SCIENCE

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Vol. 188, No. 4189

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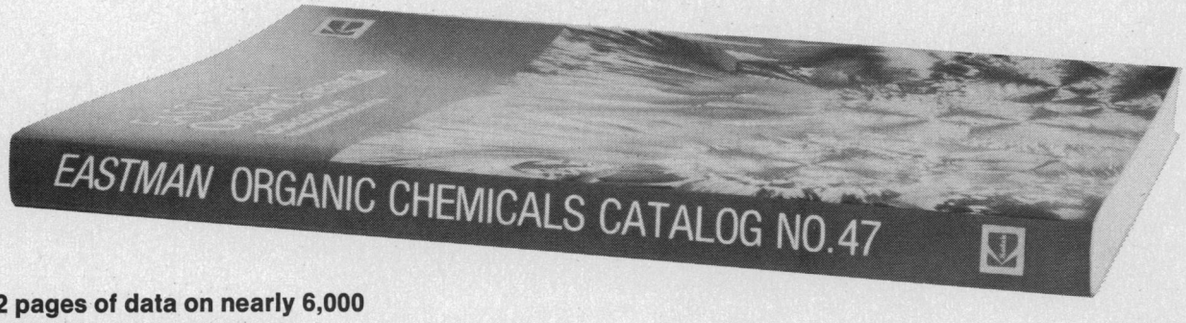

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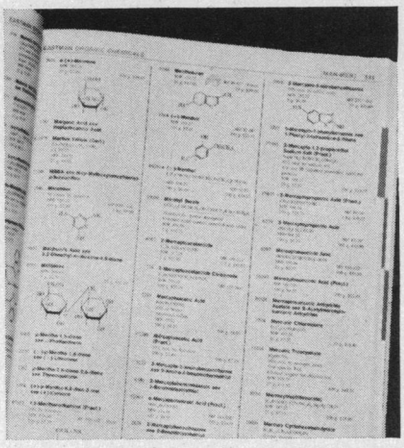

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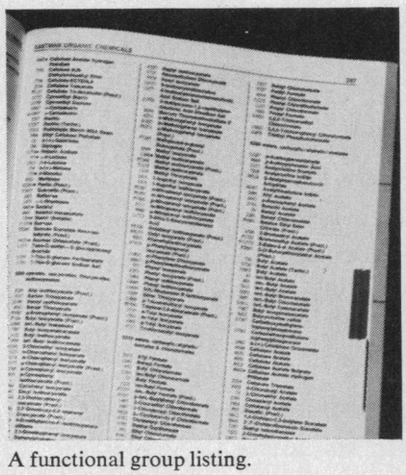

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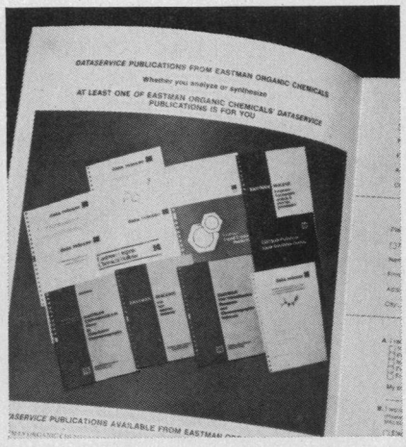

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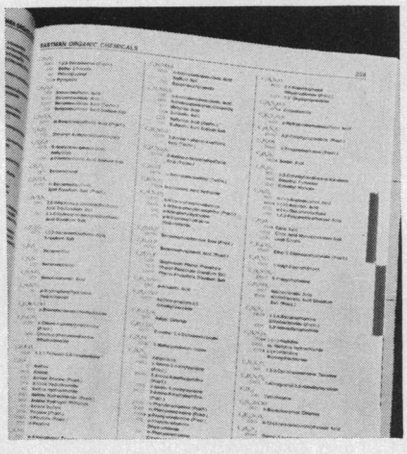

