SCIENCE

6 August 1971

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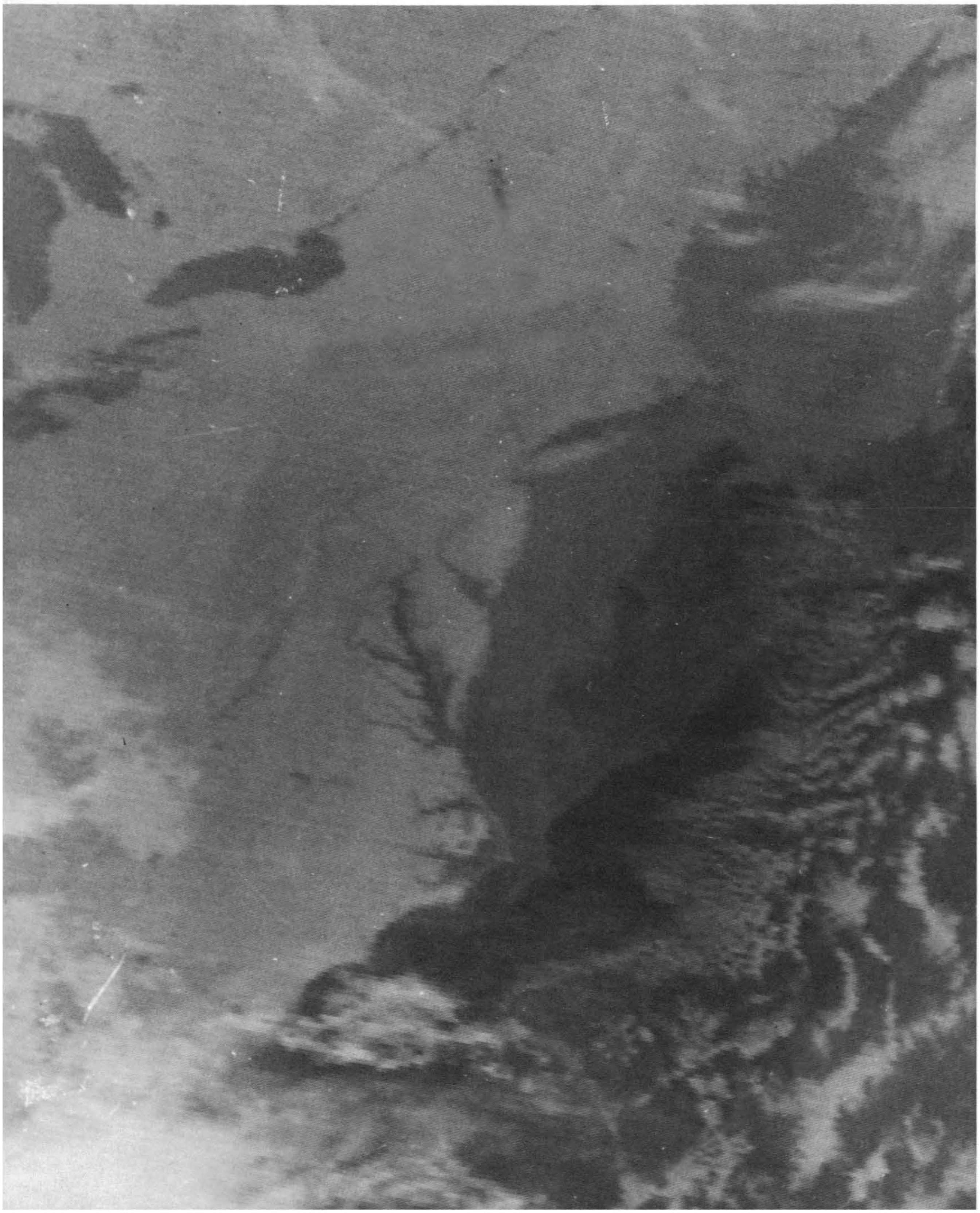
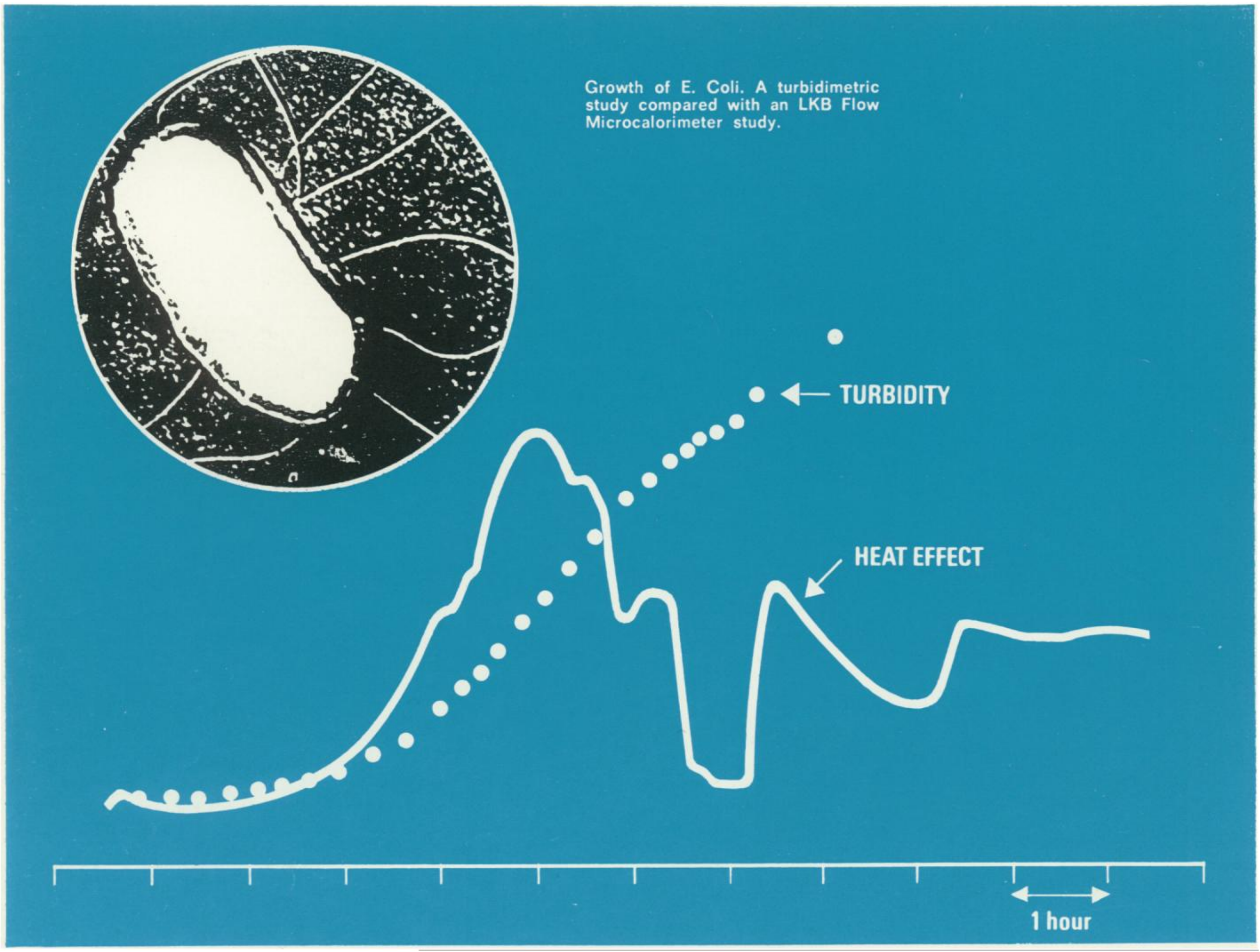
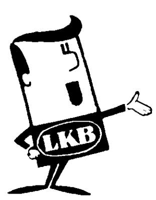
AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE







