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1.002: PROBLEMS OF ARMS CONTROL AND DISARMAMENT (138A)

1.004: Lecture XIX (Lederberg): "Emergent issues in arms control:

1.006: Chemical and biological weapons: I"

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1.010 The more basic facts about chemical warfare and its control would be
1.012 easy to summarize in one hour. Having two means tying together a very large
1.014 number of loose ends that have not yet been successfully tied together in
1.016 policy or in policy formulation; and I am not sure I'll do a very much
1.018 better job in my exposition of them to you.

1.020 For some more or less logical division of the subject I'm going to
1.022 divide the problem of the control of chemical weaponry (CW) into (a) the
1.024 core questions: of the lethal agents that might begin to compete with
1.026 nuclear weaponry in a very serious escalation of the level of fatalities in
1.028 armed conflict between nations, and (b) other aspects of CW like tear gas
1.030 and herbicides. These questions are politically and in public psychology
1.032 very much interwoven, and I must say, often highly confused. For example,
1.034 Senator Young on the floor of the Senate made a speech a few months ago in
1.036 which he referred to the accumulation of stocks of nerve gas by the
1.038 Department of Defense, intended for use in riot control in this country.
1.040 What an ugly, preposterous allegation that would be! He was possibly
1.042 thinking of tear gas and possibly thought there was not much difference
1.044 between the two. We need a level of precision in discussing chemicals which
1.046 is hard to manage with a scientifically unsophisticated audience, such as
1.048 the Congress of the United States. It may be somewhat easier in this
1.050 particular group. The closer you are to high school, probably the better
1.052 lettered you will be with respect to some of these technical concepts.

1.054 The use of poisons in human hostility has an unmeasured antiquity.
1.056 The Bible doubtless refers to poisoning of wells and other pestilences.
1.058 Thucydides records the use of the fumes that can be generated by burning
1.060 pitch plus sulphur dating back to at least the 5th century B.C. Many
1.062 so-called primitive cultures have discovered very sophisticated chemical
1.064 weapons in the form of herb poisons. Some of them have become quite
1.066 important in medicine. (Curare, for example, is a South American arrow
1.068 poison which has been used both for hunting game and for armed conflict. It
1.070 is as potent a chemical weapon as one would care to have. However, it must
1.072 be introduced into the circulation by breaking the skin which is the main
1.074 reason it does not appear in the armamentarium of the United States Army at
1.076 the present time. Its equivalent in modern technology is nerve gas.)

1.078 However, with the development of the national military state engaged
1.080 in total warfare, since the Napoleonic era, the rules of war became
1.082 crystallized around the customs of the 19th century. There was very little
1.084 use of chemical weaponry, except incidentally for smokes and so on, during
1.086 that time. Not until the large-scale use of chlorine on the Western Front
1.088 by the Germans in 1915 did chemical warfare again appear on a large scale.
1.090 The Germans started with chlorine gas which was disseminated from cylinders
1.092 -- gas tanks -- that were brought to the front. They waited several weeks
1.094 from the time of their original deployment until the weather and the wind
1.096 were appropriate for their use and then they let loose at 5 p.m. on April
1.098 22, 1915. At that time they liberated 180 tons of chlorine from 6,000
1.100 cylinders. During that period of time there was plenty of prior
1.102 intelligence. The French were well aware that something was afoot but they
1.104 made no use of the information and the initial attack was in fact quite

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2.004 devastating. However, its effectiveness went beyond what the German Army
2.006 strategic planners had expected. They did not know how to exploit this form
2.008 of attack; and they did not really capitalize on it in any very useful way.
2.010 They did try again once or twice in much the same fashion, but in spite of
2.012 a large number of casualties and in spite of a very considerable
2.014 psychological impact and disarray of the troops against which it was used,
2.016 it was not properly followed up from the point of view of an important
2.018 military advantage.

2.020 However, starting from that time, World War I was the scene of a very
2.022 considerable escalation of chemical warfare on both sides, an astonishingly
2.024 sharp and rapid buildup of a technology race involving both offense and
2.026 defense. The identification of the agents used by the enemy, the
2.028 development of gas masks and the development of a doctrine for their
2.030 effective use for defensive purposes, the search for agents that would
2.032 penetrate the then known gas masks -- all of this was going on on both
2.034 sides. By the end of the war, gas munitions came to occupy 5% of the total
2.036 artillery that was expended during World War I.

