SCIENCE

26 June 1970

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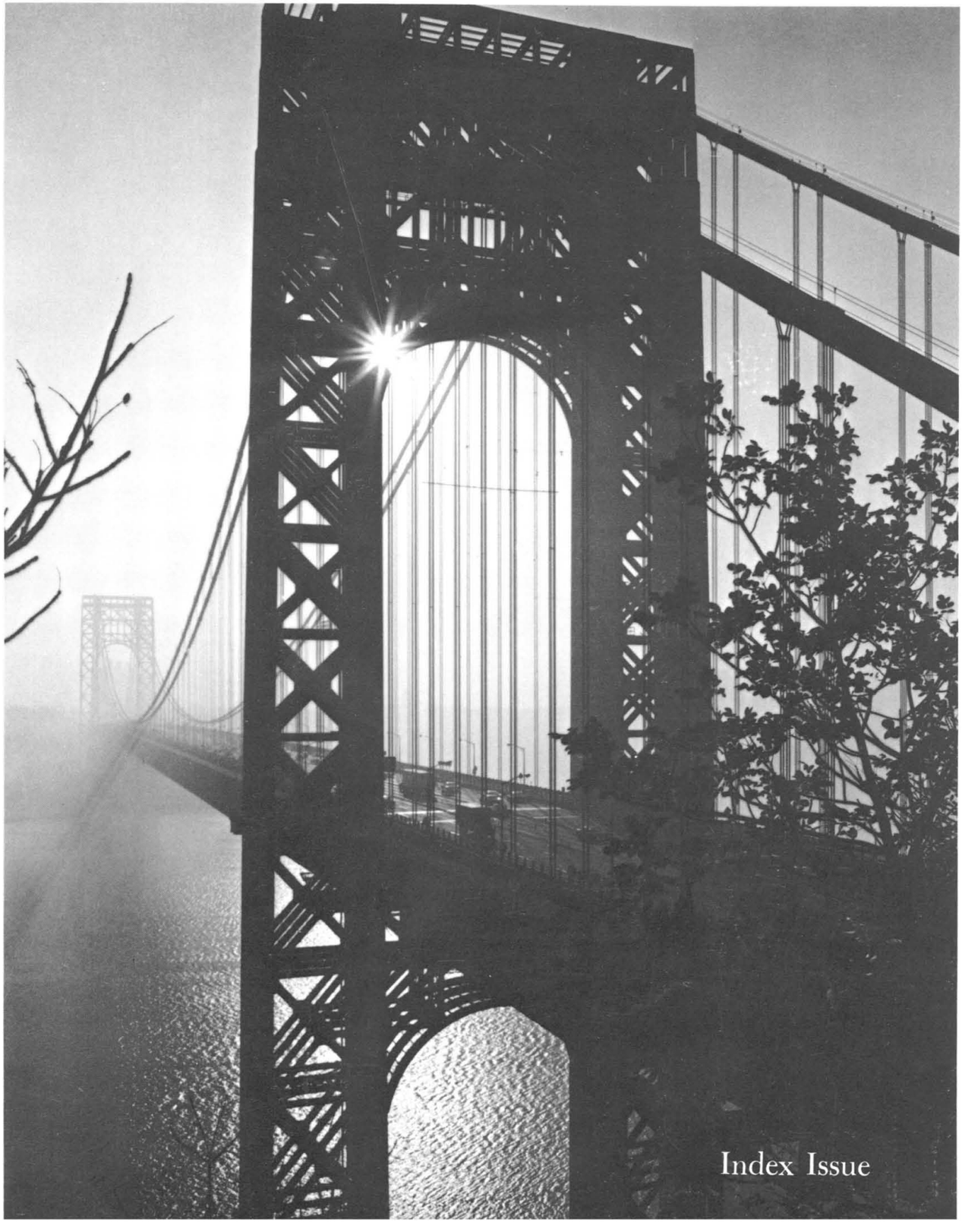
AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE



Index Issue

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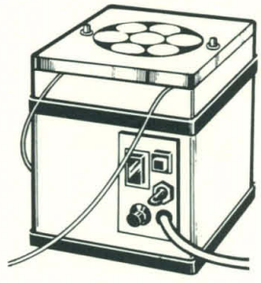

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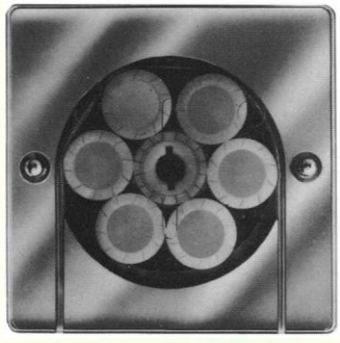

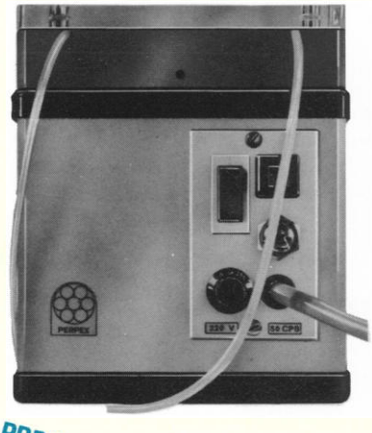

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601 pp. 415 figs. $10.25. Published April, 1970.

