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AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

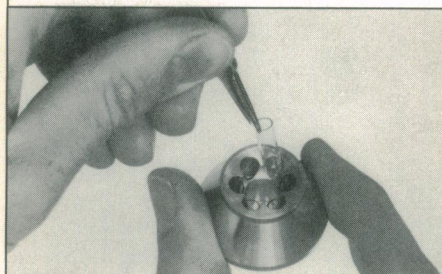
ANIMAL INDUSTRIES

A large, vertical underwater photograph occupies the lower two-thirds of the cover. It shows a bright sun or light source filtering down through deep blue water. The light creates a large, glowing circular area in the center, with numerous light rays and bubbles radiating outwards. The water's surface is visible at the top, with ripples and a slightly darker blue color. The overall effect is a serene yet powerful depiction of light and water.

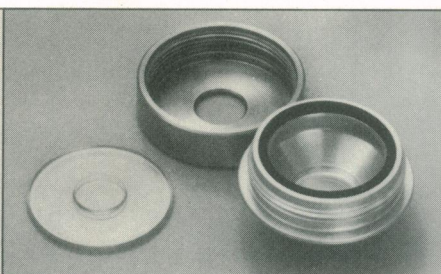
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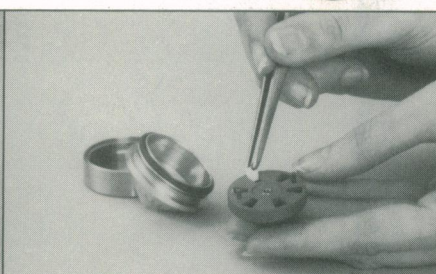
the small-sample ultracentrifuge.



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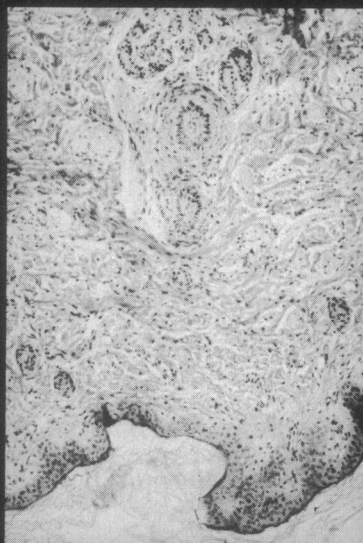
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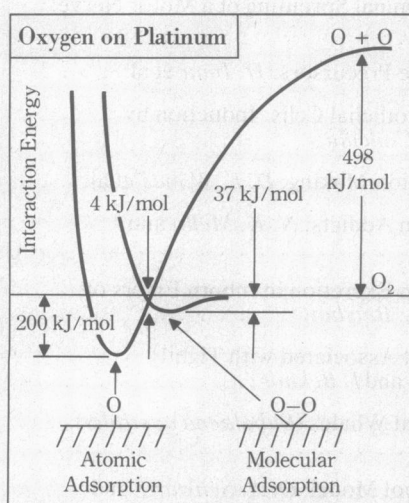
COVER

Underwater photograph of sun illustrates color of the oceanic "blue waters" caused by selective transmission and scattering of the shorter wavelengths of sunlight. Absorption of these energetic quanta can produce detectable concentrations of free radicals. See page 637. [Anita M. Brosius, Woods Hole, Mass.]

The American Association for the Advancement of Science was founded in 1848 and incorporated in 1874. Its objects are to further the work of scientists, to facilitate cooperation among them, to foster scientific freedom and responsibility, to improve the effectiveness of science in the promotion of human welfare, and to increase public understanding and appreciation of the importance and promise of the methods of science in human progress.

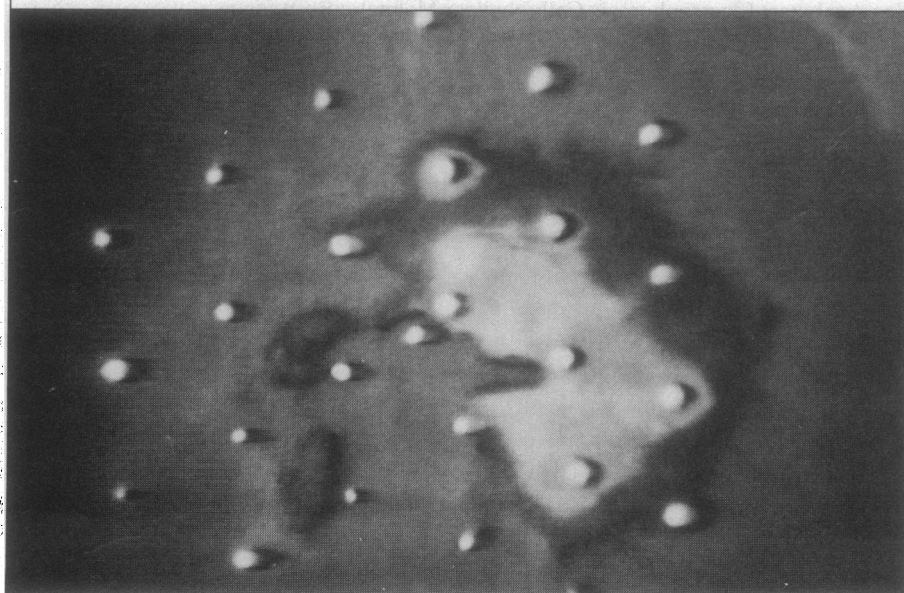
The Atomic Arrangement

In a recent experiment, scientists at the General Motors Research Laboratories studied changes in chemical bonding during the dissociation of oxygen molecules on platinum. Preliminary surface work has explored an interesting new phenomenon: the mechanism of oxygen dissociation over a wide range of temperatures.



A simplified schematic illustrating the reaction potential energy surface for oxygen-adsorption on a close-packed platinum surface.

An electron diffraction pattern which shows diffraction patterns from an oxygen-covered hexagonally close-packed platinum surface at 0° C.



UNDER what conditions will oxygen molecules dissociate into single atoms on a platinum surface? What is the mechanism for oxygen dissociation? Those are the kinds of questions that Dr. John Gland and his colleagues at the General Motors Research Laboratories are investigating to get a better understanding of the chemistry behind catalysis.