2.038 The difficulties of using cylinders of gas that then blew downwind
2.040 toward the enemy has obvious disadvantages; soon thereafter the French
2.042 played a major role in finding ways of including chemical agents into
2.044 artillery shells and this very rapidly became the main vehicle for
2.046 exchanging these materials. Altogether, (according to the account which is
2.048 summarized in the volume of the Stockholm Institute for Peace Research
2.050 which is on reserve) 113,000 tons of chemical agents were used in World War
2.052 I. They resulted in 1.3 million casualties. These were approximately 5% of
2.054 the total casualties in World War I. However, there were only 91,000 deaths
2.056 attributed to gas warfare as compared to a total of about 5 million of the
2.058 total military casualties in World War I. Gas warfare was then very
2.060 effective in disabling troops in proportion to the level of effort that was
2.062 expected in delivering chemical munitions. It also resulted in a
2.064 substantially lower fatality rate than did the other weapons during the
2.066 war. However, the use of these weapons was still escalating in 1918 and it
2.068 is impossible to predict what the further outcome would have been.

2.070 The original gases that were used were chlorine and phosgene. The
2.072 French introduced tear gas on a small scale and this became very prevalent
2.074 on both sides in artillery shells. Tear gas is a temporarily disabling
2.076 agent which provokes mostly a psychological incapacity. The main function
2.078 disrupted by tear gas is vision due to the production of tears and the
2.080 irritation of the cornea. There are secondary effects on lung functions,
2.082 and in very large amounts any of these agents can be fatal. But under the
2.084 usual conditions of military exposure they are not intended to be and they
2.086 only very rarely were. Chlorine is a lung irritant in its functions. It is
2.088 a much more serious agent from the point of view of potential fatalities.
2.090 It can cause lung edema and pneumonia and long lasting disability with lung
2.092 irritation and did in a number of cases. It was not often lethal in
2.094 proportion to the number of disabilities that it caused, but often enough.

2.096 There was a very limited use of ancient poisons like hydrogen cyanide
2.098 (or prussic acid) or cyanogen chloride. These are very poisonous agents in
2.100 the context of the chemical laboratory but in the open field they are
2.102 difficult to handle. Mostly they are rather light and volatile and they
2.104 drift away very promptly from the area of application and they were not
2.106 used extensively. Then adamsite and mustard gas were introduced later into

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the war. Adamsite was another harrasing agent probably more serious than tear gas and mustard is a very serious weapon by every count. It is described as a vesicant, that is to say it causes blistering on the skin. When inhaled it can cause internal blistering in the lungs and we now know -- it was not known at that time -- its action on cells is very similar to that of X-radiation. It does cause profound cell damage through the breakage of chromosomes at a very fundamental level in cell physiology. It is an extremely unpleasant agent with very long lasting effects. Mustard gas wounds often took years to heal properly. They probably account for a significant part of the total casualties in World War I; and the use of mustard was becoming more and more prevalent by 1918.

However, with all that, chemical warfare was not of any particular strategic significance during the war. I do not think it influenced the outcome by one whit in any way. There was not the level of commitment of it as a weapon that could have been expected to have that outcome. It undoubtedly had a very important psychological effect, particularly on civilian populations, and this may have been its major perceived utility. That is to say that the threat of chemical warfare attack would require the adversary to invest a good deal in his own counter measures, issuing gas masks to the population. Any air alarm had to also involve the disruption that is connected with maintaining defenses against gas attacks and so forth. And those may have been among the major costs. However, as you know, aerial bombardment did not reach any very sophisticated level during World War I. Civilian populations were only incidentally involved and then mostly as a byproduct of infantry and artillery movement. The concept of strategic bombardment of cities had not yet been refined.

Much of the further history of efforts at chemical warfare control is connected with the fact that the Allies won the war. The use of poison gas by the Germans became an important part of the concept of German Schrecklichkeit (horror and atrocity) in the conduct of war. The treaty of Versailles, unilaterally imposed on the Central Powers, made a specific, rather moralistic statement that, poison gas having been condemned by the civilized world, the Central Powers were bound never again to undertake the production of or use of these agents. I will come back to that again because the language of the Versailles Treaty was eventually incorporated without much further thought into the language of the Geneva Protocol a little later on.

