CASE STUDY 4:

RESEARCH AND DEVELOPMENT IN (C)BW

Twenty years later, I published a more sophisticated analysis of the attempt to differentiate between offensive and defensive research on Biological Weapons. It was published in M. Leitenberg, *The Problem of Biological Weapons*, Stockholm: Swedish National Defence College, ACTA B27, 2004

Though still available, the book is difficult to come by, and I have therefore included those additional pages here following the original 1984 case study.

RESEARCH AND DEVELOPMENT IN (C)BW

An Examination of the Possibility of Distinguishing between

Civil and Military, Offensive and Defensive

by Milton Leitenberg

(This paper was written in Stockholm in 1983-84; an earlier version had been prepared at SIPRI in 1969-70 and was presented at an International Congress of Microbiology in Mexico City.)

RESEARCH AND DEVELOPMENT IN (C) BW

This study can be seen as something of an experiment. It has three purposes. First it is an attempt to see to what degree one can distinguish between the alternative sides of three pairs of descriptors that are used to categorize research:

- basic vs. applied
- civil vs. military
- offensive vs. defensive

These issues are raised in the study from the point of view of arms control and disarmament agreements and the problems of verification in conjunction with such agreements, or of confidence assessments in the absence of verification.

Second, it is an example of the ways in which scientific research and weapons development are interrelated. This question was a particular problem for the international scientific community — particularly that in the United states and Great Britain — in the years 1965 to 1973. Since then the question has receded from public attention. The third purpose is a corrolary of the second. The intense development of weapon systems in the years since WW II produced a strong and somewhat amazing legacy of confusion directed more or less specifically at the scientific community by some of its own major figures. Important and well-known scientists often did their best to obscure precisely the relations of research to weapons development when forced to address the question in terms of concrete examples. In contrast,pre-1970 papers found in the professional literature which discuss the relation of scientific research to "national interest" are more or less disguised calls for participation in particular programmes by the papers scientific audience, without mention ever being made by the authors of the long-range aims and general context of the particular reseach programmes. The working scientists in their turn were often guilty of remarkable degrees of self-deception. The study demonstrates that both the deception of others and the self-deception are easy to dispel, and are unnecessary.

It must be stated at the outset that all the information on which this paper is based derives from Western sources, primarily US sources. This is stated simply as a matter of fact; there is no suggestion that this in any way detracts from the validity of the sources. With a few exceptions the discussion is based on examples from the US research effort. It is presumed that similar processes and situations, scaled up or down in various degrees, obtain in other nations in which parallel programmes exist or have existed, or that they would obtain if it were intended to initiate BW R&D programmes in other countries. Thus it is entirely reasonable to apply examples derived from the experience in the United States to a study of, if not the policy process, then the policy measures which in operation bind disciplinary research to weapon development.

The main body of this study is divided into the following sections:

1. "innocence and irresponsibility"
2. basic vs. applied research; civil vs. military research (application)
   a) the intrusion of the real world: Sverdlovsk, April 1979 and its aftermath.
3. offensive and defensive research
   a) the requirement for a deterrent
   b) (C) BW R&D within the industrial sector , a risk of proliferation
   c) (C) BW R&D contracted overseas, a risk of proliferation
   d) "spinoff"
4. medical requirements of conventional military operations
5. conversion of facilities.

It is hoped that, although the material presented in some of the sections is not simple, the paper will nevertheless help clarify and define a presently confused skein of issues, choices and problems.

There is, of course, overlap between several of the sections in the paper. The sections on basic vs. applied, civil vs. military, and offensive vs. defensive R&D are complex. Confusion arises in examining the separability or non-separability of the pairs of words: basic-applied, civil-military, offensive-defensive. The study argues that, in the absolute sense, separability exists to a degree not commonly recognized, and that these paradigms have not been sufficiently analyzed in the past. This would mean in the optimum case the ability to accurately categorize an individual piece of research. However, the analysis leads to the conclusion that the judgments made must include assumptions both about the aim and intention and about the national context in which research occurs. Since this is part and parcel of what one is attempting to ascertain, such assumptions may be seen to by many to undermine the conclusions, at least to an important degree.

The commonly accepted understanding is that civil-military, offensive-defensive aspects of a research programme or of a particular piece of work are not easily separated. This position is supported by two examples which are particularly interesting because of the individuals involved. S.K.Allison, the wartime Director of the "Metallurgical Laboratory" of the Manhatten Project at the University of Chicago, wrote in 1950 of the following regulations affecting the conduct of research in physics in occupied Germany

> Law No.23, issued by the Military Government, Germany to be effective September 12, 1949, in the United States Area of Control. The Law is entitled "Control of Scientific Research", and consists of thirteen articles. A "Regulation No. 1," accompanying the law, contains eight articles.
>
> Article II of the law prohibits fundamental scientific research wholly or primarily of a military nature.
>
> A conscientious military governor, attempting to enforce this article, would have some very difficult decisions to make, and I doubt that an advisory board of scientists could help him very much.
>
> Article III prohibits applied scientific research on any matter wholly or primarily of a military nature, or any of the matters specified in Schedule A. Turning to Schedule A, we find Nuclear Physics as Item I, followed by other categories which the authors of the legislation considered to be clearly military in nature . . . I judge that the least one can say about these regulations is that they are unenlightened. /1/

Several years later the eminent John von Neuman, one of the foremost post-war advisers to the U.S Government in military and scientific matters wrote:

> . . . useful and harmful techniques lie everywhere so close together that it is never possible to separate the lions from the lambs. This is known to all who have so laboriously tried to separate secret, "classified" science or technology (military) from the "open" kind; success is never — nor intended to be more — than transient, lasting perhaps half a decade. Similarly, a separation into useful and harmful subjects in any technological sphere would probably diffuse into nothing in a decade. /2/

These general truths have, however, served to obscure the possibilities of distinguishing research aims stressed in this paper, but it must be made clear that government intention is the determining factor. Again using an example from nuclear physics, Sir Rudolph Peierls has stated that it was relatively easy to ascertain the direction of so secret a programme — and in a time of active conflict — as the German atomic research programme from material published entirely in the open literature in Germany during World War II, and that the guesses made on this basis turned out to be entirely correct. /3/ The message of this example — that it is possible to distinguish research aims — supports many of the contentions made in this paper, and stands in direct contrast to the claims by Allison and von Neuman that it is not possible to distinguish them. It is possible to guess that the resolution of these apparently opposite and paradoxical positions is that Peierls was assuming the intention - purpose - of a particular body of research while Allison and von Neuman were not anticipating any in their general statements. For example, a study commissioned by the US Arms Control and Disarmament Agency in 1964 examined

> .... the problem of finding indicators which are associated with significant but unrecognized military applications of ballistic missiles and military space systems. The problem to be solved is one of technological intelligence evaluation associated with the acquisition of scientific and technological information for new military applications. The indicators which were available at the time of US development of the atomic bomb and the USSR development of Sputnik I are analyzed, and it is found that the principal problems of anticipating technological breakthroughs are those of postulating the events for which indicators are sought...
>
> ... The richest source of indicators in such initial scientific activity is the open source scientific and technical literature of the nation which is being monitored.
>
> ... The problem, however, is one of proper interpretation of the signals which are available. This interpretation depends upon: (1) a recognition of the possibility of the advanced development, and (2) the ability to separate the signals from the background noise. The technical intelligence problem is not too different from the military intelligence problem. In both cases, meaningful signals are embedded in a maze of irrelevant data and its relevance can only be recognized if the event for which signals are sought has been postulated. /4/

If, however, government intention is the key to the riddle of the offensive-defensive, civil-military paradigms, confusion is permissible. One point should nonetheless be clear. No confusion is permissible, nor can it any longer be apologized for by the scientific community in microbiology or in any other discipline concerning the relations of scientific research to weapon development. The above described standard formulations of "non-separability" of course make this abundantly clear. There should be an end to the typically misleading or obscurantist statements, sometimes purposeful, that have been customary for the past twenty years.

1. Innocence and responsibility

Few scientists anywhere in the world are overtly coerced into particular scientific disciplines or to work on particular scientific projects. It is likely that secondary institutional pressures, social reward, the availability of funds and positions, student training and fellowship programmes are mechanisms which guide the choices of scientists in all countries. There is no reason why a scientist should not be fully conscious of the intent and applications of his research to the funding agency at the same time as he chooses the research subject matter that interests him. However, to all appearances this has seldom been achievable in reality, and extraneous rationalizations and unnecessary defensiveness are the rule. The arguments presented in scores of such debates have consistently been:

1) We, the scientists, are doing only what interests us.
2) We do not know, and there is no way to know, what will happen to our results after they leave our laboratory bench.
3) If we do know, it is not the social role of the scientist to decide what shall be the application of our work; that is the function of the society as a whole, of politics, or, in particular, of another special group, the managers of the activities and priorities of the society, the "politicians".

In the present, if not historically, the last of these rationalizations undoubtedly bears a strong relationship to the source of funding for much scientific research, and the individual costs of placing personal against managerial decisions in any institution in any nation.

These general arguments quickly merge on any particular question into the basic vs. applied and offensive vs. defensive problems. An example specific to CBW is provided by the 1968 public debate in Great Britain concerning the Porton laboratories. It is important to point out that the extracts from the following letter are by Dr. E.B. Chain, a renowned, senior scientist who would understand quite well the relevance of particular lines of research and who in all likelihood, due to the eminence of his position in his profession, has probably in his career served on behalf of his government on panels concerned with scientific priorities and their goals. Dr. Chain responded to a journal article on Porton and BW.

> On reading the article /5/ however, all that transpires is that the Microbiological Establishment at Porton has been generous enough to finance research projects in various well-established university laboratories in this country for the pursuance of fundamental biochemical and biological studies. These would be judged important and sound on any academic standard, and they have no, or only the most tenuous, relation to biological warfare problems.

> Examples cited included works on electrodes capable of measuring oxygen concentration in aqueous solutions, enzymes involved in nerve transmission, studies on the fate of toxic drugs in the body and structural studies on ricin, described characteristically by your ill-informed writers as one of the most toxic "mould" products but actually a plant toxin of protein nature well known for centuries. No restrictions are imposed on the scientists in the eventual publication of the results of their work.
>
> ...
>
> What is wrong with accepting research grants from the Ministry of Defence? As is well known, thousends of scientists have, for many years, accepted such grants from the US Navy, the US Air Force, NATO, and similar national and international organizations for fundamental research in many branches of the physical and biological sciences: this does not mean that such work involved them in research on military technology. One can only be grateful for the wisdom and foresight shown by those responsible for formulating and deciding the politics of these organizations in allowing their funds to be made available for sponsoring fundamental university research which bears no immediate, and usually not even a remote, relation to problems of warfare technology.
>
> Of course, almost any kind of research, however academic, and almost any invention, however beneficial to mankind, from the knife to atomic energy, from anaesthetics to plant hormones, can be used for war and other destructive purposes, but it is, of course not the scientist and inventor who carries the responsibility for how the results of his research or his inventions are used.
>
> As far as the excellent team of scientists at the Microbiological Establishment at Porton, by international consensus of opinion one of the finest in the world, is concerned, do we not have to consider ourselves lucky to have in this country such a highly competent assembly of experts who are able to assess the effectiveness of biological warfare in attack and to develop defensive methods should a ruthless enemy, as he well might, use these techniques for attack against our people? Would not the writers of your article be thankful if, in the hour of need — may it never arise — effective methods were available to defend them, and their children, against such contingency? /6/

Two sets of comments are in order. The first is that studies on "the isolation, purification and structure" of ricin or on enzymes involved in nerve transmission or on the fate of toxic drugs in the body are definitely "fundamental, biochemical and biological studies ... important and sound" but they are also simultaneously as bona fide CBW research as will ever be found. If the special oxygen electrode is required for an unusual device in a CBW laboratory, it would qualify as well. Information on these questions are of central importance to B and CW, and are exactly what B and CW research is comprised of. Nerve gases work by inhibiting the enzymes involved in nerve transmission. A knowledge of the detoxification enzymes in liver and their substrate capabilities will tell you what molecules or side-chains on molecules may be toxic to cells, and hence how to select, enhance or modify CW agents. Purification and structural analysis of a toxin such as ricin is a preliminary to the ability to synthesize the toxin. The efforts to portray irrelevance in this instance are so extreme as to be absurd. Surprising or otherwise, the matter of eventual publication is also not the critical determinant of whether a particular piece of research is an integral part of a research program of direct relation to military concerns.