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402 pp. 154 figs. Soft cover. $5. Published April, 1970.

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591 pp. 451 figs. $8.75. Published April, 1970.

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COVER

The beauty of an engineering structure, in this case the George Washington Bridge, can be enhanced by nature and environment. However, it is originally established by good structural design. See page 1551. [The Port of New York Authority, New York City]

Now you can change applications without changing X-Y recorders.

For the first time you can buy a single X-Y recorder that will handle every application you've got. With unbeatable dynamic performance. You simply plug in a module and your recorder capabilities expand with your needs. It's state-of-the-art performance that you'll find only in Hewlett-Packard's high speed X-Y recorders.

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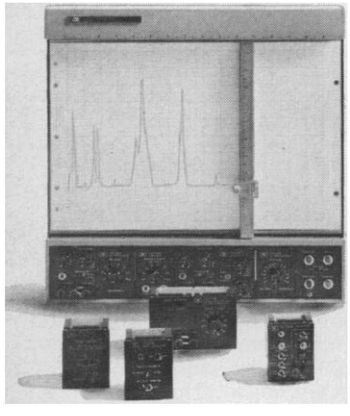

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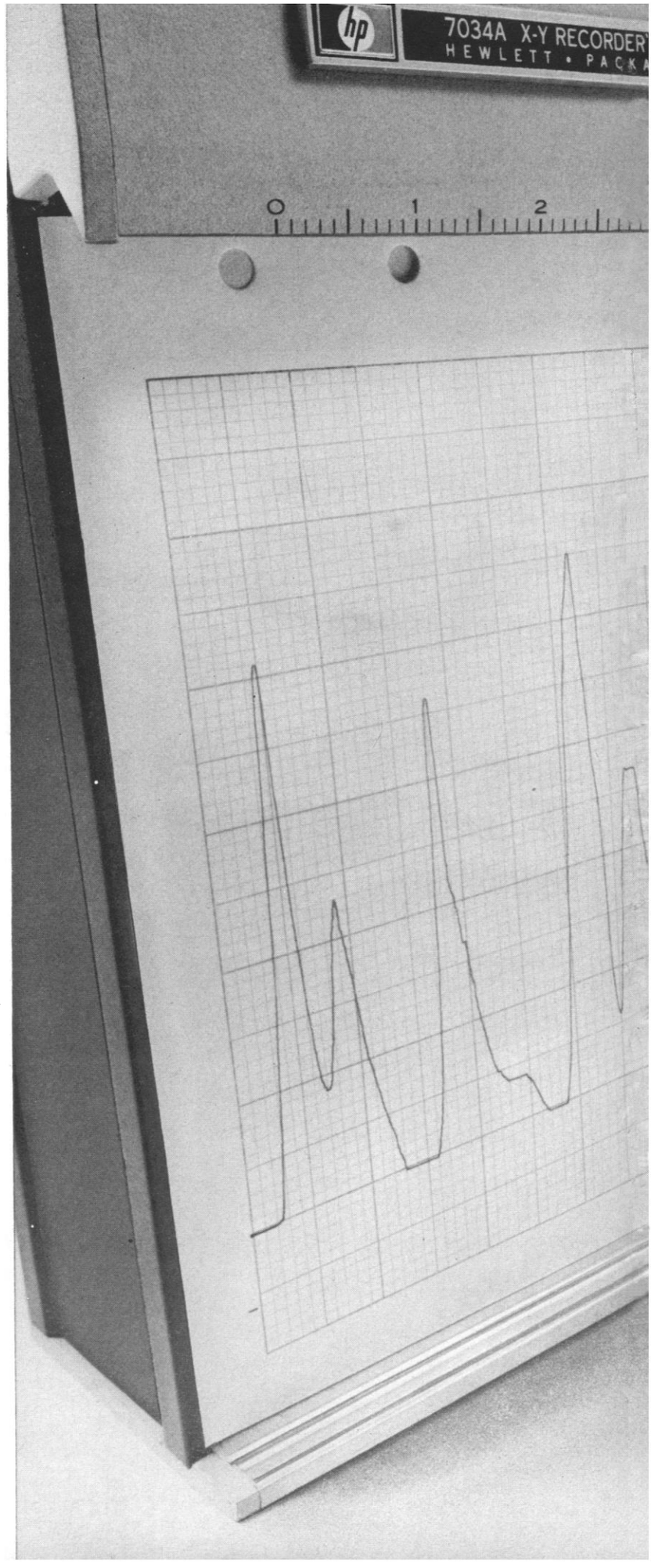

