SOCIAL AND ENVIRONMENTAL ASPECTS OF ABANDONED CHEMICAL WEAPONS IN CHINA

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From 1937 to 1945, Japan employed chemical weapons against China and then abandoned large numbers of unused chemical munitions on Chinese soil. Before the negotiation of the 1993 Chemical Weapons Convention (CWC), Japan and China rarely discussed the issue of abandoned chemical weapons (ACW). In 1991, however, the two governments became aware that the Convention would assign responsibility for destruction of ACW to the abandoning state, and initiated bilateral discussions on the legal, political, and financial aspects of this issue. The two sides also conducted several joint field surveys in China to assess the scope of the problem.

Both Japan and China have ratified the CWC, which entered into force on April 29, 1997. As a result, the two governments must now finalize arrangements for the destruction of abandoned Japanese chemical weapons on Chinese soil. According to the Convention, "For the purpose of destroying abandoned chemical weapons, the Abandoning State Party shall provide all necessary financial, technical, expert, facility as well as other resources. The Territorial State Party shall provide appropriate cooperation."[1] With respect to the social and environmental aspects of destruction, the CWC provides, "Each State Party, during the implementation of its obligations under this Convention, shall assign the highest priority to ensuring the safety of people and to protecting the environment and shall cooperate as appropriate with other States Parties in this regard."[2] Nevertheless, the CWC does not specify detailed procedures for the destruction of ACW, which much be negotiated between the two sides.

This report describes the harmful effects of abandoned Japanese chemical weapons on Chinese citizens and the environment since 1945, and their potential for causing further damage unless they are safely disposed of. The potential environmental consequences of ACW destruction are also briefly discussed.

HISTORICAL BACKGROUND

Japan began using chemical weapons against the Chinese in 1937. During the campaign against the city of Wuhan in Hubei Province from August 20 to November 12, 1938, the Japanese 2nd and 11th Armies carried out over 375 chemical attacks involving more than 9,000 chemical mortars and 43,000 toxic smoke cylinders.[3] On October 1, 1938, the Japanese Army delivered over 2,500

chemical artillery shells on a 2,700 square meter area at the battle of Dingxiang in Shanxi province.[4] On May 28, 1942, the Japanese Army used choking agents to kill over 800 people hiding in the catacombs beneath Beitan village in Heibei Province.[5] By the end of 1945, Japanese chemical warfare against the Chinese had resulted in an estimated 80,000 casualties and 10,000 fatalities.[6]

The Japanese army did not use all of the chemical weapons it had brought to China and left many behind during its retreat in the closing months of the war. Tokyo feared that discovery of these munition stockpiles by the Soviet Red Army would show Japan's actions were not consistent with the Geneva Protocol banning chemical-weapons use.[7] Accordingly, the Japanese Army sought to hide its unused chemical weapons. On August 12, 1945, for example, Unit 516 of the Japanese Kwangtung Army cast drums of chemical agent from a railway bridge into the depths of the Nenjiang River.[8] In another instance, Unit 526 of the Kwangtung Army dug two large pits and buried over 200 drums of chemical agent.[9] When the Chinese army reclaimed Japanese-occupied territory, no chemical weapons were found.[10]

In 1953, the Dunhua County Committee on the Disposal of Old and Toxic Munitions in Jilin province reported that 45,000 chemical munitions were believed to be five meters underwater in the Tumen River (near the village of Shuaiwanzi) and hence irretrievable.[11] In February 1992, at the Conference on Disarmament in Geneva, China announced that 100 tons of agent and 2,000,000 chemical munitions had been abandoned on its territory, 1,800,000 of them in Jilin province.[12] In May 1996, Shigekazu Sato of the Japanese Ministry of Foreign Affairs announced that Japanese members of a joint survey team estimated that there are 700,000 abandoned chemical munitions in Jilin province.[13]

ACW AS A HAZARD TO CIVILIANS

Japanese chemical weapons continue to injure and kill Chinese citizens. China estimates that ACW have caused 2,000 casualties and fatalities since the end of World War II,[14] with 500 cases in Dunhua County alone.[15] A wide range of people in Chinese society have been affected, including junior high school teachers and students who found ACW on the school grounds, riverboat workers who brought the weapons up during dredging operations, and construction workers digging beneath city streets. Effects of exposure to ACW have ranged from minor injuries to death.