Their work has valuable practical implications for the automotive field, where catalysis is used to remove harmful emissions from automobile exhaust. Most cars built in the U.S. use catalytic converters filled with beads containing platinum to chemically transform carbon monoxide and unburned hydrocarbons into harmless CO₂ and water.

While it has long been known that catalysts are an effective way to

convert these gases, little is known about precisely why and in what order the basic atomic reactions occur.

In seeking answers to these questions, surface chemists study the elemental composition and geometric arrangement of atoms in the first few atomic layers of the surface and the means by which atoms and molecules from the gas phase bond to the surface.

In his most recent work, Dr. Gland has been studying the adsorption and desorption of oxygen on platinum single-crystal surfaces. This is important because oxygen is the agent that must be adsorbed on the surface to react with carbon monoxide and hydrocarbons to convert them to CO₂.

The experiments were conducted in a stainless steel ultrahigh vacuum system equipped with an electron energy analyzer and a mass spectrometer. The electron energy analyzer allows one to measure the concentration and character of the oxygen adsorbed on the platinum surface. The mass spectrometer is used to measure the desorption of O₂ as the platinum surface is heated. Mathematical analysis of the desorption process allows one to characterize the chemical bond between the oxygen and the platinum surface.

In these experiments, the platinum surface is covered with oxygen at the extremely low temperature of -179°C (almost the temperature of liquid nitrogen) by exposing it to gaseous O₂ molecules. The oxygen remaining in the gas phase is pumped away, and then the desorp-

tion of oxygen from the surface is observed as the platinum crystal is gradually heated to 1000°C.

The oxygen was found to desorb from the surface in two distinctly different temperature regimes—part at -125°C and the rest at about 425°C. By using the oxygen-18 isotope, it was established that the low temperature desorption represents oxygen that was adsorbed on the surface in a molecular form while the higher temperature desorption corresponds to oxygen adsorbed in the atomic form. From an analysis of the desorption process, it was possible to establish the complete energetics. Oxygen molecules from the gas phase strike the surface and are weakly bound (37 kJ/mol). The adsorbed oxygen molecule can either desorb into the gas phase (37 kJ/mol) or dissociate into atoms (33 kJ/mol). The atoms are bonded very strongly (200 kJ/mol) to the surface.

FROM the desorption analysis, it was also possible to deduce the mechanism for the dissociation process. The interesting conclusion that results is that the formation of O atoms on platinum is a two-step process—oxygen is adsorbed in a molecular state and then dissociates to form atoms.

The GM scientists were most interested in learning how this adsorbed molecular species is bonded to the platinum surface. Fortunately, another technique was available to determine the bonding. The tech-

nique is called electron energy-loss spectroscopy and is quite new—there are only six or seven such instruments in the world. The measurements not only confirmed the existence of the adsorbed molecular oxygen but showed that it was bound by the transfer of two electrons from the platinum surface into the antibonding π_g^* orbitals of oxygen. "This was most exciting" said Dr. Gland, "because this is the first time that this type of oxygen bond has been observed on a metal surface."

"We're getting closer and closer to a more specific understanding of catalysis," says Dr. Gland. "The more we learn about simple chemical systems, the better we'll be able to control more complicated systems. That has excellent implications for protecting the environment."

THE MAN BEHIND THE WORK

Dr. John Gland, 32 years old, is a Senior Research Scientist in surface chemistry at the General Motors Research Laboratories. He heads a group of 7 investigators, 4 with Ph.D.s, all involved in work relating to the basic surface chemistry of catalysis.

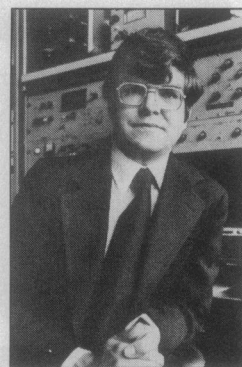
A graduate of Wittenberg University in Ohio, Dr. Gland received his Ph.D. in physical chemis-

try at the University of California, Berkeley, in 1973 and joined the General Motors staff that year.

Dr. Gland comments: "I came to GM Labs because I wanted to get in on the ground floor of an exciting new field. The atmosphere here is very open, with lots of cross-pollination among departments. With several hundred people with Ph.D.s here, we've got a lot of human resources to draw on in all the basic sciences."

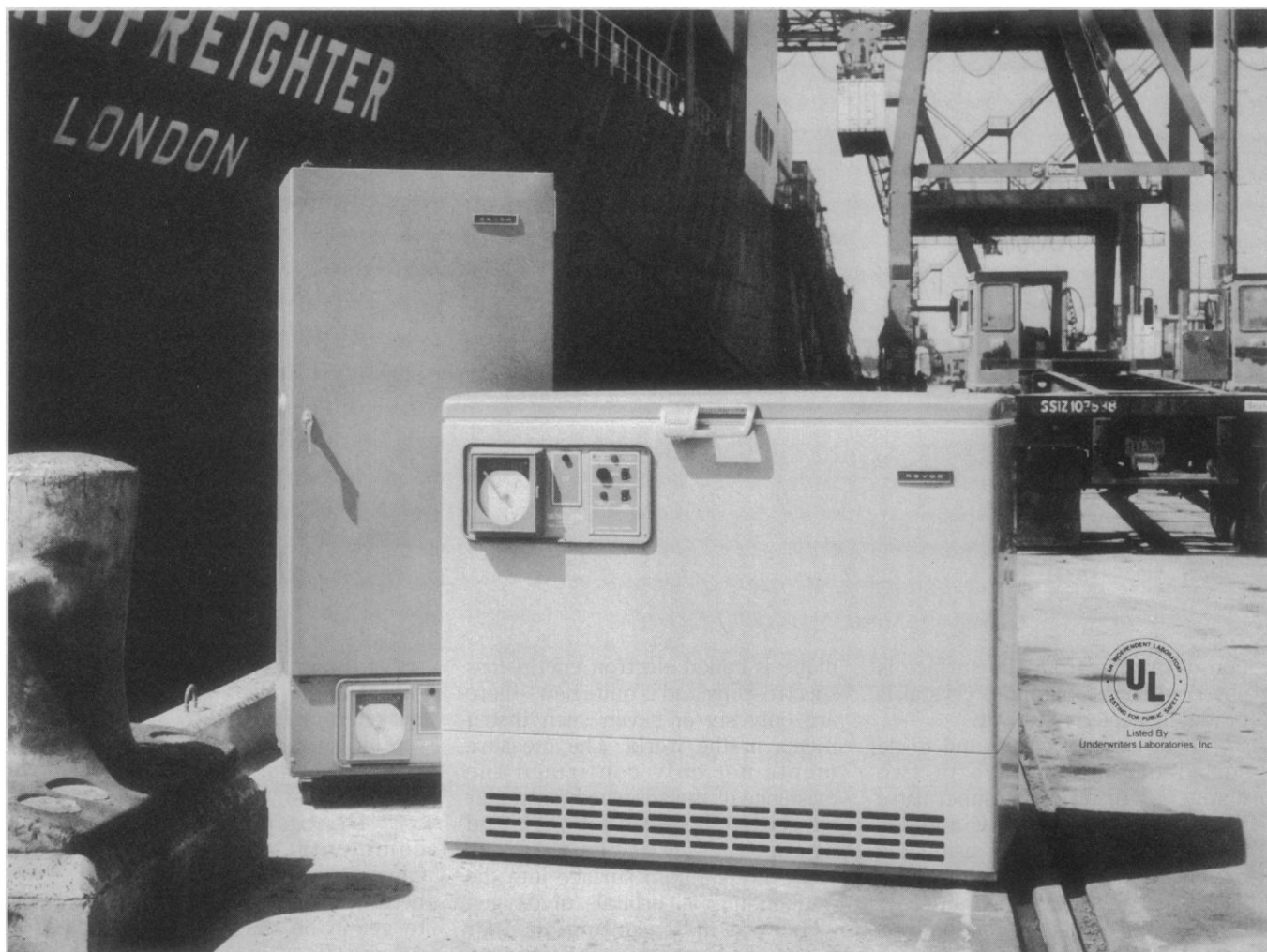
"Typically, management defines a broad problem, then we're free to tackle the solution in any way we choose. They give us the freedom, equipment and support to get the job done correctly."