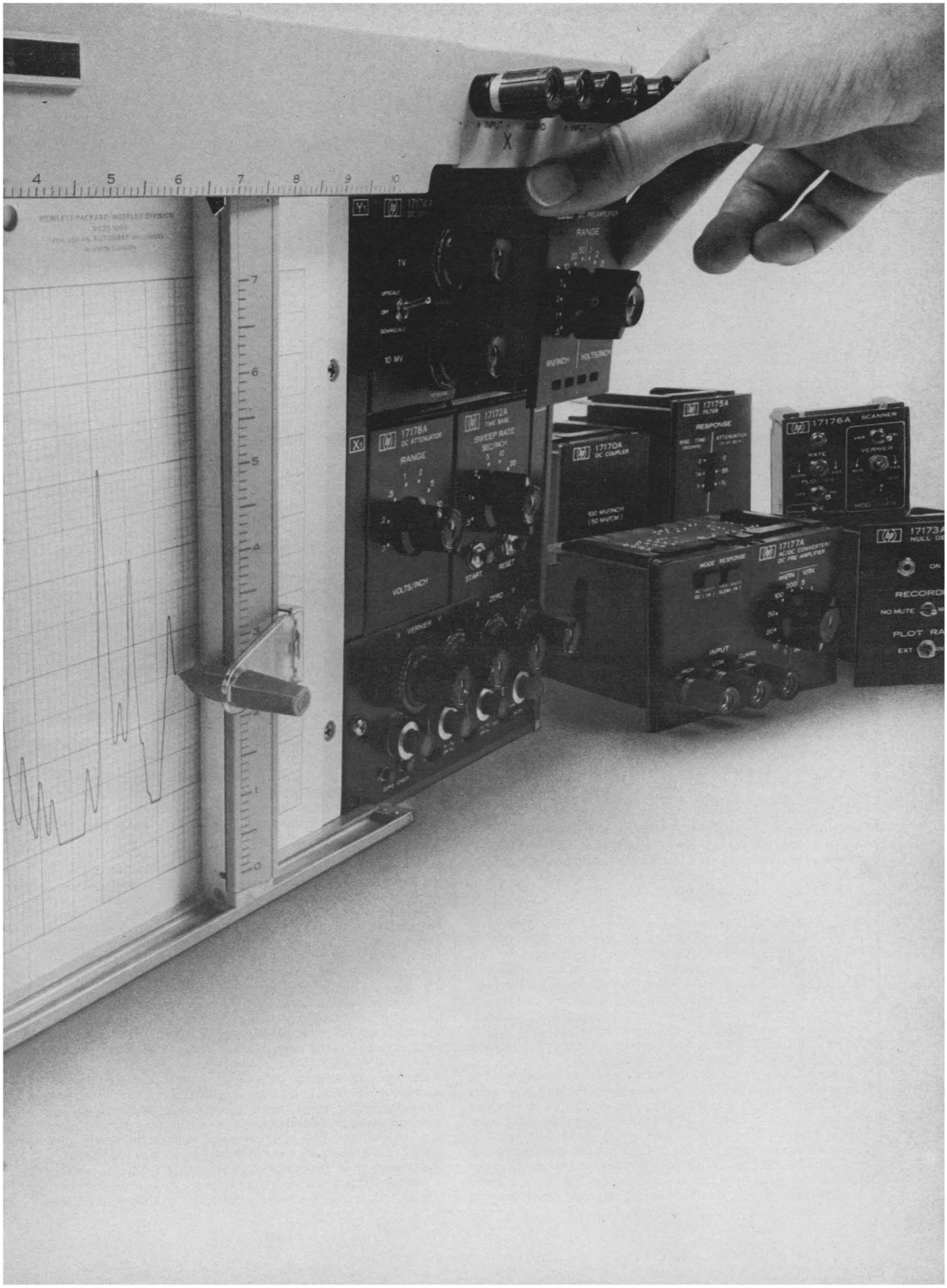
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RANGE
VOLTS/INCH
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EXT
1V
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MV/INCH
VOLTS/INCH

Pollution that assaults the lungs, the digestive tract, the ear ...and how effective instruments can lead to abatement

The Lungs

Until very recently, Molecular Rotational Resonance (MRR) Spectroscopy often seemed like a brilliant scientific breakthrough destined to remain an ivory tower curiosity for lack of a practical application in the real world of quantitative analysis.

In its pristine form, MRR allowed the scientist to look into molecular structure by measuring changes in the absorption of microwave energy which result from transitions between rotational energy levels in a polar molecule. Because differences exist in the composition or geometry of individual molecular species, there is a characteristic MRR spectrum for each molecule. Absorption peaks are unique for each molecule and MRR readily differentiates between them, even in a complex mixture, because of its inherent specificity. In the usual case, measuring the frequency of a single absorption line completely identifies the molecule.

MRR has recently been shown to be a practical quantitative tool too. In a paper published in the *Journal of Chemical Physics* (46, 3698, 1967) the response of the HP 8400B MRR Spectrometer was shown to be linear with concentration from the lowest detectable limit to 100%. More recent work with common air pollutants (SO_2, NO_2, hydrocarbons) has demonstrated that MRR gives a quantitative response for each gas, even in the complex mixtures that are commonly associated with air pollution samples. The actual sensitivity limit for SO_2 has been determined at 3.5 nanograms without using concentration techniques (... this corresponds to a concentration of 11.6 ppb in a one liter sample). To further enhance its usefulness in the quantitative analysis of air pollutants, most MRR experiments are carried out at low pressures—typically 10-15 μ Hg—a condition that greatly reduces the rate at which the pollutants react with each other.

Precisely where the MRR Spectrometer fits into the pattern of analytical chemistry is still being studied. Based on the work reported above, it certainly should be considered for air pollution analysis, especially for calibrating on-site air pollution monitors. Results of experimental work in air pollution and other significant analyses with the MRR Spectrometer are published regularly in *Molecules and Microwaves*, a copy of which awaits your request.