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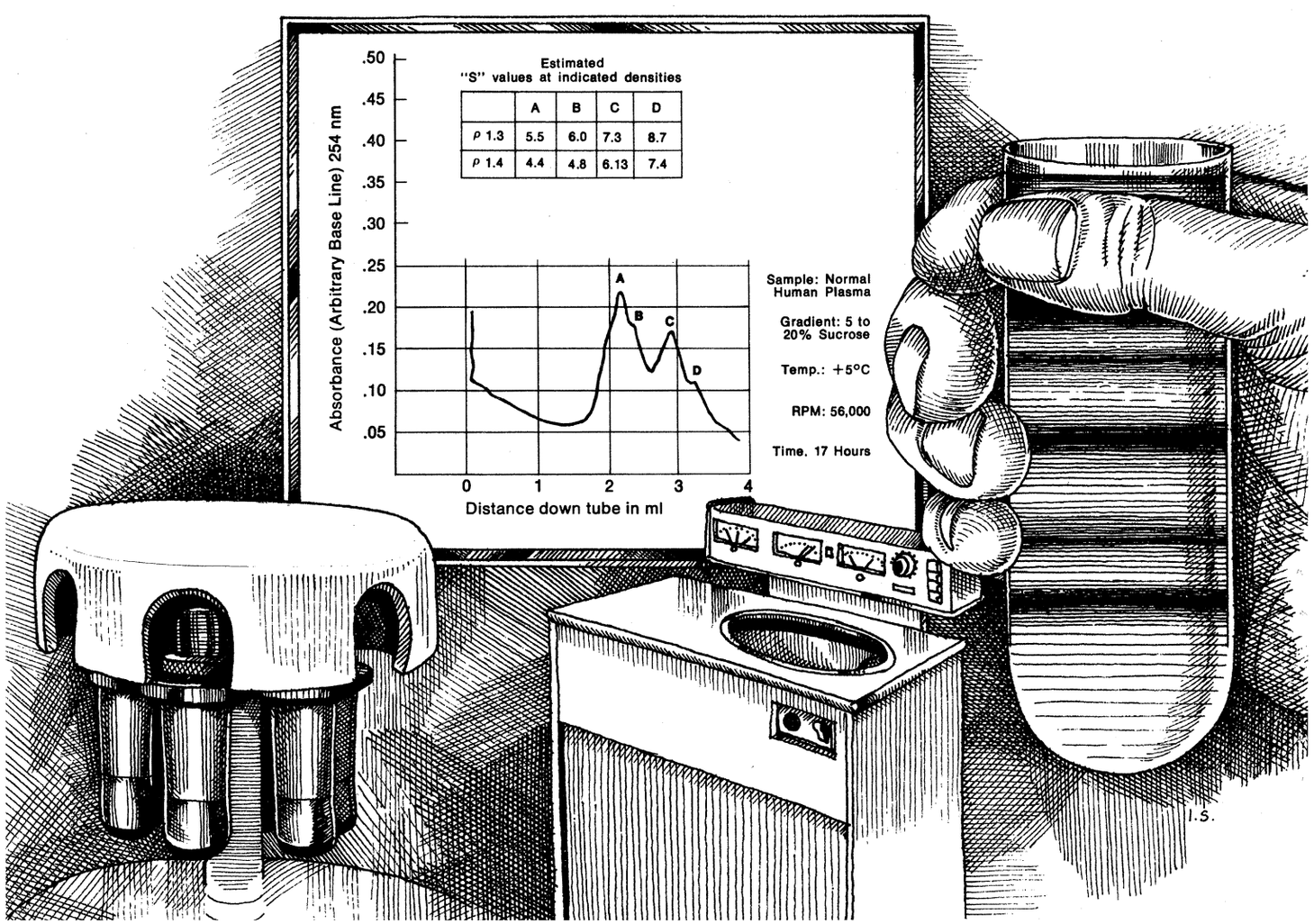