In addition to his research, Dr. Gland enjoys backpacking in Wyoming and in the Sierra Nevada Mountains in California.



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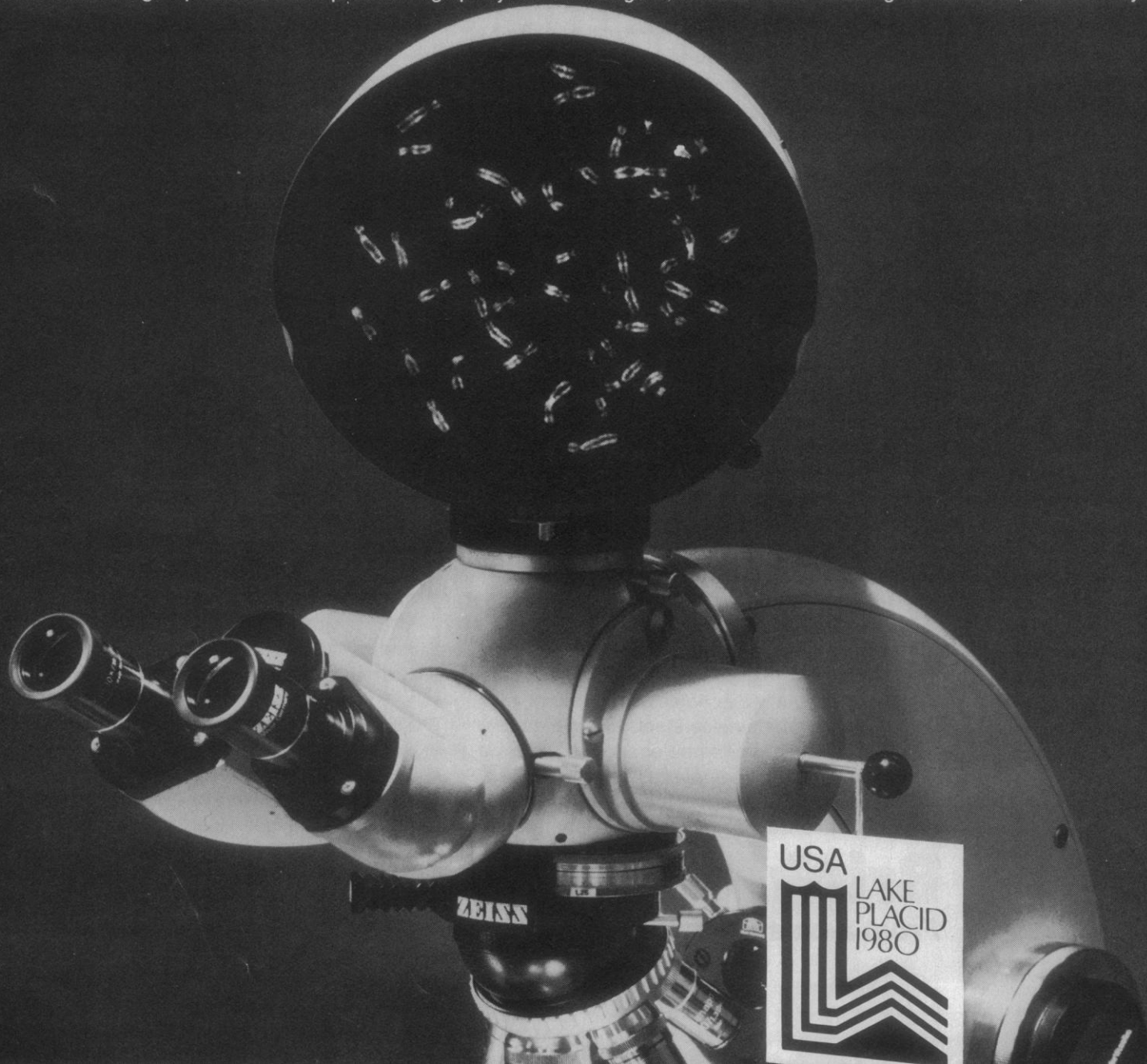
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