A Matter of Life and Death

Recording the growth patterns of bacteria reacting with antibiotics is just one of the many applications possible with the LKB Flow Microcalorimeter.

As you can see, the calorimetric curve gives more information about the growing process, and also continues to give data about what is happening even when growth has stopped. An ideal instrument for examining the effects of antibiotics and growth inhibitors when they are added to bacterial cultures. The LKB Flow Microcalorimeter simplifies biochemical analysis.

As it does not require the clear solutions so often needed in other analytical processes, time-consuming and costly separations can be avoided. What is more, LKB Microcalorimeters are simple to operate. A very short training session is all that is needed.

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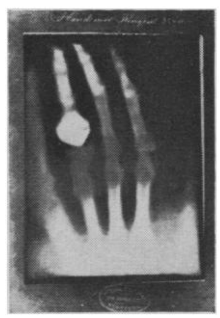
Cheaper packaging

We are pleased to announce a computer-output microfilmer of lower price—purchase or rental—than we have previously offered. At the same time the choice of output formats has broadened, and format has become easy to change.

A computer can tell you much, much more than you want to know unless you keep a firm grip on it. That's where we come in. Look for Kodak in the Yellow Pages under "Microfilming." We show you how to package and distribute the data for convenience, economy, and security. Also sanity.

Two prices for x-rays



In x-ray film for the healing arts, two quite separate kinds of economics enter. The more important of the two reckons in radiation as its coin. The radiation buys information with which to help the patient.

It was on November 8, 1895 that Wilhelm Conrad Röntgen discovered x-rays. Frau Röntgen's hand was the subject of the first human radiograph. Just for fun, of course. Nothing wrong with the hand.