In the volume of hearings for the House Committee on Foreign Affairs, there is an excellent summary by Professor Bunn of the University of Wisconsin on the history of the Geneva Protocol and other arms control efforts. He quotes many of the relevant texts. The Versailles Treaty included the provision that "the use of asphyxiating poisonous or other gases and of analogous liquids and materials or devices being prohibited, their manufacture and importation are strictly forbidden in Germany." This text was not in any real sense negotiated. It was language that was put together with a very large number of other provisions intended to hamper any possibility of German rearmament after World War I. There was no one capable of protesting, analyzing, trying to understand the implications, trying to dissect the draftmanship of the language when these phrases were put together. Had there been, one might have expected to see some "legislative history" connected to the language. Consider "the use of asphyxiating, poisonous or other gases and of analogous liquids, materials

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4.004 or devices." No one really knows what those words mean. They are a kind of
4.006 general, moral prohibition against doing anything naughty; but a defeated
4.008 power has no possibility of complaint. The matter was not carefully
4.010 analyzed at that time.

4.012 In 1922 as part of the program of attempts at universal disarmament
4.014 under the general aegis of the League of Nations the conference in
4.016 Washington proposed a treaty on submarines and on noxious gases. The
4.018 submarines part was an attempt to limit the then burgeoning arms race among
4.020 the allied powers and Japan with respect to naval vessels. It also included
4.022 language that was evidently drawn verbatim from the Versailles Peace
4.024 Treaty, "the use in war of asphyxiating, poisonous or other gases and all
4.026 analogous liquids, materials or devices having been justly condemned by the
4.028 general opinion of the civilized world..." that the parties of the treaty
4.030 bind themselves to that prohibition. The fact that the Allied powers in
4.032 World War I had no compunctions about the retaliatory use of these agents
4.034 and had invested as much in chemical warfare as the central powers is not
4.036 directly alluded to.

4.038 The 1922 treaty was proposed by the United States and the treaty was
4.040 in fact ratified by the United States including this language. It was
4.042 repudiated by France who at that time was unwilling to limit itself in the
4.044 naval arms race. When they refused to sign, it became a nullity and neither
4.046 the French nor the United States would then be further bound by a contract
4.048 that had failed of consummation.

4.050 There were further peace conferences during that era. The effort at
4.052 submarine limitation having been abandoned, the chemical warfare control
4.054 was extracted from it in further conferences and a treaty that is known
4.056 historically as the Geneva Protocol was drafted and formulated in 1925.
4.058 This picked up the language with respect to chemical agents that I have
4.060 just quoted, "the use of asphyxiating, poisonous or other gases and of all
4.062 analogous liquid materials or devices." It also added a new provision on
4.064 biological weapons. With the advance of the science of microbiology,
4.066 biological weapons ought to be nipped in the bud. The parties thus
4.068 disavowed B and CW and specifically "agree to be bound as between
4.070 themselves according to this declaration." The qualifying phrase is of
4.072 utmost importance.

4.074 The protocol was promoted by the Department of State and by the
4.076 United States delegation. It was approved by all other countries with
4.078 insignificant exceptions then involved in the negotiations. It was then
4.080 presented to the United States Senate for ratification. It was generally
4.082 believed that it would be a pro forma matter since the Senate in 1922 had
4.084 already ratified a treaty that included identical language, and evidently
4.086 not very much care was taken to clear it with the necessary people. But
4.088 this time it ran into very great obstacles. The sources of opposition to
4.090 the treaty had become crystallized. The United States was beginning to
4.092 enter into a much more isolationist path. The repudiation of the League of
4.094 Nations had already taken place. The further implications of this were
4.096 beginning to be rigidified in United States policy and in the attitudes of
4.098 the Senate. It ended up that rather than being a pro forma matter that
4.100 would be automatically ratified that the Senate refused to ratify the
4.102 Geneva Protocol. Besides the new isolationism, specific opposition to the
4.104 ban on chemical warfare had been mobilized by the chemical industry, the
4.106 chemical warfare service; the other hawks, even the American Chemical

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5.004 Society, formed a very active lobbying group against the acceptance of the
5.006 Protocol. The principal arguments were that it was only a piece of paper
5.008 that would be scrapped anyhow in the event of war, that America was
5.010 retreating to its own fortress and that it did not want to have anything to
5.012 do with the rest of the world and it would not rely on international
5.014 treaties, it would rely on its own strength and force and not get into any
5.016 entangling arrangements of any kind. So the Protocol was repudiated by the
5.018 U.S. However, enough other countries had signed it that it entered into
5.020 force as among those countries who signed.