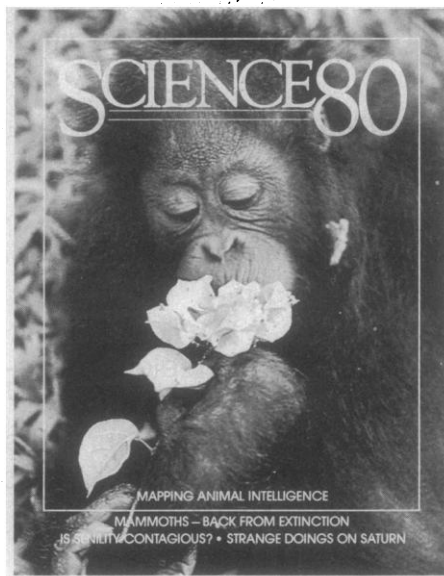
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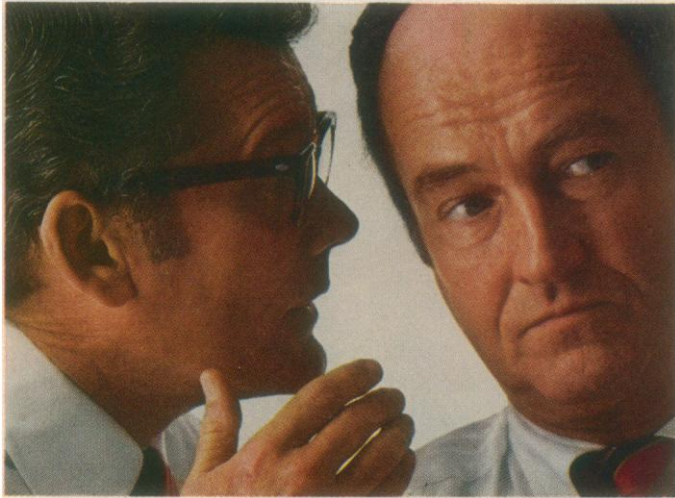
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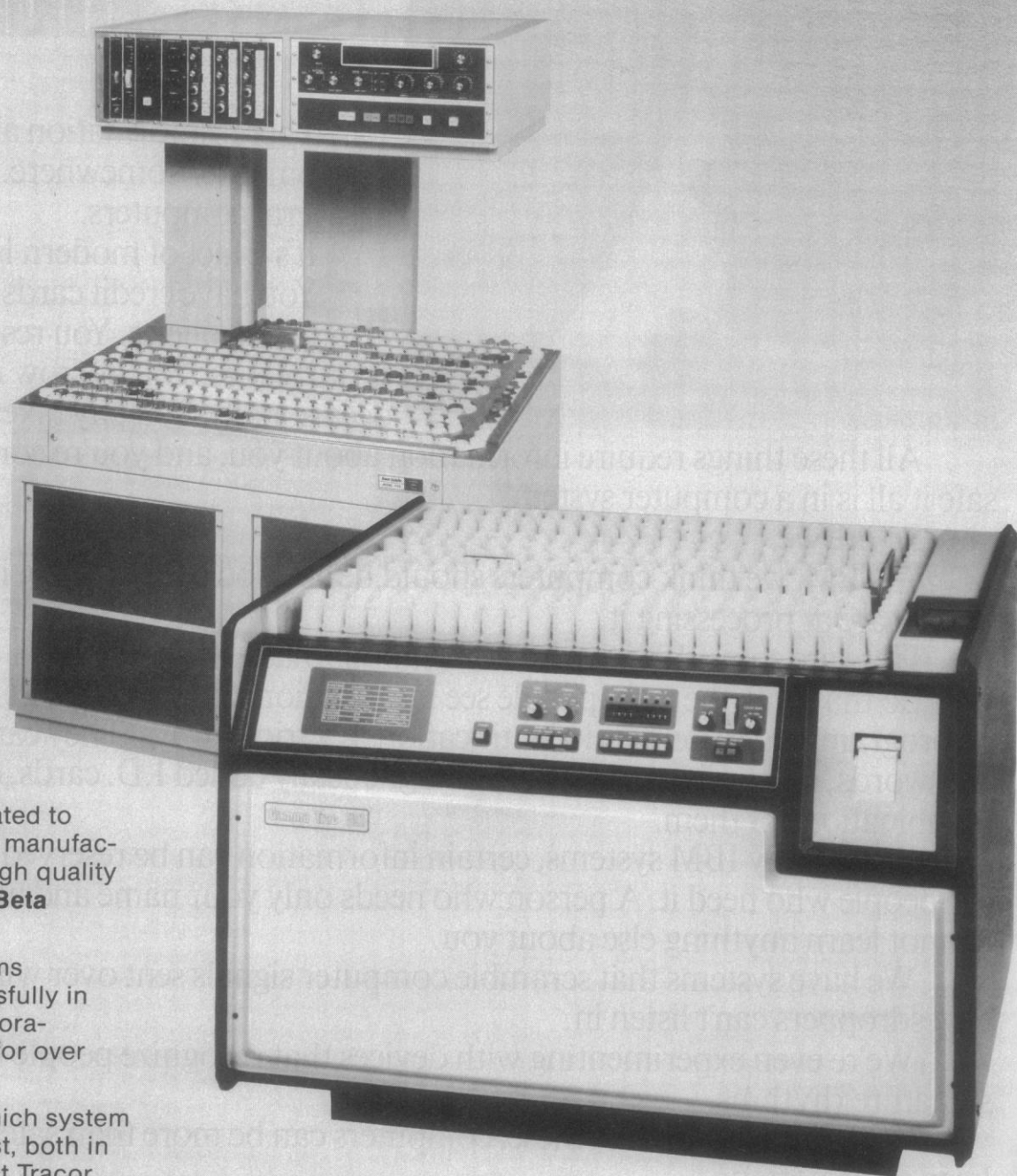