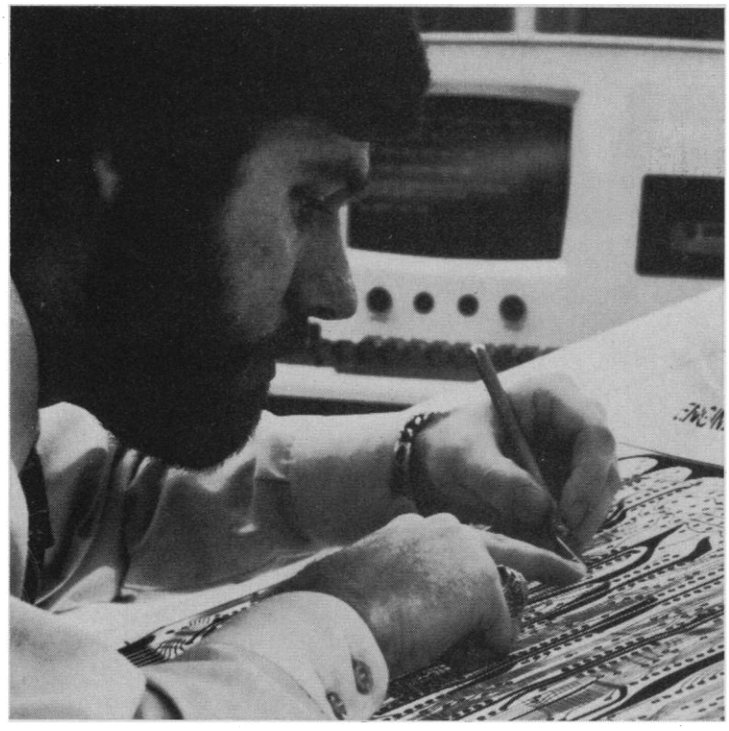

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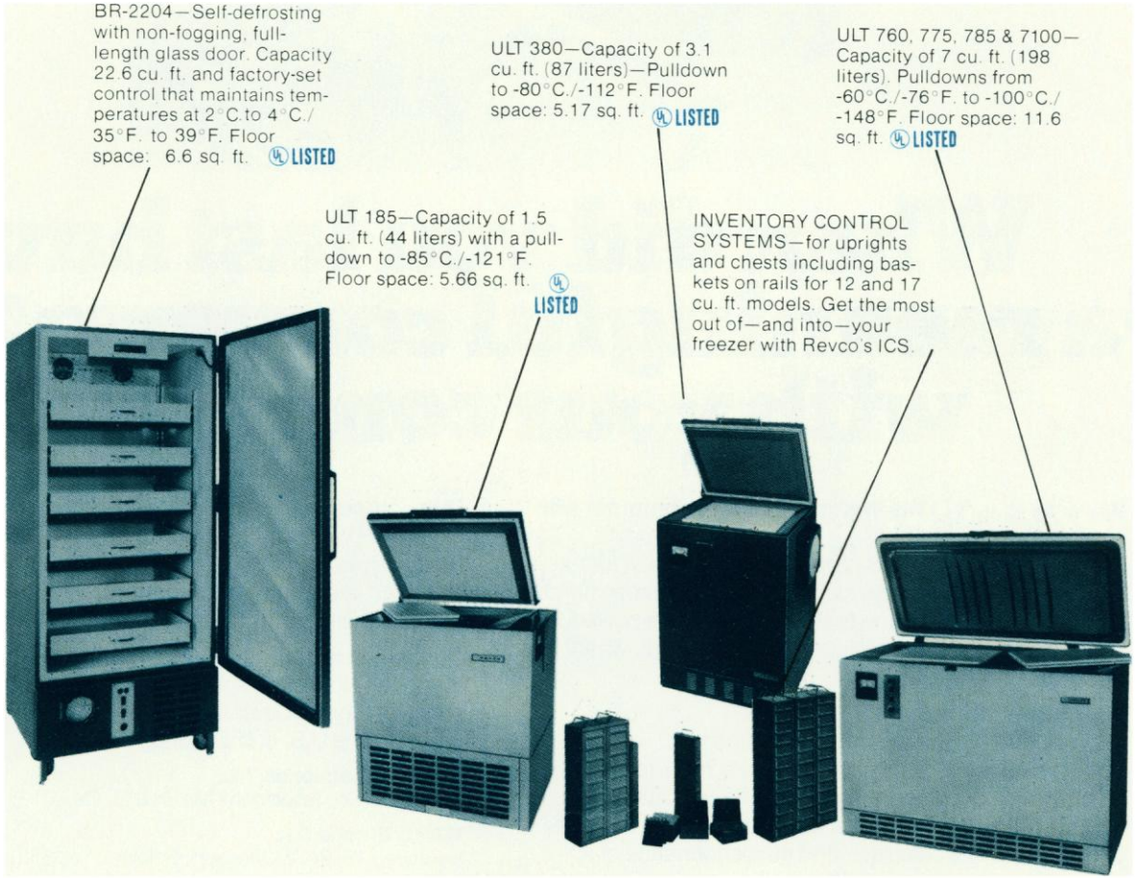