On New Year's Day of 1896 prints of the lady's finger bones were sent out. By spring, amazement had spread from physicists to medical men. Very soon, x-rays became entertainment. The first Nobel Prize ever awarded in physics went to Röntgen.

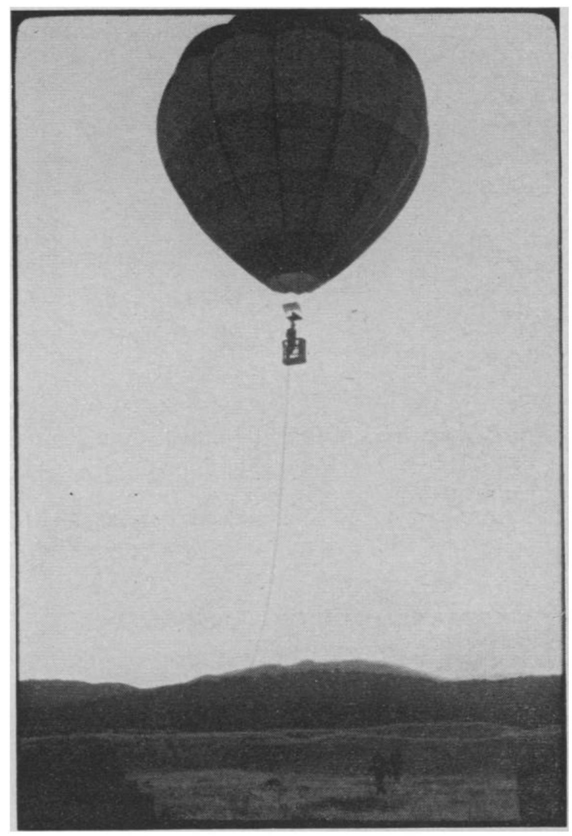
Any kind of photographic plate, film, or paper responded to his amazing rays. Some had to be exposed longer and stronger, but all responded. You merely relaxed.

While the body has no organs designed to feel x-rays, it is not oblivious to them. It took time to learn that. To *that* discovery, Kodak has responded over the years with a long succession of technical stratagems to deliver more information from less radiation. For far less than the radiation price that must have been paid to prove there were bones in Frau Röntgen's hand, more crucial knowledge is bought today, and not just of bones.

But money also counts. In 1906 a 14 x 17-inch glass Kodak plate for an x-ray "sitting" cost the photographer $1. If the client was reasonably well dressed, he might have been wearing a $7 suit and a $3 pair of shoes. By 1918 the plate had dropped in price to 74¢. By 1924, the highly flammable nitrate film that had replaced heavy glass plates had itself been replaced by Kodak safety film, but this was expensive: $1.04 for a 14 x 17-inch sheet.

Today the same size sheet of the newest, vastly more sensitive Kodak x-ray film, designed for machine processing in 90 seconds, can be bought for 84¢. On the other hand, tuition at most first-rate universities has now gone up considerably above $300 a year, and the American Board of Radiology generally confers its certification on an M.D. only after an examination that follows at least four years of radiological residency and one year of joint practice with a radiologist already holding such certificate.

Two academic attitudes toward photography



Sent to establish friendly contact for purposes of trade with a band of archeologists encamped in council on what to expect from photography, one of us came back with the above photo of a photographic platform peculiarly useful in their work. What better than a tethered balloon and the right kind of color film for perception of the signs of a site? Like all scientists, archeologists have the problem of explaining themselves beyond the circle that evaluates work by the standards of the disciplines. Surrounding the men and women of science is the larger circle of well-intentioned non-academic humanity who long to understand what it is they are paying for.

The inner circle and the outer circle require very different kinds of photography. The hand that holds the hand-axe in a photograph annoys the scholar by hiding key details from which to identify a culture. But at the expense of keeping that offending hand in the picture, a realtor with a lively mind sees why that particular sharp rock—so like other, undistinguished rocks—shows his ancestors developing the notion of property. A primeval work of art can be photographed for the beauty that the ancient artist gave it. But first it ought to be photographed in a way to record beyond doubt how it stood before the trowels descended and cut for ever the authentic thread to the life of its time.

A small outpost for trading information on archeological photography is maintained by Eastman Kodak Company, Scientific Photography Markets, Rochester, N.Y. 14650.

