Chemical and Biological Warfare (I): The Research Program

Biological warfare is the intentional use of living organisms or their toxic products to cause death, disability, or damage in man, animals, or plants. The target is man, either by causing his sickness or death, or through limitation of his food supplies or other agricultural resources. Man must wage a continuous fight to maintain and defend himself, his animals, and his plants in competition with insects and microorganisms. The object of BW is to overcome these efforts by deliberately distributing large numbers of organisms of native or foreign origin, or their toxic products, taking full advantage of the ability to utilize more effective methods of dissemination and unusual portals of entry. BW has been aptly described as public health in reverse.—"Effects of Biological Warfare Agents," pamphlet published by Department of Health, Education, and Welfare, July 1959.

During the last 18 months, the University of Pennsylvania has from time to time been the unhappy object of national attention arising from disclosures that the university is conducting secret research for the Army and Air Force on chemical and biological weapons. In an interview with *Science* last fall, one troubled university official complained that Penn's participation in CBW was being unfairly singled out. "There are a lot of people in this game," he said. He was right.

The chemical and biological weapons program is one of the most secret of all U.S. military efforts—not because it is the most important of our military R&D activities, but because the Pentagon believes it is the most easily misunderstood and because it provokes the most emotional distress and moral turbulence. Official secrecy makes a complete portrait of the CBW program difficult to construct. Rumors fly freely around the security wall that separates the "ins" from the "outs." In some portions of the scientific community the Johnson administration's "credibility gap" has taken its toll and there is readiness to believe that, every time some one in Vietnam sneezes, it is because the United States is distributing the germs. In the defense establishment the CBW program is represented as being some kind of cross between defensive preparations, on the one hand, and peaceful by-products in preventive medicine, on the other.

Defensive preparations are only one part of the program, for the United States is engaged in a comprehensive and flourishing R&D effort in chemical and biological weapons. It involves nonmilitary as well as military agencies, industry as well as the academic community, and it has received cooperation from some of the major scientific institutions of the United States. Stockpiles of chemical and biological weapons produced by this program provide a far-ranging offensive capability. Furthermore, U.S. policy concerning the use of chemical and biological weapons is ambiguous and contradictory, and is rendered even more so by the use of chemical weapons in Vietnam.

The current CBW program is the product of decisions made and steps taken during the late 1950's and early 1960's. Before that time the old-line Army Chemical Corps was regarded by the nuclear-age military establishment as custodian of a particularly controversial and probably useless emporium. The Chemical Corps had a message it had been repeating since World War I—that its wares were unusually humane—but no one was buying. The Corps existed on budgetary dregs, usually around $35 million a year. Its most active support came from the Armed Forces Chemical Association, a group of military and industrial executives supported by chemical companies and "dedicated to scientific and industrial preparedness for the common defense in the fields of chemical, biological, radiological and related technology commonly referred to as chemicals." The Corps felt continually threatened with the possibility that it would be abolished.

In 1959 the Corps took matters into its own hands and went to the public with a full-scale publicity campaign known as "Operation blue skies." It was a period of fascination with the possibility of "incapacitating" weapons, particularly psychochemicals, and, putting aside its more lethal products, what the Chemical Corps advertised—in articles, speeches, lectures, symposia, and Congressional appearances—was "war without death." Within a short time the Corps' hopes for expansion had won endorsements from a variety of outsiders, from the American Chemical Society to the House Committee on Science and Astronautics.

At the same time, the Kennedy administration came into office, concerned about the military inflexibility imposed by over-reliance on nuclear weapons. New Frontiersmen were interested in acquiring a more versatile weapons "mix." And they were especially interested in systems that, like CBW, seemed to offer particular promise in fighting limited wars. In the nuclear stalemate between the great powers, there began to be a reorientation in conceptions of how the U.S. would conduct its war against smaller nations, and CBW was just one beneficiary of the reorientation. Fantasies about battles in which whole populations would fall asleep while being captured provided a comforting alternative to the known, stark destructiveness of nuclear weapons, and also helped to establish the appeal of CBW. The relative cheapness of CBW systems played a role as well.

