after student to be *mis*cued when A's and B's are appearing on nearly every paper. And with the narrowing of the grade range from A to B, the fact that some professors play the full field while others restrict themselves to the limited range heightens the arbitrariness of grading and the difficulties of grade average comparisons.

What is needed is open discussion leading to departmental or faculty-wide resolutions endorsing either a relatively standardized system of meaningful grades or the abolition of all grades—eliminating grade inflation one way or the other. At the least, each department should compile and circulate statistics that would indicate which professors are contributing most to skewing the grading curve upward (for example, that Professor X's grades are two sigmas higher than the department profile). Such publicizing of grade inflation may help to curb it. Meanwhile, neither students who have really earned their high grade averages nor those who have just had "sympathetic" teachers know what they got.—AMITAI ETZIONI, *Department of Sociology, Columbia University,* and *Director, Center for Policy Research, Inc., 475 Riverside Drive, New York 10027*

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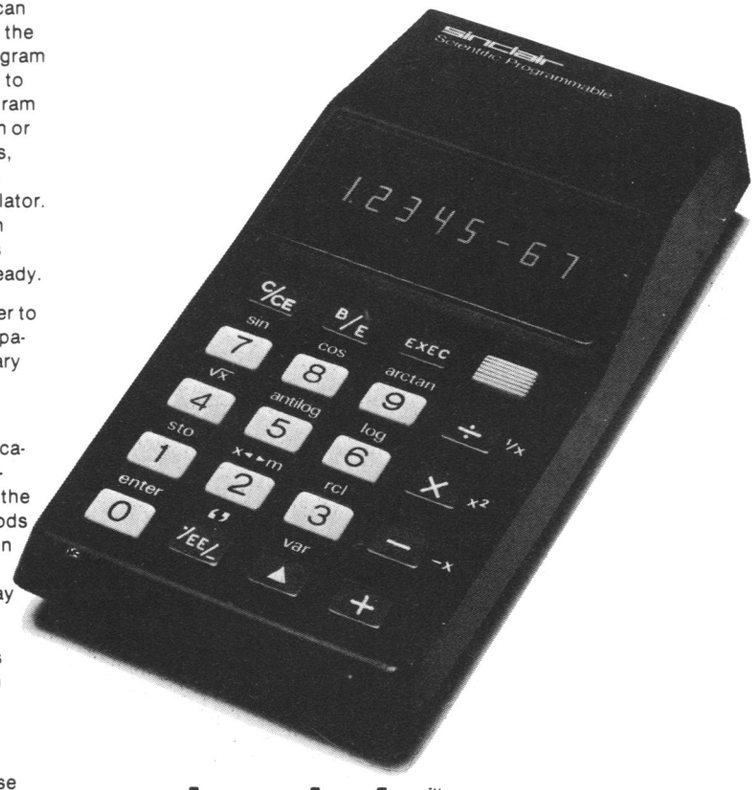


