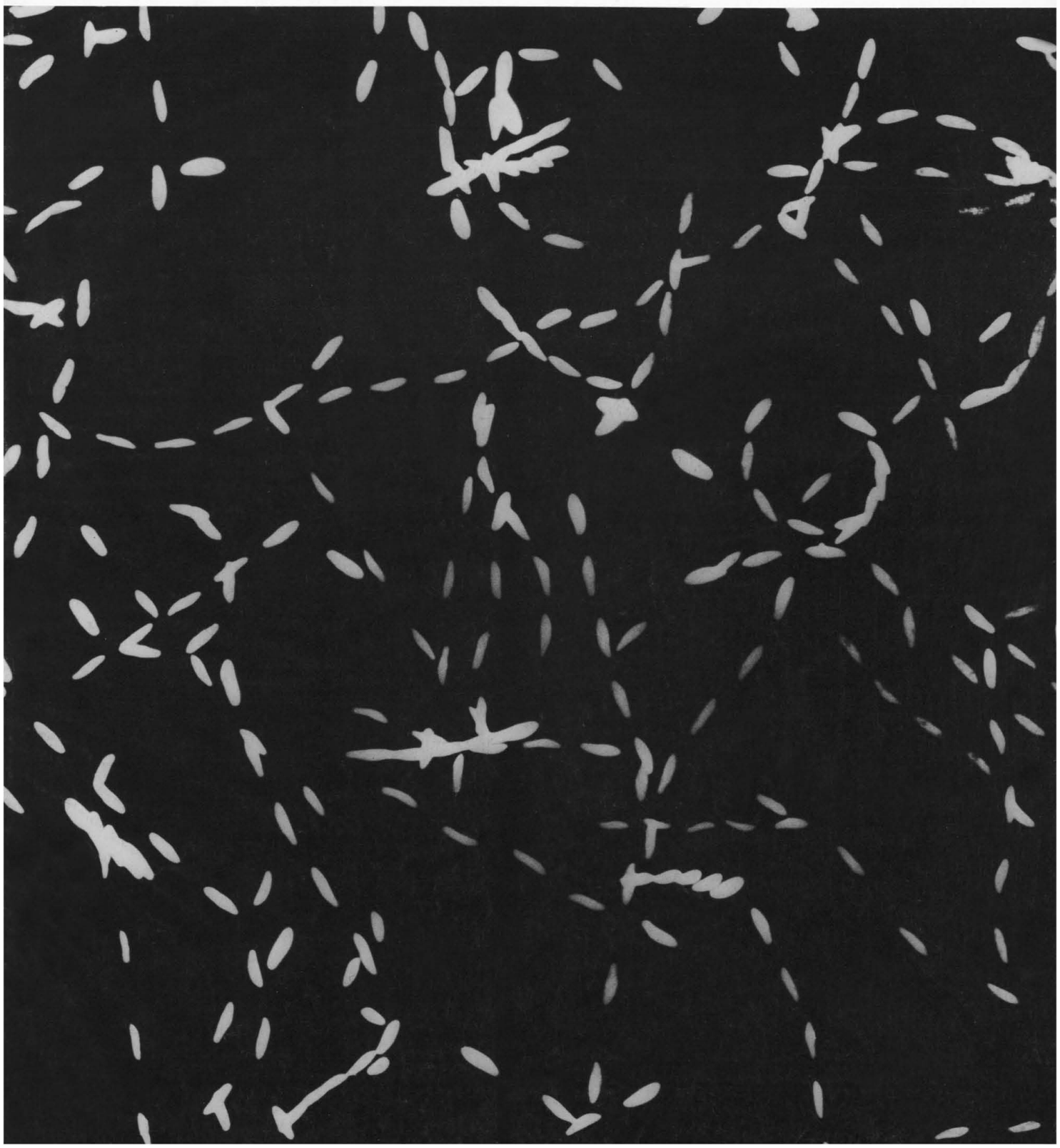
SCIENCE

5 May 1972

Vol. 176, No. 4034

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE



Some things are changing for the better.

Many people know us as an instrument manufacturer: we make more than 2,000 products for measurement, test and analysis. Others know us as a computer company: more than 10,000 own our programmable calculators and computers. We prefer to think that our business is to serve measurement, analysis and computation needs . . . in science, industry, medicine and education. This is the rationale behind every new instrument, computer or system that we tell you about in these ads. This month:

When the HP 9600 rolls through your door, your real-time and data acquisition tasks become a lot easier to perform. This new systems family's long suit is the efficient and economic handling of multitudes of analog and digital information, simultaneously.

A sensor-based system that makes real sense.

There's a growing demand in industry and research laboratories for sensor-based computer systems that handle great quantities of analog and digital information. Systems built from programmable instruments usually are too expensive; people pay for equipment features that they don't need. Yet the alternative has been a piecemeal approach – break down the customer's problem into several parts and use separate "mini-systems" to solve each part independently.