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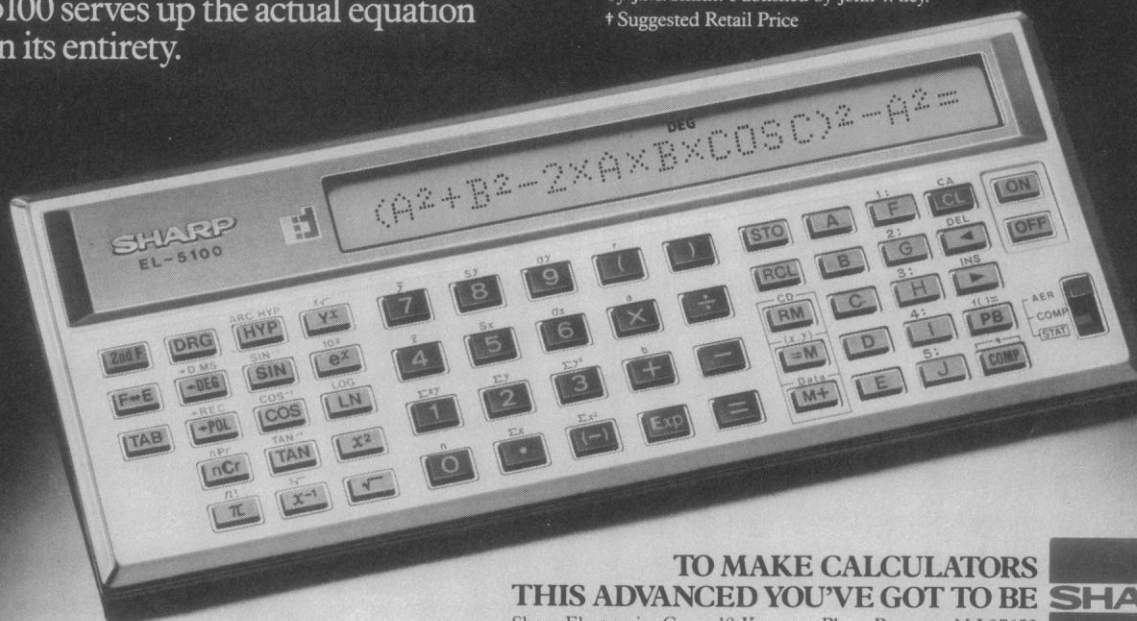
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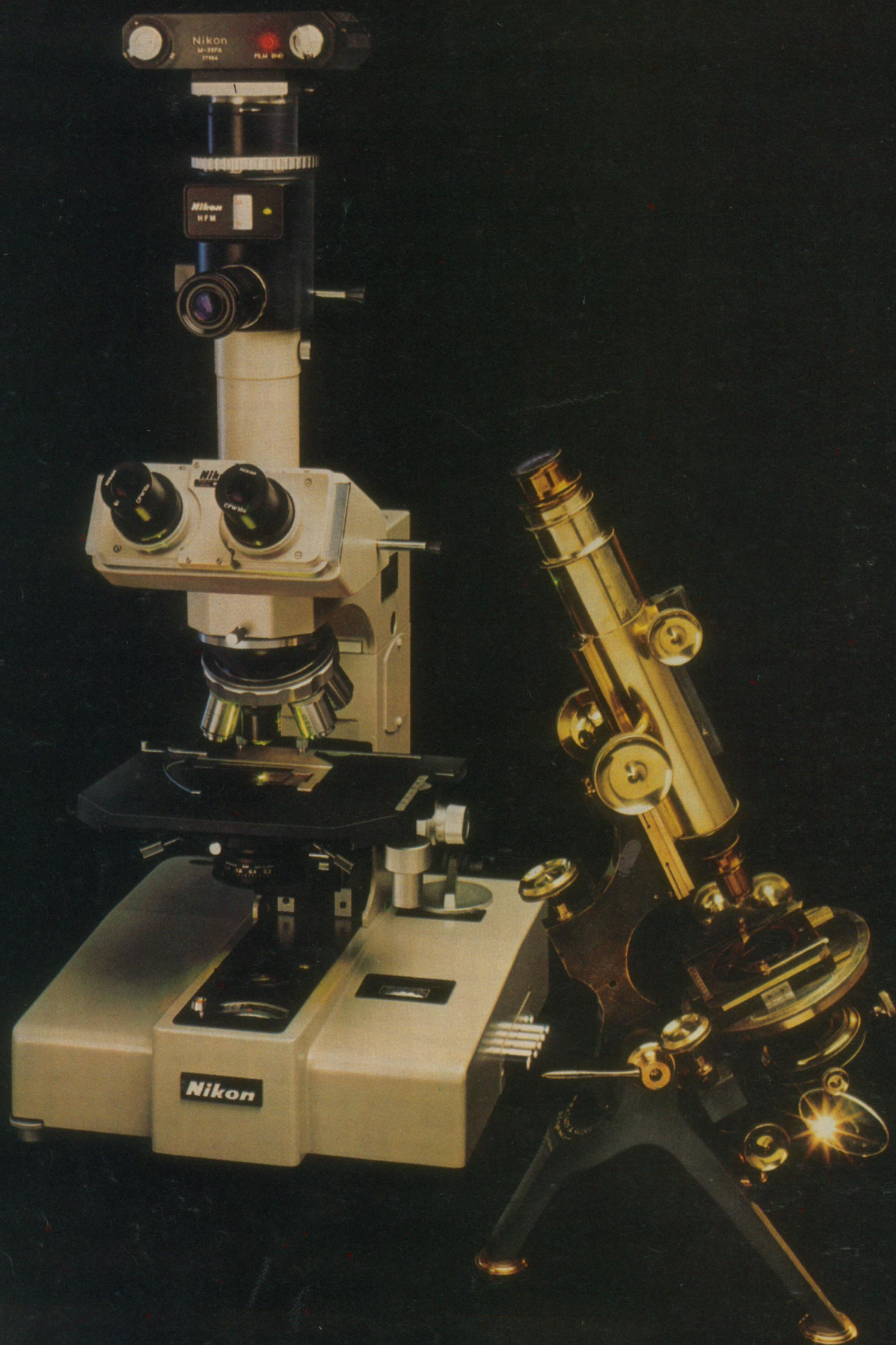
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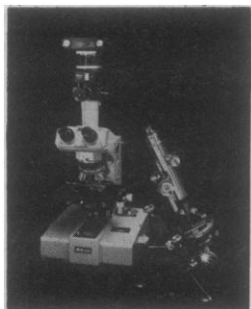