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AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

COVER

Infrared image of eastern United States and Atlantic Ocean from the Improved TIROS Operational Satellite-1 (ITOS-1) taken at about 0900 G.M.T. on 19 October 1970. Darker tones represent warmer areas viewed by ITOS at 798 nautical miles. See page 529. [Goddard Space Flight Center]

Recent Advances in the Preparation of L.S.C. Samples

Radioactive Proteins

A paper on the *"Rapid and Simplified Method for Liquid Scintillation Counting of Radioactive Proteins"*[1] clearly indicates the advantages of Aquasol for determining radioactivity of proteins. Observed counts from replicate samples prepared in Aquasol are highly reproducible; in addition, the observed radioactivity with Aquasol is higher than with a toluene/Triton X-100 (2:1) scintillation solution. Liver samples prepared in Aquasol accurately indicate actual protein activity, as shown by a linear response to protein concentration, and by a decrease in radioactivity of protein following cycloheximide and dimethylnitrosamine. Aquasol has the unique property of forming gels when mixed with water. This gel will hold the protein in suspension. On the other hand, samples prepared in toluene/Triton X-100 (2:1) scintillation solution settle on the bottom of the vial where self-absorption becomes an important factor. A procedure using Aquasol with acid-precipitated proteins follows:

1. Apply hot acid-precipitated proteins to Millipore filter under vacuum
2. Wash filter cake
3. Place filter cake and filter into liquid scintillation vial with 3.5 ml water
4. Add 11.5 ml Aquasol, shake well and count

Lipid Extraction From TLC

Data from the article, *"Recovery of Lipids from Thin-Layer Chromatography for Radioassay"*[2] demonstrates that the combination of a multipurpose scintillator, Aquasol, and a suitable elution system can give complete recovery of all classes of lipids from TLC plates. Both neutral and phospho-lipids give quantitative recoveries in the indicated systems. It was ascertained that up to 300mg of silica gel could be added to Aquasol without impairment of ^{14}C counting efficiency. Specific applications follow:

Neutral Lipids

1. Develop plate in hexane:ether:acetic acid (90:10:1)
   Unsaturated Lipids — expose to iodine vapor and allow for sublimitation of iodine.
   Saturated Lipids — develop in duplicate and spray one spot with sulfuric acid.
2. Suspend silica gel in 15 ml Aquasol
3. Shake well and count

Phospholipids (except phosphatidylcholine)

1. Develop plate in chloroform:methanol:7M ammonia (230:90:15)
2. Visualize spots by exposure to iodine vapor or H_2SO_4 spray
3. Suspend silica gel in 15 ml Aquasol
4. Shake well and count

Labeled Inulin

Inulin labeled with tritium or carbon-14 is widely used for assessment of glomerular filtration rate and determination of extracellular spaces. Signficant decreases in observed radioactivity with time have, in many instances, precluded the use of liquid scintillation counting as an analytical technique. The *"Evaluation of Liquid Scintillation Systems for the Assay of Tritiated Inulin"*[3] conclude that an Aquasol/water system affords ease of sample preparation, high counting efficiency and long-term sample stability. Samples prepared by this technique remained stable over the ninety-day experimental period, maintaining a satisfactory counting efficiency of approximately 27 percent. A brief description of the sample preparation technique is as follows:

1. Place tritiated inulin aliquod in liquid scintillation counting vial
2. Adjust sample volume to 3.5 ml with water
3. Add 11.5 ml Aquasol, shake well to form stiff gel, count

Acrylamide Gels

Data from *"Acrylamide Gel Electrophoresis of Radioactive Compounds With Accompanying Low Background"*[4] describes a method for the detection of radioactive components in polyacrylamide gel disc electropherograms by automated mechanical fractionation with the use of Aquasol. Aquasol also can be successfully utilized in the conventional, non-automated acrylamide gel counting procedures with minimal background interference. Unpublished data provided by Harris-McEvoy follows:

N, N'-methylenebisacrylamide cross-linked

1. Place 20 mg wet sample into glass liquid scintillation vial
2. Cover gel with 0.1 ml 30% H_2O_2 and cap tightly
3. Incubate at 50° until digested
4. Allow to cool
5. Add 10 ml Aquasol, shake well and count

Ethylene diacrylate cross-linked

1. Place 20 mg gel samples into liquid scintillation vials
2. Add 1.5 ml 10% NH_4OH and cap tightly
3. Incubate at 50° until digested
4. Allow to cool
5. Add 10 ml Aquasol, shake well and count

Reduction of Adsorption by Phosphates and Sulfates in Glass L.S.C. Vials

Data on the *"Incorporation of High Concentrations of Phosphates and Sulfates in Samples for Liquid Scintillation Counting"*[5] reports of problems associated with solubility and adsorption on the walls of glass vials by solutions of phosphates and sulfates. For instance, the loss of counts and reduction of apparent radioactivity over a period of time can be minimized by using Aquasol as follows:

1. Add up to 2 ml sample to 15 ml Aquasol
2. If precipitation or turbidity occurs, add water in increments of 0.2 ml, with shaking, until sample clears
3. Count