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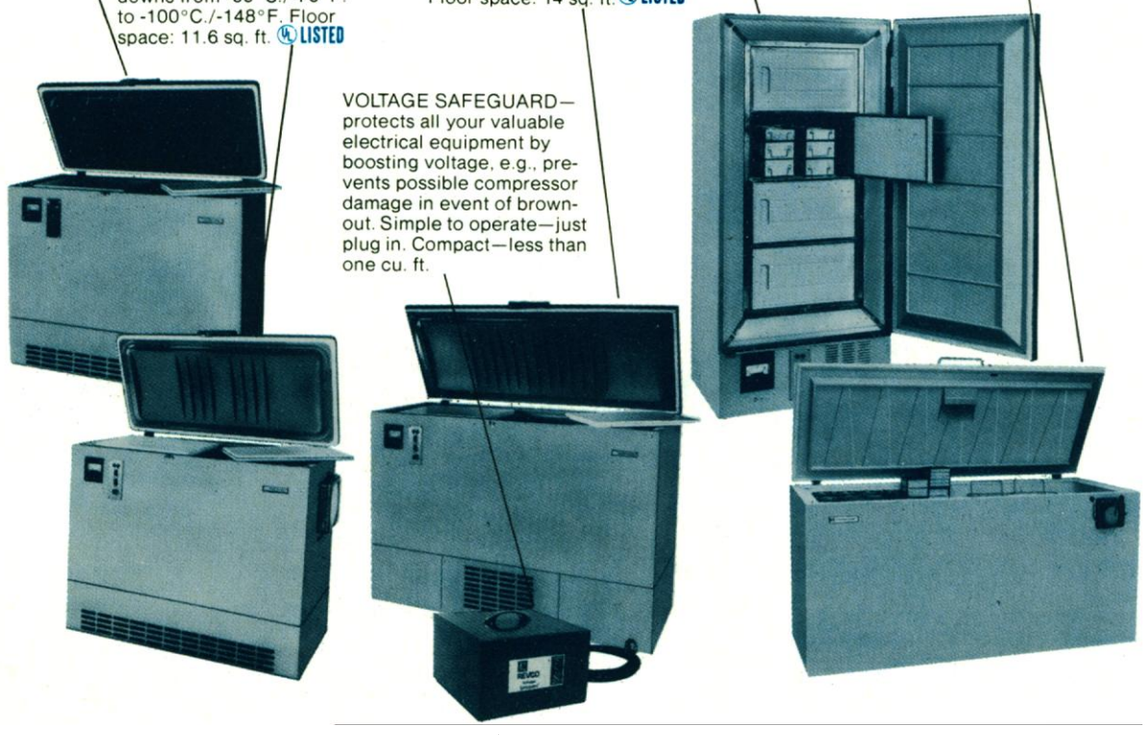

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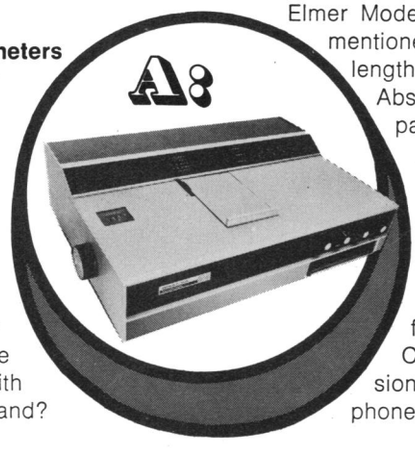

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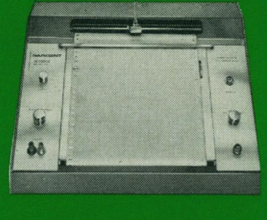
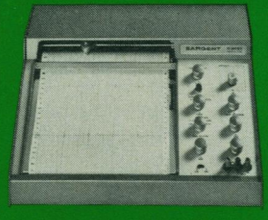
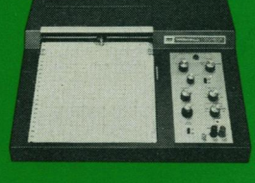


1963



1967



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a bird with a humerus length of 52 cm would have a wingspan of 523 cm, whereas *P. antiquus*, had it ever attained this humerus size, would have had a 1019-cm wingspan, and *Pteranodon* would have had a 1241-cm wingspan.

The Texas pterosaur, hereafter to be referred to as *Quetzalcoatlus northropi*, is represented by the type Texas Memorial Museum No. 41450-3, which consists of a left humerus and partial radius, ulna, proximal and distal carpals, metacarpal, and first and second phalanges of the fourth digit. An approximate regression equation for the relation of its wingspan to its humerus length

$$W = 29.70H^{1.0116}$$

can be based on a more nearly complete, smaller specimen of the same species and on the regression coefficient of *Pteranodon*. The solution of this equation for a humerus of 52 cm gives a wingspan of approximately 1600 cm.

As for the relation between mass and wingspan, Bramwell and Whitfield (*3*) list five estimates for the mass of *Pteranodon* with a wingspan of 6.95 meters that range from 12.9 to 29.8 kilograms. These estimates are based on attempts to flesh out the animal, not on a calculated relation between mass and wingspan. However, using Greenewalt's (*4*) equation for the relation between mass and wingspan in birds and insects

$$W = cl^3$$

where W is weight, l is the length of the arm, and c is a constant of proportionality, the mass of a bird with a wingspan of 695 cm would be 100 kg, and for a bird with a wingspan of 1550 cm, it would be 440 kg. Once again, the relation between some anatomical feature and wingspan does not seem to have been the same in pterosaurs as it is in birds. Both of these departures from the relation seen in birds ultimately reflect the differences in mode of locomotion. It seems that, although study of present-day flying creatures provides insight into possible structural solutions to a common problem, it does not dictate that a particular solution must be practiced by all flying creatures.