In general, ACW pose much greater hazards to civilians than military stockpiles of chemical weapons, such as those stored in depots in the United States and Russia. Military stockpiles are stored in special bunkers under lock and key, so that barring a catastrophe, ordinary citizens face no immediate threat. Since the location of many ACW is not known and civilians lack an understanding of their hazards, they risk being accidentally exposed to these weapons. A few examples illustrate this point (See Figure 1 for the geographic location of ACW accidents).

One of the largest accidents involving ACW in China occurred in February 1953 near Angangxi in Heilongjiang Province; 70 manual laborers were injured when transporting ACW purchased as scrap metal. Another occurred on September 2, 1959, in Taiyuan City, Shanxi Province. During the construction of a chemical materials facility, workers struck buried chemical munitions, and leakage from the shells injured over 80 people.[16] In 1963, the Dunhua County Committee for the Disposal of Old and Toxic Munitions cordoned off the entire region containing ACW and forbade land cultivation, felling of small timber, grazing, hunting, or the collection of mushrooms or medicinal plants.[17] This region is still considered unsafe and has been rendered unusable by virtue of the buried toxic munitions.

In February 1970, in Shuangyang, Yian County, Heilongjiang Province, five farmers were injured by mustard and lewisite when they tried to defuse a chemical munition in order to use the shell as a farming implement. The farmers routinely defused high-explosive shells for this purpose but were unprepared for a shell with a chemical fill.[18] In 1974, in Songhua Jiang in Jilin province, Mr. Li, a worker on a river dredging boat, was injured when he tried to remove a chemical round wedged in a pump.[19] He was incapacitated by this accident (blistered hands and scalp) and had to quit his job. Another man in 1974 in Harbin, Heilongjiang Province, was injured when he encountered a chemical weapon while dredging a river, and he died in 1991 partially as a result of his exposure.[20]

In 1982 in Mudanjiang, Heilongjiang Province, sewage construction workers unearthed several barrels and promptly opened them. Five were splashed with toxic liquid containing mustard agent and at least two remain visually impaired. The largest accident occurred in October 1987 in Fulaerji (alsospelled Hulan Ergi), Heilongjiong Province. Over 200 people were injured when workers at a construction supply facility tried to