A second comment concerns the question of whether scientific research subsidized by defense organizations is involved with military technology, or shows the "wisdom and foresight . . . for sponsoring fundamental university research which bears no immediate, and usually not even a remote, relation to problems of warfare technology", as Dr. Chain claimed. Until 1968-1969, such statements were routinely made by scientific statemen and, of course, appeared in the public addresses of Department of Defense spokesmen. (More will be said about this in sections 5 and 6 below.) In contrast, the official guidelines of the United States Department of Defense are straightforward and simple, and flatly contradict the above disclaimer:

> DoD REQUIREMENTS FOR RESEARCH STUDIES TO BE CONDUCTED ABROAD AT FOREIGN INSTITUTIONS
>
> The Department of Defense has continuing priority needs for certain selected foreign research and development projects.
>
> Defense has established stringent criteria for selection of research and development projects by foreign performers. All ongoing or future research and exploratory development by foreign performers shall be supported by DoD only when it has been determined that
>
> (a) it is clearly significant in meeting urgent defense needs of the US;
> (b) it cannot be deferred for later action;
> (c) the proposed foreign investigator certifies that he is unable to obtain support from any other source for the proposed project, and
> (d) at least one of the following special conditions is inherent in the proposed work:
> (1) The research or development involves geographical, environmental or cultural conditions, fauna, or flora not found and not feasible to duplicate or simulate within the United States and its territories.
> (2) The work involves diseases, epidemiological situations, or availability or clinical material which are not present within the United States.
> (3) The work involves a unique research idea highly relevant to DoD needs. /7/

The US Navy, the US Air Force and NATO are hardly "international organizations for fundamental research", and they have never pretended to be so. The combination of studies such as Project Hindsight in the late 1960s and the controversy they produced over aims and priorities in the US defense-science community, increased budgetary pressure on defense expenditure and the "Mansfield Amendment", led US Dept. of Defense research spokesmen testifying before Congress to delineate very carefully the military relevance of what had always been categorized as purely "basic research" (that is, having no identified military value). The point is that basic, like applied, research does have military relevance, always in a general and often in a specific sense. The Office of Naval Research and the Air Force Office to Scientific Research have released a series of publications over the years with the same explicit message /8/. In these reports and papers the agencies certainly do not claim to be funding science in which they see no relevance for their operational requirements. In fact they see their role as quite the opposite and clearly say so. It is only in scientific journals that the inverse case was made, in the US often in such publications as Scientific Monthly, and Science. It was the general scientific community that had to be reconvinced of its allegiance to the tradition of pure scientific curiosity. Strangely enough, the statements in this area which frequently appear in journals such as Naval Research Reviews, or Ordnance, intended to be read by the more limited and already committed members of the defense-science community, tend to approximate the position presented by the DoD guidelines. The following example is quite typical.

> In 1946, the Office of Naval Research (ONR), headed by the Chief of Naval Research, was established in recognition of the need to plan, encourage, and support basic research in our universities, our in-house laboratories, and the private industrial groups in those areas of knowledge that seem to be most relevant to long range Navy requirements. The experiences in scientific mobilization of World War II and the awesome strategic implications of the scientific/technological breakthrough in nuclear weapons demanded new organizational approaches to research and development for national security . . .
>
> ONR Washington is aided in such work by its alert scientific "bird dogs" — the Branch Offices in Boston, New York, Chicago, Pasadena, San Francisco and London. These branch office scientists — by monitoring research sponsored by the Army, Air Force, NASA, European governments and other agencies in universities, industry, and government laboratories — are able to help initiate and manage the various investigations in the Contract Research Program. . . .
>
> Navy research is "mission oriented" . . . The sciences of physics, geology, biology, chemistry, psychology and mathematics are shifting even more to the ocean depths in the Navy research plan. Acoustics, marine geology, marine biology, ocean chemistry, physical oceanography, undersea research vehicles, life support systems, deep moored and drifting buoys, remote sensing of the sea surface, advanced data handling, and new environmental prediction techniques these are some of the areas of increasing interest which should present long term challenges to scientists and engineers. Instruments for detection of undersea military vehicles, data handling of raw information and its conversion to usable data for the fleet, and command and control then obviously become major challenges that grow out of these research goals and areas of interest. /9/

One of the functions of secrecy plays its role in this situation. Secrecy has contributed to the public acceptance of subterfuge by obscuring a total picture of the research program and its purposes. However, the larger of the two factors is probably the misleading way in which research is presented. When the defense services wanted to publicize a particular aspect or segment of the CBW effort, they did so, as in the famous Project Blue Skies, an advertising campaign complete with the services of a commercial public relation organization. Incapacitants, cats, mice, and LSD were the order of the day, but no knowledge was available to the public or to the general scientific community of the total CBW programme effort, its manifold directions or the relative allotment of resources among these. That this situation holds almost as strongly for the scientific community as for the general public points to one of the domestic uses of secrecy: to minimize public reaction and possible consequent obstacles to programmes deemed in the interest of defence by the military services. Recalling the final paragraph of Dr. Chains letter, the plea made years earlier of another British scientist concerned with the same problems of CBW research is of interest. Dr. Rydon's appeal was made in the context of defence against CBW attack.

> Prof. H.N. Rydon who . . . was also one of the scientific advisors in the London Region, then discussed the nature and magnitude of the problems resulting from the use of biological and chemical warfare . . .
>
> In preparing to meet such threats, the services of trained chemists would be invaluable, and Prof. Rydon hoped that as a result of the meeting there would be a good response from chemists. The chemist could adequately perform many tasks connected with atomic and biological warfare as well as those in the chemical field, for his training puts him in a category intermediate between the physicist and the biologist. He hoped no one would withhold his services under the impression that civil defence is a purely passive function. The application of scientific advice could go a long way towards defeating an enemy's objective by minimizing the effects of his weapons, and this could at times be as important as the active operations of offensive warfare. /10/

Rydon stated his case plainly. There seems to be little rational reason that the public presentation of the relationship of scientific research to weapons development and military problems should have been as deceptive as it was for so many years, and that this relationship should be so sensitive a subject to the scientific community. This situation seems best described as an amalgam of ignorance, self deception, and purposeful deception of others to insure the continuity of programmes. These contributory factors may differ in degree for different sectors of the scientific community.

2. Basic versus applied research; civil versus military research

Lest there be any confusion, it should be stated at the outset that there are many differences between these two pairs of alternatives that have been placed in apposition here, and they are not meant to be interchangeable. Superficially all "civil" and "military" research involves an application, and hence is "applied" research. The two phrases have been paired here for convenience, because what is said about one of them often refers equally well to the other.

The following table provides a good introduction to the issue. It is taken from a paper by Morton to the first International Symposium on Aerobiology, which is clearly a symposium relevant to "military" BW.

Relationship of aerobiological techniques to useful situations

Condition	Relevance to: Medicine	Defense	Theory
Transmitted on artificial medium in vitro	No	Yes	Yes
Grown on artificial medium	No	Yes	Yes
Stored in resting suspension	No	Yes	Yes
sprayed from artificial menstruum	No	Yes	Yes
Held in the dark	1/2	1/2	Yes
Held at controlled temperature and relative humidity	No	No	Yes
Held in monodispersed cloud	No	No	Yes
Samples impinged violently	No	No	No
In fluid of "unnatural" osmotic strength	No	No	Yes
At "unnatural" temperature	No	No	Yes
Samples plated on artificial medium for "viability" (not infective power)	No	No	Yes

Source: /11/

The primary purpose of Morton's paper was to criticize the unphysiological conditions of many aerosol experiments, but he incidentally found no difficulty in separating those experimental procedures and conditions that would be utilized in an experiment having medical interest, ("civil") from those having defense ("military") interest. Theory represents "basic" research, and of course can be invoked to explain the investigation of any variable one can imagine, of any phenomenon or item, living or inanimate, in the natural world and its experimental intervention or manipulation. "What will x do to y , and what does that tell us about what y is and how y works?. When, however in a literature search one finds papers entitled: "Effect of Diluent and Relative Humidity on Apparent Viability of Airborne Pasteurella Pestis" or " A Freeze-Tolerant Solid Medium for Detection and Sampling of Air-Borne Microorganisms at Subzero Temperature" /12/ it really is not so difficult to place these items in one or another category concerning their presumptive or most likely context, though in the abstract both papers will certainly provide "basic" information about the biological organism in question. Categorizing the context of the papers becomes even easier when the second reference turns out to have concerned P. Tularensis (the organism which produces the disease tularemia) and when it transpires that both papers originated from Fort Detrick, the US military laboratory for BW R&D.

Another reference, also a product of Fort Detrick, makes the same point as Morton's table. An international survey of the design of microbiological laboratories, civil and military, that work with pathogenic organisms asked the follwoing question:

> Will infectious microorganisms be studied as aerosols, relative to
> (a) aerodynamic stability;
> (b) particle size;
> (c) mechanisms of accidental dissemination;
> (d) animal infectivity evaluations, temperature, humidity, and aerial chemical disinfectants;
> (e) other types of investigations? /13/

Depending on the answers to these questions, varying configurations of equipment are recommended. This is of course in part the basis of the feasibility on an inspection exercise or system. The corrolary is the implicit suggestion that it could be possible to distinguish the research that will take place in the particular facilities.

The blind "weighting" or assignment to categories that might be made on the basis of the title or an abstract of a research paper involves guessing the motive for the work and answering implicitly at least the following questions:

- What is the attribute of the natural phenomenon which the experiment is interested in understanding or altering?
- Are there any <u>civil</u> utilities already in existence in which that attribute or its alteration might intervene; if not, could one imagine any?
- Are there any <u>military</u> utilities already in existence in which that attribute or its alteration might intervene; if not, could one imagine any?
- If the answer to <u>both</u> civil and military is "yes", which plays a greater role in its respective sphere?

The central problem in the above task remains one of drawing boundary lines, although there would appear to be simpler solutions to the overall problem than making such differentiations. For example, one could point out that application to weapon systems is the overriding concern and that without it any amount of military research can be tolerated. If the research is not applied to new weapon systems, the problem does not exist. Unfortunately, given the existing institutional framework, the continuous pressure for weapons succession, the level of secrecy in weapons development in some nations, this is a very idealized expectation in the present world and one cannot avoid the necessity of evaluating whether a piece of research is "civil" or "military" in nature. The critical questions are:

What knowledge is being sought, by whom, and why?

If one cannot answer these questions, another way of approaching the issue is to ask:

(a) Who is paying for the R&D?

(b) What is the subsequent information distribution process; who is gathering or monitoring the results; how is it distributed, utilized, applied?

From a purely scientific point of view, militarily relevant research does not have to be funded by the military, although experience indicates that it frequently is. Funding for military-related R&D can easily be channelled through civilian agencies — and in the USSR, this seems to be very much the procedure, particularly for the "basic research" portion of military R&D. With the clear demonstration of the dependence of major weapon systems on scientific developments in the years since World War II, defense departments have not been satisfied to wait and see what would "spin off" from civilian science. In this particular case that would mean waiting for BW-relevant data to come out of medical or biochemical research. Instead, it is military research that has in general pushed both the applied "state of the art" and the basic state of knowledge. It is not that difficult to ask in what disciplinary area of science and in what kind of research problems the answers to a particular question are to be found. Military research has done this, and has done it successfully. Defense research budget allocations have funded basic science. At times, however, it has been arranged that projects of specific interest to the military services be supported by civilian government agencies, and systems have been devised to enable the military services to monitor the results of that research which they themselves do not fund.

Another way to look at the problem is to ask a hypothetical question. Assuming the same levels of research funding that existed in the United States in the period 1950 to 1970 but with the US National Science Foundation (NSF), the National Institutes of Health (NIH) and the Department of Agriculture as the only sources of funding for all US biological research within the existing criteria of their own defined missions, and omitting the mission and direction of interest that formerly existed at the US Army's military R&D facility Fort Detrick, what is one's estimate of how much of the research that was carried out in Fort Detrick would have been supported by these other agencies? In order to distinguish military from civilian R&D, one must then ask:

- Is the CBW-relevant R&D being done at an "in-house" military or defense laboratory (Detrick, Porton, CDE), etc.?
- If not, is it funded by defense budgets?
- If not, and there is military utilization of the research, how is it funded?

Intention, the motive for the research, and not the justification that happens to be expressed by the researcher in the introduction to a journal paper, is paramount. If no CBW-relevant basic research were done by defence laboratories and if it were all funded by NIH and NSF, but if the research results then went to industrial or in-house military development projects, the situation would be exactly the same as if the defence laboratories had carried out the work. For example, when the Mathieson Chemical Corporation took over the management of Fort Detrick in 1953, "somewhat over 100 existing subcontracts for research carried on in universities and commercial laboratories to further and to supplement the investigations at Camp Detrick were also transferred to Mathieson". /14/

Another example appears in an item concerning the Project Pacifica studies discussed in section 5, below. The following question was posed to and the reply comes from Dr. John S. Foster Jr., Director of Defense Research and Engineering, US Department of Defense, in 1968.