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University of California,
Berkeley 94720

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2. T. A. Vaughn, *Univ. Kans. Publ. Mus. Nat. Hist.* **12**, 1 (1959).
3. C. D. Bramwell and G. R. Whitfield, *Philos. Trans. R. Soc. Lond. Ser. B Biol. Sci.* **267**, 503 (1974).
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Sea-Floor Exploration

In the otherwise excellent article by Allen Hammond, "Submersibles: A research technology whose time has come?" (Research News, 7 Mar., p. 824), one error should be corrected. Hammond remarks that "even ordinary echo-sounding gear is almost nonexistent on most university-operated research ships." As best as I can determine, every U.S. university-operated research ship (barring rowboats) can boast an "ordinary" echo sounder adequate to determine depth on the continental shelf. All of the "blue-water" oceanographic ships in the University-National Oceanographic Laboratory System have at least one precision deep-water sounding system capable of determining the water depth to an accuracy of 1 fathom. Most have more than one system. What they don't have are "extraordinary" systems with multiple, high-power, directionally stabilized, narrow-beam transducers designed to map a strip of the bottom rather than a line at one pass. The Navy has a few of these.

U.S. academic research ships are currently suffering from a whole set of problems caused by rapidly escalating costs, limited funding, expanded claims of jurisdiction by coastal states, and a maze of red tape, but they are not in as bad shape as Hammond implies.

GEORGE G. SHOR, JR.
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DOD Sponsored Research

In the article "Department of Defense R & D in the university" (22 Nov. 1974, p. 706) by Stanton A. Glantz and Norm V. Albers, my response to a DDC (Defense Documentation Center) statement was presented as evidence of "Two different perceptions" of DOD (Department of Defense) sponsored research. It is a pity that the authors used this as an example, since my strong response was due to a misreading of the DDC statement. While the authors were very open in preparing the material included in volume 1 of their Stanford report (*1*), they used extreme secrecy in preparing volume 2 (*2*), upon which much of their *Science* article is based. As a result, I was not able to correct my error until after the report was published and issued to the public late in 1971. Early in 1972, the Stanford Workshop on Political and Social Issues (SWOPSI) policy board approved an addendum to the report giving this correction and the reasons for it. Part of this addendum is included as refer-

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ence 29 in the *Science* article; however, the authors did not make it clear, as did the addendum, that the original statement was based on my misreading of the DDC statement and that the statement in reference 29 should be substituted for the earlier statement used by the authors.

W. E. SPICER
Department of Electrical Engineering and Material Science, Stanford University, Stanford, California 94305

References

1. S. A. Glantz *et al.*, *DOD Sponsored Research at Stanford*, vol. 1, *Two Perceptions: The Investigator's and the Sponsor's* (SWOPSI, Stanford, Calif., 1971).
2. N. V. Albers, S. S. Ashley, M. F. Becker, C. A. Farlow, S. A. Glantz, R. A. Simpson, *DOD Sponsored Research at Stanford*, vol. 2, *Its Impact on the University* (SWOPSI, Stanford, Calif., 1972).

Based on an analysis of 111 DOD research contracts with a university, Glantz and Albers write: "Our study demonstrated that the military had developed a rational, well-administered program to define research priorities in terms of current and projected military needs and to purchase R & D from universities based on these needs." Their evidence for this conclusion consists of (i) the fact that DOD has a system for reviewing proposals; (ii) the fact that DOD has a list of needs; (iii) quotations from various DOD officials asserting that research is purchased in accordance with this list of needs; and (iv) the fact that there is a "DDC [Defense Documentation Center] statement" for each project which relates the project to the need.

Such evidence is weak. Most funding agencies, those both well and poorly administered, have a proposal review process, and most have a statement of needs. Assertions by interested parties that an agency is doing a good job are not usually regarded as reliable evidence. The existence of a summary statement for each project has little bearing on the question of whether the decision to support the project was a sound one.

One would suppose that a test of the hypothesis that DOD has a "rational, well administered program" would involve a comparison of the projects accepted with the projects that were not accepted; or a comparison of the state of the art in the United States with that in the Soviet Union; or interviews with knowledgeable, but uninvolved persons; or a comparison of DOD procedures with those in other agencies. No such tests were attempted.