By 1961 CBW had ceased to be scorned, and a comprehensive program for improving U.S. capabilities was underway. In fiscal year 1961 the R&D budget for CBW for all three military services was about $57 million. By 1964 it had risen to about $158 million, with the Army's share being about $115 million. It is now roughly at that level or slightly lower. In 1961 only the Army had money for procurement—about $46 million. In fiscal year 1964 the Army received a little more than $117 million for procurement related to CBW; the Navy, $11 million; and the Air Force, $8.7 million. Procurement figures for more recent years are classified.

(These sums for procurement are additional to the amounts spent for research and development.)

In addition to these annual budgets, there is a large standing capital investment in CBW activities. Fort Detrick alone, the center of biological warfare research, occupies 1300 acres of land near Frederick, Maryland, and has a building complex valued at $75,000,000. According to an employee-recruitment brochure, it has "one of the world's largest animal farms" and its "facilities for conducting research with pathogenic organisms are among the most advanced in the world."

Were it not for two things, Detrick might pass as nothing more than the particularly well-endowed microbiological research center it advertises itself to be. Research on basic characteristics of microorganisms seeks the same knowledge and is carried on in the same fashion whether the agency paying the bills is Detrick or NIH. Some of the research undertaken has a defensive motivation—an effort to discover means of combatting biological weapons that might be used by an enemy. Some of the research is neutral—not susceptible to utilization by a weapons program at all. But much of the work inescapably has a special character, an inverted quality like that of medicine turned inside out. It consists in part, for example, of efforts to breed into pathogenic organisms precisely the characteristics—such as resistance to antibiotics—that medical researchers would like to see eradicated. In the context of biological warfare even life-saving techniques such as immunization take on a strange aspect: immunity among one's own population and troops is a prerequisite to the initiation of disease by our own forces, as well as a precaution against its initiation by others. Some diseases are currently excluded from active consideration as BW agents chiefly because no vaccines against them have yet been developed.

A second factor separating Detrick from other research centers is the restraint placed on its researchers. Detrick's scientific staff consists of 120 Ph.D.'s, 110 M.S.'s, 320 B.S.'s, 34 D.V.M.'s, and 14 M.D.'s. Only about 15 percent of their findings are published through conventional scientific channels; the rest become part of a secret literature managed by the Department of Defense and available to other government agencies and contractors on a "need to know" basis.

The Detrick Research Program

Excerpts from Opportunities for Fundamental Research, *a Detrick publication issued in connection with the NAS–NRC Detrick fellowship program.*

Aerobiology

Respiratory Infections: . . . The disease process in laboratory animals exposed to aerosols of microorganisms is studied and characterized. Fundamental research is needed in the pathogenesis of disease in relation to (1) the particle size of the aerosol, (2) temperature and other environmental conditions, and (3) the effects of immunization on respiratory infectivity.

Environmental Stress: Basic research is needed in relation to the responses of airborne microorganisms to environmental stresses such as temperature, relative humidity, drying, and solar raditions. Quantitative data on the effects of these stresses are limited. In addition very little is known of the fundamental mechanisms which determine the resistance or susceptibility of cells to their environment. Studies are contemplated in which microorganisms will be exposed to natural sunlight, temperature and humidity ranges, etc., and wherein the effects produced may be measured quantitatively.

Biochemistry

Biochemistry: Various fundamental aspects of the biochemistry of microorganisms and bacterial products are being investigated. Some current problems are concerned with (1) the site and mode of action and the identification of the structure of an inhibitor of mammalian oxidation produced by various species of microorganisms, (2) the identification of the structural features of bacterial toxins required for biological activity including a study of reactive groups and the composition of partially degraded fragments, and (3) the effect of microorganisms on the metabolism of lymph tissue in vitro.