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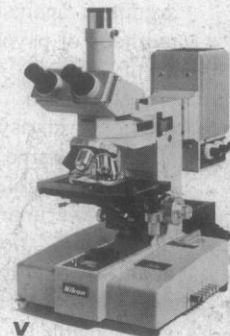
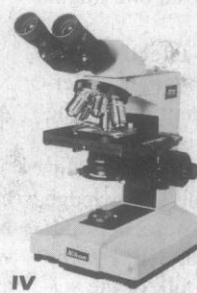
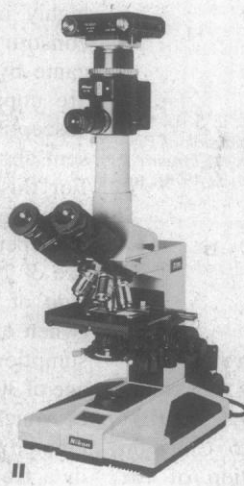
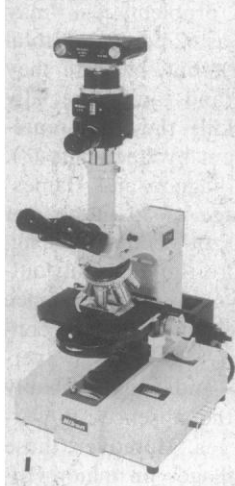
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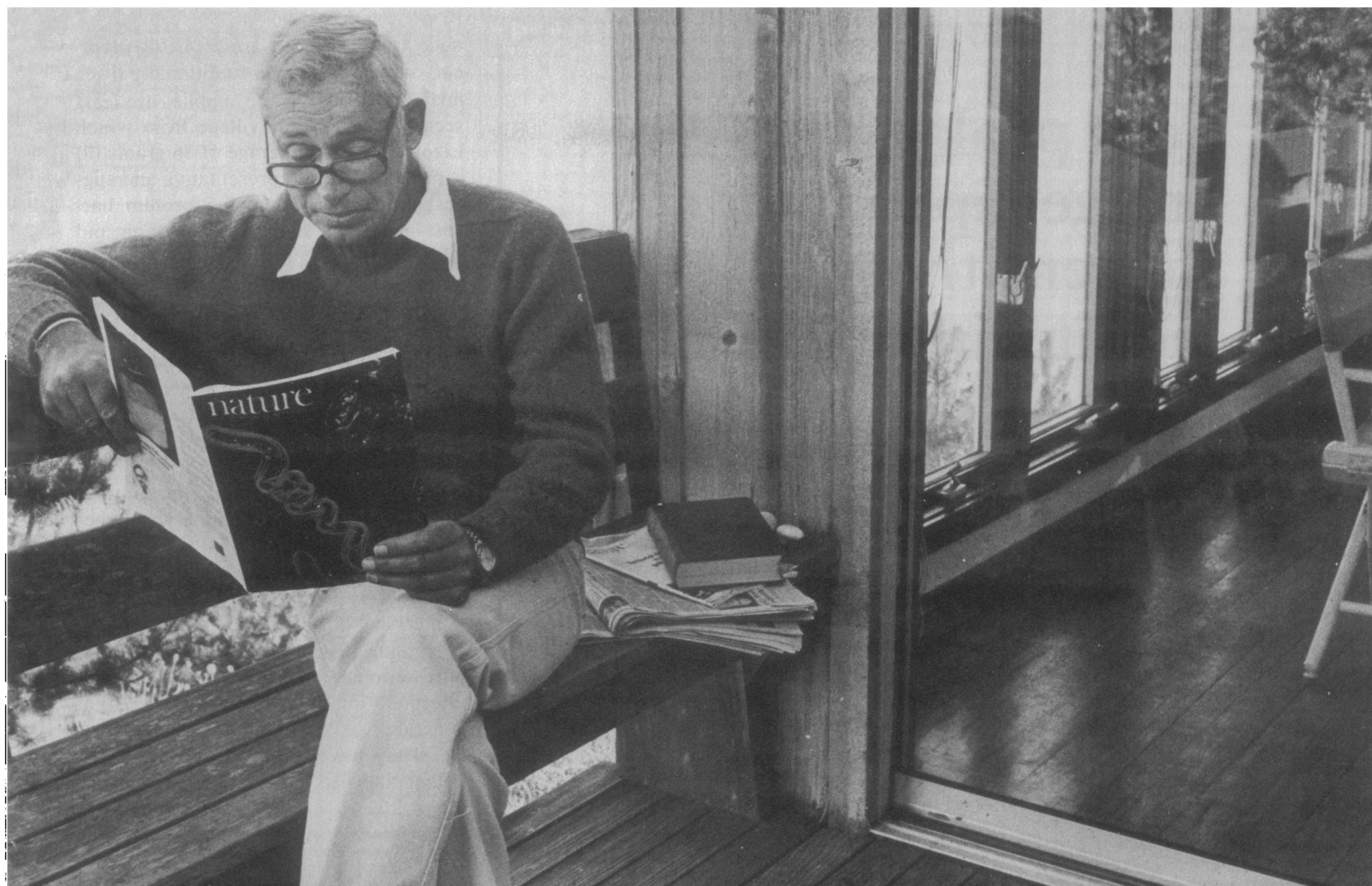
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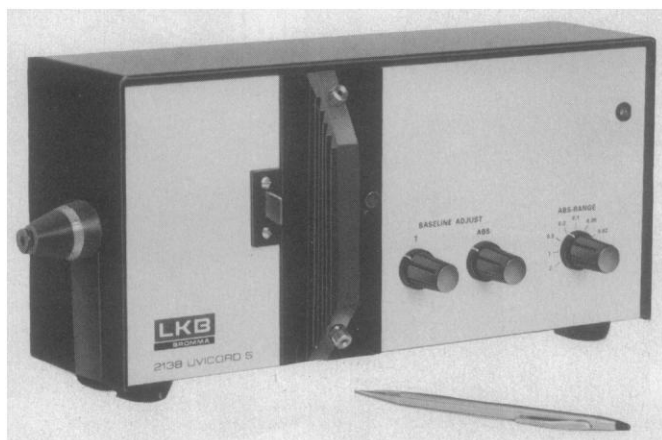
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noco tributaries (9), are probably *atypical*, since Yānomamō traditionally dwell inland (9), where game supplies are least secure. The interior village from which Lizot reports an average of 36 grams (9) is probably more representative and suggests that the Yānomamō protein harvest—when the distribution of tapir and white-lipped peccary are taken into account—may frequently become marginal, especially for large settlements and where population pressure—evidenced by high rates of female infanticide (7, 9)—has critically reduced strategic game supplies. This puts severe strains on intravillage game distribution, leading to fission and ensuing hostilities (5, 7). Nevertheless, as Chagnon and Hames note, the most intense and chronic war is between more distant villages. We attribute this in good measure to competition engendered by deep-forest hunting of certain critical but problematic species.