> Does the Army use any discretion as to what types of institutions should be encouraged or pressed into accepting funds for work in chemical and biological warfare? Does the Army see any conflict in asking a purely civilian institution, such as the Smithsonian, to do work that might conflict with the institution's activities abroad?
>
> Answer: The Army certainly uses discretion in selection of all of its contractors. The advice of the Smithsonian Institution was sought in identifying a suitable institute to do this work. As a result, they submitted a proposal, which was accepted. As a direct consequence of this work, there have been 45 papers written by Smithsonian scientists and published in the scientific literature. This has been a remarkable productive scientific investigation brought about by a coincidence of interests in the fauna of the area.

> The Smithsonian Institution was never asked to do, nor did they do, any "military" chemical and biological warfare research. It carried out scientific investigations appropriate to its charter and objectives, and published the significant findings in the scientific literature. These results are available for use by the Army, by any other government agency, or by any nation or scientist wishing to do so. /15/

This exchange also provides an answer to the usually irrelevant question of whether publications based on defense-related research appear in the open literature. There are other very similar examples of the above interrelationship of military contracting agency and operating research performer; Dept. of Defense contracts with the US Dept. of Agriculture to study tropical forest ecology and herbicide impact in the early and mid-1960's /16/, similar studies contracted to the Smithsonian institution /17/, research symposia on leaf abscission and DNA transformation conducted by the American Institute of Biological Sciences /18/, and in arborvirus surveys also carried out by the Smithsonian Institution (discussed in section 5 below).

The way in which funding programs can and do influence the training of scientists was explicitly demonstrated in several Canadian government reports in the early and mid-1950's.

> After several months' study of the problem the Committee reported that the principal limiting factor in Canadian BW research was the fact that there were not enough medical bacteriologists in Canada to meet even the civilian needs of the population. The Committee recommended that the Defence Research Board should give financial support to the training of bacteriologists, and that medical graduates should be offered positions on DRB's staff and be given two-year postings to university laboratories for post graduate bacteriological training. (1950)
>
> The Committee noted that DRB (Defence Research Board) was not making full use of all the available BW research facilities and staff at some Canadian universities and pointed out that additional grants-in-aid could later be established if this became desirable (1955). /19/

The attempt to define categorization criteria may be simple in some cases or face complications in others, but as the table by Morton shown on page 10 indicates, categorization is possible, even if it cannot be made with absolutely certainty in all cases. Nevertheless, establishing such criteria may very well attack the problem at its least profitable end. Once one can reasonably assume that a government intends to develop a particular category of weapons (in this case CBW), all boundaries one might attempt to set become artificial. Both the US and the USSR were known to have developed offensive military capabilities in the chemical and biological areas.

Once there is an offensive chemical or biological warfare capability or the intention to develop one, the purest and most basic science relevant to such a capability will or can be intended to play a role in strengthening that capability: what is the basic nature of the agent, how does it interact with environmental factors on the way to its target, and once in its target what can be done to the agent, or by supplementing it, to minimize any interactions that lessen its potency? All such questions are answered by scientific research that can without any doubt be called "basic". "Applied" is really an administrative, rather than a scientific, descriptor. It is a measure of how far down a chain of an envisaged application the "basic" research happens to be. The basic-applied paradigm is thus often specious.

Several examples have been selected at random to illustrate the multiple relevance of many areas of scientific research both to BW and to civilian activities.

1. The development of a polyvalent vaccine containing 10 to 20 different antigens has been made possible through zonal centrifugation cell separation techniques which produce fractions of great purity /20/. In a wartime situation, especially one in which BW were intended or expected to be employed, the desirability of such multiple vaccines is obvious.

2. The very same device responsible for the above development appears again in the following:

   In a US Department of Agricultural Forest Service program now underway, the zonal centrifuge's ability to concentrate and purify viruses in large quantities is being directed toward the development of viral insecticides. /24/.

   Purified viruses may of course be relevant to the development of a viral BW weapon.

3. Spray systems for solids and liquids and adapted to small aircraft and helicopters for agricultural use are proliferating rapidly and widely around the world, in technologically advanced and in underdeveloped nations. They spray pesticides, fertilizer and herbicides. The droplets produced by the spray devices are quite small, as low as 20 microns. /22/

4. Together with this development there will be in the coming years increasing interest in biological methods of insect control /23/. Some of these utilize microorganisms, such as Bacillus Thuringiensis. This preparation is already available on the commercial market /24/. Encapsulation methodology is being developed for use with this and with other microorganisms for pest control purposes /25/. Insects which parasitize other insects are also now air delivered, as are sterilized male insects utilized in yet a third aspect of biological insect control /26/. In an insect pest eradication programme in Panama and Nicaragua in 1968 it was

US Air Force personnel (USAFSO) that carried out a series of air drops of sterile male fruit flies. Each drop required about nine million flies to cover an area of some thirty square miles /27/. The flies are dropped in simple bags. In 1972, the USSR reported that it had in operation a Leningrad factory which produced 50 million insects per day, a second in operation in the Moldavian region, two more in construction, and three more planned /28/.

5. Work in mass aerosol immunization has both offensive and defensive military application /29/. The offensive uses are self-evident; the defensive ones involve using the technique as a means of rapid immunization of city-wide populations in the event of a BW attack.

6. An article in Science describes the construction of a microbiological laboratory designed with the capability to deal with both civil and military functions.

> With the risks of biological warfare in mind, the Swedish Medical Research Council, which deals with military as well as civilian matters, established the bacteriological bioengineering unit . . . to study and develop techniques for the large-scale handling of pathogenic micro-organisms, particularly in connection with the preparation of vaccines. The work was not secret and remained compatible with the unit's status as a university department . . . Defense requirements have influenced the pattern of research. The gonococcus provided, at the outset, a test case for concentrated culture of notoriously fastidious pathogens . . . A two-phase liquid culture technique . . . was adapted to the preparation of tetanus toxin and anthrax antigen. /30/

It is more difficult, however, to provide a civil context for attempting as occurred at Fort Detrick to make mutant arboviruses, except perhaps for making attenuated arboviral vaccines /31/. It seems impossible to provide a civil context for the laboratory introduction of antibiotic resistant episome factors into Vibrio Cholera and Pasteurella Pestis /32,33 /. To provide clinical information of use for therapeutic purposes, it would be sufficient to screen cholera and pestis strains isolated from clinical samples to find if such an event had occurred naturally, and, in fact, the laboratory experiment introducing resistant factors would not provide such useful therapeutic information.

Going a step further, Ljunggren prepared the following table which he called "cover activities"; civil (or military) activities that would generate knowledge of simultaneous relevance to BW interests or to a BW programme. Utilization of the information derived from these activities would again be the crucial consideration.

Cover activities

1. Air pollution: study of simulant substances and their spread during various meteorological conditions. Samplers. Particle counters.
2. Clean air room: filters, samplers, viable bacteria (especially surgery), microbiological laboratory safety measures.
3. Biological control: Aerosol study with viable organisms in open air. Decay and its preventions, i.e. photoprotection, microencapsulation. Aerosolizers, etc.
4. Automatization of chemical and microbiological laboratory: Rapid detection and identification.
5. Vaccine production: large scale production of pathogens in continuous culture. Various forms of storage and transport.
6. Aerosol vaccination: As biological control but with organisms for warmblooded organisms. Challenge of vaccinated with pathogenic microorganisma.
7. Experimental infectious disease: Volunteers, dose-response. Airborne infection.

   (Field testing is possible under 1, 3, 6.)

To summerize the points made so far in this section:

a) One can certainly distinguish that some scientific research is oriented towards military activities or provides militarily relevant information.
b) It is not that difficult for a professional to guess at the military implications of other work.
c) The "military" or "civil" orientation may be no more difficult to distinguish in "research" stages than in "development" ones. The terms or concepts "research" and "development" are vague and are more ad hoc administrative labels than indicative of what occurs in the scientific laboratory: how experiments are designed, what information is being sought, what parameters of a natural phenomenon are being investigated.

The following is a classic example within the area of BW relevant interests of the process by which pure, basic scientific research develops knowledge with obvious relevance for weapons development. The Nobel Laureate André Lwoff was concerned with the evolution of viral organisms, their virulence, and with human reactions to viral infection, specifically the complex inflammatory response and the fever reaction.

> As a consequence of viral development in an infected animal, the temperature is increased and, in inflammatory zones, the pH is decreased. Both factors act in the same direction. They both tend to depress or even stop viral multiplication. /35/

Within a given pathogenic viral species, some strains are virulent and some are not. Some strains also have higher and lower optimum temperatures for their development.

> Viral development being remarkably influenced by temperature within the range of variation of the temperature of the animal body, sensitivity to temperature is necessarily a component of virulence. It is not the only one: sensitivity of the viral development to pH is another.
>
> ...
>
> From the available data, it already appears that the virulent strains are relatively insensitive to high temperatures and to low pH, and that they develop at a relatively high rate.
>
> ...
>
> In order to be virulent, a virus must multiply abundantly and/or destroy especially important groups of cells before its multiplication is first decreased and later on stopped by the specific responses of the host. Until the effective level of antibodies is reached, viral multiplication is under the potential control of the nonspecific responses. To be virulent, a virus has two solutions: either it does not elicit host responses at all or, if it elicits responses, it manages to be insensitive to them. /36/

These problems involved unsolved questions about the basic nucleic acid structure of viral DNA, of great interest to molecular biologists. Lwoff looked for a correlation between virulence and decreased sensitivity to temperature, that is, an increased optimum temperature for viral development. Obviously such strains would be able to flourish despite a fever reaction of the human host. By growing a given strain in the laboratory at higher or lower temperatures it is simple to select mutants with different temperature optima, and this had been done by several workers. It is also easy to select strains having low sensitivity to the other nonspecific responses of the organism that influence viral reproduction. Viral resistance to the nonspecific responses of the host turned out, of course to be among the components of virulence. It was even discovered that heat resistant strains of certain viruses are able to produce atypical and more severe clinical syndromes, having pathogenic properties absent in the original strain, and producing, as it were, a different disease entity. Ten years after his first review, Lwoff again summarized the situation in a paper presented at a conference sponsored by the Office of Naval Research.

> How does fever act at the cellular and molecular level? Virulent viral mutants are able to overcome the defense mechanisms of the (host) organism. What is the molecular basis of virulence? /37/

By this time there was experimental data to indicate the involvement of an intracellular particle (lysosomes) in the triggering of fever and the resulting supraoptimal temperatures produced to combat viral replication. Interesting details concerning host and viral enzymes contributed to a better understanding of the biological process. But the ten years of basic research added little to what was obviously militarily pertinent information which had first been reported in 1959: viruses that can develop at higher optimum temperatures were more virulent than those with lower optimum temperatures. In 1959 Chisolm had written:

> It is theoretically, and perhaps practically, possible by laboratory methods to increase the virulence of some of these (BW) agents to such an extent that they could break through the natural or artificially acquired immunities which now hold them in check. /38/

In all likelihood this statement had been made obsolete before it was uttered by research within and outside of BW establishments. General research in microbiology and in public health has always shown a very strong interest in mechanisms of microbial pathogenicity /39/, and an equally strong effort in BW establishments was aimed at the selection of various mutants that would enable candidate organisms to overcome natural and acquired human immunities. Enhanced virulence is only one characteristic that will improve such a capability. The symposium on Leaf Abscision, referred to previously, and published in full in the journal Plant Physiology, also illustrated the simple and direct relationship between excellent and undoubtedly basic scientific research and military interests. /40/ The symposium's subject matter had direct relevance to the military defoliation and herbicide campaign being carried out by the United States at the same time in Indochina. The symposium was held at Fort Detrick, but under the auspices of the American Institute of Biological Sciences.

(a) <u>The Real World Intrudes in Earnest: Sverdlovsk, April 1979, and its Aftermath</u>

The problem of separating civilian from military BW-related activities left the theoretical realm and took on an extremely serious character with major arms-control consequences in the spring of 1979. The Biological Warfare Convention which was signed by the US and the USSR in 1972 and entered into force in 1975 bans the <u>development</u>, production and stockpiling of microbiological agents or toxins, but permits signatories to engage in research for defense against such weapons. /41/ It is a treaty whose provisions thus extend to the rare limitation — if not the prohibition — of military R&D.

On or around 2 April 1979, an accident took place in Military Compound, or "Cantonment", 19 on the outskirts of the city of Sverdlovsk in the USSR. Military Compound 19 is reportedly a biological and chemical research and development facility. A US Congressional committee report subsequently described it as having been "long suspected of housing biological warfare activities" /42/. As a result of this accident there were reports of as many as 1,000 cases of pulmonary inhalation anthrax resulting in rapid death.