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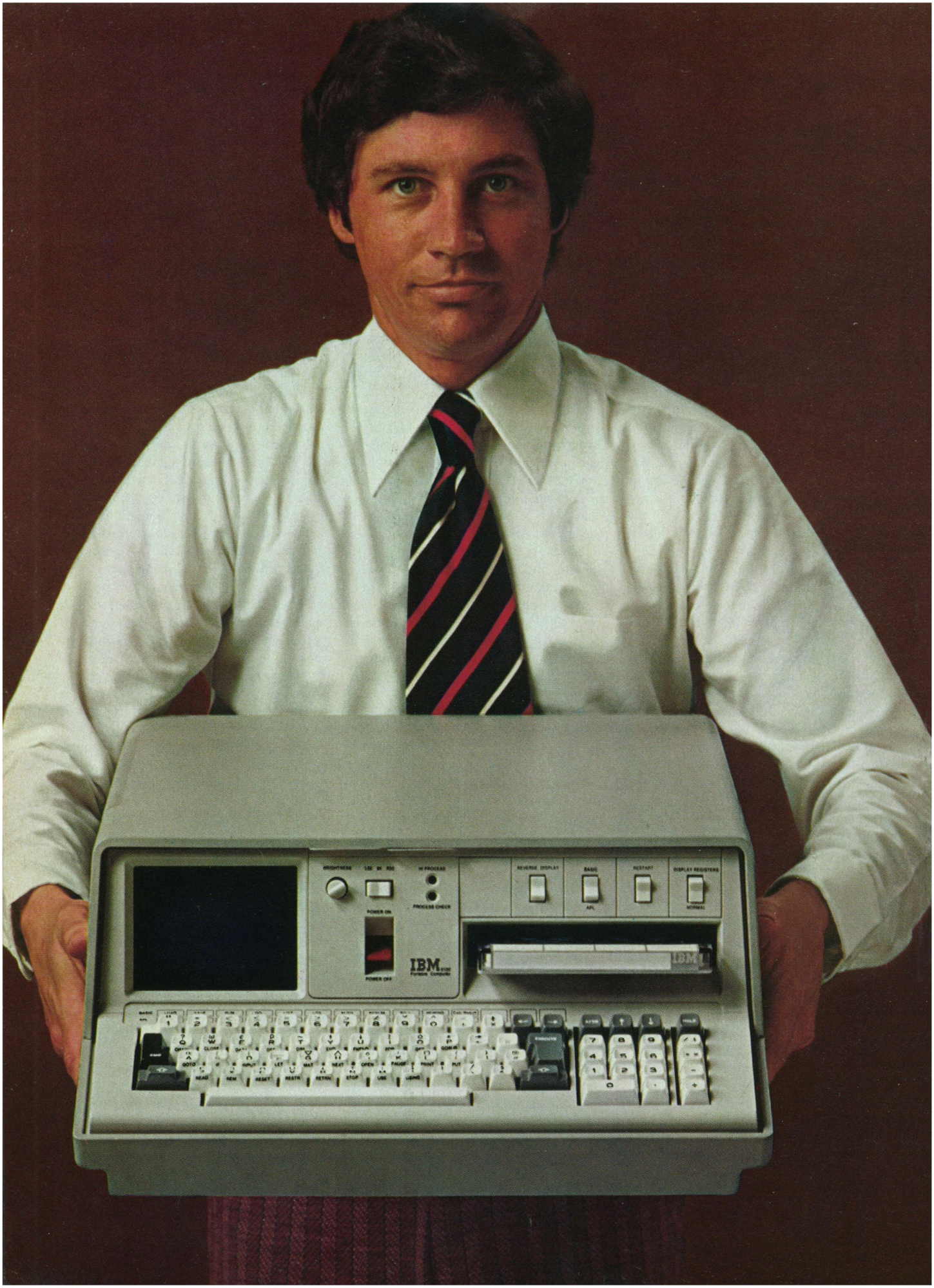
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### Blood Cell Counter

The Haema-Count MK-40 system combines electronic counting methods with a cyanmethemoglobin method for hemoglobin. In about 2 minutes, the white blood cell and red blood cell counts, hemoglobin, and hematocrit determinations may be made from a single 50-microliter sample. Two serial dilutions are made automatically. All parameters are read directly and all counts are corrected for coincidence. J. T. Baker Instruments. Circle 737.

### Column Packing Material

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### Blood Lead Screening Fluorimeter

This device measures the red fluorescence of zinc protoporphyrin, a substance in the blood that increases in proportion to biological damage done by lead in the body. A drop of blood is placed on a slide which is inserted in the fluorimeter. The sample is irradiated with blue light and intensity of the red fluorescence emitted is representative of the extent of damage done by lead. Environmental Science Associates. Circle 739.

### Aerosol Hologram Analyzer

This system determines size, shape, and location of every particle of more than a few micrometers in diameter in up to 1 liter of an aerosol. The Quantimet hologram analyzer makes the measurements and controls the mechanical operation. Holograms are obtained with a pulsed ruby laser. A pulse of 30 nanoseconds will stop the motion of particles traveling at up to 100 meters per second. Thus, aerosols may be studied without alteration or disturbance. Image Analysing Computers. Circle 740.

### Literature

*Specpure Spectrographically Standardized Substances* is a 20-page catalog devoted to chemicals for spectroscopy and other analytical techniques. United Mineral and Chemical. Circle 744.

*Revolutionize Current Measurement* describes the model 1776 digital current meter including specifications. F. W. Bell. Circle 745.

*Scanning Electron Microscopy* is the subject of four applications brochures. Cambridge Instrument. Circle 749.

*Bio-Radiations* is a technical periodical. The 19th edition features new products and describes cyclic nucleotide purification. Bio-Rad Laboratories. Circle 747.

*Finnpipette* includes a line of hand systems for precise transfer of liquids. Variable Volumetrics. Circle 748.