30% (W/V) Sucrose Density Gradients

Thirty percent (w/v) Sucrose gradient cuts were measured by liquid scintillation counting utilizing Aquasol. The results for tritium labeled samples follow:[6]

Sample Volume	Aquasol Volume	% of Sample	^3H Efficiency	Figure of Merit†
0.5 ml	14.5 ml	3.3	29.9 ± 0.1%*	14.9
1.5 ml	13.5 ml	10.0	29.3 ± 0.4%	44.0
2.5 ml	12.5 ml	16.7	27.0 ± 0.6%	67.5
3.5 ml	11.5 ml	23.3	26.7 ± 0.1%	93.3

†Figure of Merit = (volume added sample) (efficiency)

- Counting performed on Packard TriCarb Model 3320
- Absolute efficiency of TriCarb is 60% with sealed ^3H standard in toluene
- Settings: Gain — 50%, Discriminators 50-1000
- 3 samples at each point. Internal standard = 125190 DPM
- All samples clear at room temp.

*S.D. of the mean

References and Notes

1. Marvin A. Friedman, Gail Miller, Arthur McEvoy and Samuel S. Epstein, *Anal. Chem.*, Vol. 43, No. 6 (1971).
2. David Kritchevsky and Saroj Malhotra, *J. Chromatog.*, 52, 498-499 (1970).
3. Arthur McEvoy and Wayne G. Harris, *Anal. Biochem.* (in press) (1971).
4. Bohdan Bakay, *Anal. Biochem.*, 40, 429-439 (1971).
5. Unpublished data, Assay Laboratory, NEN Corp.
6. Unpublished data, Assay Laboratory, NEN Corp.

The General Conference will review the situation at its 17th session in the fall of 1972. This review will take account of the results of the United Nations Conference on the Human Environment in Stockholm and discussions of relevance to the General Assembly and the work of the International Coordinating Council.

Thirty-one research themes in four groups have been proposed: (i) those related to the natural environment that is little modified by man; (ii) those related to the rural environments used primarily for agriculture, forestry, and other uses not involving major technological transformation of the landscape; (iii) those related to urban environments or subject to major technological modification by urban-industrial society; and (iv) those concerned with the effects of pollution and related phenomena on the biosphere. Relevant research by nongovernmental agencies may be supported.

The "Man and the Biosphere" program will encourage member nations to identify and develop institutions necessary for its implementation. With its sister program, "Man and His Environment," it will undertake to promote and stimulate educational activities in environmental sciences at all levels.

T. C. BYERLY
Department of Agriculture, Washington, D.C. 20250

Science for Nonscientists

I would like to second the plea made by Palmedo in his letter of 23 April for greater attention to the teaching of science to nonscience majors in college. In all of my own 7 years in college, even as a science major, only one course, an elective not even recommended by my department, concentrated on such questions as: How did science evolve as a human endeavor? In what older traditions does it have its roots? Why is it thought of as "Western"? How is an individual in a culture with a scientific tradition different from one living in the tenth or first century A.D.? How does the discipline of a "scientist" differ from that of a lawyer, judge, inventor, gambler, painter, poet, cook, and so forth?

Teaching sections of art students bitter about having to take my required science course has convinced me that these most refractory and frequently brightest of my students eagerly seek real understanding of science and its cultural impact, how it affects and is a part of their own time and their own humanity. To the nonscience students, science taught as a discipline may possibly be intriguing, like the rules of winning chess, but it is irrelevant. How can we be surprised that a young artist or writer . . . resents being taught how properly to shuffle electrons and wired mathematical symbols in his chemistry or physics course? He never sees his own interest there; why does it surprise us when the products of his mature hand ignore or denigrate science?

Palmedo's proposal for an organized effort toward upgrading college science education for nonscientists is well made. Many excellent courses and syllabi have already been worked out, but they are ignored or not well known. Reluctance of biologists, physicists, chemists, and the like, who are our college science educators, to go beyond the borders of their prized but narrow specialties is a powerful force against widespread adoption of the interdisciplinary approach Palmedo advocates. Perhaps a prestigious committee's report and recommendations would provide impetus to a wider recognition of the need for effective science education of the nonscientist.