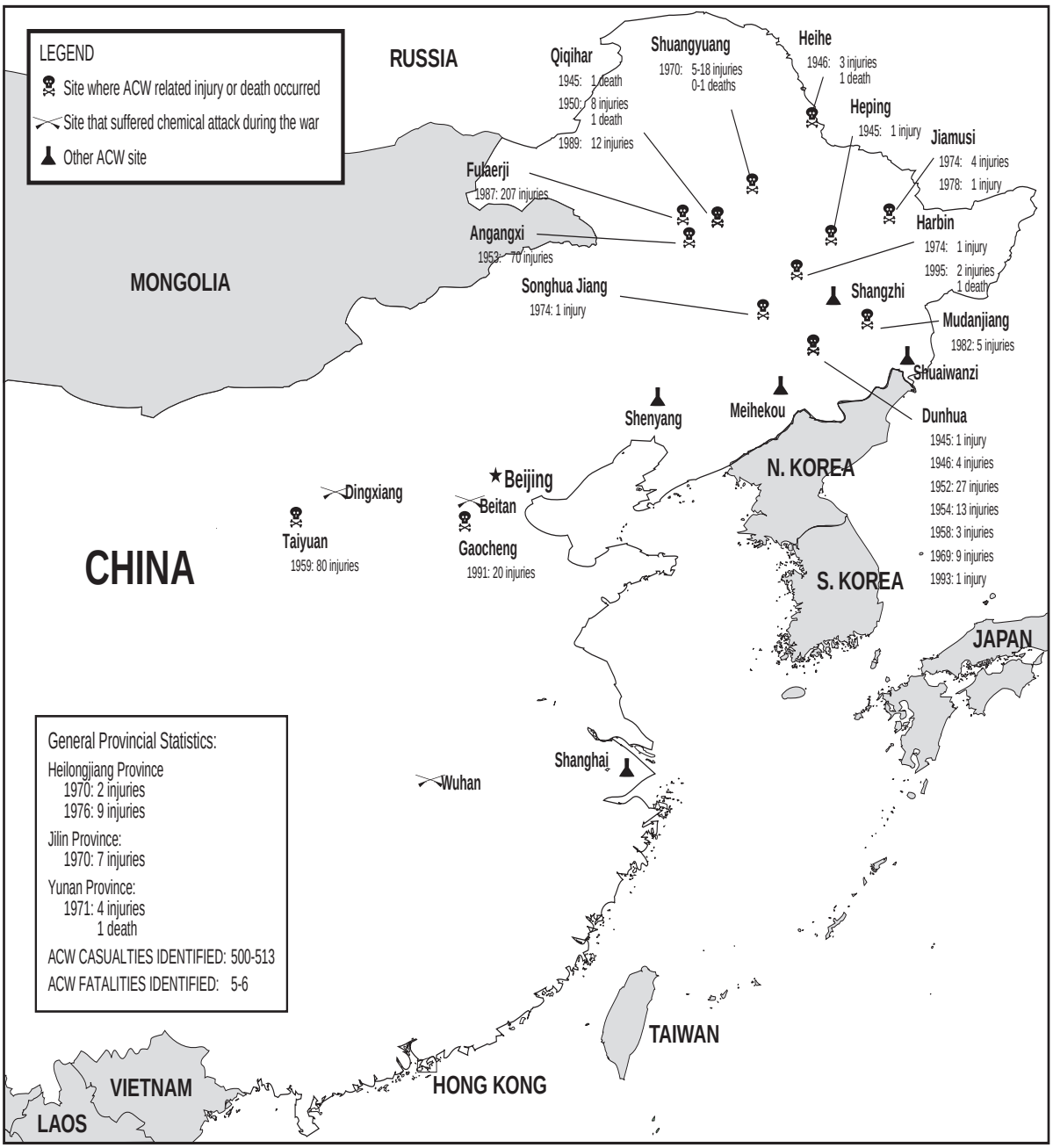

Figure 1: Some Locations of Japanese Chemical Weapons Attacks and Subsequent Chinese ACW Injuries

set fire to a barrel of liquid mustard in an attempt to identify it by testing its physical properties.[21] In 1991, in Gaocheng in Hebei Province, over 50 phosgene mortar rounds were discovered on the grounds of a junior high school.[22] Twenty people experienced dizziness, nausea, and respiratory difficulties from the leaking chemical rounds before authorities arrived to take care of the problem.[23] In 1995 in Shenyang, Liaoning Province, a joint Chinese-Japanese investigative survey found mustard agent in six corroded barrels and transferred the agent to secure containers for storage; fortunately, this operation occurred without injury.[24]

As a result of these and other ACW-related accidents, in August 1996, 10 Chinese citizens filed a demand for ¥20,000,000 in compensation from the Japanese government.[25] On December 9, 1996, 14 Chinese citizens and bereaved families also filed suit in the Tokyo District Court for similar damages.[26] The decision whether or

not to compensate victims of Japanese ACW will have far-reaching consequences. If the court sees fit to compensate the victims, they are not the only ones who stand to benefit. According to Wu Jiandong, a specialist on Sino-Japanese relations, "The Japanese seem to fear that the chemical weapons will be the fuse that ignites the issue of [war] reparations."[27] Estimates of Chinese losses as a result of the 1937 to 1945 Japanese invasion of China range from 500 billion[28] to 600 billion dollars.[29] Japan contends that all claims for war reparations were settled in the September 1972 Sino-Japanese Joint Communiqué that normalized relations between Japan and China. The Tokyo District Court has yet to rule on the ACW injuries case.

PRELIMINARY DESTRUCTION EFFORTS

China has already destroyed 10 tons of chemical agent and destroyed or preliminarily treated 300,000 munitions.[30] When resources were not available to destroy the weapons, they were merely collected and stored. From 1951 to 1963, Dunhua County had a Committee for the Disposal of Old and Toxic Munitions, which oversaw the construction of two burial pits[31] near Dunhua City where weapons discovered in other parts of China could be brought and stored indefinitely pending their destruction.[32] In 1959 to 1960, blister agents from over 200,000 munitions in Shangzhi, Heilongjiang province, were drained and moved to Meihekou, Jilin province, where they await destruction in two tanks that hold a total of 74 tons of a mustard and lewisite mixture.[33]