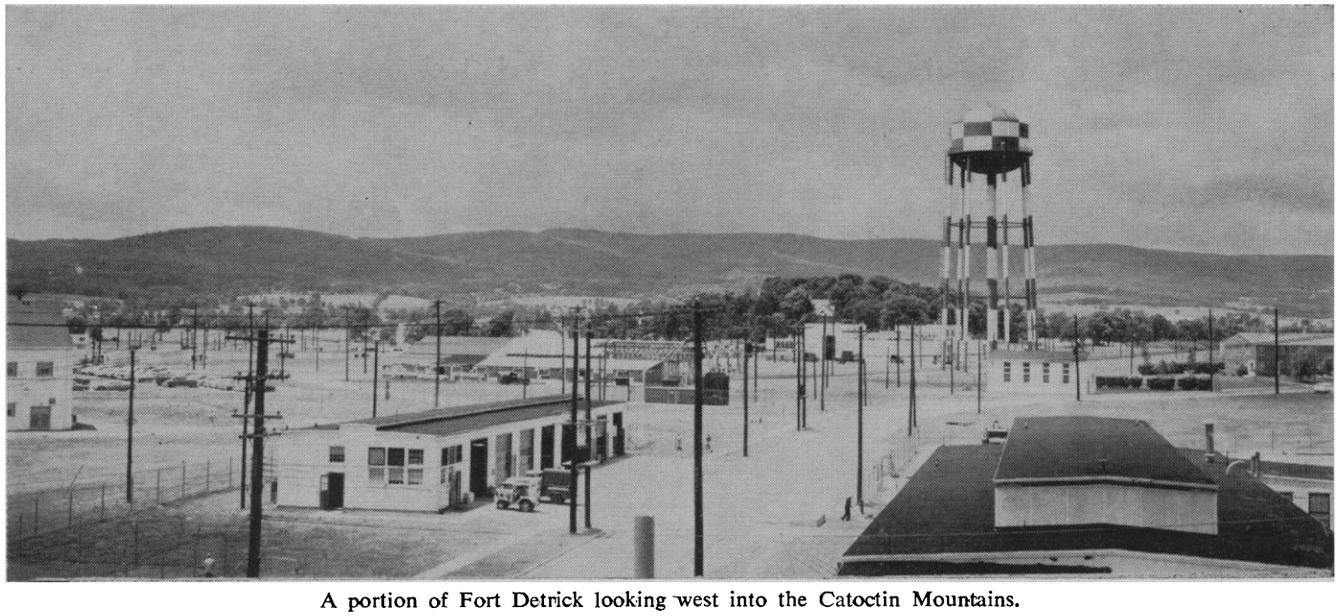
Immunology

Medical Entomology: This field involves basic research on the biology and rearing of medically important insects, the factors affecting infection of various arthropods and factors affecting transmission of microorganisms. Current problems consist of basic studies of effects of rearing procedures for various insects on longevity and fecundity; the effects of different environmental factors on infection of insects and on virulence of microorganisms.

Plant Sciences

Pathology: A broad research program on several plant diseases is in progress. Some areas currently under investigation include: Factors of environment (host plant and pathogen) which affect spore germination, germ tube penetration, establishment of infection, disease symptom expression, sporulation, viability retention, resistance to infection. These and other problems of interest extend into fields of irradiation biology, physiology and genetics.

Physiology: Excellent opportunities exist for research on growth regulators, herbicides, defoliants, and problems of absorption of chemicals. Basic research is needed on the uptake, translocation, mode of action, structure versus activity relationships, and the function of surfactant compounds in herbicidal formulations.



A portion of Fort Detrick looking west into the Catoctin Mountains.

While nothing is published that would indicate the relative degree of military interest in, or effort on, a particular agent, Detrick scientists do report in open literature on subjects such as instances of laboratory-induced or accidentally acquired infection, immunization, therapy, routes of infection in man and animals, and various experimental techniques. From these papers and from other sources it is possible to surmise a good deal about the Detrick research program.

Diseases that are at least the objects of considerable research and that appear to be among those regarded as potential BW agents include: bacterial diseases—anthrax, dysentery, brucellosis, glanders, plague, and tularemia; rickettsial diseases—Q-fever and Rocky Mountain spotted fever; viral diseases —dengue fever, several types of encephalitis, psittacosis, and yellow fever; a fungal disease, coccidioidomycosis; and botulism toxin.

In recent years a good deal of attention has been focused on plant diseases also. Recently the Army's Distinguished Service Medal, the highest award the Army gives civilians, was awarded to a Detrick researcher for her contribution to development of a rice blast fungus, a disease that in its natural form has repeatedly damaged Asian rice crops.

To make the jump from naturally occurring organisms to usable weapons, biological agents must possess certain characteristics: they must be highly infectious; they must be able to maintain viability and virulence during production, storage, transportation, and dissemination; they must be sturdy enough to withstand injury during dissemination and have a minimum decay rate; and they must be capable of being produced on a militarily significant scale. Judged from what has surfaced, a substantial portion of fundamental research at Detrick has been devoted to development of these characteristics in the organisms producing the diseases listed (see box on page 175).