5.022 In international law the Protocol has a status of a contract. The
5.024 actual language of the Protocol states that the parties are bound as among
5.026 themselves, that is to say, if I have joined the treaty, and if you also
5.028 joined it, then we are co-partners in a mutual multilateral agreement that
5.030 we will not use chemical or microbiological methods of warfare against one
5.032 another. In the treaty is the implicit reservation that it does not bar the
5.034 use of chemical weaponry against other countries that may have refused to
5.036 enter the Protocol. That is in the language of the treaty. But in order to
5.038 place even further stress on that, France, (among the first of the
5.040 countries to ratify the Protocol) added a specific reservation that said
5.042 the same thing all over again, very explicitly. As far as France was
5.044 concerned the treaty would apply only to those countries who also were
5.046 bound by the conditions of the Protocol; and furthermore, France would not
5.048 consider that it was committed in respect to any country that broke the
5.050 treaty or with respect to any country any of whose allies broke the treaty.
5.052 This was an explicit reservation. This reservation was copied by many other
5.054 countries who ratified the treaty.. By well established principle of
5.056 international law the countries who signed the treaty after these
5.058 reservations had been stated, and did not object, were bound by the
5.060 reservations. Juridically as well as politically, the Geneva Protocol is
5.062 then a promise among parties of the treaty not to use these weapons first.
5.064 And it explicitly recites the privilege of using these weapons if someone
5.066 else uses them first against you. In fact the Soviet Union has taken the
5.068 official position that the Geneva Protocol is the foundation-stone of
5.070 deterrence in the area of chemical weaponry because it reiterates the
5.072 rights and the threat of retaliation in the event that it is violated. The
5.074 Protocol is a way of announcing to the world that if anyone uses a chemical
5.076 weapon, there will be legitimized retaliation with chemical weaponry
5.078 against such use.

5.080 The Protocol says nothing about research, development, production,
5.082 stockpiles, proliferation, distribution, sales, acquisition, or any other
5.084 aspect of chemical weaponry. It is a contractual limitation on first use.
5.086 In the context that I have just indicated it is indeed a certain
5.088 encouragement to maintaining the capability of retaliation and therefore to
5.090 the development and the stockpiling of chemical weapons in order to be
5.092 available as a deterrence. No one has stated that position more clearly and
5.094 more unambiguously and perhaps more justifiably than the Soviet Union.

5.096 Between World Wars I and II were a few probing incidents in which
5.098 chemical weapons were probably applied, although the documentation for this
5.100 is incomplete. (This is recited in much detail in the SIPRI volume.) The
5.102 most credible incidents were -- first that the Italian Fascists used
5.104 chemical weapons, probably mustard, in Ethiopia: some 15,000 out of the
5.106 50,000 Ethiopian casualties during the Abyssinian war derived from chemical

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6.004 weapons. The Italian position held that this was perfectly correct despite
6.006 the prohibitions of the Geneva Protocol; because it was in retaliation to
6.008 inhuman methods of warfare, including decapitation that had been practiced
6.010 by the Abyssinians in that conflict. Furthermore it was not really a war
6.012 and therefore the protocol was not designed to be applied to it anyhow! The
6.014 significance of CW here is obviously not that it enhanced the capability of
6.016 Imperial Italy to acquire Abyssinia. It was a military field test of
6.018 particular kind of chemical technology to give military planners in the
6.020 Italian Army the opportunity to evaluate the significance of CW. Just as
6.022 the Spanish Civil War was used to test new air power technology.

6.024 We also have read many reports of the use of chemical weapons by
6.026 Japan in the invasion and occupation of China from about 1932 to 1945.

