DBS in the usual way on the basis of the manufacturers' tests. Other lots had in fact passed. (Tauraso in recalculating Morris's sums had neglected a certain correction factor.)

TAURASO: I must admit I could not conceive of Dr. Morris rejecting a lot on his tests and having this overruled by somebody above him.

TURNER: Did you know that Dr. Morris had been running a continuous fight with the hierarchy of the DBS on that very point?

TAURASO: I was not aware of this.

TURNER: Did you think before making a charge of this magnitude that it might be wise to check all of the facts on your charge before . . .

TAURASO: I think it would have been wise, yes.

TURNER: Why didn't you do it?

TAURASO: I didn't have the wisdom I have now.

It remained for the three members of the grievance committee to present their verdict. The committee found unanimously that Morris had, as he charged, been harassed by his superiors over an extended period of time from 1963 to the present. The accusations leveled against Morris in the 8 May memorandum were false, but "his reputation as a scientist would probably not suffer by these internal allegations." One committee member, Mider, added an addendum to the effect that in his belief the committee's report, with which he agreed generally, should "recognize the contributions of the grievant to the prolonged controversy."

The committee's recommendations were that Morris, as a "highly productive, imaginative scientist, highly regarded by his peers," should be allotted the facilities, staff, and supplies necessary to so function. In addition, the committee recommended thus:

"The entire management of DBS should be censured for allowing the harrassment of Dr. Morris by Dr. Shelekov and Dr. Tauraso to proceed for an extended period of time without taking remedial action."

—NICHOLAS WADE

Defense Research: The Names Are Changed to Protect the Innocent

"The influence of the military has skewed the direction of research at Stanford and it is the faculty's responsibility to restore the integrity of the process of discovering truth." So concludes a study by Stanford students of the role of the Department of Defense (DOD) in the university.

Prepared under the auspices of the Stanford Workshop on Political and Social Issues (SWOPSI), the report stirred up some predictable storms when it was released last December.* Although no official action has been taken, the report has provoked a hail of memos among faculty, SWOPSI policy-makers, and the student researchers.

What the SWOPSI students had uncovered was a Janus-faced stratagem devised by DOD to protect its university research program. DOD-sponsored research has been a target of criticism at Stanford and other well-known schools for the last several years. But since the 1969 congressional attempt to reduce the dependence of university scientists on DOD, known as the Mansfield amendment, critics have assumed that the issue was dead. SWOPSI, however, found it quite alive.

Under the present system, DOD continues to fund a great deal of basic research, even projects for which military applications are at best remote; DOD can also justify all contracts through an elaborate system of accounting, which ties even the most fundamental work to a specific, military objective; and, finally DOD, as a matter of policy, discourages scientists from stating military uses for their research.

The SWOPSI report listed the 100-odd DOD research contracts at Stanford, which, it said, stood at $14 million in February 1971, or 25 percent of all contracts and grants. The students listed the scientific descriptions of the work, names of the investigators, and the financial histories for almost all the contracts. But most important, they gained access to the statements of military relevance, which DOD draws up in-house, for each research contract at Stanford. These are about a paragraph long, are stored in the Defense Documentation Center (DDC), and are rarely seen even by the scientists whose work is described. Keyed to a series of coded numbers, the statements link the research to specific technical and strategic military needs. The SWOPSI team showed the DDC statements to the Stanford principal investigators, invited their comments, and printed the whole package.

The result is interesting reading. The DDC statements justify the research in one way, and the principal investigators often tell a totally different tale. The military departments stake out whole fields of scientific endeavor as necessary to avert war or minimize its consequences. On the other hand, the professors point out to the SWOPSI students that their work will control pollution, improve traffic on local freeways, and increase love for others. Other frequent justifications are the intellectual challenge of the work and the training of graduate students. One professor even says, "I do not flatter myself that any of my work has ever specifically been applied to anything. . . ."

A contract with R. Pantell in electrical engineering with Office of Naval Research "High-power broadly tunable laser action in the ultraviolet spectrum." (The DDC title is different: "Weaponry—lasers for increased damage effectiveness.") It is described in the DDC statement thus:

> Damage mechanisms allowed by laser weapons is under intense investigation. However, it is known that within a range of frequencies the amount of damage for a given power increases with frequency. The highest frequency, shortest wavelength, is thus desirable. . . .

However, Pantell stated that the ultraviolet lasers are

> sorely needed in the areas of medicine, long distance communication, and high energy physics research. . . . Ultraviolet

* The report is titled "DOD Sponsored Research at Stanford" and comes in two volumes. Available from SWOPSI, Room 590A, Old Union, Stanford, Calif. 94305 ($8). SWOPSI is an umbrella program which permits students to study a wide variety of topics.

lasers offer the surgeon the capability to destroy, with great efficiency and pinpoint accuracy, selected areas of diseased tissue in a patient's body. . . . Another anticipated use of these lasers is in long distance (e.g., interplanetary) communication. . . .