Detrick is also more or less the home of the science of aerobiology—the study of airborne infection—an area of much interest to researchers studying dissemination of disease, whether their interests are causative or curative. Aerobiology is of particular relevance to biological warfare, however, because the idea of disseminating infectious agents by aerosols—suspensions of small particles in the air—seems to be displacing earlier notions about how to transmit disease. Conventional images of biological warfare —the covert "man with the suitcase" or the poisoning of water supplies and ventilation systems—seem to have been discarded, partly because the number of people who could be subjected to infection at any one time is too small.

Two out of the three times Detrick has emerged to participate in a conventional way in the affairs of the scientific community, it has cosponsored conferences on airborne infection. (Its intellectual debut was a 1959 symposium on "Nonspecific resistance to infection," held in collaboration with the American Institute of Biological Sciences.) The first "Conference on airborne infection," held in Miami Beach in December 1960, was supported jointly by Detrick and the National Institute of Allergy and Infectious Diseases (NIAID), of the National Institutes of Health, and sponsored by the National Academy of Sciences. Detrick papers included "Viability and infectivity of microorganisms in experimental airborne infection," "Techniques of aerosol formation," and "Airborne Q fever."

Detrick's third meeting was the second International Conference on Aerobiology, held in Chicago last March and sponsored jointly with the Illinois Institute of Technology, a Detrick contractor. Papers by Detrick researchers included "Antibiotic prophylaxis and therapy of airborne tularemia;" "Physical and chemical stresses of aerosolization;" "Infection of pigeons by airborne Venezuelan equine encephalitis virus;" and "Attenuation of aerosolized yellow fever virus after passage in cell culture." Two papers reflected collaboration between Fort Detrick and NIAID: "Effect of route of inoculation on experimental respiratory viral disease and evidence for airborne transmission" and "Assessment of experimental and natural viral aerosols." A cooperative project between Detrick and the University of Maryland Medical School was a study of "Aerogenic immunization of man with live tularemia vaccine." A researcher at Ohio State University College of Medicine, supported by a Detrick grant, reported on "Aerosol infection of monkeys with *Rickettsia rickettsii*," the organism that causes Rocky Mountain spotted fever. Detrick, the

University of Pennsylvania: It's Hard To Kick The Habit

The University of Pennsylvania is now in the second year of an increasingly bitter dispute over the presence of CBW research on its campus. The project at Penn involves applied research on weapons systems; it has been going on for about 10 years under various titles: most recently, "Summit" (an Army contract) and "Spicerack" (an Air Force project). The contracts total roughly $1 million a year.

The Summit contract calls for the researchers, among other things, to

> Prepare analyses and studies of the behavior, technical properties, and performance of particular agents, munitions, weapons components or subsystems of C&B weapons systems. The required analyses will be directed to include estimations of the human effects of particular C&B agents; characterization of the aerosol behavior of the specific agents in field clouds; appraisal of the performance of candidate munitions-agent combinations under environmental conditions; examination of various protective procedures in specific military situations; and the estimation of human factors and response to the C&B environment.

Penn subcontracted with the Cornell Aeronautical Laboratory for additional research on "targeting." Part of Cornell's job was to

> Conduct a detailed target analysis to determine anticipated target neutralization requirements. This analysis will consider (i) protective measures against which a weapon capability should be required; (ii) acceptable time to incapacitation requirements; and (iii) target sizes and content and minimum acceptable casualty infliction to achieve neutralization.

The relation between these projects and U.S. operations in Vietnam is a matter of some debate. University officials connected with the controversy have made many contradictory statements, sometimes conceding relevance to Vietnam, sometimes denying it. But the researchers have done a good deal of study of the application of CBW to a number of crops, including rice; of the effects of crop-destruction on the economies of underdeveloped countries and on the political and nonpolitical climate of Asia. In an interview with *Science* last fall, Knut Krieger, the chemistry professor who directs the research, said that he receives Army field reports from Vietnam and that he has evaluated tests on defoliants. Penn now has a capability with which the Pentagon, for immediate or long-range reasons, is reluctant to part. "We could get along without Penn," one official recently commented, "but we're not very anxious to try."