Now there's a third choice – Hewlett-Packard's new family of compact data acquisition and control systems for cost-effective automation in industry and research. A 9600 Series system monitors, collects, and processes information from sensor-based sources. It then can generate reports, control power supplies, alert operators, drive graphic displays and plotters, and produce control signals for closed loop operations. Although you can't be everywhere at once – supervising and trouble-shooting – our system can.

Two new subsystems within the 9600, one analog and one digital, now do the things a number of programmable instruments used to do. These instrument functions are contained on plug-in cards. Instead of adding individual instruments, you merely slip in an inexpensive printed cirucuit board.

The 9600 data acquisition systems are modular. Start with a minimum low-cost system to control a single test or experiment, and expand with your growing needs.

The full story on the 9600 System family is yours for the asking.

Nothing can outperform this new digital GC – even at twice the price.

Because the gas chromatograph (GC) is essentially a tool for qualitative and quantitative chemical analysis, its value ultimately depends on how well it does this job. Over the years, many new models have been introduced that perform more accurately than previous

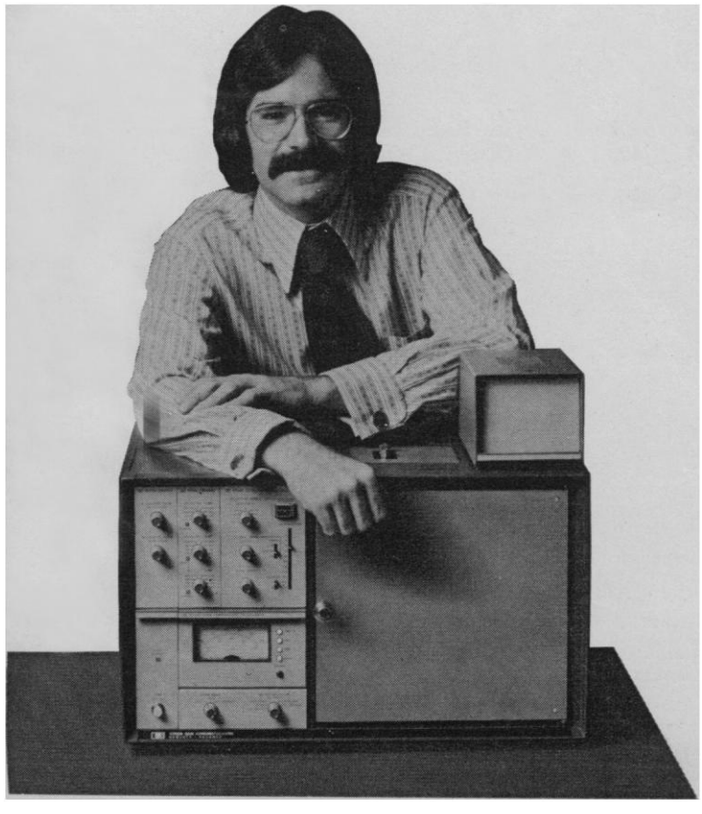
This would be an unusual case — using a battery-powered counter to check out the frequency of a mountain rescue-team's radio equipment — but it illustrates that HP's portable instruments can go anywhere service is needed.

instruments — at a price. The truly amazing thing about the new HP 5700 GC is this: it produces more accurate and precise retention time (qualitative) and peak area (quantitative) data than any GC ever built. Yet it costs about half as much as top-of-the-line GCs of comparable quality.

A new bulletin on the 5700 fully documents this perhaps startling claim. Until you have a chance to study this data consider this: one of the first 5700s off the production line was used "as is" to make two series of replicate analytical runs, one series before and one after an overnight shutdown. The sample used in both series contained seven components, out to C_{17}.

The results speak for themselves. In terms of repeat accuracy, the mean retention time of each of the seven components differed less than 0.01 minute after the overnight shutdown; the normalized area % varied only within ±0.001%. In terms of precision, the standard deviations of the replicate retention time measurements fell within 0.0175, both before and after the overnight shutdown; the standard deviations of the area % data were all within 0.0038. No other GC, regardless of price, can do better.

For a fully documented proof of performance as well as a factual description of this new all-digital, computer-compatible automatic GC, write for Bulletin 5700.



Portable instruments go where the problem is.

Capital equipment such as mobile or remote communications systems and million dollar computers have at least two things in common. They are electronically complex, and they can't be taken into a service center when they need repair. Today's traveling field service engineer must have laboratory quality equipment that will go where he goes.

HP's portable instruments enable service engineers to diagnose and repair this equipment on the spot, reducing expensive downtime. Our portable scopes are small enough to fit under an airliner seat, and, at 24 pounds, are light enough to be carried up antenna masts and into other hard-to-reach places. An HP electronic counter can be held in one hand — it takes only seconds to snap on a function module that provides the specific measuring capability needed. Then there's our multi-function meter — a high performance, instant-reading voltmeter and ohmmeter rolled into one.

And the length of HP's portable measuring capability isn't limited by the distance to the nearest wall socket. Most of our portable instruments feature their own accessory battery pack. Many can run off ordinary car, plane or boat batteries as well as a standard power line. And all of them deliver HP precision in a rugged, portable package.

