University of Michigan: Letting Go the Contract Lab

When the federal government began to sponsor university research in a major way after World War II, the fact that this research was mainly for the military raised some awkward questions in academe, particularly on the issue of classified research on campus. On the matter of classified research, solutions varied from total prohibition to generous indulgence, but a common solution was the creation of the "contract laboratory," which was of, but not in, the university.

Patterns varied considerably, but contract laboratories developed in many of the nation's most distinguished public and private universities. Lincoln Laboratories and the Instrumentation Laboratory at M.I.T., Cornell Aeronautical Laboratory, Johns Hopkins Applied Physics Laboratory, and the University of Michigan's Willow Run Laboratories (WRL) were prominent examples of contract laboratories.

Over the past few years, in the atmosphere created by the Vietnam war, a countertrend has developed, with universities reexamining policies on classified research and acting to divest themselves of their contract laboratories. This has occurred at M.I.T., Cornell, Stanford, and, most recently, at Michigan, where WRL is in the midst of a metamorphosis into the private, nonprofit Environmental Research Institute of Michigan (*Science*, 18 August).

In several ways WRL is a paradigm of the contract laboratory. It was the main bone of contention in a long debate on classified research in the university. The laboratory's expertise in remote sensing technology applicable to the so-called "electronic battlefield" made it a target of critics who charge that the United States has made unrestrained use of technology in Southeast Asia. At Michigan, as on other campuses, there was opposition to the divestiture of the contract laboratory on the grounds that the university should retain control so that it could continue to impose constraints on the kind of research done.

Divestiture of WRL is a key feature of the compromise, arrived at over several years, on the question of classified research. Under the policies approved this spring by the university regents, classified research is not banned from the campus, but the review process has been tightened somewhat. Final discussions on the new rules were the occasion for a collision between the Michigan faculty and the regents when the regents early this year rejected recommendations on research policy which the faculty had negotiated over several months. In practical terms, the cutting loose of WRL will remove more than 80 percent of classified research from campus and presumably has taken the steam out of the issue.

At Michigan controversy over military research began in earnest in the mid-1960's and led in 1968 to action codifying rules for classified research. The cardinal point in the new guidelines was that the university "will not enter into any contract supporting research the specific purpose of which is to destroy human life or to incapacitate human beings." Rules also required that sponsored research contribute to the advancement of knowledge and to the teaching function of the university.

Review Committee Created

To implement the new policy, the creation of a research review committee was called for. The committee, composed of nine faculty members and three students, was to review research applications that required national security classification. The group served in an advisory capacity to the vice president for research, who retained final authority in matters of contracts, but there were provisions for reporting disagreements to the faculty senate.

There was criticism that the research review committee was not acting energetically enough in enforcing the new rules, but at the same time existence of the committee raised campus consciousness on the issue of classified research. In 1970, a student member of the committee released information on research applications in more detail than had ever been available before, and a series of articles on WRL in *The Michigan Daily* seems to have helped fix critics' attention on WRL. In 1971, there was increased pressure, including a fast by faculty members, and by the end of the year the regents had determined on the divestiture of WRL and a rough timetable for the separation.

During the year, the faculty thrashed out recommendations for a revision of policy that would, in effect, have prohibited the university from undertaking federal classified research. These faculty proposals were rejected by the university's elected, eight-member board of regents in February.

The action was resented by some faculty members as much for its implications for the role of the faculty in the governance of the university as for the rebuff to the proposal on classified research. There was also some feeling that university President Robben W. Fleming's administration had undercut the faculty position. At the time, some faculty members observed that all of this could influence faculty opinion when the question of organizing for collective bargaining arises in the future.

In March the regents approved revised policies that were essentially a modified version of the 1968 rules. Classified research was to be permitted under some conditions, and the regents' official comment was, "The disadvantages of complete elimination of classified research at the University are deemed to outweigh the disadvantages of participation in areas where some limited restrictions exist on freedom to disseminate some of the results of research."