The Biological Warfare Convention obligates all parties to the treaty to "consult one another and to cooperate in solving any problems which may arise". On 17 March 1980, the United States formally requested the USSR "to explain whether they were developing germ-warfare capability or storing bacteriological agents in violation of an international convention..." /43/. The United States moreover publicly released its allegations on the day following the transmission of its diplomatic note to the USSR, as a review conference on the Biological Warfare Convention was underway in Geneva. Rep. Lester Aspin, a strong and consistent supporter of arms-control agreements with the USSR and the Chairman of the Congressional subcommittee responsible for the report, stated "The future of arms control hangs in the balance until we get a full, accurate account of what happened in Sverdlovsk" /44/. A Washington Post editorial was even more blunt in echoing the same sentiments: "The larger issue is how the Soviet government views its arms control commitments and how it weighs the risks and benefits of cheating" /45/.

The USSR replied within several days that an outbreak of anthrax had occurred in Sverdlovsk, but that the disease had been caused by improper food handling — the sale of anthrax-contaminated meat /46/. The USSR made portions of its reply public. Soviet publications aimed at the West referred to reports of the incident as a "forgery from the Central Intelligence Agency" and did not refer to the presentation of a formal request for clarification by the US Department of State to the USSR, or the USSR's official reply /47/. The explanations offered by the USSR were not considered credible and the United States Department of State continued to pursue the question through diplomatic channels, with no apparent improvement in clarification /48/. In all, there were three US-USSR exchanges of messages. The United States did not at any point lodge a complaint with the Security Council of the United Nations.

The USSR reportedly innoculates between one and two million people each year against anthrax. One might therefore have presumed that the facility in Sverdlovsk was devoted to producing anthrax vaccine /49/. It is known, however, that a non-virulent anthrax strain is used to produce the vaccine, and an accident [distributing its spores] presumably should not have produced virulent pulmonary anthrax. There should be no need for such a facility to lie within a military-restricted area unless it were performing both civilian and military functions. The public explanation of events offered by the USSR did not claim that the facility was a civilian vaccine production facility; in fact, it made no mention of the Sverdlovsk facility whatsoever.

Clearly the verification provisions in the Biological Warfare Convention had not functioned at all in the first case in which they mattered. Robinson writes: "We cannot doubt that the Sverdlovsk incident weighs heavily and adversely on the whole future of arms control. This was recognized from the start." /50/. In his chronology of US policy consideration regarding this event, Robinson lists the following:

14 March 1980:	Carter Administration decides to oppose inclusion of any language in the Final Document of the Biological Weapons Convention Review Conference (Geneva, 3-21 March 1980) that would suggest that the treaty was being complied with fully.
Later in March:	Carter Administration reportedly decides to reject the Soviet explanation, and, early in April through its Moscow Embassy, may request meetings with senior Soviet scientists to discuss the contraindicative evidence.
28 May 1980:	State Department announces that the US Administration will seek talks with Moscow about compliance with the 1972 Biological Weapons Convention.

The incoming Reagan administration summed up its official position as follows:

> The United States now has very good reasons for believing that the Soviet Union has violated the Biological Weapons Convention — an arms control treaty negotiated, signed, and ratified when the illusions of "detente" were most prevalent. We have evidence of an inadvertent release of anthrax bacteria from a highly secured military installation in the Soviet city of Sverdlovsk during the Spring of 1979. This incident points strongly, we believe, to biological warfare activities in the Soviet Union that exceed those allowed under the treaty for protective purposes. We regard the explanation offered by the Soviet Government — that the outbreak of anthrax was due to natural causes — as inconsistent with our analysis of the evidence /51/.

On the assumption that there were no biological weapons being produced at Sverdlovsk, the entire episode could have been simply and satisfactorily resolved if the USSR had invited in a neutral observation team to make an on-site inspection at the facility. Such a team might have come from the World Health Organization, for example. However, the USSR made no move to do this, and the implausible public explanations it offered only aggravated the affair.

In a way, there had been forewarning of the situation almost immediately after the Biological Weapons Convention came into force in 1975. There were a series of allegations in 1975 and 1976 that the USSR was building or had built between three to six facilities "... that may be capable of producing biological warfare weapons..." /52/. The locations were specified and one of these was Sverdlovsk. The reports contained gross ambiguities:

The allegations against the USSR could have easily been resolved by on-site inspection by a United Nations agency or another international body. As part of its comprehensive study of Chemical and Biological Warfare in 1969-1970, SIPRI carried out just such a biological agent on-site inspection exercise. Eight research laboratories in Europe (three in member-nations of the Warsaw Treaty Organization) and six production establishments (one in Yugoslavia, none in WTO member-states) were visited /59/. The exercise was considered to have been technically successful. There were, however, no inspections within the USSR /60/.

(b) "Offensive" and "Defensive" Research

Chemical and Biological agents seem to pose some problems different from other weapons. High explosives come in various packages, but characteristics remain essentially the same and no one is attempting to make an alarm system for high explosive mortars and shells (though there are now fire location radars for mortars and for artillery). The traditional view regarding offensive-defensive CBW research borderlines is that if one is concerned to provide the most efficient countermeasures against CBW attack, one has to have a clear idea of the forms that such an attack might take. To design alarm systems or develop decontaminants, one has to know the physical and chemical properties of potential CBW agents; to provide therapeutics or prophylactics, one has to know the pharmacological, immunological, etc., properties of potential CBW agents. This implies that defensive CBW research establishments must perform an actual search for potential CBW agents. If there is a great range of potential CBW agents — which there seems to be — some assessment must be made as to which of them might be most attractive to a potential enemy, and this implies an active examination of possible manufacturing techniques and performance on dissemination from possible weapons. The more fully such an assessment is made, the more knowledge is acquired about the offensive possibilities of new CBW agents, with the corrollary that if the nation conducting this research should decide to acquire CB weapons of its own, a large body of information would be available from which to design them. The more defensive research that is carried out, the shorter the lead-time required to reach an offensive capability after the initiation of a CB weapons procurement programme.

In principal this results in the conclusion that the offensive/defensive distinction must be drawn not in the nature of the questions asked or examined in the research done, but in the state of instrumental application that the work reaches, and that an appropriate stage for a distinction is that called "development", the elaboration of a model delivery system. The problem then is to define what development means. It is simple to go on and argue, as is often done, that it is necessary to produce a complete offensive weapon system so that defenses can be tested against an experimental attack with the real or simulated agents. The only difference between what the defender had developed and an offensive capability would be that of scale. There would be no difference in what was produced, only in the scale on which it was produced. This conventional view thus carries one far beyond the stage of research.

In 1969, Rosebury suggested that just such a formulation stood behind the United States' World War II BW R&D effort. He added that a deterrent rationale subsequently grew out of the programme /61/. In 1952 when Great Britain carried out BW tests off the Scottish coast "an admiralty spokesman . . . confirmed reports that the research in defensive germ warfare was under way" /62/. In 1954 the trials off Scotland were expanded by British tests in the Bahamas.

> Trials of methods of defence against biological warfare are to be carried out this year in Bahaman waters . . . An obvious requirement in planning defence measures against biological warfare is information about the distribution which results at ground level from the release of known quantities of material at different heights and under different conditions. Infectious or toxic material could be released as a fine powder, the equivalent of a smoke, or as a spray. The area covered depends in either case on the size of the particles or droplets. Both methods have been used in chemical operations for the control of plant pests, and there is a good deal of information about the patterns of distribution which result when release is at low altitude. Much less is known about the distribution produced by release at greater heights, as would be possible with some of the highly toxic materials known to be available. The more dependable climate of the Bahamas would offer advantages for this purpose. /63/

The United States carried out a large-scale nationwide program of simulant and live BW agent testing from 1949 to 1969, across the entire country, in cities, along coasts and highways and in the country side. /64/. BW research in Germany in World War II was also ostensibly "aimed at devising defensive measures against possible Allied use of biological agents and specifically against the sabotage efforts of guerilla fighters that menaced the German Army in Poland and Russia." /65/ But Germany had initiated such research long before it was fighting the Allies, Poland, or Russia. Japanese rationales for use of CW agents in the China theatre were similar. After World War II though West Germany was legally restricted from producing CBW munitions, it was under no limitations regarding CBW research. A situation was thus able to develop in which quite advanced research began to raise problems of offensive-defensive categorization:

> Towards the end of the fifties the (Federal Defence) Ministry established cooperation with an institution of the Frauenhofer Society, the "Aerobiological institute" in Aberg, ... As the Federal Defence Ministry was investing more funds in the institute, the projects ordered became more

> ambitious. In 1965, the ministry requested even microbiological tests within the stratosphere ... When in Autumn 1967 ministerial adviser Dr. W. Strathmann took over the ABC defence section of the Defence ministry, he found the experiments at ... (Aberg) ... so questionable that he had them stopped immediately and for ever. He motivated his action as follows: The experiments could be interpreted as a first step towards bacteriological warfare. /66/

The Canadian government position in the 1950's and 1960's also seemed confused and problematical. Regarding the Canadian testing range, Suffield, it was stated:

> Suffield is not directly concerned with development of chemical and biological agents which could be used by Canada's armed forces in an attack role. The fact remains however that as many such agents as possible have to be developed in the laboratory to develop, in turn, a counter-measure against them, informants said. /67/

While it was stated that it was the policy of the Canadian Defence Research Board "to undertake only the defensive aspects of biological research" and "it was recommended that the Canadian BW programme should concern itself only with the defensive aspects of biological warfare research", it was in this same program that;

> Throughout 1952 the chief emphasis at Suffield was on the testing of CW ammunitions for both the United Kingdom and the United States equipments. A new type of dynamic bursting chamber was constructed in this same year for the testing of BW munitions. /68/.

A published interview with Archie Penney, then Deputy Chairman of the Canadian Defense Research Board, produced only greater confusion about the distinction between offensive-defensive CBW R&D and testing. It seemed to prove that existing Canadian programmes had other than solely "defensive" purposes, and certainly were not intended to stress any distinctions if they could be identified. /69/. Penney's interview also raised the issue of multinational agreements and associations in regard to offensive and defensive CBW R&D and testing, in which knowledge was pooled. The British CBW laboratory, MRE-Porton, had retained its World War II wartime arrangements with that of the United States, Fort Detrick, /70/ and Canada and Australia had similar arrangements. In 1968 when this question was raised by a reporter at Porton's "open visiting day" it brought forth some interesting comments by Gordon Smith, the director of Porton, particularly in regard to this study:

> Another questioner, noting that MRE acknowledges reporting all its work to Fort Detrick, asked whether Detrick reported all its work to MRE. Gordon Smith replied: "We have access to their work, but this is supplied on a need-to-know basis." When the questioner asked him to clarify his answer, ... Gordon Smith went on to explain that since MRE is concerned only with the defensive aspects of biological weapons, it has no interest in Fort Detrick's offensive work. Asked whether the two can be separated, he responded, yes, they could, though there are some difficulties — or words to that effect. /71/

In contrast Michael Howard has written the following about the legitimacy of research into CBW.

> The point was very properly made that there can be no valid distinction drawn between research for offensive and for defensive purposes in this or in any other field of weapon technology /72/.

This is certainly true if one already has or intends to have an offensive force. In such a situation all distinctions between "defensive" and "offensive" military equipment are essentially meaningless; everything depends on operational usage. Certainly it should by now have been made abundantly clear that any single piece of research in CBW that has "defensive" relevance has by its very nature "offensive" relevance as well. Numerous examples can be extracted from the research done during the 1960's at Porton, the British Microbiological Research Establishment which illustrate this dual nature /73/. Beyond this, how much offensive R&D is or is not necessary for a defensive capability is difficult to determine. The descriptions of the mission of the US BW R&D installation was always simpler and less equivocal:

> William Jacobs of the US Biological Laboratories described the program of that facility. The Biological Laboratories are responsible for the conduct of research and development on offensive and defensive biological weapons. /74/.

> Today Fort Detrick's primary mission is the investigation of biological agents and weapons — and defense against such weapons. /75/

With the degree to which military research directorates have found themselves free since World War II, at least in the USA and the USSR, to pursue research into prospective weapon systems to their systematic conclusions, there is every reason for the appropriate divisions of these organizations given the responsibility for CBW weapon systems to push their work in these areas as far as they are permitted. The postwar process described in the opening chapter of this book has made the focus of advanced weapon research the technology of the weapon itself, rather than the political decision about the utility or function of the weapon. One should thus as a matter of course expect the realistic sounding analyses concerning the degre of "offensive" research that must be carried out within a "defensive" programme which were offered in the beginning of this section to be self-serving, and at least to some degree therefore suspect. These are the formulations of the military research directorates and no one with the equivalent knowledge has yet come forward with any other formulation. Very few individuals outside of military services and defence ministries or their scientific advisory boards have the requisite knowledge of how much would, in fact, be needed for defense, and how much not. Individuals in these institutions are not inclined to be public critics, and, in the very rarest of instances when they have been, it has not been in the context of the questions posed here.