Ask for the full story on portable instruments that go where the problem is. Write Hewlett-Packard, 1507 Page Mill Road, Palo Alto, California 94304; Europe: 1217 Meyrin-Geneva, Switzerland.

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HEWLETT hp PACKARD

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SCIENCE

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COVER

Sequential exposure of swimming models of *Paramecium* made with five successive xenon flashes, 1 second apart, in a thin layer of a solution of adenosine triphosphate–magnesium ions. Since the first flash was brighter than the others, the first image of each model is the brightest. Swimming direction as well as swimming velocity can be determined (about × 22). See page 523. [Y. Naitoh, University of California, Los Angeles]

We've improved our 4x5 films so much

Obviously, this extraordinary offer is a result of changes in our 4x5 films.

We've made complex changes. Chemical adjustments in our black and white films have improved their quality and sensitometry.

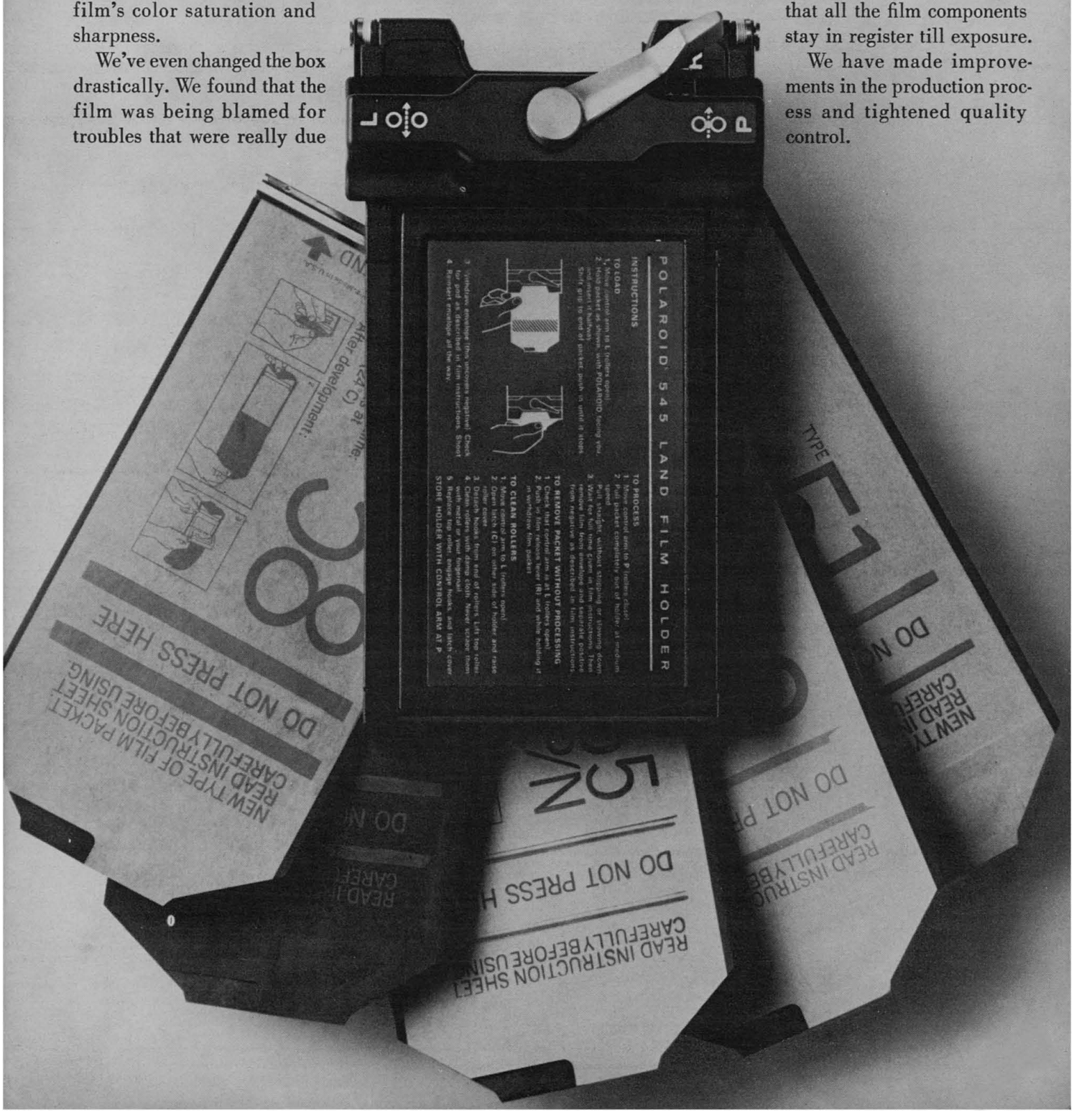
And we've made simple changes—such as venting the color film packet to let air escape when you pull the packet out of the holder. This change improved the film's color saturation and sharpness.

We've even changed the box drastically. We found that the film was being blamed for troubles that were really due to dropping the box or to vibration, rough handling or pressure.