Since 1991, Japan has participated in joint field surveys with China. On the first two surveys in 1991 and 1992, Japan participated merely as an observer, but it became a more active participant during the next five surveys from 1995 to 1996. The eighth survey took place in May of 1997.[34] These investigations, while small in scale and duration, have proven valuable in many ways. For example, before the surveys, Japan stated that it could not take responsibility for destroying the ACW in China because of a lack of evidence concerning ownership. Japan's position has now changed, and Tokyo recognizes that most of the abandoned munitions belong to the former Japanese Army. In addition, whereas Japan formerly claimed that only incapacitating agents such as tear gas had been deployed to China, it has since acknowledged the presence of lethal agents such as mustard and lewisite.[35]

The joint surveys also provide an early opportunity for China and Japan to cooperate. According to the CWC, China is obligated to assist Japan in destroying ACW, but the type of cooperation is not defined. This requirement for joint destruction derives from the special nature of ACW; in contrast, the United States and Russia need not agree on how destroy their respective chemical weapons stockpiles. Early in 1997, Japanese Prime Minister Hashimoto requested the assistance of the Chinese People's Liberation Army in destroying the abandoned weapons.[36] In any event, China and Japan must reach a mutually acceptable arrangement on key aspects of ACW destruction, including selection of the destruction technology, siting and building of the destruction plants, and the timetable for destruction.

Under the CWC, Japan is obligated to begin destroying the ACW left in China by April 29, 1998. Since early 1996, Japan has sought a destruction timetable that is consistent with the CWC.[37] However, a destruction plant takes a long time to build. Recently Japan has offered to begin initial destruction at a temporary facility in April 1998, and subsequently move the operation to a larger, more robust facility.[38]

CIVILIAN ATTITUDES TO ACW

When ordinary Chinese people learn that Japan abandoned chemical weapons in China, they often express strong feelings of indignation. Then they become anxious: What damage can the weapons cause? Will Japan take responsibility for their safe disposal? Because the memory of Japan's harsh, decade-long occupation of China remains fresh in collective memory, the presence of the abandoned chemical weapons is deeply disturbing to many people. Thus, the burden of these weapons is psychological as well as physical. An increasing number of Chinese victims of ACW are seeking financial restitution from Japan. For instance, Li Chen was so badly injured by ACW that he has been unable to work for 23 years.[39] He and others are trying to force the Japanese government to pay compensation by filing lawsuits in Japanese courts.

Chinese citizens understand that the threat of ACW will remain until all the weapons have been uncovered and destroyed. According to Dunhua City's Disaster Prevention Officer, "These chemical weapons are a great threat to the 500,000 people in Dunhua [County]. I hope that the Japanese government will dispose of them as soon as possible. If that is done, the problem of pollution in the environment and injuries to people will be basically

settled."[40] The discovery of chemical munitions buried behind Dunhua City Hall has emphasized the pervasiveness of the problem.[41] A scrap-yard foreman in a suburb of Dunhua City, where recovered weapons are taken every year, summarized the conundrum as follows: "There's nothing we can do. Even if someone throws a chemical munition away it's still dangerous, so you can't throw it away."[42]

Although there is public support for ACW destruction, the methodology, timing, and location of destruction have yet to be decided. As has been learned from the debate over chemical-weapons destruction in the United States and Russia, gaining the support of local populations is a key element of a successful destruction program. If Japanese courts rule in favor of compensating ACW victims, such a move could help build local support for the destruction of ACW.

ENVIRONMENTAL ASPECTS OF ACW

The longer ACW are stored, the more severely the munitions rust and leak. Many Japanese chemical weapons abandoned China contain a mixture of two blister agents, mustard and lewisite. On hot days, agent seeping from corroded shells evaporates, forming a toxic cloud that pollutes the air and poses a serious health hazard. In addition, the seepage, adsorption, and diffusion of toxic agents from buried munitions have destroyed the fertility of the soil. After entering the soil, the toxic agents are concentrated by earthworms, spiders, centipedes, and other soil-dwelling organisms, resulting in disruption of the soil ecosystem.[43] As a result, most lands contaminated by buried ACW have gone out of cultivation.[44]

Even more troubling, significant amounts of ACW are buried near urban water supplies. For example, many severely corroded chemical munitions have been found near a large reservoir in Dunhua County.[45] If these munitions leak, they will pollute the water. Lewisite is relatively unstable and is easily hydrolyzed in the presence of water to form 2-chlorovinyl arsyline acid, which is converted to arsenite ion in the presence of alkali. Arsenite ion is known to damage tissues and internal organs.[46] Another chemical-warfare agent, hydrogen cyanide, is also soluble in the water. These water-soluble agents could therefore pollute local water supplies when they are carried into the rivers by rain.