The formulations described in the opening of this section sound complete and satisfying. They have always been the accepted military formulations. But more often than not they are rationalizations of the status quo and the desire to push research into offensive systems as well. In addition, the attempt to develop alternative formulations — and this study is an example of such an attempt — does not appear to produce simple and neatly summarized definitions. If one accepts that for "defence" one must research and develop "offensive" agents and delivery systems, then one must accept any, all, and as much offensive research as military directorates desire. Paradoxically the hard, realistic, conventional formulations logically imply full acceptance that no offensive systems will be procured, deployed or utilized. But having carried the research process so far, they produce the very scepticism and lack of faith which motivates inspection schemes. Scepticism is born of the frequency with which defensive systems are considered insufficient, and "deterrent" systems are considered necessary. It is therefore still desirable to attempt to understand how much of a research effort is aimed at a "defensive" and how much at an "offensive" capability by looking at the research and asking: what is it for? what is its probable payoff? how much to "defence"? how much to "offence". It is easier to defend this argument when one moves from generalizations to specific examples. Consider the following pieces of research.

— a 1967 summary of studies on "Microbial Survival In The Aerosol", describing research with 14 viral, 22 bacterial and mycoplasmic, and 2 fungal species /76/

— a 1967 summary of studies on "Additives to Spray Fluids", describing work with 7 viral and 6 bacterial species (77/

— a 1961 summary of "Infectious Diseases Which Have Been Intentionally Produced in Man", which lists 14 bacterial, 20 viral, 6 ricketsial, 5 spirochetal and 5 protozoal species. /78/

It is not as difficult as one might assume to evaluate whether the work has more meaning in an offensive context or a defensive one. Perhaps the only further conclusion that it is possible to add to those made heretofore is that all "defensive" research is "offensive" research as well, but that some offensive is more offensive than others — enough to cause scepticism. In this regard the detailed delineation of Porton's research activities on aerosol stability of pathogens, genetic manipulation of surface antigens, studies of virulence, etc., are excellent examples of the problem. /79/

(a) Requirement for a Deterrent

The need expressed by various nations for a CBW force or a CBW potential as a deterrent is discussed in the study produced in the early 1970's on Chemical and Biological warfare by SIPRI. It was also touched upon early in part 2 of this paper. Only a few additional points will be added here. (Deterrent against what or against whom will not be discussed here.)

— Some formulations require that in order to have a deterrent function one must have an offensive CBW force, while
— others state that one only needs an offensive capability.
— Other stated positions are that a purely defensive capability, (masks, shelters, protective garments, rapid detection and identification devices, an organization to deal with a CB attack, vaccines, etc.) would serve as a deterrent to CB use against oneself.

It is obvious that if the requirement for an offensive capability or force is accepted, it essentially makes all discussion on the "civil-military" R&D issue irrelevant. The arguments concerning how much offensive R&D is required to have a purely defensive capability would, however, remain.

For the most part a notion of specific deterrence is accepted; i.e. ones own possession of a militarily meaningful quantity of a specific weapon system deters the use of that weapon by a potential opponent. It is very possible that this has been or is plausible in particular nations and historical situations. However, it is also evident that in many cases the deterrent argument is used as a public apologia and rationalization for the policy choice of an offensive strike force. In such instances it becomes progressively more difficult with time to set limitations on the amount of capability required for the deterrent. In either case it is a difficult theory to argue, and R&D and weapons development issues would be lost in the face of the much more visible discussion around the deterrent strategy. This is in fact what has happened in the case of CBW, or at least in CW. As regards BW the deterrent aspect of the US BW effort became particularly problematical in the 1960's as there was no publicly available evidence that the USSR had developed and produced BW weapons.

(b) BW R&D Within The Industrial Sector: A Risk of Proliferation

In the study of arms control, discussion of military R&D of all kinds has uniformly suffered from being couched in vague, abstract, and unrealistic formulations, and from insufficient examination of the actual initiation of the research, how it is carried out, and the roles of the institutions involved.

BW R&D is performed by government laboratories, industrial corporations and private research institutes and under research grants to university researchers. Discussions concerning control of R&D usually focus explicitly or implicitly on the first and/or third of these institutions, and tend to omit the industrial sector. To some degree the considerations are similar, as the national government remains the final purchaser of the commodity and arbiter of its utility. But it is important to realize that in past years about 65 percent of the US CBW research and development budget has gone to private industry, specifically to chemical and pharmaceutical companies. /80/ No breakdown of this amount into its chemical and biological components is available. An examination of the US Government Research and Development Reports found that, of 104 institutions that produced unclassified reports related to C and BW, 58 were industrial or commercial organizations. The names of the largest American aerospace, chemical and pharmaceutical corporations appear in the list. It is possible to assume that somewhat more classified work occurs under industrial auspices than in the universities, but, if anything, these numbers suggest that a smaller proportion of CBW-related research takes place under industrial auspices than does defence-related research of other sorts. An inspection of CBW related projects listed in the US Technical Abstracts Bulletin supplies an analogous list of the foremost industrial organizations. From the project titles it seems very likely that the government is the initiator of the research projects.

In February 1968 the US Army Munitions Command of the Army Material Command, in affiliation with the National Security Industrial Association, presented an Advanced Planning Briefing for industry. The "Conference Objective" was described as follows:

> The objective of this conference is to keep industry informed on the long range research and development plans for munitions and related items. It is intended to present problems requiring solutions together with technological forecasts and assessments of the state of the technology. The conference is designed especially for industry executives who are advanced systems planners, directors of research and technology, senior engineers and individuals concerned with the formulation of corporate long range objectives. Individual briefings should provide the basis for future direct dialogue between industry and the government in the field of munitions and related items. /81/

Thirty-three technical presentations were made at the conference by Army Ordnance personnel, two of which are relevant to this study: "Biological Agent Development and Production" and "Biological Weapons Systems". A list of some of the 40 corporations represented at the conference again included the leaders of the aerospace and chemical industries. /82/ The US Navy apparently has held similar CBW-related conferences for industry. In some cases it appears that in this cooperative climate the industrial firm takes the initiative.

> The Hayes Corporation, which wants to manufacture the hardware, ('in quantity — to mount an engagement') already manufactures defoliation equipment for use in Viet-Nam, and is actively developing CBW hardware. At its own expense, Hayes is working on a number of (CB) weapons systems..." /83/

It is interesting that the question of the spread of information that could contribute to weapon development — and hence the international proliferation of CBW capabilities — via the employees of industrial corporations that have carried out classified R&D on behalf of the government has been discussed at least slightly in the area of nuclear technology but has never been considered in relation to CBW. It would seem that there is an unidentified potential for CBW proliferation in the numbers of CBW development contracts let to industry, and hence in the numbers of personnel within industry that have relevant knowledge and experience in these projects. Such individuals could then be hired for greater or lesser periods of time by other nations. There are no indications that there are any safeguards against such proliferation.

(c) BW R&D contracted abroad; a risk of proliferation

A similar potential for proliferation resides in the US practice of placing R&D contracts with scientists in foreign nations. Some fraction of these relate to CBW, though in most instances they are contracts for research rather than for development. In addition to the "DOD Requirements" quoted on page 7, their role may simply be to bring some research personnel abroad into areas of work closely related to CBW, and thus to produce new ideas for the contracting agency and to provide a nucleus of such individuals within the foreign scientific community.

> There are two primary reasons for the Army's support of foreign research. First, the individual scientific contribution achieved through the contract and grant program with foreign scientists. Second, the scientific liaison and communication facilitated by this program between scientists of Army laboratories and scientists pursuing research relevant to Army requirements around the world. This program has established for the Army a rapport with the world wide scientific community which is of significant benefit when compared to the relatively low level of funding involved. Some examples of the benefits from foreign research in the field of medicine are as follows: ...
>
> General Betts In the recent past we have cut back on our support of research in Europe. I believe that the work we are now supporting there is not only very good research, but for comparable research in this country we would have to pay higher prices.

> Mr. Sikes. What areas do you consider are of particular importance to us in foreign research?
>
> General Betts. There are always the obvious areas of medical problems indigenous to a particular country. But that is only a part of the answer, because outstanding scientists are where they happen to be found. If we can find a man who is particularly expert in some discipline, who is willing to work for us on a research program in some foreign country, it gives us a window on the total research effort in that discipline that we could get in a timely fashion by no other means. Consequently, for a relatively small amount of money, we buy the results of research that we might not be able to get any other way. /84/
>
> ....
>
> Because the research program is so broad in scope, the closest possible relationship also is maintained with research facilities of universities, industries, and Government agencies in the United States and throughout the Free World. Noted specialists from all parts of the world are numbered among the consultants who provide the program with the benefit of their knowledge and experience. /85/.

A wide reading of material concerning US Department of Defense support of scientific research in other nations makes absolutely clear that the main motive is the benefit to be derived by the US Department of Defense and its relevant programs and not, as is often stated for public consumption, the furtherance per se of science abroad.

— Not only is the effort not intended to be a duplication of domestic research, but it is hoped that a unique piece of research not available domestically is acquired.

— A researcher with some degree of special expertise, and with "high motivation" is acquired.

— The foreign researcher supplies a "monitor" function. He reads his domestic literature in his own language. He is presumed to know what other researchers in his own nation are doing that may be relevant.

— He is a useful contact, often suggesting relationships with DOD agencies to other researchers in his nation and alerting DOD overseas contracting officers of leads that would be of interest to them.

Fragmentary records for 1961 indicate that in that year academic scientists in Japan (5), France (1), Belgium (1) and Ireland (1) received CBW-related contracts. /86/ Hearings before the Senate Foreign Relations Committee in 1968 produced a list which included 23 CBW-related contracts in twelve nations supported by the US Army and active as of April 1, 1967. /87/ These were in Italy (5), West Germany (4), Israel (3), U.K. (2), Sweden (1), Brazil (1), Colombia (1), Uruguay (1), Japan (1), Switzerland (1), Venezuela (1), Austria (1) A more complete list (Research Studies Being Conducted Abroad, Active on Jan. 1, 1969, and funded by the US Army, Navy, Air Force and ARPA) entered into the US Congressional Record, Senate, in 1969, indicates 52 CBW related projects, contracted to academic scientists in 25 nations abroad: Australia (2), Austria (1), Belgium (1), Brazil (2), Canada (5), Ceylon (1), Colombia (2), Costa Rica (1), West Germany (2), India (1), Indonesia (1), Israel (1), Italy (1), Japan (9), Korea (3), Lebanon (1), Malaysia (1), Netherlands (1), Norway (1), Peru (1), Philippines (3), Taiwan (4), Thailand (4), U.K. (1), Uruguay (1). /88/. In some of these nations there is and unquestionably would be a large amount of nationally-funded research analogous to that financed by US agencies.

One other criterion seems to affect the selection of locale for overseas CBW relevant research and of reseach relevant to the medical requirements of conventional military operations. This is the availability of excess foreign currencies. This is clearly combined with a particular topic of interest, as the repetition of the same topic in different geographic areas shows.

Department of the Navy - Fiscal Year 1968 research undertakings proposed for financing from foreign excess currencies (in thousands of dollars).

Abbreviated title:	Country:	Amount:
Diseases in the Middle East	United Arab Rep.	1,250
Protective blood proteins	United Arab Rep.	100
Protective blood proteins	India	150
Toxinology	Ceylon	100
Toxinology	Congo	100
Protective blood proteins	Guinea	100

Mr. Sikes. What are some of the principal things being done?

Admiral Leydon. The principal project in the United Arab Republics is the study of diseases in the Middle East

Mr. Sikes. Who are we working with there?

Admiral Leydon. The activity at which the project will be carried out is the Naval Medical Research Unit No. 3 in Cairo, Egypt, which was established in 1946. This is an opportunity to use excess currency available in that country to fund their efforts.

Mr. Sikes. That is primarily what you are doing, is it not using up excess currency?

Admiral Leydon. Yes, to study research and development in biomedical sciences by that unit.

Mr. Sikes. Are both advantages which justify going to an area other than that of excess currency. This is not an area which is renowned for its scientific achievement.

Mr. Frosch. No, but it is an area in which there are a collection of epidemic and infectious diseases that are more or less unique to that portion of the world and where the best way to study the problem is to do medical work in that area. This is a matter of keeping our military medical knowledge in tropical and exotic diseases up and keeping our ability to work on those diseases in our armed services should it be necessary. /89/

Under these programs the United States financed studies in both Egypt and Israel during a period of intense conflict between both governments.