So we've introduced extra-sturdy boxes and put a layer of polyurethane foam in each to protect the film. While we were at it, we color coded the boxes. Now you can tell at a glance which of the five films you're working with.

We made mechanical changes in the film packet so that all the film components stay in register till exposure.

We have made improvements in the production process and tightened quality control.



that now we can guarantee your results.

We are very confident of the quality of our film—so confident, that here's what we're offering.

Polaroid's extraordinary guarantee:

1. If in your judgment any picture taken with our 4x5 film is unsatisfactory for any reason whatsoever, we will replace up to 5 boxes—free.

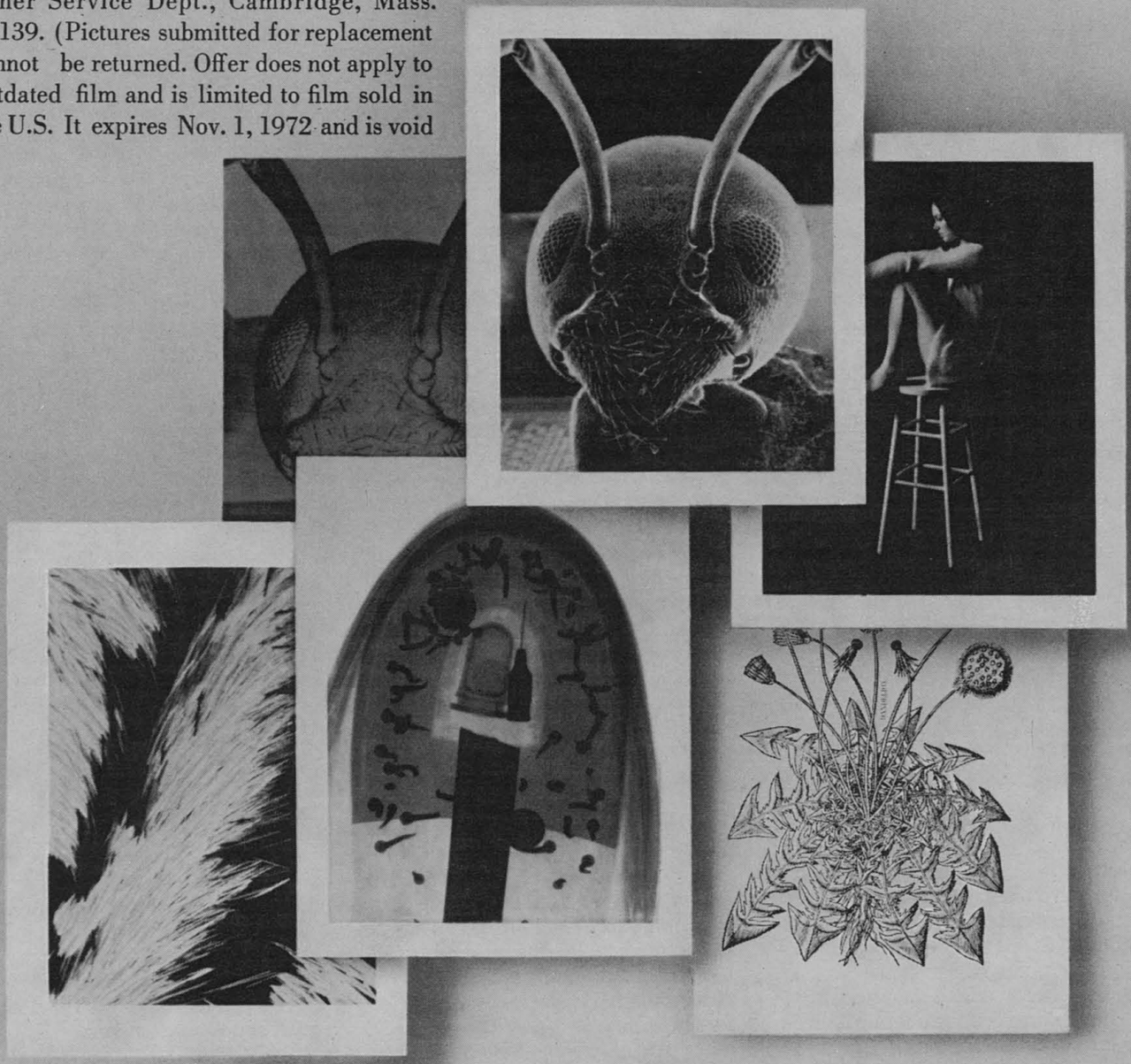
2. We will then give you—free—all the technical assistance you need to get exactly the kind of pictures you want. Just send the pictures with the negatives and any unused film from the box to Polaroid's Customer Service Dept., Cambridge, Mass. 02139. (Pictures submitted for replacement cannot be returned. Offer does not apply to outdated film and is limited to film sold in the U.S. It expires Nov. 1, 1972 and is void where prohibited, regulated or taxed.)

3. You can call us collect. The toll-free phone number is 617-547-5176, and it's in every box if you need it. This direct line to Polaroid for technical assistance is available to you as often as you wish, regardless of the kind of camera or equipment you own or the type of Polaroid instant films you are using.