What the article does show (despite an explicit statement to the contrary), is how DOD evades the Mansfield Amendment, which requires that DOD sponsored research be relevant to military needs. In the article, seven contracts are used as examples. Three of these relate to helicopters, and two relate to radar; their military relevance is obvious. The other two, however, have no demonstrated relationship to military needs at all.

It turns out that the "DDC statement" describing each project is not a part of the project proposal. It is not even written by the principal investigator. Rather, it is written by a DOD official, and it is written after the decision to recommend approval of the project has been made. Such statements are not convincing as support for the assertion that the DOD selects projects on the basis of their relevance to military needs.

ROBERT N. ANTHONY
Waterville Valley, New Hampshire 03223

Anthony fails to find our arguments convincing because he seems to believe that DOD, after reviewing academic proposals, invents a military need for the proposed work to fool Congress. This inverted perspective of DOD research and development comes from focusing on individual projects rather than looking for broad patterns of support. For example, taken together, Stanford's contracts at the time of our study reflected programs to develop laser weapons, guided bombs, helicopters, and the electronic battlefield. Often people in different academic departments with no formal ties to each other worked on different aspects of these programs. Later, when we obtained research objectives and other documents from DOD, we could systematically match the university projects with the military programs that led to their being funded. These documents, written before proposals are reviewed, are used to help decide which contracts to let; we found that these documents outlined scientific objectives which, if reached, could reasonably be expected to help in attaining the stated military objectives. To establish that Stanford's contracts were compatible with the military objectives they were let to meet, we studied each contract and found, on a technical basis, work consistent with the military objectives outlined in internal DOD documentation. The summary statements written by the contract monitors and available from the Defense Documentation Center (DDC) provided another check on the relationship between the contract work and the military's needs. While these statements reflected a different perspective on the work than that of the principal investigator, we found them technically reasonable summaries of the work. Our conclusion that the DOD's R & D program is rational and well administered follows from our independent assessment that its internal objectives documents are

logically consistent from a military point of view and the fact that all the work at Stanford fits neatly into this logical structure.

Anthony incorrectly asserts that two of the contracts we cite in our paper have "no demonstrated relationship to military needs at all." The relationships for all the example contracts are as follows.

1) "Micropower Integrated Circuits": Army portable equipment, including specific communications; surveillance; countermeasures receivers; navigational, meteorological, command and control, and clandestine intelligence gathering equipment.

2) "Investigation and Development of Cryogenic Microwave Detectors, Nuclear Gyroscopes, Accelerometers and Magnitometers": Air Force tactical detection of trucks, weapons, other magnetic objects.

3) "Research on Aircraft Structural Analysis and Design": Army helicopter structures.

4) "Study of the Dynamics and Control of Rotary Wing VTOL Aircraft": Army helicopter guidance and stabilization.

5) "Basic Studies in Aerodynamic Noise": Army helicopter rotor noise.

6) "High Energy Physics": Cryogenic technology to permit more efficient electromagnetic devices on board Navy ships (*1*).

7) "Microwave Device Techniques for Aerospace Users": Air Force radar and electronic warfare.

8) "Research on Devices Using Acoustic Surface Waves": Navy radar and electronic warfare.

9) "Fundamental Investigation of Amorphous Semiconductors and Transition Metal Oxides": Army night vision program.

Spicer's letter omits many important details. The two statements quoted in the body of our article did appear in the second volume of our report, published in November 1971, but they appeared there as verbatim quotes from the first volume of our report, published the previous June. Thus, although Spicer had 6 months to correct his misreading, he only chose to do so after publication of the second volume. We held our findings confidential because of the highly charged political atmosphere which prevailed while we were preparing our study. We were under substantial pressure from opponents of DOD work to release our more explosive results piecemeal and from elements of the faculty to stop the study. We hoped that releasing all our results to everyone at once would lead to a more rational debate than was then taking place. We are, however, sensitive to Spicer's views, so after review and publication of our report, we agreed to permit him to include an addendum stating his revised

position and included what we believed to be its most important part as a footnote in our article. This approach permits the reader to draw his own conclusions concerning the validity of our arguments based on the full record. We do not agree, however, that Spicer's shift from saying "absolutely no connection can be made" between his work and night vision to his statement that, "I think it is very doubtful that our work will contribute to night vision," affects the point we were making by quoting him.

These two letters provide good evidence of the success of DOD's policy of not encouraging university workers to think about the military implications of their work.