The storage pits near Dunhua are 640 meters above sea level, and water runs down from this elevated area to rice fields below.[47] After the sixth Sino-Japanese joint survey, Shigekazu Sato, the head of the Japanese survey team, announced that some of the munitions may be leaking, since soil samples contained higher than normal concentrations of chloride ions.[48] Sato concluded, however, that based on a preliminary assessment, the weapons did not pose an environmental hazard.[49] However, Mr. Huang Yu, the Chinese delegate to the CWC Preparatory Commission in The Hague, said he was not satisfied with the

Figure 2: Comparison of Destruction and Disassembly Technologies for ACW in China

DESTRUCTION TECHNOLOGY	Negative Political Response	Short-Term Environmental Effects	Long-Term Environmental Effects	Suitability for ACW Bulk Agent Destruction	Suitablity for ACW Munitions Destruction
Incineration	High	Low	?	Good	Good
Catalytic Extraction Processing	Low	Low	?	Good	Poor
DISASSEMBLY TECHNOLOGY					
Cryofracture	?	Low	?	N/A	Good
Pool	?	Low	?	N/A	Good

preliminary nature of the survey and called the results of the environmental sampling "unrealistic."[50]

ACW DESTRUCTION

Given the presence of toxic agents in abandoned chemical weapons, particularly arsenic,[51] destruction of ACW in China must protect public health and the environment. It is vital to perform a comprehensive analysis of various destruction methods, including their safety, health, and environmental consequences. For each of those major risk categories, the evaluation should include the consequences of the release of chemical agent and of toxic by-products of the destruction process.[52]

From the standpoint of environmental protection and human health, destroying CW can produce short-term and long-term effects. Short-term hazards mainly involve worker safety and the effects of an accidental release of agent. Long-term hazards result from the exposure of plant workers, the surrounding community, and the environment to low-level emissions and discharges from the destruction process itself. The risks to local environment are associated with the total environmental burden resulting from aqueous discharges, atmosphere emissions, and solid-waste management.

The environmental effects of destroying ACW depend greatly on the technology chosen. A host of different destruction technologies are available.[53] Of all these technologies, only incineration is proven to be effective,[54] and is currently employed by Germany and the United Kingdom to destroy old chemical weapons left over from World War I.[55] Most of the other methods are still in transition from laboratory research and development to scale-up testing. Nevertheless, each technology has its strengths and weaknesses. Figure 2 describes the environmental effects of several technologies that may be suited for future destruction of ACW in China, based on the fact that most ACW are heavily corroded and the chemical agents inside them are sometimes unknown.

Catalytic Extraction Processing (CEP) destroys bulk agent by combining it with molten metal. Although local communities have tended to oppose incineration of chemical weapons, CEP destruction facilities may be politically more acceptable because they do not have large smokestacks.

Prior to actual destruction, the munitions must be recovered, identified, and disassembled—operations that are arguably more costly, hazardous, and time-consuming than the destruction process itself. In particular, munitions armed with a fuse may detonate accidentally. Cryofracture and pool technologies offer useful ways to disassemble a munition safely. With cryofracture, the whole munition is frozen in liquid nitrogen to render it brittle and then mechanically fractured into small pieces. These pieces are then either fed directly into a high-temperature incineration plant or treated by a chemical neutralization process. In pool technology, the whole munition is submersed in a large pool containing a chemical solution. The munition is then opened or detonated to release the agent, which is neutralized chemically.

CONCLUSIONS

Until all ACW have been eliminated, Chinese citizens will continue to live under the threat of accidental exposure to chemical weapons. Many civilians have already been killed or injured, and scarce natural resources have been contaminated. One possibility is for residents who live in the area where a possible destruction plant will be built to demand compensation from the Japanese government, as Russian residents who live near chemical stockpiles have done.