The Digestive Tract

In the days before Rachel Carson's *Silent Spring*, the only popular connection between pesticides and the human digestive tract was benign: one was reassured that large parts of the world would be hungry, even suffer famine, except for the beneficial effect of pesticides on agricultural production. Nowadays, it's more common to hear warnings from respected scientific sources that pesticides constitute a real and present danger to life on this planet because they are ingested as residues in the food we eat and the liquids we drink.

These are not mutually contradictory arguments so much as they are accurate descriptions of both sides of the split personality of pesticides. The only conceivable solution to this very human dilemma is better control of the use of pesticides, and more careful analysis of pesticide residues in foodstuffs.

Enter the gas chromatograph (GC). While the men engaged in pesticide detection are many and far-flung, instrumentation for this sensitive work falls almost solely on the GC. On this basis, Hewlett-Packard has directed much research effort towards perfecting both instrumentation and technique. Although pesticide detection is still most often recorded in the nanogram range, an HP GC—more than four years ago—separated a laboratory pesticide sample at the picogram level. Most of this chemical detective work is being performed on the HP Model 402 High-Efficiency GC—an instrument perfected especially for this and other biochemical research. HP's pesticide analysts prefer to use this instrument equipped with an electron capture type of detector. The latter employs a radioactive tritium source to produce electrons whose capture by the pesticide molecules is a direct measure of their presence. Recently, HP chemist-designers have perfected a new electron capture detector that employs a radioactive Ni^{63} source that is more stable at higher temperatures thereby holding out a promise of more searching pesticide detection than the older tritium type can accomplish.

Sometimes the inherent difficulty of pesticide analysis is resolved by improvements in technique rather than hardware. HP chemists have developed special techniques for the analysis of pesticide residues in many foodstuffs, and sample extraction techniques for the analysis of bovine and human milk.

If you'd care to pursue this subject in more depth, write for Applications Lab Report 1003, yours on request.

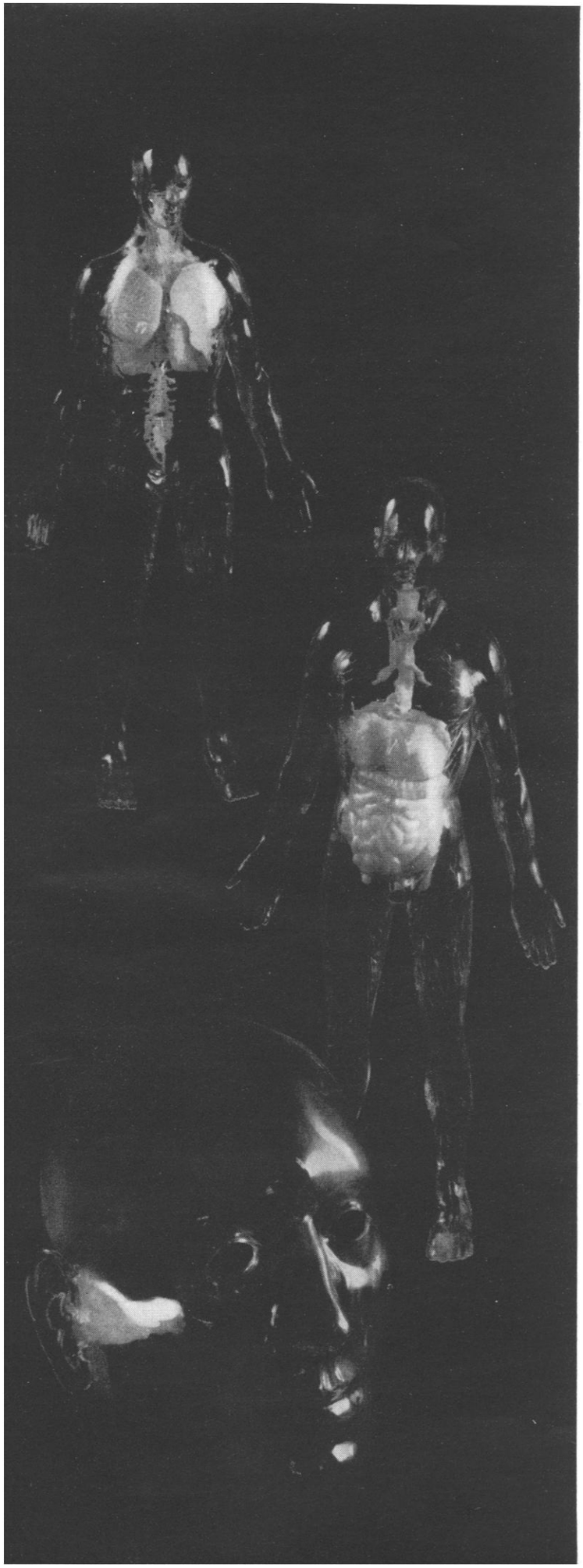
The Ear

Well played by a fine orchestra, Brahms can only be described as beautiful. But reproduced too loud on a cheap phonograph, it's noise. An increasingly widespread and serious form of pollution, noise can make us uncomfortable; prolonged loud noise damages hearing; very loud noises can cause pain, psychosis and even death.