SAM G. COLLINS
Department of Exploration and Field Research, American Geographical Society, New York 10032

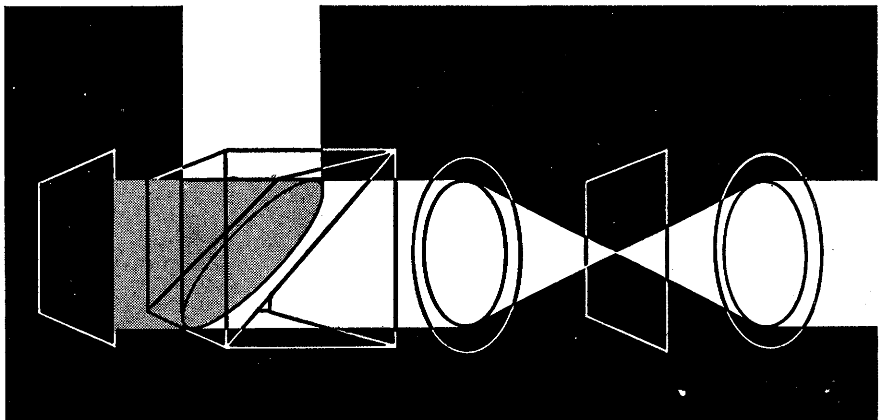
Palmedo's analysis of the problem of science courses for nonscientists is satisfactory, but his proposed solution has been tried many times (*1*). Giving prestige and other emoluments to the calling will do more than any committee, however exalted. Science for nonscientists can be raised higher in the academic pecking order by simply giving it departmental status equal to that enjoyed by classical subjects. An interdisciplinary operation or one within a department is now the rule and is evidently not doing the job, else Palmedo and others (*2*) would not be so concerned.

MORRIS GORAN
Roosevelt University, Chicago, Illinois 60605

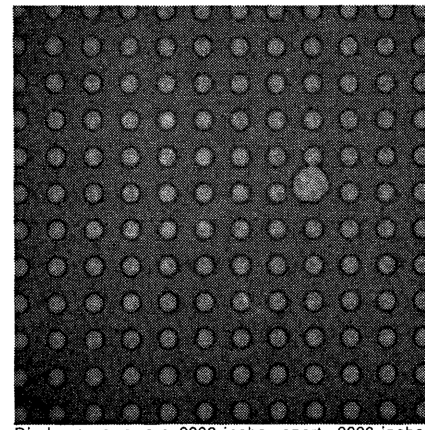
References

1. E. J. McGrath, *Science in General Education* (Brown, Dubuque, Iowa, 1948); M. Correll and A. Strassenburg, Eds., *The Proceedings of the Boulder Conference on Physics for Nonscience Majors* (Commission on College Physics, College Park, Md., 1965).
2. F. Reif, *Science* **164**, 1032 (1969).

Turning tiny dark flaws into big bright spots.



Expanded laser light is passed through special polarizing prism which reflects entire beam toward diode array, and passes entire beam reflected back from diode array, through lens, through spatial filter placed at that lens' focal point, and through second lens which again makes beam parallel.



Diodes on array are .0006 inches apart, .0003 inches in diameter. Single flaw in array is visible to right of center.

One problem you run into when you're making things exceedingly small is that they can be ruined by flaws that are far smaller. For the Picturephone® camera target, an array of almost 850,000 solid state diodes, a fatal flaw can be as small as .0003 inches across.

Now, Picturephone camera targets are made by a critical photolithographic process. And, if any portion of the process is faulty, or indeed if the target has been contaminated in some way, it will be noticeable in the picture transmitted by the camera tube.

Up to now, the only practical way to find flaws in a target has been to look at it under a microscope. This doesn't sound like much until you realize that any of the diodes on the target can be defective.

Using similar technology, Western Electric makes millions of solid state components like the Picturephone camera target for its Bell System equipment. Bell System quality standards being what they are, we're constantly looking for new ways of detecting flaws. And an extremely promising new way has been developed by the joint efforts of our engineers in Princeton, N. J. and at our plant in Reading, Pa.

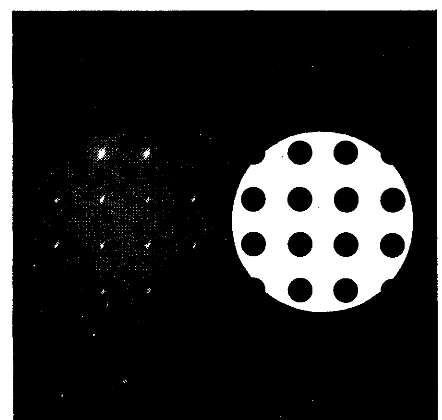
It makes use of the way laser light behaves when it reflects from a periodic pattern—like the rows of diodes on a target. Diffraction and interference cause the light to break up into an array of dots like the one on the left side of figure at middle right. If we capture these dots on a photographic plate, we have what we call a "spatial filter". This filter will block the light reflected from another, similar target, because that target will break up laser light exactly the way the first one did.

But suppose there's a flaw in that second target?