You'll find the full details of this program in every box of Polaroid 4x5 film.

We've been working hard to perfect our films. And we want to do anything we can to help you perfect your skills.

Polaroid 4x5 Land Films



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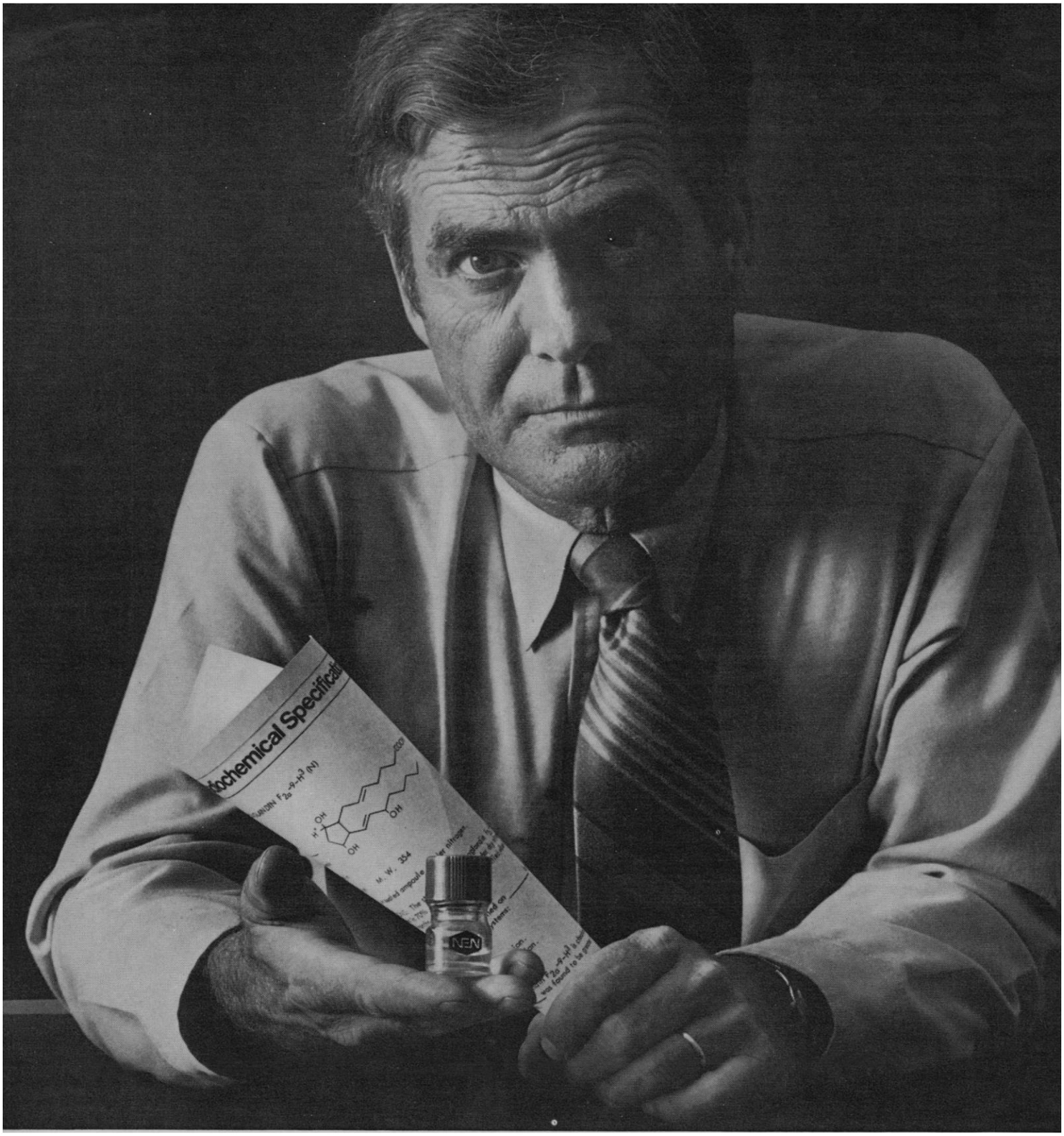

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important if your reported trends approached statistical significance, because then it might be argued that there was at least slight justification for your article. Also, be sure to test, and then discuss at length, each of the comparisons—not just the overall one which you initially report as nonsignificant.