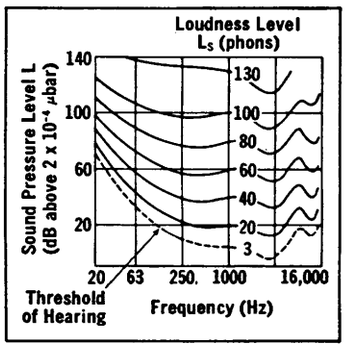
Obviously the time has come to control this form of 20th century environmental pollution. When HP scientists turned their talents to noise measurement, they ran into a very unusual problem. Objectively sound is simply a matter of rapidly changing air pressure, easy to measure with traditional sound level meters. But noise is really not an objective phenomenon: what the ear hears is a subjective sensation of loudness involving complicated physiological and psychological mechanisms.

For an instrument to measure sound as the ear hears it, it must imitate the unique properties of the ear. Take loudness level which is traditionally measured in *phons*. Although the logarithmic phon scale covers the large dynamic range of the ear—120 dB—it does not fit a subjective loudness scale. The trouble is that a noise that sounds twice as loud as another does not measure double the number of phons. So a subjective measure of loudness was developed by international agreement in which the unit is a *sone* and whose scale corresponds closely to the subjective sensation of loudness. For example, the comparison between a jet takeoff and a quiet conversation is 3:1 in phons (120 vs. 40) ... and a much more realistic 60:1 in sones (256 vs. 4).

Neither is the frequency response of the human ear a straightforward thing: the ear responds differently to sounds of different



frequencies and loudness levels. Although there is a small variation from person to person, normal ears agree within a few dB with the plot reproduced here (ISO Recommendation 226).



An even more significant peculiarity of the ear is its response to the pitch and bandwidth of a noise. Broadband sounds, like those of jet aircraft, seem much louder than narrow-band noise of the same sound pressure level. Thus accurate loudness measurements can be made only by taking into account the spectral distribution of the sound and relating it to empirically determined critical bandwidths. This phenomenon has given rise to the *Bark* scale: the audio range comprises 24 Bark, each of which equals the ear's critical bandwidth at a given center frequency.

Probably the most significant difference between objective and subjective measure of loudness occurs when two sounds are presented to the ear simultaneously. If the two sounds are widely separated in frequency, their partial loudnesses simply add to form the total loudness. But if they are not separated by a critical bandwidth, one sound masks the other: the closer together, the greater the influence. The noise analyst expresses this characteristic quantitatively in terms of *loudness density*, in sones/Bark.

The HP 8051A Loudness Analyzer is, in effect, a calibrated electronic ear that takes all of these subjective reactions of the human ear into consideration in measuring loudness based on ISO Recommendation 532 (Zwicker's Method). It listens to sound through a calibrated microphone or tape recorder, automatically produces a continuous spectral analysis and displays it as a plot of loudness density vs. subjective pitch. The instrument also computes and displays the total loudness of the sound, that is the integral of the Zwicker diagram.

The instrument is a great help in noise abatement studies because it shows how noise reduction techniques can be applied most effectively. Its spectral analysis points the finger at the most obvious sound-producing component, suggests what kind of sound-absorbing material may be needed, offers quick *before* and *after* comparisons of noise abatement programs.

A much more complex and versatile instrument for audio spectrum analysis, the recently announced HP 80501A Audio Data Processor combines the equivalent of a Loudness Analyzer with a powerful HP 2115A Digital Computer. The 80501A measures loudness with Kryter, Stevens, TALARM, SAE or dB weightings depending on the choice of standard computer programs. Results are available immediately: for example, the 80501A yields a complete analysis of aircraft noise while the plane is still overhead.

Our new 116-page Acoustics Handbook does justice to this rather complex subject. For your copy, write to Hewlett-Packard, 1507 Page Mill Road, Palo Alto, California 94304. In Europe: 1217 Meyrin-Geneva, Switzerland.