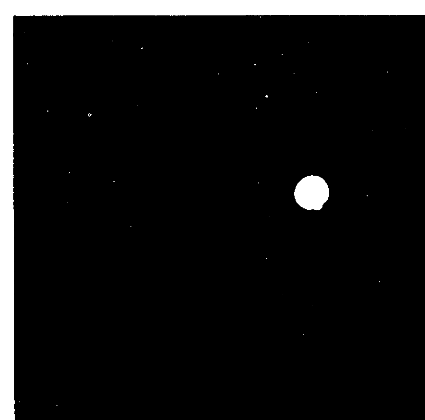
Well, that flaw is obviously not part of any periodic pattern. So the light that reflects from it is diffracted so that it spreads out over a different portion of the filter. The filter can't stop this light; and with a proper lens we can project on a screen a greatly enlarged image of the original flaw in its relative position on the target.

Incidently we are now making even better filters synthetically, using computers to design them.

Considering the major role that Picturephone is going to play in future communications, developments like this will help in keeping down the cost of service.



Dots in diffraction pattern (left) are .16 inches apart. Spatial filter (right) is calculated by computer.

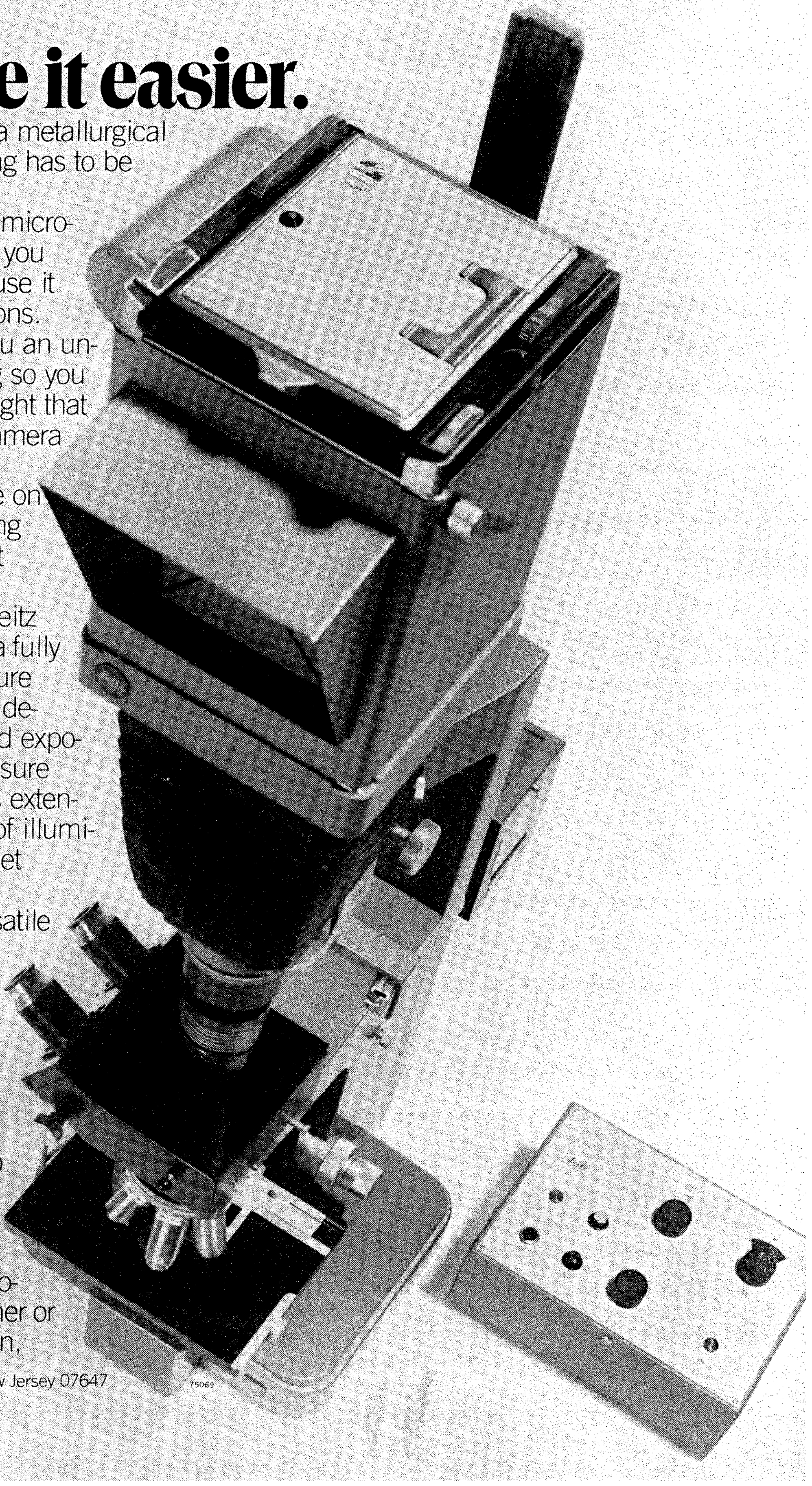


Spatial filter transmits only irregularities in pattern, in precise spot where they occur, and can be enlarged to any desired size.