Under the CWC, Japan and China are conducting bilateral negotiations to address the details of ACW destruction, and both sides must cooperate in the destruction effort. Japan must take responsibility for providing all necessary financial, technical, expert, facility, and other resources as an Abandoning State Party. China must provide appropriate cooperation as the Territorial State Party. While Beijing and Tokyo have agreed in principle that ACW can be destroyed in China, differences remain over the number of munitions to be destroyed and the threat they pose to the environment. In selecting a destruction method, the prospective technologies should be assessed with a view to minimize the short- and long-term hazards to human health and the environment.

[1] *Chemical Weapons Convention* (CWC), Verification Annex (VA), Part IV(B), paragraph 15.
[2] CWC, Article VIII, paragraph 3.
[3] Gakujin Ki [Xueren Ji in Chinese], *Nihongun no Kagakusen* [The Japanese Army's Chemical Warfare], (Tokyo: Otsuki Shoten, 1996), pp. 134-137.
[4] *Ibid.*, Table 12, p. 79.

[5] Gyoen Ko [Xiaoyan Gao in Chinese], *Nihongun no Iki Doku Gasu Heiki* [The Japanese Army's Abandoned Poison Gas Weapons], (Tokyo: Akashi Shoten, 1996), pp. 15-28; *Kagaku Heiki o do Shori Suru no ka?* [How to Dispose of Chemical Weapons?], broadcast by Nippon Hoso Kyokai (NHK), September 22, 1996.

[6] Gakujin Ki [Xueren Ji in Chinese], *Nihongun no Kagakusen* [The Japanese Army's Chemical Warfare], (Tokyo: Otsuki Shoten, 1996), pp. 304-306, 329-330.

[7] *Ibid.*, p. 340; *Kagaku Heiki o do Shori Suru no ka?* [How to Dispose of Chemical Weapons?], broadcast by Nippon Hoso Kyokai (NHK), September 22, 1996.

[8] Masaharu Takahashi, Unit 516 soldier, *Kagaku Heiki o do Shori Suru no ka?* [How to Dispose of Chemical Weapons?], broadcast by Nippon Hoso Kyokai (NHK), September 22, 1996; Gakujin Ki [Xueren Ji in Chinese], *Nihongun no Kagakusen* [The Japanese Army's Chemical Warfare], (Tokyo: Otsuki Shoten, 1996), p. 340.

[9] Yasujiro Kaneko, Unit 526 soldier, *Kagaku Heiki o do Shori Suru no ka?* [How to Dispose of Chemical Weapons?], broadcast by Nippon Hoso Kyokai (NHK), September 22, 1996.

[10] Gakujin Ki [Xueren Ji in Chinese], *Nihongun no Kagakusen* [The Japanese Army's Chemical Warfare] (Tokyo: Otsuki Shoten, 1996), p. 340.

[11] *Ibid.*

[12] *Some Information on Discovered Chemical Weapons Abandoned in China by a Foreign State*, Conference on Disarmament document CD/1127, February 18, 1992.

[13] Yoshito Horie, "Kagaku Hodan, Suitei 70 Manpatsu [Chemical Shells Estimated at 700,000]," *Asahi Shimbun*, June 3, 1996, p. 1; Kenji Yuasa, "70 Manpatsu Risetsu to Suitei [700,000 Shells Unearthed, Estimated]," *Nihon Keizai Shimbun*, June 3, 1996, p. 38.

[14] *Some Information on Discovered Chemical Weapons Abandoned in China by a Foreign State*, Conference on Disarmament document CD/1127, February 18, 1992.

[15] "Japanese Gas Shells in China Continue to Cause Damage," Kyodo News Agency, November 4, 1991; in BBC Monitoring Service, Summary of World Broadcasts, November 6, 1991; William Brent, *AFP*, Hong Kong, January 3, 1992; in FBIS-CHI-92-002 (3 January 1992), pp. 17-18; Gyoen Ko, *Nihongun no Iki Doku Gasu Heiki* [The Japanese Army's Abandoned Poison Gas Weapons], p. 72.

[16] Angangxi: Gyoen Ko, *Nihongun no Iki Doku Gasu Heiki* [The Japanese Army's Abandoned Poison Gas Weapons], p. 95. Taiyuan: Gakujin Ki [Xueren Ji in Chinese], *Nihongun no Kagakusen* [The Japanese Army's Chemical Warfare], (Tokyo: Otsuki Shoten, 1996), p. 344.