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ANALYTICAL INSTRUMENTS

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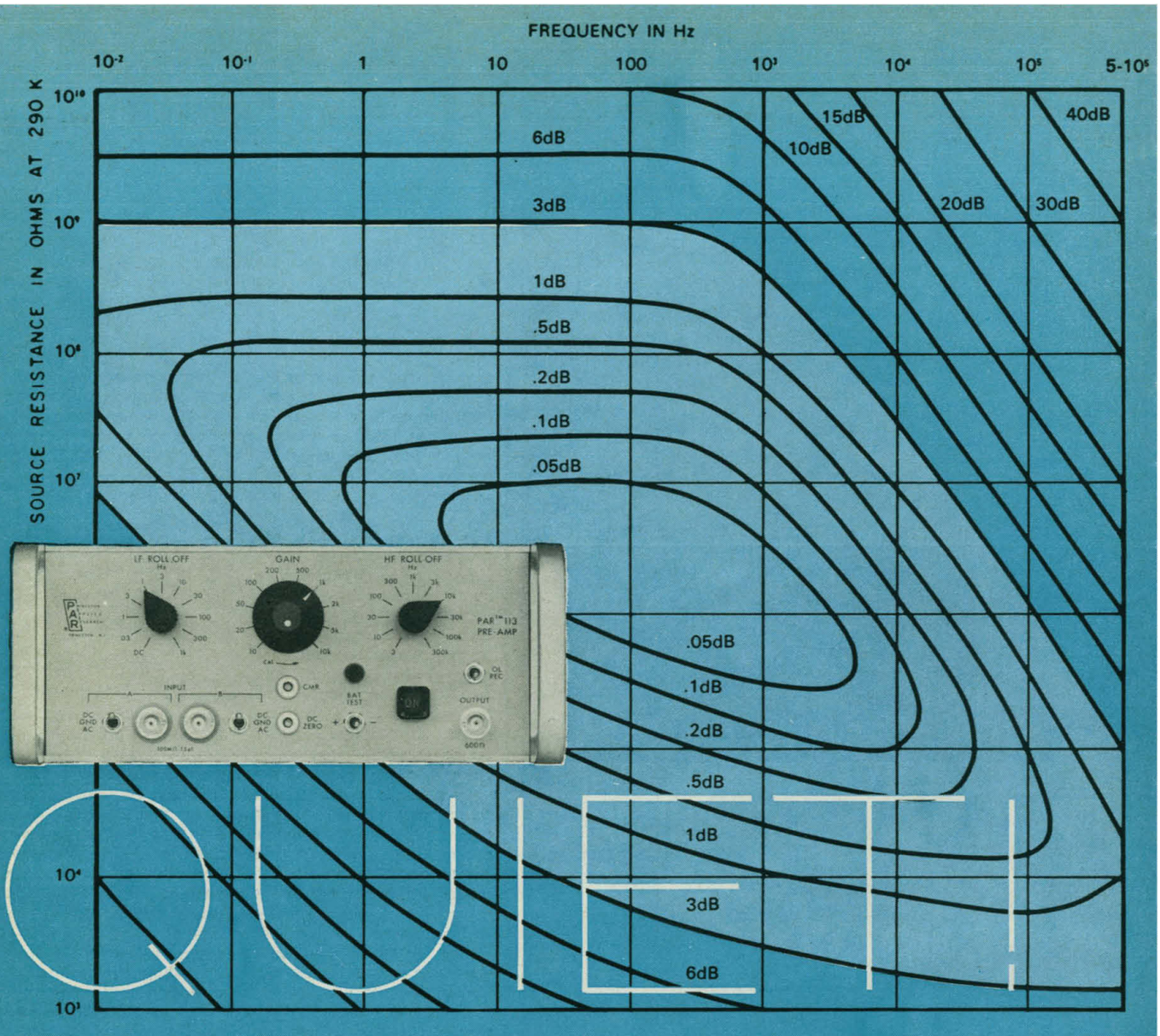

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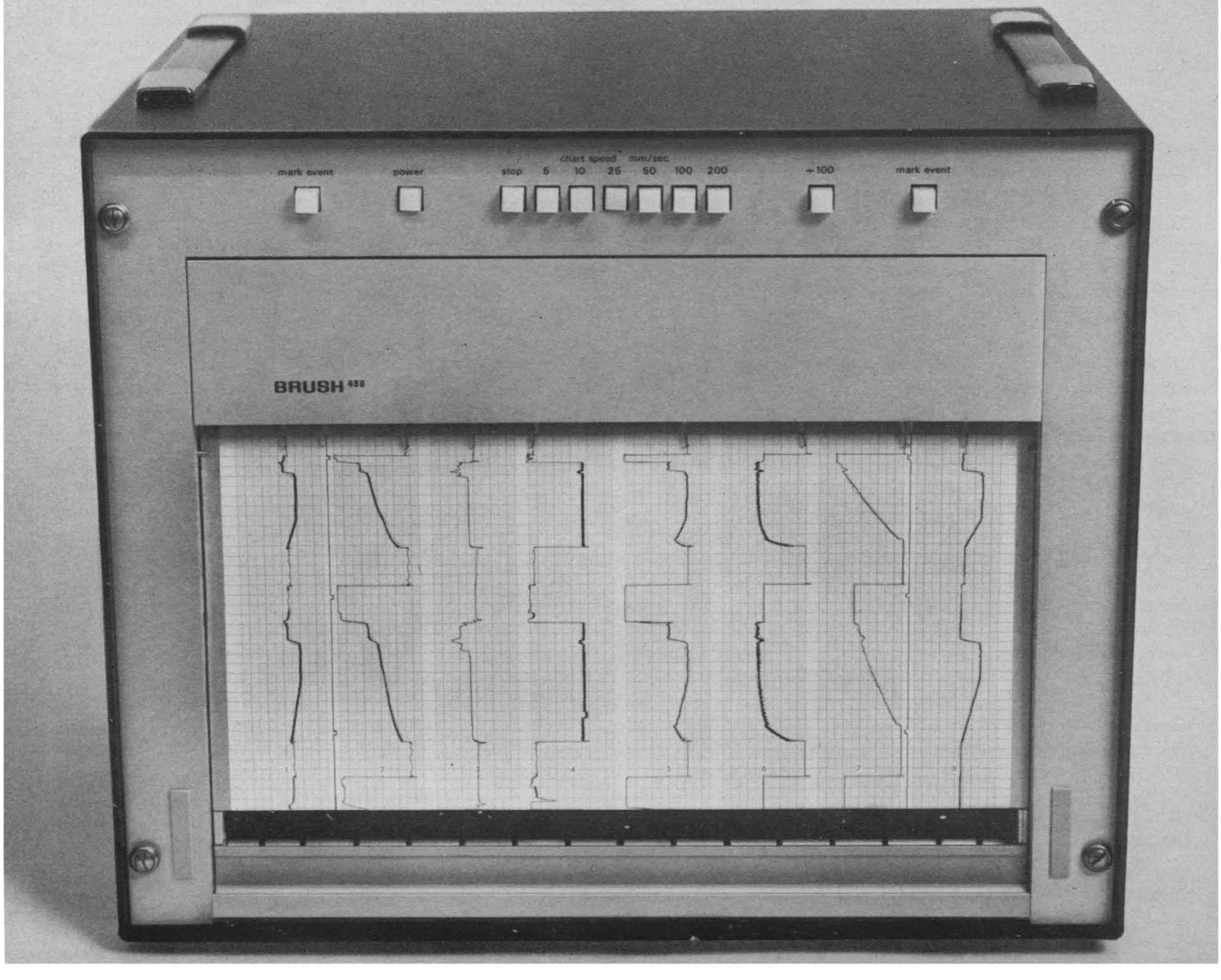