Earlier in this chapter areas of civilian application that would facilitate the proliferation of knowledge and technology applicable to BW were identified: biological insect control and aircraft spray techniques for agent dispersal, aerosol immunization, micro-encapsulation, and others. As in the case of the nuclear weapons non-proliferation treaty, portions of the Biological Warfare Convention could also be seen as paradoxically contributing to the spread of relevant technology rather than to its containment. Article 10 of the treaty reads as follows:

1. The States Parties to this Convention undertake to facilitate, and have the right to participate in, the fullest possible exchange of equipment, materials and scientific and technological information for the use of bacteriological (biological) agents and toxins for peaceful purposes. Parties to the Convention in a position to do so shall also cooperate in contributing individually or together with other States or international organizations to the further development and application of scientific discoveries in the field of bacteriology (biology) for prevention of disease, or for other peaceful purposes.
2. This Convention shall be implemented in a manner designed to avoid hampering the economic or technological development of States Parties to the Convention or international cooperation in the field of peaceful bacteriological (biological) activities, including the international exchange of bacteriological (biological) agents and toxins and equipment for the processing, use or production of bacteriological (biological) agents and toxins for peaceful purposes in accordance with the provisions of the Convention.

It has become something of a tradition for developing countries and some of the advanced industrialized ones as well to demand the inclusion of clauses such as these in various arms control agreements.

(d) Spinoff

'Spinoff' is the term applied to discoveries, techniques, or devices which are developed in the course of defence related R&D and which have, or are released for, their industrial or other civil applications. Justification for various kinds of defence related R&D or appeals for their support are often made in terms of their past or potential spinoff. CBW R&D is no exception./90/

> Furthermore it should be noted that biological warfare research, besides being dictated by councils of common prudence, frequently pays enormous dividends in the form of new medical and veterinary discoveries which may be used in civilian life. /91/

The largest compendium of such "dividends" from the US CBW R&D program was prepared in 1969, at a time when the program was being exposed to substantial criticism and public pressure. Its introduction states:

> Since the end of World War II, when the war-time restrictions on

> publications were removed, the scientists and engineers of Fort Detrick have published more than 1400 individual contributions to the scientific literature. These have described the results of research investigations in the biological, chemical, medical, and plant sciences; and in the various engineering specialties. The original observations recorded in these publications have made important contributions to the public welfare, and to scientific knowledge, particularly in the fields of agriculture, medicine, and public health. Examples include the development of vaccines and toxoids, quantitative techniques for the study of experimental airborne infection, improvement in the quality of laboratory animals, purification and characterization of the toxins responsible for food poisoning, gaseous sterilization, identification of hazards in the microbiological laboratory, air-sampling devices, and the development of standards for the safe transportation of biological materials. /92/

These arguments are irrelevant to the pros and cons of any defence related R&D, including that on CBW. Spinoff is fortuitous and unlooked for, though greater or lesser efforts may be devoted to its efficient utilization. By its very definition it can only be a fraction of the output produced. If one were primarily concerned to obtain the civilian application benefits, the research which produced the contributions listed above could have been carried out at the ivilian Communicable Disease Research Center in Georgia and would have produced even more of these contributions. It is therefore not very sensible to argue that spinoff justifies the disposition of resources to military R&D. If a government were primarily interested in civil sector benefits, the equivalent monies, manpower, administrative effort and research apparatus could be used for their direct development. It is specious to justify a primary venture, given higher priority and access to resources, on the basis of what is at best a coincidental or marginally beneficial by-product. /93/ That is simply a self-serving argument. It is notable that the constant praise of spinoff comes from the beneficiaries — the military and space R&D programme and its government administrators — of those primary resources rather than from sectors of the scientific community, the public, or even industry that on occasion benefit by the chance spinoff. "In the US . . . companies tended to say that the effect of spinoff was negligible, while federal agencies said that the importance of spinoff could not be overestimated." /94/

4 Medical Requirements of Conventional Military Operations

Research carried out to define the medical and epidemiological problems that would result from the initiation of conventional military operations in a particular geographical area is considered a legitimate concern of military R&D. It could, however, in many cases be indistinguishable from BW research if one does not know of the intended application of the information gained.

Research projects such as the following could clearly serve both civil and military purposes:

- Ecology and Distribution of Mammalian Ectoparasites, Arboviruses and their hosts in Venezuela. /95/
- Potential Vectors and Reservoirs of Disease in Strategic Overseas Areas . . . This project is concerned with the study of the vertebrate hosts and their parasites that are endemic to most of the areas in Africa south of the Sahara in order to obtain basic information needed to evaluate the actual and potential disease hazards that might be encountered during military operations. /96/
- Ecology of a Tropical Delta Forest Environment: . . . Data collected will be interpreted in terms of influence on military activities. /97/

Long term studies of large geographic areas have also been undertaken within this framework;

> Arthropods of Medical Importance in Africa is the first published result of a 15 year study of the worldwide distribution of arthropods being sponsored by the Office of the Chief of Research & Development, Department of the Army. The 800 page Technical Report was prepared by Cornell University under contract with the US Army Natick (Mass.) Laboratories. A similar report on Asia is being printed . . .
>
> Similar studies are scheduled for Latin America, Australia, North America and Europe. /98/

Volumes produced in the USSR describing local birds, flora, insects, mites, plant parasites, and so on are the object of an extensive translation program. /99/

Some comfort can be gained from the fact that it is only a few military powers whose interests and expectations encompass geographical areas of this magnitude. It is clear from the above examples, in which the research was undertaken by scientists at the Smithsonian Institution and at Cornell University, that all of the arguments and counter-arguments that would ensue on a public examination of the functions and intended utilities of this research would certainly be joined in these cases. The ad hoc solution of the puzzle supplied by a piece of research without the context in which it was sought and funded by the contracting agency, can at times remind one of the parable of the blind men and the elephant.

In the late 1960's the Smithsonian Institution was involved in public controversy over the Project Pacifica studies and similar studies performed in Brazil. /100/ The disclaimers were often contradictory and are exemplary of the public dissembling that is so common in this area. Points made in defence of the work on separate occasions and often in contradiction to one another included:

- the need of the information for conventional military operations
- the research produced a spinoff
- the defensive nature of the BW application
- the performing researchers were uncoerced
- the research results are published
- the performer was ignorant of the intended use of the research data.

Pentagon officials maintain that the studies, which have cost more than $3 million so far, are of public health interest "because we want to know what would happen with viruses and diseases if we (American troops) were in other countries.

Smithsonian officials say the studies are purely basic-research projects, initiated and proposed by Smithsonian investigators who want to understand more about the environment. Smithsonian researchers, according to Dr. Sidney R. Galler, assistant secretary for science at the Institution, are "free from pressure by the military, conducting research of their own choosing, just as any academic scientist would under a similar agreement." . . .

The Smithsonian's Galler says there is no question that the Defense Department has some biological-warfare interest in at least one of the two projects headed by an ornithologist loosely attached to the Institution's Museum of Natural History. Support for the bird study of the Pacific Ocean Biological Survey Program has, in fact, come directly from Fort Detrick.

But Galler stresses that this kind of zoogeographic, ecological research, by its nature, could be useful for public health and epidemiological purposes, as well as for biological warfare. And it is likely says Galler, that any bacteriological-warfare use would be of a defensive nature.

"What they (the DOD agencies) do with the data I don't have any idea." Humphrey said. "We just send them copies of our results."

Both of Humphrey's studies are aimed at understanding the modes and methods of transmission of various rare diseases by tropical birds, Humphrey says.

Galler, (who spent 15 years on the staff of the Office of Naval Research before coming to the Smithsonian), however, sums up the whole situation with a bit of philosophy aimed at the "chain-rattling university professors" who "have hurt us worse than our enemies could have" over the issues of chemical and biological warfare, and military research, both classified and unclassified.

"We have a commitment as scientists and engineers to find the truth", he says. "If our nation can make use of that knowledge for national defense purposes, should we be sorry? Knowledge and truth are universal and, so long as we seek them openly and honestly, we never need to be ashamed."

. . . .

Downs of Rockefeller and Yale says that Philip S. Humphrey... is doing ecological research on birds in the Amazon basin — not virus research. But a Humphrey assistant working at the Belem Lab, Thomas Lovejoy of Rockefeller, is studying birds and viruses under grants from the Air Force and the US Public Health Service.

Downs says that Humphrey "will get money from wherever he can." Furthermore, he says, research results on tropical birds and viruses are of use to the military and should be made available to it.

> "I was in the Solomons during World War II," he adds, "and I saw the effects of disease on the troops. All this yak-yak about we shouldn't do anything of use to the Army is a lot of damned foolishness." /101/
>
> Almost no one believes that the Army's explanation of why it is interested in the project is the complete truth. In fact, Humphrey, the project's director, says he learned "fairly early" in the survey "why the military is interested in this in a general sense." He says he is "sure" the Army wants to test CBW in the Pacific and is looking at the findings of the ecological survey to be certain that any potential site is "safe". But he says the Smithsonian itself is not trying to pick such a site; it is simply trying to learn more about the animal and bird populations of the area.
>
> . . .
>
> All in all — if one can accept the testimony of the scientists involved — the Smithsonian has behaved much like hundreds of other institutions and researchers who accept Defense Department support. It is conducting a basic research project that it believes has great intrinsic merit; it is accepting Army money to finance the project; and the Army presumably is using the results for military purposes. /102/

insert: clear relation of the Pacific project to BW testing was later identified

The portion of the Smithsonian studies which were carried out in the central Pacific could have several support functions for BW testing which was reported to have taken place on Eniwetok Atoll. /103/

The problem of clear assessment is compounded in that the funding for the Brazilian projects was supplied by the National Institutes of Health, the Rockefeller Foundation, the Air Force Office of Scientific Research, the Army Research Office and the Brazilian Ministry of Agriculture. Brazilian biologists were also involved in the project studies.

The Smithsonian-Army studies in Brazil also serve as an example of how broadening defence interests gradually involve and subsume areas of scientific concern which may already have been in existence for many years without any defence relationships. The virus laboratories at Belem, Brazil, at which part of the research discussed above was done, were originally set up and funded entirely by the Rockefeller Foundation. In the mid-1960's the world-wide Rockefeller arbovirus research program was transferred to various universities and government sponsored laboratories. /104/

Insofar as the studies in Brazil were concerned with discovering unknown virus species, they bear a relationship to some of the worldwide field survey activities of the US Naval Medical Research Units, NAMRU /105/. The mission of the NAMRU units "is to collect information on infectious diseases of potential military importance". In many cases the publicly stated activities of these groups might be described without too any reservations as being within the requirements of US military personnel in the area, or even to be

In other examples the US Navy was concerned with surveying windborne insects, pollen, and bacteria over the Pacific airspace /112/ and the US Air Force with gas chromatography for the identification of bacteria /113/.

In an exercise similar to Morton's (see page 10) Wilkes prepared the following table estimating the uses to which a series of 28 research projects described in the April 1967 Annual Progress Report of the SEATO Medical Research Laboratory (Bangkok) could be put. /114/

Fields in which research is being undertaken by SEATO Medical Research Laboratory and its relevance to Thai public health, to US military health and to US biological warfare research

Field of Research	Relevant to			
	Thai health	US military health	BW	Misc.
Arboviruses	x	x	x	
Bladderstones	x			
Cholera	x	x	x	
Diarrheal infections	x	x		
Ecology of gibbons				x
Ectoparasites	x	x	x	
Enteroviruses	x	x		
Meningoencephalitis	x			
Gnathostamiasis	x			
Growth and development	x			
Hematology	x			
Laboratory animals				x
Leptospiroses	x	x	x	
Malaria	x	x		
Melioidoses		x?	x	
Mollusca	x			
Mosquitoes	x	x	x	
Mycotic diseases	x	x	x	
Neurology	x			
Neuropsychiatry		x		
Nutrition and metabolism	x			
Rabies	x		x	
Renal studies	x			
Respiratory viruses	x	x		
Rickettsial diseases	x	x	x	
Trematodes	x	x		
Venereal diseases		x		
Zoonoses	x	x	x	

Wilkes' table and that by Morton presented earlier, extracted from the <u>First International Symposium on Aerobiology,</u> are the only attempts known to this author to assign utility values to specific biological or bacteriological research studies in an effort to distinguish between R&D useful for civil public health purposes and military purposes, including BW. (Morton focussed on experimental design parameters while Wilkes examined specific research projects.)

5. The conversion of the US biological warfare facilities

The control of BW provides a very rare case of the recorded conversion of military R&D facilities. This instance is all the more interesting because the nation concerned was producing biological weapons. The USA closed and converted its two main BW R&D and production facilities, Fort Detrick and Pine Bluff Arsenal, subsequent to the renunciation of the US military biological warfare capability.