*Lab Products Catalog* describes membranes for ultrafiltration and dialysis and materials for other types of separation. Spectrum Medical Industries. Circle 750.

*Clinical Diagnostics* includes colorimetric reagents, reference controls, and descriptions of new products. Calbiochem. Circle 751.

*TM 500 Modular Test and Measurement Instruments* includes counters, digital multimeters, signal sources, power supplies, signal processors, and oscilloscopes. Tektronix. Circle 720.

*Microcomputer Assembly Language Reference Cards* are 6-page, pocket-sized folders for comparing machine codes to assembly language. Control Logic. Circle 734.

*Short Form Catalog* lists recorders, data printers, tape transports, data terminals, and other peripherals. MFE. Circle 735.

*Oil-Free, Clean, Dry Compressed Air* discusses causes of trace accumulation and reviews equipment options. Hankison. Circle 752.

*The Source for Synthetic Peptides* describes a facility for this product line. Beckman Instruments. Bioproducts Group. Circle 753.

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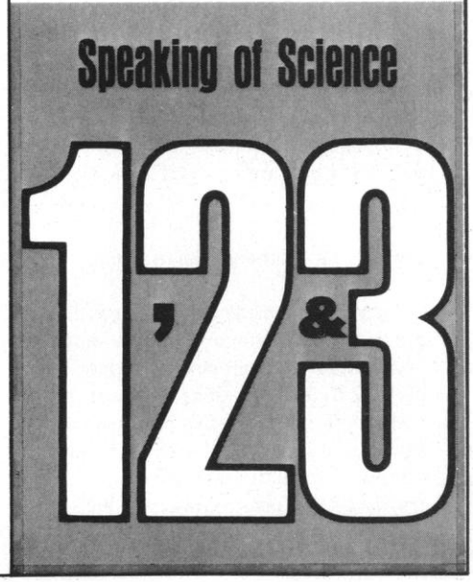


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## BOOKS RECEIVED

*(Continued from page 142)*

**Biological Transport**. Halvor N. Christensen with contributions by Dale L. Oxender and Gunnar Ronquist. Benjamin, Reading, Mass., ed. 2, 1975. xxii, 514 pp., illus. $19.50.

**A Biologist's Guide to Principles and Techniques of Practical Biochemistry**. Bryan L. Williams and Keith Wilson, Eds. Elsevier, New York, 1975. xxii, 256 pp., illus. Paper, $9.95. A Series of Student Texts in Contemporary Biology.

**Biology Laboratory Manual**. A. M. Winchester. Brown, Dubuque, Iowa, ed. 5, 1975. x, 348 pp., illus. Spiral bound, $7.95.

**Cell Membranes**. Structure, Receptors, and Transport. Papers from a seminar, Aspen, Colo., July 1974. Cecilia Fenoglio, Carmia Borek, and Donald West King, Eds. Stratton, New York, 1975. vi, 90 pp., illus. Paper, $7.95. Advances in Pathobiology, vol. 1.

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**Classical and Quantum Mechanical Aspects of Heavy Ion Collisions**. Papers from a symposium, Heidelberg, Germany, Oct. 1974. H. L. Harney, P. Braun-Munzinger, and C. K. Gelbke, Eds. Springer-Verlag, New York, 1975. viii, 312 pp., illus. Paper, $12.10. Lecture Notes in Physics, vol. 33.

**Clinical Aspects of Immunology**. P. G. H. Gell, R. R. A. Coombs, and P. J. Lachmann, Eds. Blackwell, Oxford, ed. 3, 1975 (U.S. distributor, Lippincott, Philadelphia). xvi, 1754 pp., illus. $79.

**The Coast and Shelf of the Beaufort Sea**. Proceedings of a symposium, San Francisco, Jan. 1974. John C. Reed, John E. Sater, and Wade W. Gunn, Eds. Arctic Institute of North America, Arlington, Va., 1974. 750 pp., illus. Paper, $25.

**Collecting and Studying Mushrooms, Toadstools and Fungi**. Alan Major. Illustrated by Barbara Prescott. Arco, New York, 1975. 268 pp. $12. An Arco Guide.

**Communities and Alternatives**. An Exploration of the Limits of Planning. Shimon S. Gottschalk. Schenkman, Cambridge, Mass., and Halsted (Wiley), New York, 1975. xx, 170 pp. Cloth, $9.95; paper, $5.95.