Many of the professors express complete agreement with the DDC statements of their project's applications, and some decline comment. Some praise their sponsors, and one, A. London, in mechanical engineering, comments simply, "What is good for technology is good for the Navy."

However, William E. Spicer, in electrical engineering, reacted violently to the DDC description of his work on amorphous semiconductors, which related them to "improved photocathodes" in "night viewing devices," with the following comment:

> The DDC statement . . . is a misstatement of the facts. As can clearly be seen from the proposal . . . absolutely no connection can be made between the studies being done here and "The ability of their materials to effect the emission of electrons through radiation which is a crucial function of the materials used as photocathodes in night viewing devices." Whoever wrote this statement was as ignorant of the work involved as he is of the use of the English language.

(Since the report's appearance, Spicer has reconsidered this position. He now maintains, in an addendum to the report, that the DDC statement was "garbled by the computer" and that it is only "very doubtful that our work will contribute to night vision.")

Another approach was taken by some professors who declined to make any connection between their work and the DDC statements of military relevance. George Herrmann has an Air Force grant titled "Dynamic behavior and stability of solids and structures." The DDC statement links the work, among other things, to "weapon delivery and reconnaissance. . . . Also knowledge of landing fields and silo interaction with missiles are of vital importance. . . ." However, Herrmann also remarks, among other comments, that

> As far as I know the justifications of the funding agency shift from year to year and are related to various missions. . . . My work is so fundamental and general that it is quite far removed from any type of immediate application, whether military or nonmilitary. . . .

Another professor, R. N. Bracewell, who performs radio astronomy work funded by the Air Force, says, among his general comments on the merits of advancing astronomy, the following:

> In my opinion, the Air Force does not know what applications my work may have. This opinion is based on conversations with contract monitors, on contracts written before the Mansfield Amendment, and on the performance of civilian panels advisory to military agencies supporting research in astronomy. . . .
>
> The funding agencies justify particular research projects in different ways according to the background of the inquirer, who may be a layman, a taxpayer, a scientific advisor, an Air Force general, a budget officer, and so on. . . .

The students also found discrepancies in the titles. One contract, carried out by P. G. Zimbardo in psychology, is "Individual and group variables influencing emotional arousal, violence, and behavior." But the DDC title suggested its military relevance: "Personnel technology factors influencing disruptive behavior among military trainees."

The report explains that the discrepencies are due to the Mansfield amendment, passed in 1969. Today, the amendment is worded differently and no longer in force as such. However, for a year, it did bar DOD from funding research that did not have a "direct and apparent relationship to a specific military function or operation." It forced DOD, early in 1970, to make a review of its sponsored research and terminate about $8 million in projects judged to be irrelevant. (This cut was small compared to the $64 million slash that Congress made in the DOD research budget that year.)

But the SWOPSI report found that "the Mansfield amendment . . . did not significantly affect the nature of the work being done at Stanford under DOD sponsorship." The report listed some projects that even the principal investigators said were more useful in the civilian than in the military sphere. For example, S. J. Kline, describing to SWOPSI uses for the Air Force of his work "Basic structure and stability of turbulent shear flows," "estimates the ratio of nonmilitary to military applications to be ten to one or greater."

The report also listed one study of Chinese politics and regionalization in a future, post-Mao period whose primary relevance to DOD's mission might be questioned. An Air Force

David Cultivates the Grass Roots

President Nixon's science adviser, Edward E. David, Jr., has been barnstorming the country off and on in recent weeks, conducting a round of briefings for scientists and engineers on federal science policy. The unpublicized colloquies, which have ranged from Washington to Boston to the West Coast, have given David a chance to deliver pep talks on the Administration's R & D budget to a wider cross section of the scientific community than ever before. And a free exchange of views during the briefings is said to have helped him "crystallize his understanding of the community's concerns."

John Lannan, a special assistant to David, said the main objective of the briefings is to sound out the views of scientists and engineers in preparation for the President's upcoming message to Congress on R & D. Lannan said the meetings, about a dozen of which have taken place so far, have been "extraordinarily helpful" in illuminating gaps in Administration policies.

Guest lists for the briefings have included leading lights from the major scientific societies, industrial laboratories, and colleges and universities. One group also included about 30 of the 51 state and territorial science advisers. The free-wheeling discussions have ranged from the problems of jobless scientists and retrenchment in industrial research to the difficulties of expanding the role of universities in civilian technology.

"There's nothing very complicated about these meetings," one White House aide said. "David is reaching out to his 'constituency.' They're getting essentially the same briefing, with the same charts, that the press got before the '73 budget was released."