NANCY J. BELL
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The actual data-gathering phase of our study was carried out during the latter part of 1969. At that time, no behavioral data on discrimination against women at the time of hiring had been reported in the literature. Naturally, the ideal methodology would have been one permitting the direct observation and evaluation of the actual decision-making process of departments when female applicants were evaluated in competition with male applicants. Although this type of study was not feasible (and still is not feasible), we are pleased that our results, employing a less sensitive methodology, support the discrimination hypothesis and are in agreement with similar studies, such as Fidell (*1*), and

Table 1. Summary of questionnaire responses of department chairmen by item and classification of sample for average male, average female, and superior female job applicants. Question 1 concerns the general impression of the résumé. The response range is graded *a*, very impressive; *b*, average; *c*, unacceptable. Question 2 concerns the inclination to hire the applicant. The response range is graded *a*, hire the applicant; *b*, indifferent; *c*, reject the applicant. In question 3, an evaluation of the applicant's educational background is requested. The response range is indicated by *a*, excellent; *b*, average; *c*, unsatisfactory. Question 4 concerns the possible change in response if the applicant were not recommended by a colleague of the department chairman. The response range is indicated by *a*, yes or *c*, no; a higher percentage of "yes" responses implies a lower rating of the applicant. The direction of preference of an average male over an average female (M/F) and of an average male over a superior female (M/SF) is also evaluated.

Classification	Question	Response: Average male (%)			Average female (%)			Superior female (%)			Preference	
		a	*b*	*c*	*a*	*b*	*c*	*a*	*b*	*c*	M/F	M/SF
Overall comparison of applicants												
	1	72	28	0	68	32	0	89	7	4	+	−
	2	29	68	3	18	71	11	52	48	0	+	−
	3	93	7	0	89	11	0	100	0	0	+	−
	4	25		75	35		65	15		85	+	−
Geographical location of school												
East-West	1	10	60	30	0	66	34	22	78	0	+	−
	2	0	20	80	0	11	89	0	45	55	+	−
	3	30	60	10	22	56	22	78	22	0	+	−
	4	40		60	45		55	45		55	+	+
Midwest-South	1	30	45	25	30	45	25	67	27	9	0	−
	2	0	23	77	8	15	77	9	55	36	−	−
	3	69	8	0	62	38	0	100	0	0	+	−
	4	23		77	23		77	46		54	0	+
Quality ranking of school												
Above median	1	14	53	33	0	64	36	29	71	0	+	−
	2	0	14	86	0	0	100	0	29	71	+	−
	3	57	43	0	29	71	0	86	14	0	+	−
	4	29		71	50		50	43		57	+	+
Below median	1	25	38	37	43	43	14	53	38	9	−	−
	2	0	25	75	0	29	71	9	60	31	−	−
	3	50	38	12	71	0	29	92	8	0	−	−
	4	31		69	0		100	46		54	−	+
Age of department chairman												
Below median	1	25	42	33	9	64	27	100	0	0	+	−
	2	0	25	75	0	0	100	13	62	25	+	−
	3	58	42	0	36	55	9	100	0	0	+	−
	4	17		83	27		73	50		50	+	+
Above median	1	19	50	31	23	42	35	22	61	17	−	−
	2	0	31	69	0	29	71	6	35	59	+	−
	3	44	44	12	53	35	12	78	22	0	−	−
	4	31		69	41		59	39		61	+	+
Length of time as chairman												
Below median	1	25	33	42	0	70	30	50	25	25	+	−
	2	0	33	67	0	10	90	25	38	37	+	−
	3	50	42	8	40	40	20	75	25	0	+	−
	4	41		59	41		59	50		50	0	+
Above median	1	19	56	25	28	39	33	41	53	6	−	−
	2	0	25	75	0	22	78	0	44	56	+	−
	3	50	44	6	50	44	6	88	12	0	0	−
	4	13		87	34		66	41		59	+	+

with the many statistical surveys subsequently available regarding the hiring and promotion of women in universities. In Table 1, we have reproduced a summary of the statistical data underlying our analysis.

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Reference

1. L. S. Fidell, *Amer. Psychol.* **25**, 1094 (1970).

Cooperation

On the report "Human environment conference: search for a modus vivendi" (News and Comment, 18 Feb., p. 736), Nigel Hawkes states, "Throughout the preparations for the conference, U.N. sources have been complaining privately of the obstructive attitude the British have taken."

Quite to the contrary, the British representatives have been very cooperative and sources of constructive criticism and productive ideas. Whatever successes the Stockholm conference may have in June will be due in no small measure to the contributions of the United Kingdom. I make these observations after having recently completed a 6-month assignment with the conference secretariat.

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Testing for Teratogenicity

The eminent gentlemen who signed the protest (Letters, 5 Nov. 1971, p. 545) against *Science*'s treatment of the 2,4,5-T advisory committee report (News and Comment, 13 Aug., p. 610) appear to say that if a study *does* find a teratogenic effect in some species when doses of a chemical are given that are far in excess of any possible human exposure, it does not constitute scientific grounds for banning the chemical. Presumably if a study *does not* find a teratogenic effect in some species, it also does not constitute scientific grounds for banning the chemical. What then are the scientific grounds for banning a chemical because of its possible teratogenic effects? Obviously the answer is, "There are none," since studies are not made of the effects of doses that are below any possible human exposure. (Toxicological experiments of the type needed to permit the labeling of 2,4,5-T or similar substances are usually performed on a few animals that are exposed to high doses; little effort is made to tell what would happen to the animals—not to say anything about man—if they were given low doses.) In fact, Alvin M. Weinberg (Letters, 5 Nov., p. 546) makes it clear that the establishment of a teratogenic effect from low doses is believed to be "trans-scientific," since it would take too many animals to establish such an effect.

