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<table>
<thead>
<tr>
<th>Estimated &quot;S&quot; values at indicated densities</th>
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<tbody>
<tr>
<td>A</td>
</tr>
<tr>
<td>P 1.3</td>
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<tr>
<td>P 1.4</td>
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</tbody>
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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

\[ W = 29.70H^{0.016} \]

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 1500 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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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 (baring 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 make 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.
University-National Oceanographic Laboratory System,
La Jolla, California 92037

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

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 “DOD 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...
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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 Magnetometers": 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

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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 con-
cerning 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 vi-
sion,” affects the point we were making by
quoting him.

These two letters provide good evidence
of the success of DOD’s policy of not en-
couraging university workers to think
about the military implications of their
work.

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NORM V. ALBERS
1601 Slagle Creek Road,
Grants Pass, Oregon 97526

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 en-
gage in high energy physics research; the Navy
sponsored the work to obtain the cryogenic tech-
ology. Once laboratory construction was com-
plete, the Navy had no further interest, and sup-
port for the high energy physics research shifted to
the National Science Foundation.

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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 con-
tribute to population erosion through em-
physema and cancer, but this hardly seems
a humane means of population control,
and these diseases cause a great drain on
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1. B. C. Akehurst, Tobacco (Humanities, New York,
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