The old rules are to be applied to WRL during the current phase-out period, but new applications for projects that would require acceptance of classified research will be handled differently than they were in the past. The new guidelines are as follows:

> The following review procedures will be instituted for all other proposed agreements, contracts or grants involved in federal security classifications:
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> a. The proposal will be reviewed initially by the Dean or Director of the unit in which the proposal originates for compliance with the provisions of these policies. The proposal will then be forwarded to the Vice President for Research accompanied by a statement indicating the Dean's or Director's judgment as to compliance.
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> b. The proposal will then be reviewed by the Vice President for Research and three other persons chosen as follows: two members of the faculty elected by

the Senate Assembly and one student elected by the Student Government Council. If all of the persons specified above concur that the proposal is in full compliance with the provisions of these policies, it will be regarded as cleared for administrative processing and funding.

c. If any of the persons specified above (i.e., Dean or Director, Vice President, faculty member, or student) believes that there is a substantial question as to the proposal's compliance with any of these policies, the proposal shall be referred to the Committee on Research Policies for review. Their evaluation as to compliance shall be transmitted in writing to the Vice President for Research prior to acceptance or rejection of the proposal for signature and forwarding of the sponsor.

While the Vietnam war obviously forced the issue, changes in federal-university relations have not been brought about simply by activist attitudes. A. Geoffrey Norman, vice president for research at Michigan since 1964 and a member of the Michigan faculty since 1952, has been in a prime position to observe the process.

After World War II, scientists and engineers were drawn into military research at most major universities. At Michigan, it started in the engineering college, says Norman, and widening sponsorship "soon made it clear that the engineering college was not the place to administer it."

The Michigan Aeronautical Research Center was established at Willow Run (the name change came in the 1950's) and did the sort of thing that resulted in its being chosen to share the work and the acronym with Boeing in producing the BOMARC study for an integrated air defense system against bombers. For a considerable time, says Norman, "the work came in the form of big contracts allowing considerable latitude for us to do what we were interested in. It was a very desirable kind of federal-university relationship permitting university researchers to examine new areas of technology." To a degree, says Norman, university researchers "became science advisers to the agencies. Until the mid-1960's, this pattern prevailed."

Since then, "a different attitude has developed in the agencies" of the Department of Defense (DOD), says Norman. And this change is reflected in the requirement of much more specific work statements. Behind it is the Mansfield Amendment, which for a time required that research commissioned by DOD agencies have a direct relation to the agency's mission. "The Mansfield amendment, I would say, had a very subtle and damaging effect.

A Message from Corn Blight:

"And he gave it for his opinion, that whoever could make two ears of corn or two blades of grass to grow upon a spot of ground where only one grew before, would deserve better of mankind, and do more essential service to his country than the whole race of politicians put together." Swift's prescription in *Gulliver's Travels* for earning a nation's gratitude has been amply fulfilled by the plant geneticists and others through whose efforts the crop production per acre in the United States has doubled over the last 40 years. But this triumph contains the seed of a potential disaster. Crops have tended to become genetically more uniform, rendering them vulnerable on an epidemic scale to new pathogens. A foretaste of what could happen was the epidemic of corn leaf blight in 1970, which devastated 15 percent of the crop. The blight, a new mutant strain, attacked only a single type of corn, but that type was grown by almost every farmer in the country.

The blight was brought under control the following year by favorable weather and the return to a resistant type of corn. It prompted concern about the extent to which other essential crops had become genetically uniform and vulnerable to epidemics. The question has been addressed in a report published this month by the National Research Council (NRC) of the National Academy of Sciences and prepared by its Committee on the Genetic Vulnerability of Major Crops.* The committee's answer is that "most major crops are impressively uniform and impressively vulnerable."