Nothing in Chagnon and Hames' report seriously discredits the ecological interpretation of Amazon warfare (10) in general or of Yānomamō war in particular. They have yet to propose a compelling alternative.

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7. N. Chagnon, *Yānomamō: The Fierce People* (Holt, Rinehart & Winston, New York, 1968).
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9. ———, *Man* 12, 497 (1977).
10. For a more detailed discussion of these issues, see (5); also J. Ross, in *Beyond the Myths of Culture: Essays in Cultural Materialism*, E. Ross, Ed. (Academic Press, New York, in press).

The response by Ross and Ross to our report on tribal warfare in Amazonia is punctuated with so many undocumented assertions and misrepresentations of the existing literature that it would take an article-length response to address them. Coincidentally, however, we have already submitted a two-part expanded version of our report to another sci-

entific journal. Most of the topics mentioned by the Rosses are dealt with more extensively in the expanded version than was possible in our original *Science* report, and we believe we adequately answer the questions raised by the Rosses.

One overriding major issue, however, should be kept fully in mind in this debate. In the sciences there must be a meaningful relation between empirical evidence, analytical methods, and general theoretical propositions. Theories must be falsifiable, and a peculiar attribute of the "Protein School" is that the various members consistently modify their positions to remove their theory further and further away from the possibility that it could be falsified. Thus, in 1974, one of the senior spokesmen of the Protein School, Marvin Harris of Columbia University, summarized the general position accordingly: When asked, "... how do you explain warfare among the Yanomamö?" he replied "I think there may be a shortage of protein there..." (1), a contention prompted by the then-valid claim that the first author of the *Science* report had not presented quantified data on protein consumption during the course of his previous field studies. Our *Science* report was an attempt to provide such data, and the field research conducted by the second author was specifically designed to answer that criticism. Astonishingly, after our report in *Science* was published and clearly showed that there is considerable reason to doubt that a protein shortage exists, Harris argued, "... it is not surprising that the small settlements studied by Chagnon and Hames enjoy high per capita fish- and game-protein levels" (2). This new position is found in the above criticism of our report by the Rosses, adumbrated also in a recent publication by E. Ross (3) that describes efforts to reconcile scientific disagreements by recourse to evidence as "... vacuous empiricism..." How does one falsify the "scientific" claim that a *shortage* of animal protein in native Amazonian diets leads to tribal warfare when *high* per capita protein consumption also leads to the same effect? We would indeed, using the logic of the Protein theorists, find it difficult to provide a compelling alternative to this kind of preemptive theorizing!

As for an alternative approach to the relation of material resources to human biocultural evolution, we believe the second part of our forthcoming article will adequately address this issue. The general bodies of theory relevant to this issue have been laid out in Chagnon and Irons

(4) (reviewed in *Science*, 14 December 1979, p. 1294) and in the general field of evolutionary ecology, summarized in such texts as Krebs and Davies (5) (reviewed in *Science*, 24 August 1979, p. 781). Ecology, finally, derives from the field of biology—whether or not it is modified with the adjective cultural—and the "cultural ecology" of the Protein School seriously violates many principles of ecological theory as these are widely understood by biologists.

We sincerely hope that the theory to be presented in the forthcoming essay by J. Ross (cited in reference 10 of the Rosses' critique) on Amazon warfare unambiguously presents propositions that can be verified or falsified by empirical data.

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RAYMOND B. HAMES

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Pennsylvania State University,
University Park 16802

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4. N. Chagnon and W. Irons, Eds., *Evolutionary Biology and Human Social Behavior: An Anthropological Perspective* (Duxbury, North Scituate, Mass., 1979).
5. J. Krebs and N. Davies, Eds., *Behavioural Ecology* (Sinauer, Sunderland, Mass., 1978).

Erratum: In the caption to the picture accompanying the review of *Solar System Plasma Physics* by Michael C. Kelley (18 Jan., p. 297) the date of the launching of Explorer I should be January 1958.

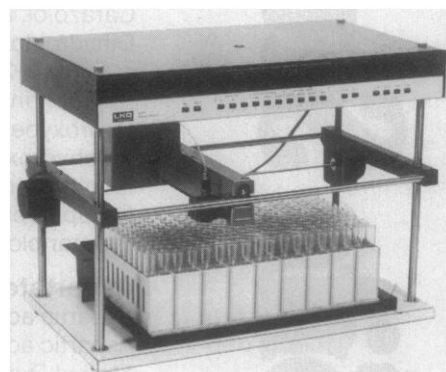
Erratum: In the list of recent recipients of the National Medal of Science (News and Comment, 25 Jan., p. 387), Lyman Spitzer, Jr., should have been identified as professor of astronomy at Princeton University.

Erratum: In the report "Aboriginal Indian residence patterns preserved in censuses and allotments" by John H. Moore (11 Jan., p. 201), Table 1 was inadvertently omitted:

Table 1. Distances from mothers' to married children's allotments for first-generation descendants of Sand Creek family heads.

Choices	Distance (miles)	
	Daughters (N = 23)	Sons (N = 14)
Near	0.5	0.5
	0.5	1.0
	0.5	3.1
	1.0	
	1.0	
	1.3	
	1.6	
	1.9	
	2.2	
	2.4	
	2.4	
	2.8	
	3.0	
	3.7	
	4.5	4.5
Far	5.5	18.0
	5.5	18.8
	9.0	21.2
	15.1	21.3
	16.6	25.0
	19.3	25.2
	35.0	31.5
	36.6	32.9
	37.1	41.4
		46.9
		47.5

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WB-4101 (2,6-Dimethoxyphenoxyethyl)
aminomethyl-1, 4-benzodioxane,
2-[phenoxy-3-³H(N)]-
Epinephrine, *levo*-[methyl-³H]-
Norepinephrine, *levo*-[7,8-³H(N)]-

β -Adrenergic

Carazolol, DL-[3,6-³H(N)]-
Dihydroalprenolol hydrochloride, *levo*-
[propyl-2,3-³H]-
Epinephrine, *levo*-[N-methyl-³H]-
Hydroxybenzylisoproterenol, *p*-[7-³H]-
Iodohydroxybenzylpindolol, [1²⁵I]-
Isoproterenol, DL-[7-³H(N)]-
Norepinephrine, *levo*-[7,8-³H(N)]-
Propranolol, L-[4-³H]-

Aspartate

Aspartic acid, D-[2,3-³H]-
Aspartic acid, L-[2,3-³H]-
Methyl-D-aspartic acid, *N*-[methyl-³H]-