tect unwilling fathers, whose situation has been generally disregarded, and so prevent the birth of any child who is not really wanted by both parents at the time he is born. Such a system on a national scale would introduce no class or ethnic discrimination. The problems involved are not technical, but educational, administrative, and political. My conjecture is that the young generation wou!d accept this solution once they understood that vasectomy does not interfere with normal intercourse.

ANNE ROE
5151 East Holmes Street,
Tucson, Arizona 85711

Shortage of Caviar

Before we condemn the polluted Caspian Sea for the lack of caviar (Editorial, 10 Apr., p. 199), let us take a lesson from our Columbia River or British Columbia's Fraser River. Both formerly bore good runs of the white and the green sturgeon. Indeed, in 1897, the press described a sturgeon having been landed at Mission which weighed 1800 pounds. There were no oil spills, no industrial waste on the Fraser then. Nor were these hateful things on the Columbia. A sturgeon has been described as a "very slow growing fish" (*1*) and these are unusually vulnerable to overfishing. Perhaps the heady price of caviar has had as much to do with the disappearing Caspian sturgeon as have man's wastes.

R. W. SIMMONS
Tidewater Laboratories, Inc.,
Post Office Box 247,
Bellingham, Washington 98225

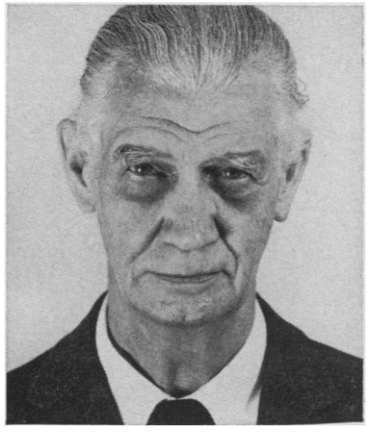
Reference

1. W. A. Clemens and G. V. Wilby, "Fishes of the Pacific Coast of Canada," Bull. 68 (Fisheries Research Board of Canada, Ottawa, 1946).

Which Products Contain Arsenic?

In "Arsenic in detergents: Possible danger and pollution hazard" (17 Apr., p. 389) Angino *et al.* call attention to the problem posed by the possible contamination of water supplies from arsenic contained in detergent products. Tables 1 and 2 indicate that there is considerable variation from one product to the next. Enzyme presoak F, for example, contains only 7 parts per million arsenic compared to 59 parts per

Don't search your life away.