**Competition in the U.S. Energy Industry**. Thomas D. Duchesneau. Ballinger (Lippincott), Cambridge, Mass., 1975. xiv, 402 pp. Cloth, $17.50; paper, $8.50. A Report to the Energy Policy Project of the Ford Foundation.

**Complexes and First-Row Transition Elements**. David Nicholls. Elsevier, New York, 1975. xiv, 216 pp., illus. Paper, $15. A Macmillan Chemistry Text.

**Composite Materials**. Lawrence J. Broutman and Richard H. Krock, Eds. Vol. 8, Structural Design and Analysis. Part 2. C. C. Chamis, Ed. Academic Press, New York, 1975. xxiv, 292 pp., illus. $35.

**Computer Science**. A First Course. A. I. Forsythe, T. A. Keenan, E. I. Organick, and W. Stenberg. Wiley, New York, ed. 2, 1975. xxii, 742 pp., illus. + appendices. $15.95.

**A Conceptual Approach to Moving and Learning**. David L. Gallahue, Peter H. Werner, and George C. Luedke. Wiley, New York, 1975. xxii, 424 pp., illus. $10.95.

**Consciousness and Creativity**. Transcending Science, Humanities, and the Arts. Bill Romey. Drawings by Lucretia Romey. Ash Lad Press, Canton, N.Y., 1975. 278 pp. Paper, $5.

**The Conservation Alternative**. Raymond F. Dasmann. Wiley, New York, 1975. xii, 164 pp., illus. Paper, $5.95.

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**Design of Digital Computers**. An Introduction. Hans W. Gschwind and Edward J. McCluskey. Springer-Verlag, New York, ed. 2, 1975. x, 548 pp., illus. $19.50. Texts and Monographs in Computer Science.

**The Design of Electrical Services for Buildings**. F. Porges. Spon, London, 1975 (U.S. distributor, Halsted [Wiley], New York). x, 264 pp., illus. $18.75.

**Detente**. Promises and Pitfalls. Gerald L. Steibel. Published for National Strategy Information Center by Crane, Russak, New York, 1975. xiv, 90 pp. Cloth, $4.95; paper, $2.95. Strategy Paper No. 25.

**Determinants and Origins of Aggressive Behavior**. Papers from a conference, Monte Carlo, Monaco, July 1973. Jan de Wit and Willard W. Hartup, Eds. Mouton, The Hague, 1974. Dfl. 84. New Babylon Studies in the Social Sciences, 22.

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**Digital Signal Processing**. William D. Stanley. Reston (Prentice-Hall), Reston, Va., 1975. xii, 324 pp., illus. $15.95.

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**The Divided Academy**. Professors and Politics. Everett Carll Ladd, Jr., and Seymour Martin Lipset. McGraw-Hill, New York, 1975. xviii, 418 pp. $17.50. Sponsored by the Carnegie Commission on Higher Education.

**Dynamic Nuclear Magnetic Resonance Spectroscopy**. Lloyd M. Jackman and F. A. Cotton, Eds. Academic Press, New York, 1975. xvi, 660 pp., illus. $48.

**Ecological Strategies of Xylem Evolution**. Sherwin Carlquist. University of California Press, Berkeley, 1975. xii, 260 pp. + plates. $12.50.

**The Economics of Natural Environments**. Studies in the Valuation of Commodity and Amenity Resources. John V. Krutilla and Anthony C. Fisher. Published for Resources for the Future by Johns Hopkins University Press, Baltimore, 1975. xx, 292 pp., illus. Cloth, $16.95; paper, $4.50.

**Education and Politics at Harvard**. Seymour Martin Lipset and David Riesman. McGraw-Hill, New York, 1975. xiv, 450 pp. $15.95. Prepared for the Carnegie Commission on Higher Education.

**Elements of a Two-Process Theory of Learning**. J. A. Gray. Academic Press, New York, 1975. x, 424 pp., illus. $16.50.

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**The Environmental Price of Energy**. Alfred J. Van Tassel, Ed. Lexington Books (Heath), Lexington, Mass., 1975. viii, 328 pp., illus. $21.

**Enzyme Kinetics**. Behavior and Analysis of Rapid Equilibrium and Steady-State Enzyme Systems. Irwin H. Segel. Wiley-Interscience, New York, 1975. xxii, 958 pp., illus. $27.50.