It is not clear whether the council of the Society of Toxicology speaks for all toxicologists, for a majority of toxicologists, or simply expresses the view of an establishment in toxicology. It is curious, nevertheless, that the main appeal in the letter is to respect the views of authority (that is, of the council of the society) and of the majority (that is, of toxicologists)—not very persuasive arguments for scientists to advance.

If the council believes it has a case, then the Society of Toxicology ought to sponsor an open examination of these issues. They are "fundamental" to all interests, and light, not heat, is needed to illuminate them.

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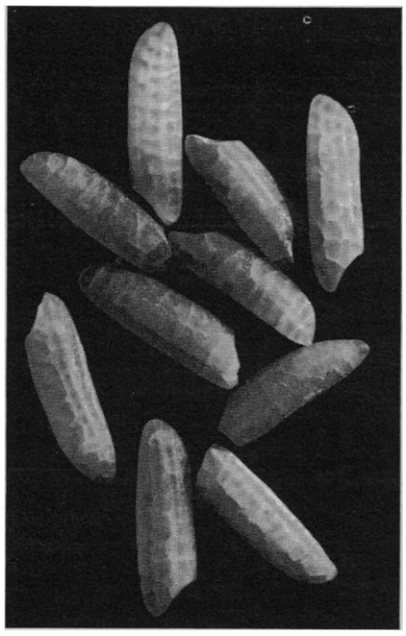
Sorensen and pH

John Walsh is safe in writing (News and Comment, 3 Mar., p. 973) that S. P. L. Sørensen "achieved the first really accurate method for the determination of *p*H," because nobody had ever before determined it. It was in fact Sørensen's brilliant achievement to perceive that the acidic intensity of an aqueous solution is best expressed as a logarithmic function of the concentration of H_3O^+. Today. pH is a vigorous near-septuagenarian, some premature obsequies in the recent clinical literature notwithstanding.

A. GORMAN HILLS
Department of Medicine, University of Miami School of Medicine, Miami, Florida 33152

We want to be useful ...and even interesting

Getting in close



If you had some rice grains and wanted to make a point about the cracks in them, it would be well to know a thing or two about photographic lighting. Otherwise the fanciest of cameras and the finest of films won't help. In conveying unadorned fact, one sometimes needs quick, convenient photography and sometimes eloquent photography. Kodak, a house built on convenient photography, considers its books on technique for eloquence to be products worth their price just as much as camera and film.

One such book is H. Lou Gibson's "Close-up Photography and Photomacrography," a hard-cover production that belongs in any library serving patrons whose interests encompass more than interpersonal relations. Carries a jacket price of $10. Order from a photographic dealer as Kodak *Technical Publication No. N-16. Separately bound without hard covers, the two subjects each carry a $2.75 price. Note that the second of the subjects is not photomicrography but photomacrography, the photography of subjects which visually require a hand lens but not a compound microscope.*

Expression of faith

Science isn't all it's cracked up to be, according to readily available curbstone opinion. There have been indications that a few prominent names in American industry have come to share this opinion, however reluctantly. Not Kodak. We seem to be plowing ahead as though there were no tomorrow. Or to put it more sharply, because there *is* a tomorrow.

This year—this month in fact—we began giving prizes to brilliant high schoolers at the International Science and Engineering Fair. Now! With the Sputnik scare receded 15 years into ancient history!

These prizes, as well as over 200 regional ones, are awarded for effective use of photography in a science project. It figures. Good for business.

Good for business at a different level is the program of Eastman Kodak Research Grants. This vehicle of old-fashioned faith in science has been plowing on through thick and thin for years at selected universities and colleges, large and small. They are selected not by contests but by a simple-minded criterion: we know them well.

Some are known as well to the rest of the world. They are fountainheads. In their debt stands any business that builds technology on science.

Often, however, a product of some lesser-known institution does nice work for us, gets to enjoy the job, fails to hide this enthusiasm from Old Siwash, attracts other high-performing Siwashians to Kodak. Strong Kodak-Siwash bonds form. Research grants from Kodak help upgrade the Siwash graduate program. After a while Siwash Ph.D. theses and post-docs turn up some basic things.

Basic research, honestly defined, occupies about 2% of the in-house R&D budgets of many research-minded companies. (Kodak's happens to run much higher.) The distinction from the remaining 98% has to do with the depth to which objectives are planned and who does the planning. Basic research is sometimes seen as a gambler's game with constantly lengthening odds. This bothers some businessmen. It doesn't bother scholars. Good for business that it doesn't.

Random samples of facts recently learned with the help of Kodak bucks on campuses and scattered to the four winds by scholarly dispersal mechanisms:

The 4-element, 6-atom molecule formamide exists in interstellar space and has been identified by microwave spectroscopy.

The route by which nature synthesizes nicotinic acid in green plants is quite different from the route followed in molds and animals, including man.