This somber warning is based on a review of the genetic history of the major crops and an analysis of the economic and legislative pressures that encourage uniformity. Many of the technological advances in crop production depend on small numbers of genes. Prominent examples are the dwarf varieties of wheat and rice that comprise much of the base for what has been called the Green Revolution. The danger is that, if one of these genes is incorporated into many varieties and a parasite with a preference for the characters controlled by that gene were then to come along, the stage would be set for an epidemic. Uniformity resting on a single character was responsible for the epidemic of corn leaf blight. The same kind of uniformity has been introduced into commercial varieties of sorghum, millet, sugar beet, and onion. The trend toward uniformity is also evident in the handful of major varieties that account for the bulk of many crops. For example, two types of pea and nine varieties of peanut comprise 95 percent or more of their respective crops in the United States.

How did things get that way? Uniform crops are easier to sow, easier to harvest, and easier to market. The farmer's demand for high-yield varieties drives out the lower yield varieties, which also makes for uniformity. Since crop uniformity is what society demands, that is what the scientist provides, "knowing full well that one day his uniform variety may suffer in the face of an epidemic," the NRC report states. The irony is that, when an epidemic does occur, the scientist, not the forces of the market, tends to receive the blame.

In the case of the 1970 corn blight, the uniformity lay in the single source of cytoplasm, known as Texas male-sterile cytoplasm, which had been used by breeders in developing the majority of the corn hybrids planted that year. The Texas cytoplasm hybrids had been extensively tested for resistance to the corn blight fungus and found to perform as well as plants with normal cytoplasm. True, the fungus was known to attack the Texas cytoplasm plants in the Philippines, but this was ascribed to the Philippine weather, not the nature of the parasite. In any case, past breeding experience indicated that the cytoplasm was not a factor that was likely to be important in disease resistance. In the light of hindsight, it may have been a mistake to convert so much of the

* *Genetic Vulnerability of Major Crops.* Obtainable from the Printing and Publishing Office, National Academy of Sciences, 2101 Consitution Ave., NW, Washington, D.C. 20418; $7.50.

It started people thinking too much about military applications." Citing pioneering work done on holography at Willow Run, he observed that researchers "did not start looking for technological applications, spinoffs. The Mansfield Amendment inverted this. The kind of work we've been doing for the past 5 years has been less and less suitable for graduate student participation, courses in engineering. All of this has been a change and made us ready for a different kind of operation here."

(Defense research funding has declined steadily at Michigan since the 1968–69 academic year when defense agencies provided about $14 million or 22 percent of the $62.1 million research budget for the university. For 1971–72 tentative figures show that the amount from DOD sponsors was down to $7.3 million or around 11 percent of the total budget. In a total research budget of $62.2 million in 1970–71 federal funds amounted to about $45 million with the $17.2 million provided by the Department of Health, Education, and Welfare representing the largest amount from a single sponsor.)

Norman acknowledges that, as U.S. involvement in the Vietnam war increased, defense agencies laid greater stress on "weapons end-item development" but insists that the university's role was limited to "demonstrating the feasibility of applications." Defense agencies turned to military contractors for subsequent steps.

Norman, who himself has been a target of criticism in the debate over classified research, feels that the effort to rewrite the research guidelines "did not make them much more precise." He believes that "the committee got to the point of prejudging what was in the mind of the sponsors." Part of the trouble, he says, is that the sponsors were using military language rather than scientific language. "There's a jargon," says Norman, just as there is in the health field, indicating that applications for biomedical research grants often stress rather optimistically the implications for health care in the research in question.

As for Willow Run, says Norman, from the university's standpoint "we realized that for the health of the enterprise, separation was necessary." He suggests that separation was also in the national interest, since "these activities would probably not thrive if they remained here."

"The separation from the university

The Dangers of Uniformity

commerical corn to a single source of cytoplasm, the NRC committee states. But there are no villians to uncover, only a "system where unseen forces carry well-meaning scientists toward a problem they had not intended or foreseen."