Summit and Spicerack carry with them some obvious liabilities. President Gaylord Harnwell says that Penn loses money on the contracts—about 5 percent of the cost of the projects or about $50,000 a year. The bookkeeping on such matters is extremely intricate, and on the basis of other universities' experiences it is safe to say that profit and loss can be calculated in a great many different ways. However, the university is plainly not reaping great financial rewards from CBW, and officials state there is no hidden funding from which they are benefiting. The CBW projects have given the university painfully bad publicity. And, finally, the controversy has aroused and divided faculty, students, administrators, and alumni.

The answer to the question why, in this troubled climate, the research has not simply been abolished has to do in part with internal politics of the university, in part with the fact that the controversy touches on some of the most sensitive issues in academia. Last year a small group of professors sought to have the CBW projects thrown out because they considered its subject matter immoral. A much larger number of faculty members were unwilling to set a precedent of vetoing the substance of a colleague's research; instead they took up the issue of publishability. The faculty passed a resolution reaffirming an old but, practically speaking, extinct university policy that called for accepting "contracts or grants only for research projects whose principal purpose is to produce results which will be freely available and freely publishable in the ordinary manner of open research in the relevant discipline." The faculty also set about devising a mechanism which would assure review by the faculty of contracts suspected of violating the criteria.

The publishability issue did not prove an effective vehicle for accomplishing the faculty's object of ending CBW. President Harnwell believed that, under a special dispensation negotiated into the Spicerack contract at renewal time last spring, Krieger was technically free to publish his findings and that the research therefore did not come under the terms of the faculty resolution. Accordingly, he renewed the contract. The difficulty is that Krieger does not want to publish. "My findings are not of general interest," he told *Science*, "they are highly specialized. And in the second place I don't think it's the kind of work that ought to be published. It's a matter of national security."

Harnwell adds another argument to Krieger's. "He's a tenured professor," the President remarked to *Science*. "How can we make him publish if he doesn't want to? It's really a question of academic freedom. If I told someone what research to do or not to do or what and when to publish, another portion of the faculty would be down here knocking at the doors."

Harnwell's attitude—that what is at stake is neither the substance of the research, nor its publishability, but academic freedom—has been echoed this year by a faculty group that was relatively silent earlier, a group centered in the engineering sectors of the university. This group, heavily involved in defense contracting, feels that the ban on classified research, endorsed by most of the faculty, would harm the engineering schools. University officials have also been hearing from alumni, some of whom are reportedly shocked that the propriety of the University's conducting research related to national defense should even be called into question.

At this point, the future of Spicerack and Summit is uncertain. President Harnwell recently indicated that he would like to get rid of the research because he is tired of the emotion-racked controversy. But the University cannot simply run out on the Pentagon, and one problem is where to ship the research. The University is contemplating, among other possibilities, transferring it to the University City Science Center, a new, nonprofit, R&D corporation in Philadelphia, owned by a consortium of Pennsylvania colleges and universities. The trouble is that the consortium includes Quaker colleges Haverford and Swarthmore; there have been reports that they don't want CBW either.—E.L.

University of Arizona, and the Public Health Service all cooperated in a study of "Experimental epidemiology of coccidioidomycosis," an infectious fungal disease.

PHS Involvement

The Public Health Service has also cooperated with Detrick in other ways. In 1960, for example, the PHS received more than $380,000 in funds transferred from the Army Chemical Corps, and, according to a PHS spokesman, annual transfers of funds measure only a fraction of the real cooperation between the two agencies. The PHS says that it does not take Army money to conduct research that it would not otherwise undertake, but only to bolster ongoing projects in fields in which it has an independent interest. Its policy is that none of the research results obtained in collaborative projects may be classified. However, the subject matter of an Army–PHS transfer of funds cannot always be discussed because—even though it may concern an area in which the PHS is studying openly—the mere fact of military interest in it may be classified.

Apart from the transfer of funds, there is active liaison between the two agencies—communication on several levels, and efforts on both sides to avoid duplication. And the PHS has also cooperated with Detrick by delaying required reporting to international health authorities of quarantinable diseases occurring at Fort Detrick. One such instance took place on 1 September 1959 when a 22-year-old enlisted technician named Ralph Powell became ill with pneumonic plague. The following day Detrick informed the Frederick County Health Officer, and on the second day it informed the Public Health Service. Its memo to the PHS, classified secret, stated that "no press release has been made or is contemplated by any DOD agency, unless death occurs. In such a case, the cause of death would not be announced." Powell recovered, the report was downgraded to "for official use only," and on 6 November the PHS reported the case. If the PHS is assured that no epidemic hazard exists, it allows the military's declaration of "national security" to take precedence over its international obligations.