Western Electric

It's tough getting an AgCuCdSn alloy to pose for you.

So we made it easier.



Taking a photomicrograph of a metallurgical specimen isn't easy. Everything has to be just right.

And we've got a camera-microscope combination that helps you get everything just right, because it performs two important functions.

The microscope gives you an unusually wide choice of lighting so you capture the specimen in the light that makes it show up best. The camera gives you automatic exposure control so you can concentrate on picture-taking instead of fiddling with controls or worrying about meter readings.

The camera is the new Leitz 4″x 5″ bellows camera. It has a fully transistorized automatic exposure system, with a photomultiplier detector, and practically unlimited exposure range. You get exact exposure control independent of bellows extension, eyepieces and methods of illumination. Exposure can also be set manually.

The microscope is the versatile Leitz ORTHOPLAN Met. It takes many accessories, including bright-field, dark-field, and phase-contrast attachments and 3 different interference systems.

The field of view is flat, edge to edge, and large—up to 2½ times greater than that of conventional-field microscopes.

The camera and the microscope can be purchased together or separately. For more information, write: Leitz® E. Leitz, Inc., Rockleigh, New Jersey 07647

Making Faces across the Gulf . . .

It is now some 12 years since C. P. Snow, in his Rede Lecture at Cambridge University, developed the theme of the "Two Cultures." As a novelist of distinction and a scientist of highly regarded reputation, Sir Charles was well qualified by experience across both areas to speak with reasoned authority.

If what he said in 1959 was pertinent—and not many denied it—how much more so it is today.

"In fact," he said then, "the separation between the scientists and non-scientists is much less bridgeable among the young than it was even 30 years ago. Thirty years ago the cultures had long ceased to speak to each other: but at least they managed a kind of frozen smile across the gulf. Now the politeness is gone, and they just make faces."

Closing the gap, he said, "is a necessity in the most abstract intellectual sense, as well as in the most practical. When these two senses have grown apart, then no society is going to be able to think with wisdom." As a scientist and as a humanist, Sir Charles could come to only one solution. "There is only one way to get out of all this: it is, of course, by rethinking our education."

The National Endowment for the Arts and the U.S. Office of Education, in their Artists-in-the-Schools Program, are attempting to work at least half of the problem. At the core of the program is the desire not to teach specific art disciplines—not to train painters and poets and sculptors—but to provide children at an early age with a feeling of esthetic sensibility, a way of absorbing creativity so that it colors an entire manner of experiencing, and reacting to, all of life.

A child so taught, were he to become a pure scientist, would have with him, always, a comprehension and an appreciation of the other "culture." It is not likely that he would reside complacently on one side of the "gulf of mutual incomprehension" of which Sir Charles spoke.

For one thing, he would know intimately, at the human level and in the course of his daily life, what sort of a person an artist is and from him what art is, how basic it is to the needs of and encouragement of life. For another, he would discover in the most refreshing sense the joy and sustenance engendered in that comprehension.

Through more than 300 professional dancers, musicians, poets, theater artists, film makers, painters, and sculptors, the Artists-in-the-Schools Program in the 1970–71 school year brought the essence of art as creativity to elementary and secondary school students in 31 states. Work is under way to expand the program next year to each of the 50 states.

Pure science and pure art may exist by themselves, but it is people they are for and people must have a comprehension of both to be whole. It is hardly possible to imagine a world totally without either art or science without projecting one uninhabitable for civilized human beings. Sir Charles's message is still clear—if the people who practice these indispensable disciplines don't learn to communicate more, there is the possibility that neither will be of much use to the totality of human beings.

There is, one would like to suggest, an "ecology" affecting the arts and sciences, the violation of which can be as harmful to civilization as any unbalancing of the natural order of things in the physical world. —NANCY HANKS, *Chairman, National Endowment for the Arts, Washington, D.C. 20506*

AAAS-Westinghouse Science Writing Awards 1971

To encourage and recognize outstanding writing on the natural sciences and their engineering and technological applications (excluding medicine) in newspapers and general circulation magazines. Three awards of $1000 each for science writing: in newspapers with circulation of more than 100,000; in newspapers with circulation of less than 100,000 and in general circulation magazines.

Contest year. Material must have been published within the United States, Oct. 1, 1970, through Sept. 30, 1971. Deadline date for submitting entries is Oct. 10, 1971. For entry blanks and detailed rules, contact Grayce Finger, Dept.W, American Association for the Advancement of Science, 1515 Massachusetts Ave., N.W., Washington, D.C. 20005.