Could a similar epidemic threaten rice, a crop that feeds half the world's population? The high-yield dwarf strains developed at the International Rice Research Institute have now been introduced into almost all the countries of tropical Asia. Is there a danger that all of the dwarf varieties may succumb to some disease or insect simply because all have the same dwarfing gene? The consensus of opinion is that they will not. But the introduction of the dwarf rice is reducing genetic diversity by replacing traditional varieties. The high-yielding dwarfs also seem to be more prone to certain disease organisms and insects, whose multiplication is favored by the increasing use of fertilizer and the luxuriant growth that results. "Other things being equal, the danger of serious crop losses from the attacks of major diseases is greater today than in the past," the NRC committee considers.

Wheat is another major crop whose natural variability is being eroded by the widespread introduction of new strains. Rapid acceptance by farmers and the popularity of a few varieties has led to near monoculture in some regions of the world. The high-yield, semidwarf wheats from Mexico have caused notable increases in wheat production in many countries. But there is a potential danger in having a single genetic type gain such widespread popularity. Very little is known about the genetic interaction between wheat and its numerous parasites. As a result, the NRC committee warns, "We have the frightening probability that wheat is genetically vulnerable to damage by disease."

Epidemics of the past have sometimes been tragic in their consequences. Ceylon, the leading coffee nation of the world in 1870, was unable to export a single bag by 1885 after an attack of coffee rust disease—and the British became a nation of tea drinkers. Three successive epidemics ravaged the French wine industry in the latter part of the last century. Banana wilt struck throughout the Caribbean at the turn of the century, wiping out one variety of bananas and ruining many plantations. The Bengal rice crop was devastated by a fungus in 1942 and tens of thousands died of hunger.

If uniformity is the crux of genetic vulnerability, then diversity is the best insurance aganst it. The procedures used by most plant breeders tend to narrow rather than expand the genetic base of cultivated plants, in part because proven, elite germ plasms are easier to work with than untested ones. Plant breeders, says the NRC committee, should provide diversity, including back-up systems when things go wrong. In the epidemic of corn leaf blight, the breeders had a highly effective back-up system in the form of replacing the Texas cytoplasm with normal cytoplasm. To maintain a base for genetic diversity, gene pools need to be developed for major crops, particularly those in whose area of origin the primitive varieties and wild types are being threatened by the import of "improved" varieties. For wheat in particular, the erosion of centers of natural diversity is proceeding at an alarming rate.

The NRC committee recommends that a "watchdog system" be set up to study crop pests abroad that could be a major threat if introduced into the United States. A national monitoring committee should be established to assess the development and production of major crops and to watch for potential hazards. The committee, to be composed of scientists from all interested constituencies, should be advisory in nature but free to issue warnings whenever it feels them justified. The NRC committee itself warns clearly that the methods and technology of production in the United States and elsewhere are increasing the probability of major crop epidemics.—NICHOLAS WADE

is a real one," says Norman, "clean and complete. No university officers on the board of trustees, no joint appointments." The term WRL was used to denote a kind of work, not just a geographical location, and personnel at the university who are engaged in such work will go to the institute.

At both the university and the institute there seem to be expectations that some faculty members will work at both places. This would be possible for a faculty member with a part-time appointment at the university, says Norman, but he would have to make his own arrangements. The new ground rules are not yet worked out, and graduate students fall into one of the hazier areas. Institute Director William M. Brown says he hopes that graduate students will work at Willow Run as they have in the past, but Norman says there are obvious problems. It will not be very likely that a graduate student's major professor will be on the scene at the institute, and the university will presumably regard the institute as it would any other nonprofit organization.

Effects of the separation on the university are hard to predict. WRL has been a recruitment route for faculty, particularly in engineering, says Norman, and there will be the indirect costs of the loss of faculty and the expense of replacements. Any adverse impact would be expected to be strongest in electrical engineering.

Perceptions of the process by which the research policy was revised differ sharply on campus. A fair number of critics among students and faculty members have felt that the research review committee was too docile. The actual workings of the system were also criticized. For example, some assumed that it would take seven members of the 12-member committee to approve a project, while it is said that, under Norman's interpretation, it took seven to disapprove. Close votes were disputed, and some faculty members have decided that the committee is a seriously divisive factor.