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Notes

1. This contract typifies those in which the DOD was interested in a different aspect of the work than were the principal investigators. The latter were building a high energy physics laboratory to engage in high energy physics research; the Navy sponsored the work to obtain the cryogenic technology. Once laboratory construction was complete, the Navy had no further interest, and support for the high energy physics research shifted to the National Science Foundation.

Cabbage Cigarettes?

Isn't it hypocritical to expound piously on the world food shortage and impending mass starvation while agricultural agencies the world over are aiding and promoting the growing of tobacco, "the most widely grown commercial non-food plant in the world" (*1*)? To be sure, tobacco does contribute to population erosion through emphysema and cancer, but this hardly seems a humane means of population control, and these diseases cause a great drain on medical resources and finances.

Since 44.8 percent of the world's vast tobacco acreage lies in "starving" Asia (*1*), would it not be humanitarian to offer economic inducements to farmers to switch from tobacco to food crops?

If people must smoke, let their cigarettes be made of a less toxic plant material—not a monopolizer of arable land, but a vegetable by-product of food crops, say, cabbage, lettuce, or papaya leaves.

JULIA F. MORTON
Morton Collectanea, University of Miami, Coral Gables, Florida 33124

Reference

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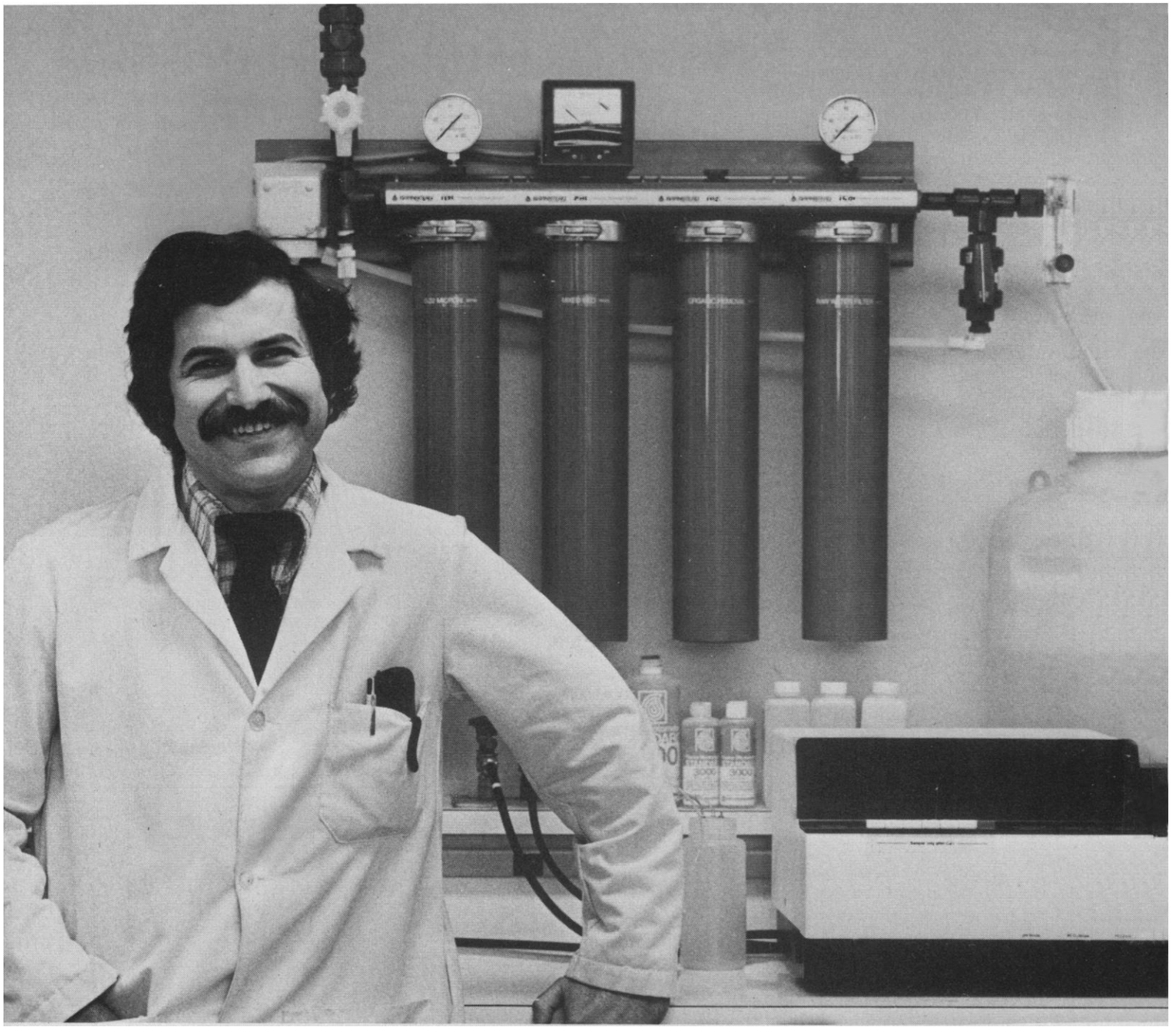