Another source of advice for the biological warfare effort is the National Academy of Sciences. In addition to occasional formation of special groups to consider particular problems, the NAS has for several years sponsored a program of postdoctoral "Resident research associateships" designed in part to help bring talent into Detrick. The fellowships are supported by Detrick for research at its laboratories, but candidates are screened by the Academy. Appointees, who must be investigated and cleared, are subsequently permitted to describe themselves as having received an NAS–NRC fellowship.

Additional intellectual assistance for Detrick comes from the American Society for Microbiology, which maintains a permanent Detrick advisory committee. In 1966 the President of the ASM was Riley D. Housewright, scientific director of Fort Detrick. Detrick also uses the part-time consulting services of a number of individual researchers drawn largely from the academic community.

A Million Dollar Secret

A number of universities and research institutes also have come into the CBW constellation. The terms of the research sponsored by Detrick or by its chemical-weapons counterpart, the research laboratories of Edgewood Arsenal, vary. Some of it is secret, some open. Some of it amounts to support for basic microbiological research in which Detrick and university-based investigators happen to have simultaneous interest; some is closer to a straight purchase of manpower for a particular task. The scale and magnitude of university-based CBW research is also variable, occasionally running—as at Penn—into large projects but most-often consisting of a few researchers together with perhaps a handful of graduate students.

Between 1955 and 1963, as an example of one end of the spectrum, John Hopkins received over $1 million for work described as "studies of actual or potential injuries or illnesses, studies on diseases of potential BW significance, and evaluation of certain clinical and immunological responses to certain toxoids and vaccines." Hopkins reports that its work, which is continuing at a reduced level, produced no results published in open literature. At the other end of the spectrum is the Duke University Medical Center, where researchers have been working since 1958 to develop a vaccine against *Coccidioides immitis* and have made several contributions to professional journals. Some of the CBW work, such as that performed in the late 1950's at Stanford University, is strictly classified; or, like that done at Brooklyn College, the New York Botanical Gardens, and the Midwest Research Institute, at least does not contribute to open literature. Most of the research seems to occupy an ambiguous middle ground where at least some fraction of the results may be publishable, but only with clearances, releases, and so forth from the Department of Defense. Among the institutions where researchers recently performed or are now performing work in this category are the Southern Research Institute, the University of Maryland, the Illinois Institute of Technology, and Hahnemann Medical College.

Another group of institutions has done or is doing research, supported by the CBW program, that is not classified; it includes the universities of Chicago, Minnesota, Michigan, and Texas, Ohio State University, and M.I.T.

Cooperation, including joint support of graduate students, seems particularly flourishing between Detrick and universities in the Washington area, such as the University of Maryland and George Washington University. GW had Detrick contracts totaling $1,202,000 in 1960, and from 1952 to 1959 it conducted a comprehensive research program relating to the "physical and biophysical factors incident to the explosive dissemination of biological aerosols." The annual report of the dean of sponsored research for 1959 reported "phenomenal success improving the efficiency of dissemination of liquids" and noted that, "While it is quite obvious that the end result . . . will be a new weapon," GW's role was limited to research and did not include development. GW maintained a special laboratory at Fort Detrick during that period. Similarly close relations appear to exist between the Dugway Proving Ground and academic institutions in its area. In 1960 the University of Utah had eight contracts with Dugway, totaling $1,570,000. Utah State University also has worked with Dugway.

Finally, it should be pointed out that many more institutions than those cited have contributed to the CBW program. While the Army has turned to academic organizations for basic research, especially on the biological side, industrial contributions to the chemical-weapons program have been substantial. At times nearly 65 percent of the military R&D money in CBW has gone to industry, which is reported to be

the most productive source of new compounds. Arthur D. Little, Inc., and DuPont are among companies mentioned as prominent contributors to the CBW program. From outside the chemical industry, many aerospace companies now devote some fraction of their efforts to CBW.