Britain also converted its single biological warfare R&D facility, but its size was much smaller and it had not been doing offensive work for many years. After the end of World War II Britain's biological warfare laboratory was renamed the Microbiological Research Department. In 1957 it terminated work on the development of offensive BW programmes and the facility was again renamed as the Microbiological Research Establishment (MRE). In 1979, after the BWC had come into force, the MRE was transferred from the Ministry of Defence to the Department of Health, and became the Centre for Applied Microbiology and Research within the Public Health Laboratory Service. At the same time Britain's Chemical Defence Establishment (CDE) assumed responsibility for work on biological defence as well by setting up a new Defence Microbiology Division, and eventually the entire facility at Porton Down was renamed the Chemical & Biological Defence Establishment (CBDE).[22]

In the United States the process began in March 1969 when the US National Security Council began a major review of US policy concerning biological warfare. The government agencies participating in the review were the Department of State, Department of Defense (DOD), Arms Control and Disarmament Agency (ACDA) and the Office of Science and Technology. Comments were also received from the scientific community and evaluated by the President's Science Advisory Committee. Pending the outcome of the study, the Department of the Army ceased all production of toxins and biological agents and the filling of dissemination devices with these agents on 15 August 1969. On 25 November 1969 the President issued an announcement of US policy regarding biological warfare which included the following:

1. The USA would renounce the use of lethal biological agents and weapons and other methods of biological warfare.

[22] Carter, G. B., '75th anniversary: the chemical and biological defence establishment (CBDE), Porton Down, 1916–1991', *ASA Newsletter*, no. 4 (Aug. 1991); Carter, G. B., 'The Microbiological Research Establishment and its precursors at Porton Down, 1940–1979', *ASA Newsletter*, no. 6 (Dec. 1991); Carter, G. B., 'The Microbiological Research Department and Establishment, 1946–1979', *ASA Newsletter*, no. 1 (Feb. 1992).

2. The USA would confine its biological research to defensive measures such as immunization and safety measures.

3. The DOD would prepare recommendations for the disposal of existing stocks of bacteriological weapons.[23]

On 14 February 1970, a White House announcement extended the policy to military programmes involving toxins, whether produced by biological means or chemical synthesis, and directed the destruction of toxin weapons and stocks which were not required for defensive research programmes.

There were two primary results of these policy decisions: first, 'demilitarization', the name given to the programme to destroy existing BW stockpiles, and second, the conversion of BW R&D and production facilities. In addition, the US Congress passed legislation which mandated the preparation of a public semi-annual and later annual report to the Congress by the DOD on funds obligated in chemical warfare and biological research programmes. Subsequently, when annual Arms Control Impact Statements were initiated by the US Government in the late 1970s, these routinely included an analysis on chemical warfare.

Before turning to an examination of the conversion experience, it is useful to provide a brief description of the 'demilitarization' programme and the subsequent public reporting of information on R&D activities in the chemical and biological area.

Plans for the destruction of BW stockpiles were approved by December 1970.[24] Stocks were located and would be destroyed at four separate sites. The destruction plans were reviewed by officials from several different federal and state agencies, including the US Department of Health, Education and Welfare (HEW) and the Department of Agriculture. Observers from both of these agencies were also appointed to monitor the entire programme. The agent destruction was carried out with substantial publicity which included press briefings, information releases and public tours.

On 1 May 1972 the former Pine Bluff Arsenal was turned over to the Food and Drug Administration (FDA) of the Department of HEW as a new National Center for Toxicological Research (NCTR).[25] The entire destruction programme was carried out on the schedule outlined in table 8.1.

For some years prior to 1973, the DOD supplied Congress with a semi-annual report on its chemical and biological warfare research, development, training and evaluation (RDT&E) programme. Beginning with the report transmitted in November 1973, classified information was removed from the report so that it could be released publicly.[26] This would presumably enable any interested foreign nation to satisfy itself that the United States was adhering to the restrictions that had been established on its biological warfare R&D programme.

[23] *Statements by the President* (White House, Office of the Press Secretary: Washington, DC, 25 Nov. 1969), 2 pp., mimeo.

[24] *Pentagon Press Briefing on the Biological Demilitarization Program,* 21 pp., mimeo.; US Department of Defense, 'Demilitarization of biological agents and weapons', *Press Release*, no. 1025-70 (18 Dec. 1970), 1 p.

[25] 'Demilitarization' (annex L), *US Army Activity in the US Biological Warfare Program*, vol. 2 (US Army: Washington, DC, 24 Feb. 1977), pp. L-1–L-11.

[26] 'Department of Defense Semi-Annual Report on Chemical and Biological Warfare Programs', *Congressional Record,* Senate, 2 Nov. 1973, pp. S-19818–S-19830.

Table 1. Destruction of US biological warfare agents

Facility	Stored agents	Destruction completed during
Directorate of Biological Operations, Pine Bluff Arsenal	Antipersonnel	10 May 1971–1 May 1972
Beale Air Force Base	Anticrop	By 10 Mar. 1972
Rocky Mountain Arsenal	Anticrop	By 15 Feb. 1973
Fort Detrick	Anticrop	17 Jan.–18 May 1972

Source: 'Demilitarization' (annex L), *US Army Activity in the US Biological Warfare Program*, vol. 2 (US Army: Washington, DC, 24 Feb. 1977), pp. L-1–L-11.

Subsequent reports were published in the *Congressional Record*, at first bi-annually, and after a congressional modification in the reporting requirements, annually.[27] A further mechanism which enhanced the transparency of the US chemical and biological R&D programmes were the *Arms Control Impact Statements* submitted to Congress beginning in 1978.[28]

The two major facilities affected by the US decision of November 1969 were the Army's Biological Defense Research Center at Fort Detrick, and the Division of Biological Operations, the production facility at Pine Bluff Arsenal. The disposition of the biological complex at Pine Bluff (which was physically distinct from a CW production area that was also in operation at the arsenal) turned out to be the simpler of the two.

It consisted of 33 buildings, in operation since around 1953, at which about 300 people were reportedly involved in as many as 40 R&D programmes.[29] The solution of engineering problems associated with the safety and control of the production processes necessary to culture and store infectious micro-organisms and toxins had resulted in very specialized facilities. Nevertheless on 12 January 1971, very soon after the announcement of the approved plans to destroy the biological stockpiles at Pine Bluff, the Commissioner of the FDA wrote to the Secretary of the Army proposing that the FDA take over the installation and establish a National Center for Food and Drug Safety at the site. Pine Bluff Arsenal had by then already been visited by FDA personnel, who found that it could be adapted to the needs of their agency. The new centre would 'examine the biological effects of a number of chemical substances which are found in man's surroundings, such as pesticides, food additives, and therapeutic

[27] *Congressional Record,* Senate, 11 Mar. 1974, pp. S-3334–S-3348; *Congressional Record,* Senate, 12 Sep. 1974, pp. S-16508–S16521; *Congressional Record,* Senate, 17 Mar. 1975, pp. S-3999–S-16349; *Congressional Record,* Senate, 19 Sep. 1975, pp. S-16348–S-16357; *Congressional Record,* Senate, 11 Feb. 1977, pp. S-2709–S-2723; *Congressional Record,* Senate, 17 Mar. 1978, pp. S-4025–S-4040; *Congressional Record,* Senate, 19 July 1979, pp. S-9921–S-9939.

[28] For example, US Congress, Joint Committee Print, *Fiscal Year 1980: Arms Control Impact Statements*, 'Chemical warfare', 96th Congress, 1st Session (US Government Printing Office: Washington, DC, Mar. 1979), pp. 218–83; US Congress, Joint Committee Print, *Fiscal Year 1981: Arms Control Impact Statements*, 'Chemical warfare', 96th Congress, 2nd Session (US Government Printing Office: Washington, DC, May 1980), pp. 306–38; *Fiscal Year 1982: Arms Control Impact Statements*, 'Chemical warfare', 97th Congress, 1st Session (US Government Printing Office: Washington, DC, Feb. 1981), pp. 34717–52.

[29] *Problems Associated with Converting Defense Research Facilities to Meet Different Needs: The Case of Fort Detrick*, Report to the Congress, by the Comptroller General of the United States, B-160140 (US Government Printing Office: Washington, DC, 16 Feb. 1972), pp. 9–10. An unpublished study was prepared for a UN Secretary-General's working group on military R&D in 1983–84; see Longwell, V., *Fort Detrick: From Biological Warfare to Cancer Research*, mimeo., undated. It was not used in preparing this paper.

drugs. Pine Bluff Arsenal would become a major research centre for the purpose of studying the significance to man of toxicological data obtained from animal testing'. The main effort would be a very large-scale animal screening programme. FDA officials expressed their intention of employing all of Pine Bluff's professional personnel and most, if not all, of the other personnel. The new centre was named the National Center for Toxicological Research and conversion was completed in an opening ceremony in the spring of 1972.

Determining what new research would be undertaken at Pine Bluff Arsenal was free of the decision-making elements that introduced complications at Fort Detrick. Aside from the main effort in animal testing, which seemed clearly established as the primary programme, a study paper proposed a large group of research projects that might be undertaken in the future. These fell into two groupings. One group was clearly based on new priorities and needs, and concerned pollution and pesticide problems, recycling and food production. These included: (*a*) selective biological destruction of undesirable plants; (*b*) viral control of algae; (*c*) disposal of toxic wastes by micro-organisms; (*d*) destruction of pesticides by micro-organisms; (*e*) control of oil spills with micro-organisms; (*f*) utilization of waste material; (*g*) production of single-cell protein food supplements, amino acids and growth factors; and (*h*) production of cellulose and other enzymes.[30]

A second group of research topics, however, was either much more closely related to and/or made more particular use of Pine Bluff's existing specialized facilities: (*a*) microbial insecticides, (*b*) viral and rickettsial vaccine production, (*c*) production of bacterial and fungal vaccines and toxoids, (*d*) aerosol immunization, (*e*) development of decontamination systems, (*f*) aerosol applications of air pollution control, and (*g*) development of rapid, automated bioanalysis techniques.

Hedén has pointed out that these topics 'belong to the areas . . . where the reciprocity of international cooperation and fellowship programs might serve a verification purpose', as it is this group that comes closest to classical biological warfare research. He indicated that 'it would be unwise to initiate one of the projects: "production of toxins, specific bacterial pathogens, viruses and rickettsiae", before such international cooperation had started'.[31]

It is not clear to what degree, if at all, any of these proposed projects were subsequently carried out at the new NCTR.[32] The important context is the intent to convert facilities in which military R&D has been carried out, after weapon development of that type is renounced. If existing biological warfare facilities are converted, it is clearly beneficial from the disarmament and arms control standpoint the more 'distance' there is in the projects chosen for the converted facility from those that might have biological warfare relevance as well. Thus *from this standpoint* research in production of cattle feed from paper waste, or of fertilizer, cattle feed or single-cell protein from mixed waste—all processes in which there already existed research in 1972—would clearly have been pre-

[30] *Concepts for Future Utilization of the NCTR Facilities*, 1 June 1972.

[31] Hedén, C. G., 'Global monitoring of the environment, a factor in the control of CBW-research', Seminar on Chemical and Biological Disarmament, Helsinki, Finland, 20–30 Sep. 1972, pp. 13–14. See also Hedén, C. G., 'The opportunity for a redeployment of military microbiology', Seminar on Microbiological Control of Insects, Helsinki, Finland, 8–9 June 1977, mimeo.

[32] Schmeck, Jr, H. M., 'Deadly arsenal turned into a health research center', *New York Times*, 23 Feb. 1975.

ferable to projects in biological methods of pest control or in aerobiological aspects of disease spread or control, and even more so to viral and rickettsial production, however useful knowledge or products in the latter areas might be. It would simply allay suspicion of intent. This would be so despite the fact that research in biological methods of pest control might already be under way in the laboratories of an agriculture ministry in the same country, and that such research would continue. It would equally be so even if a military agency possessed the ability to monitor and attempted to adapt such research results in the absence of any other analogous research of its own. This example in fact points to the explicit formal relationships that underlie judgements of intent in areas of prospective weapon development.[33]

At the time of the US decision in November 1969 to curtail its biological warfare R&D programme there were roughly 1800 professional, technical and support personnel employed at Fort Detrick.[34] It was a very much larger facility than Pine Bluff Arsenal, with 460 individual structures and a value of $190 million. The Army estimated that the number of people required and the basic operating costs of the Fort Detrick facilities—300 people and $6 million annually—were alone equal to the totals involved in the transfer of Pine Bluff to the FDA. An additional complication was that the Army had originally hoped to retain all of Fort Detrick's research personnel—which turned out not to be feasible—and that while several different federal agencies expressed interest in the laboratories none of them seemed willing to allot the funds required for the conversion out of their existing budgets.[35] The final resolution was that some portions of the military programme were moved from Fort Detrick, some remained, and several new research institutions arrived with the result that after 1972 some half dozen federal programmes shared the facilities:

1. 240 civilian and 190 military personnel were relocated to the Dugway Proving Grounds in Utah. This represented 19 to 24 per cent of the research personnel of the original installation.[36]
2. The Analytical Science Office and the Biological Defense Material Division studying physical defences against BW, representing some 40 research personnel, were transferred from Fort Detrick to Edgewood Arsenal, Maryland.
3. Civilian personnel, equipment and facilities of the Plant Sciences Directorate of Fort Detrick were transferred to the US Department of Agriculture in April 1971 to continue the work on defence technology against crop disease, in accordance with a recommendation made by the President's Science Advisory Committee. This involved 20 researchers.