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16 May 1975, Volume 188, Number 4189

SCIENCE

The Shaming of Science

What shall we make of the congressional furor over biological and social science research? According to Miles' law, where you stand depends on where you sit. If one is a social scientist, one sees Congress at its worst, meddling in matters it doesn't comprehend while Rome burns. If one is less involved, one may put it down to a tiresome political overreaction to far-out research projects. The serious question is whether we are seeing the beginning of something much deeper: a loss of nerve where science and technology are concerned.

It is unlikely that anybody knows the answer. But the scientific community ought not to merely sit back and take a bad rap. If open season is being declared on long-accepted processes for determining scientific merit and social value in the funding of research, a very great deal is at stake. Summary judgments may spread to science as a whole because of dissatisfaction with a few fields.

For three decades, politics and science in this country have struggled to come to terms. Neither can do without the other, and neither can afford to undermine confidence in the other.

Both government and science can absorb criticism. Government has reaped a bumper harvest of it. Science and technology have been called to account for going too far or falling too short. So be it. Criticism reinforces accountability in a society based on rights and responsibilities.

Science and politics have enough trouble finding common ground without removing the quality of respect from the relationship. While only a small part of the research enterprise has been called into question, the continued parading of research projects in the streets to a drumfire of ridicule and intimidation can very quickly bring an end to respect and replace it with a quarrel. That is a high price for a nation which came to believe in science as a discovery process and an edge of light in a troubled world.

Congressional oversight of science is not at issue. But ambushing one research project after another is not what we expect of oversight. One cannot believe that Congress is about to fit social science research for a straitjacket; it will not come to that. But a smog of uncertainty hangs over the administration of research. The danger is that first-rate biological and social science research will carry unacceptable risks for good investigators, and that funds will be spent only where they can be spent safely, well out of the range of political guns. There is no satisfaction in that sort of cease-fire.

The shaming of science has gone far enough. There is plenty of work for legislative oversight. Neither the Executive Branch nor Congress has established an enduring policy relative to long-term investment in basic science. The equities in the peer review system are fair game for legislative scrutiny. Examination of the question of trading off incentives for private sector innovation against direct funding of R & D is overdue. The decline in research and development investment in the United States, relative to that of competing nations merits more than hand-wringing.

We should keep some sense of perspective. Over the years, Congress has done much to advance the sciences and to be an action-forcing influence on a reluctant Executive Branch. At its best, legislative oversight earns high marks.

It comes down to a matter of asking the right questions instead of the wrong ones about science and public policy. If the rules of political oversight are reasonable, science and government can reinforce each other. But if oversight is employed only to discredit scientific motive and responsibility, it will be a cold winter.—WILLIAM D. CAREY

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(Continued from page 725)

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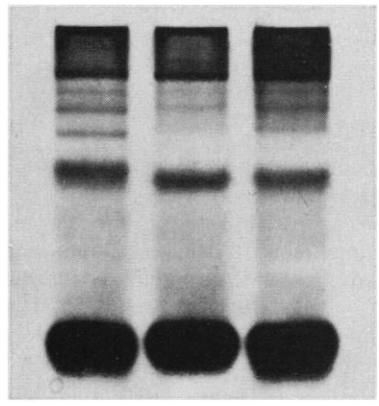

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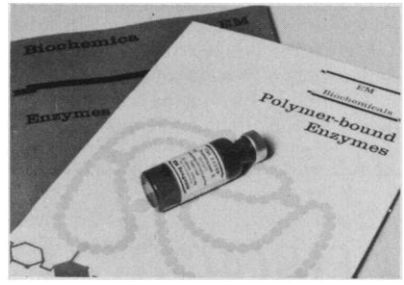

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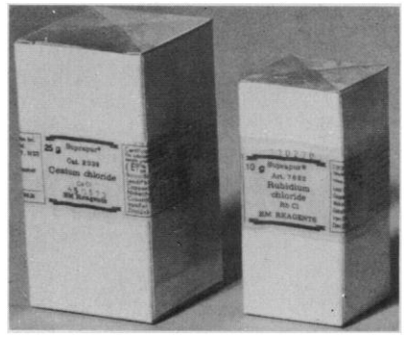

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