Despite an obvious theatrical format, White House sources say that the meetings have enabled the Office of Science and Technology, which David heads, to reach beyond the established science advisory groups and to "make contact with a younger set of guys who haven't had much exposure to the Washington scene. They seem impressed that David is coming to them."—R.G.

study, which will not be funded after this year, was a computer analysis of language use in British Parliamentary speeches and in German Reichstag speeches in the period before World War I, to test "a lateral pressure model for the path to war." The study has been ongoing since the early 1960's. However, the principal investigator, R. North, commented to SWOPSI of his work, "Most government people either could not or would not understand it."

Finally, the students uncovered an administrative decision, made in the wake of the Mansfield amendment, by which the scientists were relieved of giving their projects military-sounding titles, or writing about potential military applications. The report quotes Secretary of Defense Melvin R. Laird in congressional testimony as having said in March of 1970:

> I am going to recommend that we don't make the university scientists certify that any DOD-supported university research has a defense related outcome. . . . In their project report, in their request for a grant, I considered seriously requiring them to do that . . . [but] I hope we can avoid making it necessary for project applicants . . . to include a statement.

Why is DOD reluctant to require scientists to come forward and state military uses of their work? Laird explained that it might cause DOD to lose top scientific talent and research. In an interview, Edward Reilley, assistant director of Defense Research and Engineering, said it would "advertise" DOD's weaknesses. "we don't believe it's possible for any faculty member to be versed in DOD's needs." As for faculty who seek support from DOD telling their campus constituency that their work has no military uses, Reilley saw no need to "punish" those "few" by requiring a statement. Whether a "few" of the faculty at Stanford need their knuckles rapped, however, is a relatively minor matter. The main point is that DOD now exempts all scientists from grappling with the key moral issue of the uses to which their research results will be put.—DEBORAH SHAPLEY

RESEARCH NEWS

Lunar Research: No Agreement on Evolutionary Models

New and in some instances surprising results from experiments on Apollo 14 and 15 and on the U.S.S.R.'s Luna 16 were presented at the third lunar science conference a few weeks ago, and interpretations of the data provided additional perspective on the earlier findings from Apollo 11 and 12. In comparison with earlier conferences, a far more comprehensive picture of the moon but far fewer claims to understand how the moon evolved were evident. Independent evidence from several types of experiments indicates that the moon is now a relatively cold and inactive planetoid, but that it has had a complex thermal history. There is an apparent conflict between geochemical evidence that suggests an initially cold moon in which partial melting of its outer layers took place and magnetic evidence that seems to indicate an initially hot moon with a molten core during the early part of its history. Other observations were also puzzling to investigators, such as the indication that radioactive materials, at least on the moon's surface, are concentrated in one area, and evidence of an unexpectedly high heat flux from the moon's interior at the Apollo 15 site. Not so puzzling, but still unexpected, is seismic evidence that the moon has a layered crust some 65 kilometers in thickness.

The moon is thought to have originated about 4.6 billion years ago, at the time of formation of the earth, of meteorites, and presumably of the solar system itself. Although speculations that the moon fissioned from the earth or formed elsewhere and then was captured by the earth have not been ruled out, most lunar scientists believe that the moon was formed by the accretion of planetesimals orbiting the earth and of other space debris. Most of the moon's thermal and geophysical activity appears to have been confined to the first 1.5 billion years of its history. Within this period, two major phases of thermal evolution have been identified: (i) widespread melting that apparently occurred about the time of the moon's formation; and (ii) partial melting beginning perhaps as early as 4.1 billion years ago to form basalts enriched in potassium, rare earth elements, and phosphorus (KREEP basalts), and somewhat later, flooding of preexisting basins with lava to form the lunar maria between 3.1 and 3.7 billion years ago. Since the formation of the maria, however, the internal heat engine of the moon appears to have shut off, stopping further internal evolution and leaving the moon a slowly cooling and largely inactive body.

Geochemists and petrologists have now studied samples of lunar soil and rocks from five different locations on the moon (see Fig. 1). In addition to the detailed information available from the Apollo and Luna 16 samples, more systematic studies of the composition of the lunar surface were carried out from lunar orbit on Apollo 15. A team headed by I. Adler, of Goddard Space Flight Center in Maryland, used an x-ray spectrometer to determine concentrations of aluminum, silicon, and magnesium. Spectrometer measurements of the fluorescent x-rays produced by the interaction of solar x-rays with the moon's surface showed distinct patterns in the composition of the surface materials. The maria were found to have relatively low ratios of Al to Si, as do the samples of mare basalt returned from the surface; but the highlands of the moon showed high Al/Si ratios characteristic of plagioclase-rich materials. The concentration patterns correlated well, for the most part, with measurements of the amount of light reflected from the surface—the brighter, high albedo regions corresponding to the aluminum-rich highlands and the darker regions with the maria.

The region around the Imbrium basin (see Fig. 1), however, appears to have some unusual features. Observations of the gamma rays given off by radioactive materials showed much higher concentrations of uranium, thorium, and potassium in Mare Imbrium and in the neighboring lava flows of Oceanus Procellarum than elsewhere on the moon. The observations were made