[33] These interrelationships were investigated in a larger study by the author, *Research and Development in Chemical and Biological Warfare: An Examination of the Possibility of Distinguishing Between Civil and Military, Offensive and Defensive R & D.* This study was prepared for the Ministry for Foreign Affairs, Sweden, in 1983, and an earlier examination of some of the same issues was presented by the author in a paper to the International Congress of Microbiology, Mexico City, 1970.

[34] *Problems Associated with Converting Defense Research Facilities to Meet Different Needs: The Case of Fort Detrick* (note 29), pp. 16, 27. The exact number given in the GAO report to Congress is 1 792. Other numbers have appeared in the literature: 1 595 civilians and 650 military, for a total of 2 245 in Goldhaber, S. Z., 'CBW: interagency conflicts stall administration action', *Science*, vol. 169, no. 3944 (31 July 1970), pp. 454–56; and 1 685 civilian plus 160 military, for a total of 1 845 in Boffey, P. A., 'Fort Detrick: a top laboratory is threatened with extinction', *Science*, vol. 171 (22 Jan. 1971), pp. 262–64.

[35] See Boffey (note 34).

[36] See Goldhaber (note 34).

4. Research in the field of medical defences against biological agents was transferred to the US Army Medical Research Institute of Infectious Diseases (USAMRIID) which remained at Fort Detrick. In 1977 it had 461 employees.

5. The US Navy also continued to maintain a small medical research detachment at Fort Detrick.

6. The President's decision in October 1971 to establish a branch of the National Cancer Institute, part of the National Institutes of Health (NIH), Department of HEW, at Fort Detrick reflected purely domestic political considerations rather than scientific priority.[37] Once the decision had been made on the major area of new work to be done at Fort Detrick, it was considered desirable for economic reasons to retain as much of the equipment and performance capacities of the former laboratory as possible. Thus the National Cancer Institute concluded that the principal activities for which the facility was suited were: first, the large-scale production and testing of viruses in cancer research, and second, the breeding and location of animals to be used in large-scale screening programmes. The cancer research programme was to be managed by a contractor, and was expected to employ 200 people.

By early 1972 most of the professional staff not absorbed by these various programmes had sought positions elsewhere, and only some 600 support staff remained. As part of the conversion process, it was arranged for two Soviet officials to visit the facilities in August 1972. These were the USSR Minister of Health and the head of a cancer research institute.[38] The visitors portrayed themselves as relatively unenthused by what they were being shown, and could not reply to a question of whether the Soviet equivalent(s) to Fort Detrick were also being converted. The Minister of Health replied that he could only state that his ministry had no such facilities, which was at one and the same time a partial truth and a gross evasion. The USSR's Ministry of Health was responsible for the 'medical' aspects of the R&D that took place in the USSR's biological warfare R&D laboratories. The laboratories themselves were under the authority of a special section of the General Staff of the USSR, but it was none other than the Deputy Minister of Health of the USSR who was the liaison with them.[39] An offer, first made by President Richard Nixon in October 1971, that several laboratories at Fort Detrick be set aside for use by foreign scientists, including scientists from the USSR, was repeated, but there was no response to this. Official representatives of Soviet ministries—including the then Deputy Minister of Health of the USSR—again visited the laboratories in 1988, at the time of their visit to the US National Academy of Sciences to present the Soviet

[37] A Republican, President Nixon, made the decision to pre-empt the calls by a major Democratic opponent, Senator Edward Kennedy, for a national cancer research programme. See Meyer, L., 'U.S. to use Ft. Detrick for research in cancer', *Washington Post,* 15 Oct. 1971; Meyer, L., 'Cancer research lab planned at Ft Detrick', *Washington Post,* 19 Oct. 1971; Semple, R. B., 'Nixon counting on conversion of military facilities', *New York Times*, 19 Oct. 1971; Greenberg, D., 'Washington view: modern cancers', *New Scientist,* vol. 54, no. 796 (18 May 1972), p. 393; 'NCI announces award for Fort Detrick', *Science*, vol. 176, no. 4042 (30 June 1972), p. 1402; Schmeck, Jr, H. M., 'Litton will run cancer unit lab', *New York Times,* 25 July 1972.

[38] Wade, N., 'Russians reserve doubts: is Fort Detrick really de-tricked?', *Science,* vol. 177, no. 4048 (11 Aug. 1972), p. 500; Auerbach, S., 'Russians see once-secret germ lab', (from the *Washington Post*), *International Herald Tribune,* 5–6 Aug. 1972; 'Fort Detrick converting to major medical research center', *Army Research and Development News Magazine*, vol. 14, no. 4 (July/Aug. 1973), pp. 16–19.

[39] See Leitenberg (note 11).

version of what happened during the epidemic of anthrax in the Soviet city of Sverdlovsk in April to June 1979.[40]

In February 1970, early in the conversion process, a senior US Government official apparently implied that all future defensive biological warfare research would be carried out on an unclassified basis, and was quoted as saying 'there will be no need for secret research in this field under this program'.[41] That this was obviously not the case was quickly realized, and either the original reports were incorrect or any such intention was revoked. Classified biological warfare research was still going to be carried out, which rapidly led to criticism that the Army had not reduced or altered the types of research it was doing after the President's renunciation of biological warfare and the announced closing of Fort Detrick.[42] Testimony to Congress, however, indicated the degree of change that had taken place in funding levels.

Immediately following the President's policy announcement of 25 November 1969, all offensive biological research and development was terminated. The defensive effort has also been reduced as the following figures show (in millions of dollars):

Fiscal year	1969	1970	1971	1972
Biological offense	3.158	3.964	0	0
Biological defense	18.378	14.376	15.585	13.200
Total	**21.536**	**18.340**	**15.585**	**13.200**

The portion of the program comprising the technological base is unclassified and will remain at Fort Detrick. This will require approximately 160 civilian personnel. The Army considers defensive work in biological alarms and physical defense, and vulnerability analysis to be classified since knowledge of alarm characteristics or U.S. vulnerability to attack would be an invaluable asset to a potential enemy. Consequently, 52 civilian spaces will be transferred to Edgewood Arsenal for the alarm and physical defense work, and 9 civilian spaces will be transferred to Dugway Proving Ground for the vulnerability analysis work.[43]

From the point of view of arms control, the combination of the conversion of the BW production facilities *as well as* the cessation of the 'offensive' R&D programme is almost the best thing that could possibly have happened. Perhaps the very best would have been if it could have taken place even without the stated maintenance of 'defensive' research. In the mid-1980s (under the Reagan Administration), US defensive BW research was sharply expanded and sub-

[40] See Leitenberg, 'A return to Sverdlovsk: allegations of Soviet activities related to biological weapons' (note 11), p. 187.

[41] See Goldhaber (note 34). The official who made the remarks was President Nixon's National Security Advisor, Henry Kissinger.

[42] US Department of Defense Statement, 'U.S. curtailing chemical biological weapons research', 6 Dec. 1971, *Press Release*, no. 350, 8 Dec. 1971; 'Fort Detrick's future disputed', *Baltimore Sun*, 20 June 1970; Smith, R. M., 'U.S. slow to dismantle germ-war arsenal despite Nixon stand', *New York Times*, 10 Nov. 1970; Getler, M., 'U.S. issues plan to destroy biological warfare stocks', *International Herald Tribune*, 19–20 Dec. 1970; Schmidt, D. A., 'Senator asserts army plans to expand biowar research', *International Herald Tribune*, 25 Jan. 1971; Lewis, F., 'Full speed ahead on chemical and biological weapons', *Washington Post*, 6 Dec. 1971.

[43] Authorization For Military Procurement, Research and Development, Construction and Real Estate Acquisition for the Safeguard ABM and Reserve Strengths, Fiscal Year 1972, 'Research and development', Hearings before the Committee on Armed Services, US Senate, 92nd Congress, 1st Session (US Government Printing Office: Washington, DC, Feb.–May 1971), Part 3 of 5 parts, p. 2605. Under the Reagan Administration in the 1980s, US expenditure for all chemical and biological weapons R&D increased by an order of magnitude, including that for defensive BW R&D. See also footnote 44, below.

stantive questions were raised as to whether particular research projects were of an 'offensive' or a 'defensive' nature.[44] It may also be considered advantageous that the 'defensive' biological warfare R&D was not transferred to an existing civil installation, since in that case all the problems of distinguishing between 'military' and 'civilian' research would descend in turn on the civilian institution. On the other hand there would presumably be much less suspicion of 'offensive' research being carried out under a 'defensive' guise in such circumstances. In other cases in which limitations on military R&D are conceivable, a reduction in production capability might not necessarily be expected. Conversely, in cases in which there were decisions not to produce and deploy a particular system—such as the anti-ballistic missile (ABM) system—continued ABM R&D was frequently supported even by those who strongly opposed the procurement of ABM systems.

A Very Brief Summary

This study has examined research and development in those sciences that relate to weapons development for biological (and chemical) warfare. Its purpose has been to investigate whether research in basic and applied science can be divided into "civil" and "military" components. The study has thus examined the customary dichotomies of "basic" versus "applied", "civil" versus "military", "offensive" versus "defensive" research. Several other aspects of scientific research related to weapons development have been examined, including an example of the conversion of extremely specialized military R&D and production facilities to civilian work. These facilities were as specialized, if not more so, as those that would be found in any other area of military R&D.

The very nature of the cellular processes or biochemical reactions relating to biological and chemical warfare which are the subject matter of R&D in these fields makes it impossible <u>absolutely</u> to separate basic research into "civil" or "military" categories. The "basic" versus "applied" dichotomy is in addition ordinarily exaggerated. Similarly, the nature of a particular discovery, or item of information or knowledge is inseparable into "offensive" or "defensive" categories. Nevertheless. a major point of this chapter is that it seems in fact relatively easy to ascertain the possible application of nearly any piece of research, even the most "basic". It is also far more likely than is customarily assumed that even its purpose or intention can be established. This determination is made by looking at the institutional context of the particular piece of research, its funding, the interested or sponsoring agencies, the processing of information derived and so on. It is possible, however, that such information is far more useful in resolving the "military/civilian" question than the "offensive/defensive" one.

The argument presented in this chapter stands in contrast to the more traditional view, expressed for instance by the incoming director of Britain's Porton laboratories in 1971, "... that the difference between defensive and offensive research was one of scale." /133/ This chapter belies the apparent simplicity of this traditional view through the numerous examples it provides. At the same time, this author's initial expectation concerning the ease with which research could be categorized as offensive or defensive was probably overoptimistic. Very much would seem to depend on the overall context in which the research takes place and not primarily on the individual piece of research in question. The most important determinant of all is probably whether one already knows that an offensive military program of the systems in question already exists in a nation when examining basic research subsequent to that point, or whether one has very strong reason to expect that it exists.

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Article 1.
Each State Party to this convention undertakes never in any circumstances to develop, produce, stockpile or otherwise acquire or retain:
1. Microbial or other biological agents, or toxins whatever their origin or method of production, of types and in quantitites that have no justification for prophylactic, protective or other peaceful purposes:
2. Weapons, equipment or means of delivery designed to use such agents or toxins for hostile purposes or in armed conflict.

Article IV.
Each State Party to this Convention shall, in accordance with its constitutional processes, take any necessary measures to prohibit and prevent the development, production, stockpiling, acquisition or retention of the agents, toxins, weapons, equipment and means of delivery specified in article 1 of the Convention, within the territory of such State, under its jurisdiction or under its control anywhere.

Article V.
The States Parties to this Convention undertake to consult one another and to cooperate in solving any problems which may arise in relation to the objective of, or in the application of the provisions of, the Convention. Consultation and cooperation pursuant to this article may also be undertaken through appropriate international procedures within the framework of the United Nations and in accordance with its Charter.

Article VI.
1. Any State Party to this Convention which finds that any other State Party is acting in breach of obligations deriving from the provisions of the Convention may lodge a complaint with the Security Council of the United Nations. Such a complaint should include all possible evidence confirming its validity, as well as a request for its consideration by the Security Council.

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Facility	Stored agents	Destruction completed during
Directorate of Biological operations: Pine Bluff Arsenal	Antipersonnel	May 10 1971 to May 1, 1972
Beale Air Force Base	Anticrop	by March 10, 1972
Rocky Mountain Arsenal	Anticrop	by Feb. 15, 1973
Fort Detrick	Anticrop	Jan.17 to May 18, 1972

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