6.028 In 1937 a group of chemists in the Nazi regime in Germany discovered
6.030 nerve gas, tabun, as a byproduct of searches for a chemical pesticide.
6.032 (There is a very close connection between the biology and the technology of
6.034 an important class of insecticides, the organic phosphates, and the nerve
6.036 gas.) In these experiments, molecules known to interfere with the
6.038 transmission of the nerve impulses are tested for their relative toxicity
6.040 on insects and on mammals. Insecticide research is, of course, looking for
6.042 agents that have a very high degree of safety as far as mammals, livestock
6.044 and man are concerned. These agents have improved very considerably since
6.046 their early introduction; yet there are still fatalities in the
6.048 agricultural use of the agents designated as insecticides. By accident,
6.050 tabun was stumbled upon and was found to be at least as toxic to mammals as
6.052 to insects. This was very highly classified information. Further
6.054 investigation in Germany then uncovered a series of other related and even
6.056 more effective agents like sarin and one or two others. That started a new
6.058 generation of CW agents. These were from a military point of view very much
6.060 more effective than the others: except that they were lethal, which is not
6.062 a military advantage. But they acted very quickly, they are insidious, they
6.064 could work if applied to the skin as well as if they were breathed. If they
6.066 did not kill they would incapacitate, but not very long. If you are going
6.068 to die you'll know it within a few minutes; and if you have not received a
6.070 dose that kills you fairly promptly then you probably will recover from it
6.072 because the effects on the nerves are reversible. The way in which nerve
6.074 gas kills -- is paralysis of the respiratory centers and the stoppage of
6.076 respiration. Nerve gas was not known to the outside world during the entire
6.078 period of World War II. The Germans, of course, kept it a secret.

6.080 As early as 1942 the Nazis began large-scale production of nerve gas.
6.082 They ended the war with stockpiles of at least 12,000 tons of nerve gas.
6.084 There is incomplete documentation of German policy during World War II
6.086 about the use of these agents. There is little doubt that a major element
6.088 in their initial decision not to use it in the early period of the war was
6.090 fear of retaliation. German intelligence was just as faulty as the Allies.
6.092 They heard rumors of a considerable breakthrough in some
6.094 insecticide-related research that was being kept highly classified; and
6.096 they jumped to the conclusion that the Allies had also discovered nerve
6.098 gas. That material was not nerve gas, it was DDT, and this was a military
6.100 secret because a major devastation in military activity for centuries
6.102 immemorial has been typhus fever spread by lice among soldiers in
6.104 encampments. (On the other hand, we had equally faulty intelligence that
6.106 exaggerated the Japanese CW capability. There was information about their

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7.004 having used chemical weapons in China. Particularly had there been an
7.006 American invasion of Japan, there was considerable fear that the Japanese
7.008 were preparing for the use of chemical weaponry. Actually they were not
7.010 competent, both from the point of view of any new agents and from the point
7.012 of view of the development of the chemical industry.) In the later part of
7.014 the war it appears that German military doctrine was starting to lean
7.016 toward the use of chemical weapons. However, by that time their chemical
7.018 industry was so disrupted and there were such acute shortages for synthetic
7.020 rubber and fuel; their economy was beginning to fall apart. They had also
7.022 lost the air war and they therefore no longer had the major instrument for
7.024 the delivery of these weapons and therefore any significant opportunity
7.026 they may have had to take advantage of their unmistakable technological
7.028 lead had been lost.

7.030 During the war all of the Allied countries made statements to the
7.032 effect that the Allies would not be the first to use chemical weaponry but
7.034 if the Germans used CW against the USSR or any of the Allies, then their
7.036 retaliation would be unleashed. The bluff worked! The fact that this
7.038 strategy saved the Russians from being clobbered with nerve gas during
7.040 World War II, which could have been a decisive factor in the German
7.042 invasion of the Soviet Union, undoubtedly plays a large part in their
7.044 present position with respect to arms control measures.

7.046 U.S. presidents have repeatedly committed the U.S. to the general
7.048 principles of the Geneva protocol, without having had the wish or the power
7.050 to see it formally ratified by the U.S. Senate. Since 1961, the war in
7.052 Vietnam has raised new issues in this field. The anti-war reaction has
7.054 focussed a degree of attention on curbing CW that was never achievable
7.056 before despite the grave threats of escalation in lethal CW technology. On
7.058 the other hand, tear gas and herbicides were introduced in a way that
7.060 complicates the interpretation of what CW should mean. It will be difficult
7.062 to achieve further progress in the control of C or BW until this complex
7.064 array of issues is disentangled, with inevitable delays in dealing with the
7.066 issues of most crucial import.

7.068 END OF LECTURE I