**Equality and Efficiency**. The Big Tradeoff. Arthur M. Okun. Brookings Institution, Washington, D.C., 1975. xii, 124 pp. Cloth, $6.95; paper, $2.95. The Godkin Lectures on the Essentials of Free Government and the Duties of the Citizen.

**Equilibrium and Nonequilibrium Statistical Mechanics**. Radu Balescu. Wiley-Interscience, New York, 1975. xvi, 742 pp., illus. $29.95.

**Ergebnisse der Angiologie**. Norbert Klüken, Ed. Band 8. Papers from a congress, Marburg, Germany, Oct. 1973. H. C. Friederich and H. Hamelmann, Eds. Schattauer, Stuttgart, 1974. viii, 176 pp., illus. Paper, DM 36.

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**Exercises in Physical Geology**. W. K. Hamblin and J. D. Howard. Burgess, Minneapolis, Minn., ed. 4, 1975. vi, 234 pp., illus. Paper, $6.95.

**A Field Guide to Birds' Nests**. Hal H. Harrison. Photographs by the author. Drawings by Ned Smith and Mada Harrison. Houghton Mifflin, Boston, 1975. xxx, 258 pp. $8.95. The Peterson Field Guide Series, 21.

**Fluid Power**. Theory and Applications. James A. Sullivan. Reston (Prentice-Hall), Reston, Va., 1975. xx, 460 pp., illus. $18.95.

**Forests for Whom and for What?** Marion Clawson. Published for Resources for the Future by Johns Hopkins University Press, Baltimore, 1975. xiv, 176 pp. Cloth, $11.95; paper, $3.65.

**From Village to Suburb**. Order and Change in Greater Beirut. Fuad I. Khuri. University of Chicago Press, Chicago, 1975. xiv, 272 pp., illus. $19.50.

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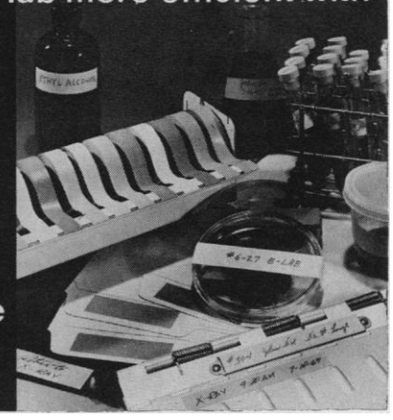

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*(Continued from page 136)*

RNA polymerase—the enzyme that copies DNA into RNA when genes are transcribed. This enzyme is composed of five protein subunits: two copies of $\alpha$, and one each of $\beta$, $\beta'$, and $\sigma$.

About a year ago, Joel Kirschbaum of the University of Geneva and his associates discovered that a phage carrying genes from the neighborhood of 79 minutes carries genes for RNA polymerase subunits $\beta$ and $\beta'$. Subsequently, Jaskunas and his colleagues found that this phage also carries genes for several ribosome proteins and genes for the three rRNA's. Since they found ribosome genes at 79 minutes, where initially RNA polymerase genes were discovered, Jaskunas and his associates thought it possible that they might find RNA polymerase genes at 64 minutes, where initially ribosome genes were known to be located. Accordingly, they looked for and found the gene for the $\alpha$ subunit on a phage carrying genes from that site.

Jaskunas, Burgess, and Nomura report that not only is the gene for the $\alpha$ subunit of RNA polymerase near genes for ribosome proteins but it is also regulated along with some of those genes. They obtained this result when they isolated a certain deletion mutant of a transducing phage that carries genes for the $\alpha$ subunit and three ribosome proteins, along with other genes. In this mutant phage, the region of bacterial DNA (the promoter) that appears to control the initiation of the transcription of the $\alpha$ gene and these three ribosome protein genes was missing; these four bacterial genes were fused to, and their transcription controlled by, the promoter for phage genes. Genes controlled by this phage promoter are only expressed when bacteria infected by this phage contain no phage repressor (a protein that binds to the DNA and prevents transcription of genes under the control of the phage promoter). Jaskunas and his associates showed that, when bacteria are infected with this mutant phage, the expression of the genes for the $\alpha$ subunit and the three ribosome proteins depends on the presence or absence of the phage repressor.