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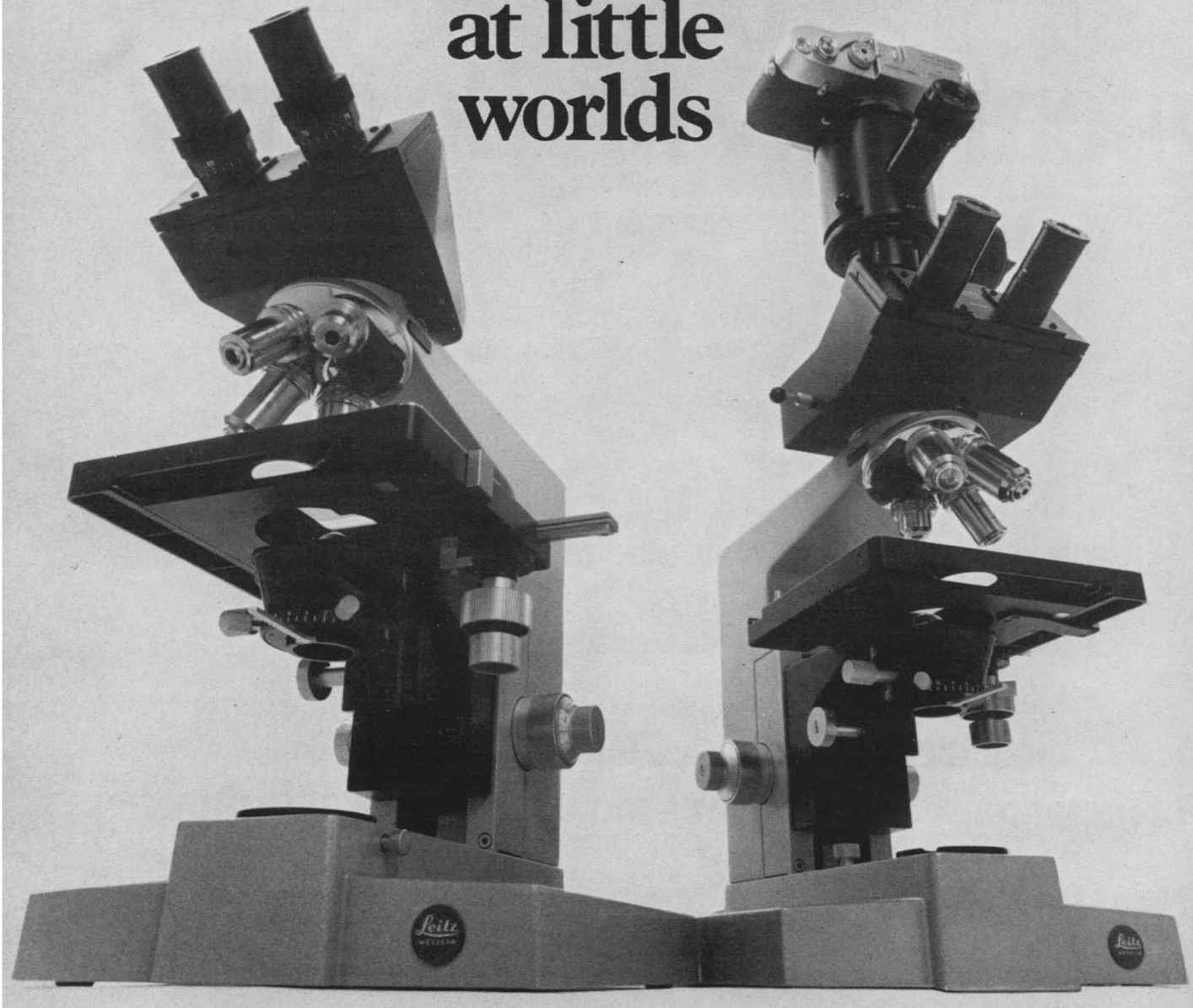

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Dael Wolfle at AAAS

This month, after more than 16 years' service as Executive Officer, Dael Wolfle leaves AAAS. During that period, to a large extent he has shaped the evolution of the organization. This has come about in part because of the nature of the organization and in part because of Dael Wolfle's character.

The primary electorate in AAAS is a Council of about 500 members, selected mainly by scientific societies as their representatives. The Council elects a Board of Directors which is responsible for governing the Association. The Board meets four times a year, and its policies are implemented by a full-time Executive Officer. In principle the Executive Officer is the servant of the Board. Dael Wolfle has been that and much more.

Illustrative of Dael Wolfle's constructive efforts are the changes he effected in publications. In 1954 AAAS published *Science* (circulation 32,000) and *Scientific Monthly* (circulation 27,000). *Science* was of little consequence and did not enjoy substantial advertising revenue. Soon the format of *Science* was made more attractive, and an effective advertising agency was created. The two magazines were merged, providing a better base for revenue. With more funds it was possible to improve the content of the magazine, and Dr. Wolfle initiated the News and Comment section, in the early 1960's. Subsequently a vigorous and successful membership program was begun. This expanded the financial base and made possible further improvements in the content of *Science*.

Another important activity that has undergone constructive evolution has been the annual meeting. While retaining aspects of traditional scientific gatherings, the meeting has come to have a public impact much greater than that of any other meeting of its kind. This is attributable to the numerous high-quality interdisciplinary scientific symposia and the many symposia devoted to problems of science and society. The meeting is accorded extremely effective coverage by the mass media. A recent and expanding development has been coverage of the meeting on radio and television.

Improvement of science education for the young is another area of activity that Dael Wolfle has fostered. Particularly effective is a long-term effort that is now having an impact at the kindergarten and primary school levels. An AAAS Commission on Science Education has developed a program called *Science—A Process Approach*, consisting of teaching materials and a curriculum for teachers of science at these grade levels. The materials have been used in actual classes, and revised, summer after summer, on the basis of these experiences. Some 50,000 elementary school teachers are now using this system of instruction. Distribution is being handled commercially, and a further expansion in use of the program is likely.

One of the key factors in Dael Wolfle's ability to function effectively is an unusual quality of self-discipline that enables him to be self-effacing when this is appropriate, yet decisive when decisions are required. Typically, he is silent during several hours of discussion, at the end of which time he summarizes succinctly, retaining that which is cogent and useful while quietly discarding the irrelevant or worthless. Flexible in accepting the ideas and opinions of others, he is inflexible in matters of principle, such as honesty and financial rectitude.

Dael Wolfle leaves a vital, financially sound AAAS and a solid base for future achievement. We wish him success, good fortune, and happiness as he begins a new life as professor of public affairs at the University of Washington.—PHILIP H. ABELSON