Beyond Basic Research

During the past few years the Army and the Air Force together have moved into another area of CBW research. It goes by a lot of contemporary-sounding titles but boils down to evaluation of chemical and biological weapons and delivery systems. The controversial contracts at the University of Pennsylvania are of this type (see box). But, although Penn is a crucial cog in this phase of the CBW program, it is not the only one: New York University also is performing such studies, under an Air Force contract, and a Pentagon official recently stated that related studies are being conducted by, among other organizations, RAND, the Stanford Research Institute, and the Institute for Defense Analyses.

Research Analysis Corporation, a small firm located near Washington, in a brochure designed to reflect past support by government as well as to attract more, lists the following "research capabilities." Under the heading "Agricultural warfare" are "Study of biological and chemical attacks on crops and some analyses of effects on livestock," "Covert attack on a food crop," and "Impact of chemical attack on guerilla food crops." Under "Guerilla warfare and counter-insurgency" are "Evaluation of counter-insurgency requirements in Southeast Asia," and "Southeast Asia environmental-data collection." And under "CBR warfare" are "Military potential of GB" [a toxic nerve gas], "The feasibility of chemical warfare in defense of a perimeter in the Naktong Valley basin," and "The value of toxic chemicals in ground warfare."

Another leading entry in the field of CBW is the Travelers Research Center, an outgrowth of the Travelers Insurance Companies. Its most recent brochure reports studies of military operations that are "highly sensitive to the natural environment." Chief among these, the report continues,

> . . . are chemical and biological weapons systems, which exhibit a high degree of dependence on meteorological, terrain, and vegetative factors. The extensive experience of the TRC staff in research on turbulent diffusion and transport of atmospheric contaminants provides a firm base for TRC's participation in the nation's CB weapons analysis program. The Center's interest in this field stems not only from the importance of understanding the environmental phenomena involved, but also from our desire to support and assist the United States in acquiring effective, humane, incapacitating (nonlethal) systems for coping with proliferating limited war and counter-insurgency. One study was undertaken for the Army to identify the most effective approaches for contending with difficult military situations with a minimum loss of human life to both sides. Another study conducted for the Navy provided an updated review of the influence of micrometeorological factors on chemical warfare in the form of a technical manual to assist in the identification, observation, and prediction of relevant meteorological factors and processes. In another study for the Army, TRC began comprehensive research on dosage prediction techniques to provide up-to-date knowledge of dispersion processes in the lower atmosphere, and with a critical evaluation of the capabilities and limitations of present quantitative techniques for predicting the behavior of atmospheric contaminants. This study is similar in many respects to those being conducted on urban and regional air pollution.

Travelers has branched out in another new direction: "Because modern military planning must often consider technical and strategic goals in relation to their political, sociological and psychological implications, particularly with respect to limited war and counter-insurgency," the brochure states, "a study was undertaken for the Air Force to assess not only the military potential of non-lethal CB weaponry, but also the psycho-political reaction to its use."

This is the chain of research. The United States government is developing chemical and biological weapons. It is learning how to use them effectively. And, finally, it is inquiring into the public reaction to their use.

—ELINOR LANGER

(This is the first of two articles on chemical and biological weapons.)

Tax Laws: Conservationists Must Step Gingerly on Capitol Hill

The resurgence of the conservation movement that began in the early 1960's is evident in the creation of new parks and national seashores, the establishment of a national wilderness system, and the enactment of antipollution measures. Despite these notable successes, however, conservationists will have to throw themselves into some grinding legislative struggles in the future if they are to consolidate and increase their gains. Mounting population pressures, highway construction, air and water pollution, dam building, and other resource exploitation all will inevitably threaten natural and scenic values.

A tentative ruling on 16 December by the Internal Revenue Service (IRS) revoking the Sierra Club's privilege of receiving tax-deductible donations has raised the question of how vigorously conservation groups will be able to carry on the fight. In considering the significance of this matter one must bear in mind that an organization can be "tax-exempt"—that is, have no tax obligation on its income—without being able to assure its contributors that they can deduct their donations from their gross income. The Sierra Club, a San Francisco-based group with about 40,000 members, says it has lost an estimated $125,000 in potential donations during the six months since IRS announced that its privilege of receiving deductible donations was in question. Tax questions related to the political or lobbying activities of a variety of nonprofit organizations are pointed up by the Sierra Club's misfortune.

The Sierra Club's problem stems especially from its efforts—which appear highly effective—to defeat a legislative proposal to authorize the construction of two hydropower dams in the