The evidence that the $\alpha$ gene is regulated along with ribosome protein genes indicates that the synthesis of RNA polymerase, which functions in gene transcription, may be coordinated along with the synthesis of ribosomes, which function in the translation of the genetic code. However, although the $\beta$ and $\beta'$ genes are close to ribosome genes at 79 minutes, it remains uncertain whether these genes are regulated with ribosome genes. In fact,

Burgess points out that there is some evidence that $\beta$ and $\beta'$ could be regulated differently than $\alpha$ and that the amounts of $\beta$ and $\beta'$ in a cell could be the limiting factors in determining the amount of RNA polymerase. As yet, the location of the gene for the $\sigma$ subunit of RNA polymerase is not known.

Since genes for the $\alpha$, $\beta$, and $\beta'$ subunits of RNA polymerase are all found near ribosome genes, it is possible that the gene for the $\sigma$ subunit is also near ribosome genes. The genes located at 64 and 79 minutes account for only about 70 percent of the ribosome protein genes in *E. coli*. Thus ribosome genes must be located elsewhere on *E. coli* DNA. At least one gene for a ribosome protein is known to be located at 84 minutes, and investigators suspect other such genes may be located between zero and 10 minutes. Near one of these other sites of ribosome genes, the gene for the $\sigma$ subunit may be found. If the $\sigma$ gene is also near ribosome genes, the possibility becomes more likely that the synthesis of ribosomes, which function in the translation of genetic messages, is coordinated with the synthesis of RNA polymerase, which functions in the transcription of genetic messages.

In addition to genes for RNA polymerase, other genes whose products are involved in gene expression are clustered with ribosome genes at 64 minutes and 79 minutes. Jaskunas, Burgess, Lindahl, and Nomura find that the phage that carries genes from 79 minutes, including genes for the $\beta$ and $\beta'$ subunits of RNA polymerase and several ribosome proteins and rRNA genes, also carries a gene for a protein (elongation factor EF-Tu) used to transport transfer RNA (tRNA) molecules carrying amino acids to their proper positions on ribosomes.

A phage that carries the $\alpha$ gene and genes for 30 ribosome proteins located in the neighborhood of 64 minutes also carries another gene for EF-Tu and a gene for a different elongation factor—EF-G—that moves the ribosome along the mRNA as the genetic message is translated. Although it is not carried by this transducing phage, a gene coding for another protein used in gene expression—CRP—is also located around 64 minutes. A few years ago, Robert Perlman, Ira Pastan, and their colleagues, then working together at the National Cancer Institute, mapped the position of the CRP gene at about 64 minutes. The CRP gene codes for a protein that binds 3′,5′-adenosine monophosphate and is necessary for the initiation of transcription of a wide variety of genes in bacteria.

Besides providing new insight into the possible coordinated control of RNA polymerase and ribosome synthesis, the identification of genes clustered with ribosome genes on transducing phages is leading to other discoveries that may help explain the molecular biology of protein synthesis. For example, the discovery that there are two genes for elongation factor EF-Tu—one at 64 minutes and the other at 79 minutes—is thought to be significant because few genes in bacteria are present more than once per cell. Burgess speculates that the two genes, generated by gene duplication, may have diverged slightly and thus may not be identical, although they certainly code for very similar proteins. At least three different functions for EF-Tu have been proposed. One function is to aid in protein synthesis. A second is to serve as part of an enzyme involved in the replication of a particular virus. The third is to help stimulate the synthesis of RNA polymerase. It is not known whether all of these functions can be carried out by each of the two EF-Tu's coded by the two genes.

Nomura and Jaskunas suggest another hypothesis to explain why there are two genes for EF-Tu. The gene clusters at 64 minutes and 79 minutes may be physically close in *E. coli* cells because of the way the DNA is folded. The two genes for EF-Tu could be attached to each other to maintain this proximity and, possibly, keep the two clusters of active genes in a position where they can be easily transcribed.

Nomura and his associates, including E. Lund and James Dahlberg, have also discovered that a tRNA gene is located among and transcribed along with rRNA genes at 79 minutes. They speculate that this tRNA may have some additional function in the cell besides its usual role in protein synthesis. For example, it could be involved in the control of rRNA production or ribosome assembly.

Although ribosome genes have been studied for more than a decade, the recent use of transducing phages to investigate these genes has led to the first major advances in understanding how ribosome genes are organized and controlled. And since ribosome genes are adjacent to other genes whose products are crucial to gene expression, studies of ribosome genes may help molecular biologists to understand how the transcription and translation of genetic messages are integrated.

—GINA BARI KOLATA

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