Benzodiazepine

Diazepam, [methyl-³H]-
Flunitrazepam, [methyl-³H]-

Cholinergic

Muscarinic

Acetylcholine chloride, [N-methyl-³H]-
Choline chloride, [methyl-³H]-
Pilocarpine, [³H(G)]-
Quinuclidinyl benzilate,
DL-[benzyl-4,4'-³H(N)]-
Scopolamine methyl chloride,
[N-methyl-³H]-

Nicotinic

Acetylcholine chloride, [N-methyl-³H]-
 α -Bungarotoxin, [1²⁵I]-
Choline chloride, [methyl-³H]-
Tubocurarine chloride, *dextro*-[13'-³H(N)]-

Dopaminergic

ADTN Amino-6,7-dihydroxy-
1,2,3,4-tetrahydronaphthalene,
2-[5,8-³H]-
Amphetamine sulfate, D-[³H(G)]-
Apomorphine, [8,9-³H]-
Chlorpromazine, [³H]-
Dihydroxyphenylethylamine,
3,4-[ethyl-1-³H(N)]- or [ethyl-2-³H(N)]-
Haloperidol, [³H(G)]-
Propylnorapomorphine, *N*-[propyl-³H(N)]-
Spiroperidol, [1-phenyl-4-³H]-

GABA

Alanine, β -[3-³H(N)]-
Aminobutyric acid, γ -[2,3-³H(N)]-
Dihydropicrotoxinin, α -[8,10-³H]-
Isoguvacine hydrochloride, [³H]-
Muscimol, [methylene-³H(N)]- or [4-³H]-
Nipeotic acid, [ring-³H]-

Glutamate

Glutamic acid, L-[3,4-³H]-

Glycine

Glycine, [2-³H]-

Histamine

H₁

Histamine, [³H(G)]-
Pyrilamine, [pyridinyl-5-³H]- (Mepyramine)

H₂

Histamine, [³H(G)]-

Opiate

Dihydromorphine, [7,8-³H(N)]-
Enkephalin (5-L-leucine), [tyrosyl-3,5-³H(N)]-
Enkephalin (5-L-methionine),
[tyrosyl-3,5-³H(N)]-
Enkephalinamide
(2-D-alanine-5-L-methionine),
[tyrosyl-ring-2,6-³H]-
Ethylketocyclazocine, [9-³H]-
Morphine, [6-³H(N)]-

Serotonin

Hydroxytryptamine binoxalate, 5-[1,2-³H(N)]-
Hydroxytryptamine creatinine sulfate,
5-[1,2-³H(N)]-

Steroid

Androgen

Dihydrotestosterone,
[1,2,4,5,6,7,16,17-³H(N)]-
Methyltrienolone, [17 α -methyl-³H]- (R1881)*
Testosterone, [1,2,6,7,16,17-³H(N)]-

Estrogen

Estradiol, [2,4,6,7,16,17-³H(N)]-
Iodo-3, 17 β -estradiol, 16 α -[1²⁵I]-
Moxestrol, [11 β -methoxy-³H]- (R2858)*

Glucocorticoid

Dexamethasone, [6,7-³H(N)]-
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Triamcinolone acetone, [6,7-³H(N)]-

Mineralocorticoid

Aldosterone, D-[1,2,6,7-³H(N)]-

Progesterone

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The Eagle and the Bear

Barely a month into the new decade, the fragile texture of Soviet-American forbearance has come apart and the outlook for mutual restraint is dim. SALT II is no longer a starter, the Comprehensive Test Ban Treaty looks little better, and the lid is ready to come off the military budget. Even the course of the American national elections is being reshaped by the actions of those hereditary foes, the Soviet Union and Iran. As winter turns to spring, the world will be maintaining an anxious storm watch. We are back to where we were two decades ago, when a somber President said, "Each day the crises multiply. Each day we draw nearer the hour of maximum danger."

A few years ago social scientists flailed at what they saw as signs of the failures of knowledge. The evidence in that direction is now much more telling. We have a feast of knowledge, but it has not done much to improve political technology. As a case in point, cultural and scientific exchanges with the Soviets, less than a decade old, were meant to reduce tensions and foster mutual understanding. To some degree they did, but it is apparent that the armies of knowledge did not make enough difference. Still, if the hour of maximum danger is drawing closer, there is all the more reason to balance political censure and economic pressure with civil discourse. When governments are not on speaking terms, the burden of such discourse falls by default on others.

More by coincidence than intent, the recently concluded Annual Meeting of the AAAS in San Francisco concerned itself with these matters. The Council voted a strong resolution for control of the nuclear weapons race and for plans to convert nuclear weapons facilities to peaceful uses in phase with arms control agreements. That done, the Council voted its endorsement of a National Academy for Peace and Conflict Resolution. Moreover, the Council mandated a AAAS task force on nuclear arms control and directed that this topic be a major theme of the 1981 Annual Meeting in Toronto. The thrust is not toward a new dance of détente, but rather toward limiting technological terror and extending the search for a stable peace. If Soviet censorship permits these words to be read by scholars within the U.S.S.R., a degree of response in kind is not unthinkable.

The real price that has been exacted by the Soviet strike into Afghanistan is, to be sure, an extinction of that minimum of trust that is necessary to legitimize conflict management between nations. Absent that element, governments and publics have scant choice but to resort to stronger military capability in order to influence an opponent's calculus of risks and consequences. Both science and technology inevitably will be harnessed to that task. And the derivative cost is in the diversion of attention and effort from a host of problems that, left unattended, can lead to as much grief as almost any quarrel between superpowers: swarming population, crushing indebtedness of developing nations, forest and cropland depletion, failure of emerging nations to achieve their expectations with stability, and virulent poverty. The 1980's might have been the decade for inspired uses of science and technology to manage peaceful change and the abatement of incendiary dangers. It could yet be, if our priorities are not unreasonably skewed.

A major discontinuity has been introduced into our working assumptions, with global ramifications. In many ways the ramifications are likely to count for more, in the end, than the discontinuity itself. How they are perceived and understood, and whether they lead to reactive or proactive responses, to sterile reflexes or to a surer grasp of the meanings of the turning century, is the urgent question. The contest between the eagle and the bear is no small part of all this, but it is not the whole of it. That is something to remember.—WILLIAM D. CAREY

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