In a reaction such as $F+H_2 \rightarrow HF^*(v)+H$, the HF product is highly excited vibrationally. Its average energy content accounts for more than 60% of the exothermicity. Such studies provide new insights into some elementary chemical reactions.

Light waves may be used as a kind of radar to follow the Brownian motion of macromolecules in solution.

In the CS_2/O_2 electrically pulsed laser system, the lasing is done by CO that is produced by oxygen atom attack.

When a molecule absorbs light, the manner in which the energy is redistributed within its structure governs the subsequent photochemical reactions.

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5 May 1972, Volume 176, Number 4034

SCIENCE

Intertwined Societal Problems

The public is aware of problems with respect to the environment, energy, balance of payments, and national security. However, there does not seem to be general awareness of the extent to which these problems are intertwined.

The demand for clean energy has continued to grow, while reserves of natural gas and petroleum have diminished. Imports of hydrocarbons have expanded sharply and seem destined to increase much more. Already these imports are responsible for much of our deficit in the balance of payments. Continuation of present trends must lead to much deeper deficits, more devaluation, and massive loss of confidence in the dollar. At the same time, we are becoming vulnerable to petroleum blackmail.

The demand for clean energy has caused major shifts in the utilization of fuels. To the householder, electricity is the cleanest form of energy possible, and his use of it continues to increase. Emissions from the generating plants are someone else's problem. The utilities, under pressure to reduce sulfur dioxide pollution, have turned from coal to oil. Near the Atlantic coast, the number of electric generating stations burning coal has dropped sharply. In New York City, for the first time in 90 years, not one pound of coal is being burned by Consolidated Edison. Along the East coast during the period from 1968 to 1972, some 28 million tons of coal were displaced by oil from foreign sources.

The desire for clean energy has also increased the demand for natural gas, which is one of the most convenient and pollution-free forms of energy. However, gas distributing companies in many states are finding it necessary to refuse to serve new applicants. Last year, consumption of natural gas was 22 trillion cubic feet. Current reserves are 278 trillion cubic feet, and new discoveries fall far short of matching consumption.

A number of installations are now developing processes for obtaining methane from coal, but the level of effort hardly seems commensurate with the need. In addition, schemes are being implemented to import liquefied natural gas from North Africa. This procedure has the drawback of depending on sources that have not heretofore proved reliable.

Our major, and perhaps most vital, source of energy is petroleum and its various refined products. These materials provide 44 percent of our energy needs, but reserves and producing capacity are falling. In 1957, during the Suez crisis, we were able to supply our own needs and much of Europe's. Today, about 25 percent of our needs are supplied from abroad, and imports are increasing rapidly. Last year, total consumption of petroleum and its products was 5,523 million barrels. Reserves in the 48 contiguous states dropped to about 28,000 million barrels. New discoveries during the year contributed a trifling amount.

In the face of this deteriorating position, we are projecting increased consumption of gasoline. Schemes for controlling auto emissions entail losses in engine efficiency ranging in the neighborhood of 17 percent.

A continuation of our present trends in the utilization of energy and in growing dependence on foreign sources must lead to problems of unprecedented magnitude. We must place more emphasis on finding means of curtailing energy consumption while moving vigorously to develop acceptable substitutes for oil and natural gas.—PHILIP H. ABELSON

An excellent set of hearings on energy was conducted by the Committee on Interior and Insular Affairs of the House of Representatives under the chairmanship of Wayne N. Aspinall (D–Colo.). Committee prints will be available about mid-July from your congressman.

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5) A. M. Cartter, "Scientific Manpower for 1970–1985," 9 April 1971 (8)
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9) A. Crancer, Jr., *et al.*, "Comparison of the Effects of Marihuana and Alcohol on Simulated Driving Performance," 16 May 1969 (4)
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12) N. I. Dishotsky *et al.*, "LSD and Genetic Damage," 30 April 1971 (12)
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14) C. Djerassi, "Birth Control after 1984," 4 Sept. 1970 (12)
15) C. A. Doxiadis, "Ekistics, the Science of Human Settlements," 23 Oct. 1970 (12)
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17) H. F. Eichenwald and P. C. Fry, "Nutrition and Learning," 14 Feb. 1969 (8)
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23) G. Hardin, "The Tragedy of the Commons," 13 Dec. 1968 (8)
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26) L. B. Lave and E. P. Seskin, "Air Pollution and Human Health," 21 Aug. 1970 (12)
27) L. Lemberger *et al.*, "Marihuana: Studies on the Disposition and Metabolism of Delta-9-Tetrahydrocannabinol in Man," 18 Dec. 1970 (4)
28) H. L. Lennard *et al.*, "Hazards Implicit in Prescribing Psychoactive Drugs," 31 July 1970 (4)
29) L. Marx, "American Institutions and Ecological Ideals," 20 Nov. 1970 (12)
30) S. Milgram, "The Experience of Living in Cities," 13 March 1970 (12)
31) N. E. Miller, "Learning of Visceral and Glandular Responses," 31 Jan. 1969 (12)
32) L. W. Moncrief, "The Cultural Basis for Our Environmental Crisis," 30 Oct. 1970 (8)
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