The outsider gains the impression at Michigan that no strong majority of students and faculty ever united on a stand on classified research. This is not to say that WRL was not a real issue. The laboratories seem to have been resented both in principle and as "an empire within an empire"; and opposition to classified research on campus appears to have been quite widespread. But in the debate, disparate views tended to counterbalance each other.

Donald L. Rucknagel, professor of human genetics in the medical school and a leading critic of classified research, says that different groups saw the issue in different lights. Radical students used it to radicalize and organize. People who opposed the war rallied around the issue of classified research. Perhaps as a result, the university community was never galvanized as it had been in the black action movement on campus (*Science*, 10 April 1970), which extracted a commitment from the regents to raise substantially the proportion of minority students at Michigan.

One close observer of the debate, David Chudwin, who as an undergraduate wrote the informative series of *Michigan Daily* articles on WRL and who enters medical school at Michigan this fall, thinks there were several clearly differentiated factions in the debate. The critics were divided into two main groups. Those who stressed that academic freedom and classified research were in conflict he calls the faculty liberals. Then there were those who sought "to get the university out of being in complicity with the war." These he labels the more radical faculty. On the other hand, he says, there was "a group who felt you can't disarm unilaterally" and another group who "simply felt you can't do this [close WRL] to your colleagues."

Nuances in the Debate

All of these nuances figured in the debate and influenced it. A case was made for WRL staff who might lose their jobs and for graduate students who might be denied opportunity to work on subjects they wished to pursue. A proposal was even made at one point that the university be responsible for those who lost their jobs. Others felt that outlawing classified research could abridge academic freedom by denying some faculty members the opportunity to carry out research that interested them. One suggestion was that the new research criteria should stress more strongly the potential contribution to knowledge of proposed research. Another group felt that there should be a kind of contingency clause citing "benefits to mankind," permitting classified research in the event another Hitler appeared.

Chudwin—who favored the university's retaining control of WRL and converting it to nonmilitary research if possible and closing it if this were not possble—says he thinks student opinion at Michigan generally was on the side of shutting down WRL rather than separating it. He thinks the regents decided on separation mainly because of a sense of responsibility to people working there.

There could be something of a backlash over the details of the transfer of equipment to the new institute. In the first place, the question has been raised as to whether the regents acted properly in giving WRL to a private nonprofit corporation since the property and reputation of the lab were obviously of substantial financial value. Second, the question has been asked whether the transfer of $15 million in equipment paid for with federal research money is a legitimate use of public funds. It is understood that an Ann Arbor peace group, the Interfaith Council for Peace, is completing legal action to recover for the university the $558,000 "gift" to the institute. At this point, however, no suit has been filed.

What about classified research at Michigan in the future? The revised research policies do not rule out secret research, but they do tighten restrictions. University Vice President Norman thinks divestiture of WRL "might have the result of ending classified research." But the classified research remaining on campus will amount to perhaps three quarters of a million dollars. The university's radiation laboratory on the north campus does antenna research work, which apparently does not inflame the critics. And the department of aerospace engineering also has some classified military contracts. But about a half million dollars in classified research is done in the Cooley electronics laboratory on campus. Electronic counter-measures and antisubmarine projects are said to figure prominently. The laboratory was closed down in demonstrations last spring, and it is possible that there will be future pressure against this research.

Is there some larger significance in the separation of WRL? In itself, the separation seems unlikely to have national impact, since DOD will no doubt obtain adequate help in sensor technology from the WRL's new incarnation and elsewhere. But the cumulative effect of the divestiture of the contract laboratories is another matter. The contract laboratories were a major element in quid-pro-quo agreement between the military and the universities after World War II. Now, after a quarter of a century, both sides will have to make new arrangements.—JOHN WALSH