[17] *Ibid*., pp. 343.

[18] Gyoen Ko [Xiaoyan Gao in Chinese], *Nihongun no Iki Doku Gasu Heiki* [The Japanese Army's Abandoned Poison Gas Weapons], (Tokyo: Akashi Shoten, 1996), pp. 218-219. By another account, 18 were injured and one person died in this incident. *Ibid*., pp. 197-204.

[19] *Kagaku Heiki o do Shori Suru no ka?* [How to Dispose of Chemical Weapons?], broadcast by Nippon Hoso Kyokai (NHK), September 22, 1996; Gyoen Ko [Xiaoyan Gao in Chinese], *Nihongun no Iki Doku Gasu Heiki* [The Japanese Army's Abandoned Poison Gas Weapons] (Tokyo: Akashi Shoten, 1996), pp. 222-225.

[20] *Kyodo News*, August 14, 1996; in FBIS-EAS-96-159 (14 August 1996); *Kyodo News*, December 9, 1996; in FBIS-EAS-96-237 (9 December 1996).

[21] Mudanjiang: *Kagaku Heiki o do Shori Suru no ka?* [How to Dispose of Chemical Weapons?], broadcast by Nippon Hoso Kyokai (NHK), September 22, 1996; *The Abandoned Chemical Weapons Discovered on China's Territory*, video by the Government of China, 1995. Fulaerji: Gyoen Ko, *Nihongun no Iki Doku Gasu Heiki* [The Japanese Army's Abandoned Poison Gas Weapons], pp. 100-112, 230-231.

[22] *Some Information on Discovered Chemical Weapons Abandoned in China by a Foreign State*, Conference on Disarmament document CD/1127, February 18, 1992; *The Abandoned Chemical Weapons Discovered on China's Territory*, video by the Government of China, 1995; *Kagaku Heiki o do Shori Suru no ka?* [How to Dispose of Chemical Weapons?], broadcast by Nippon Hoso Kyokai (NHK), September 22, 1996.

[23] Gakujin Ki [Xueren Ji in Chinese], *Nihongun no Kagakusen* [The Japanese Army's Chemical Warfare], (Tokyo: Otsuki Shoten, 1996), pp. 344-345; *Kagaku Heiki o do Shori Suru no ka?* [How to Dispose of Chemical Weapons?], broadcast by Nippon Hoso Kyokai (NHK), September 22, 1996.

[24] *Kagaku Heiki o do Shori Suru no ka?* [How to Dispose of Chemical Weapons?], broadcast by Nippon Hoso Kyokai (NHK), September 22, 1996

[25] *Ibid.*; *Kyodo News*, August 14, 1996; in FBIS-EAS-96-159 (14 August 1996).

[26] *Kyodo News*, December 9, 1996; in FBIS-EAS-96-237 (9 December 1996).

[27] William Brent, *AFP*, Hong Kong, January 3, 1992; in FBIS-CHI-92-002 (3 January 1992), pp. 17-18.

[28] Lu Mingzhuo, "To Hell With the 'Historical Concept of Aggression,'" *Renmin Ribao*, August 31, 1995, p. 5; in FBIS-CHI-95-182 (20 September 1995), p. 11.

[29] William Brent, *AFP*, Hong Kong, January 3, 1992; in FBIS-CHI-92-002 (3 January 1992), pp. 17-18.

[30] *Some Information on Discovered Chemical Weapons Abandoned in China by a Foreign State*, Conference on Disarmament document CD/1127, February 18, 1992.

[31] The first pit was dug and filled from 1953 to 1956, employing up to 500 people every winter. This pit has dimensions of 25 meters in length, 12.5 meters in width, and 10 meters in depth. In 1954 the pit became full, and it was capped with three meters of earth to keep it from overflowing. The munitions were transported by 86 horse and ox drawn carts and sleds from Shenyang, Harbin, Qiqihaer, and other northeast cities, mobilizing around 3,000 people. The second pit was begun in 1954 about 40 meters away from the first, with dimensions of 20 meters in length, 10 meters in width, and eight meters in depth.

[32] Gakujin Ki [Xueren Ji in Chinese], *Nihongun no Kagakusen* [The Japanese Army's Chemical Warfare] (Tokyo: Otsuki Shoten, 1996), pp. 342-343.

[33] *The Abandoned Chemical Weapons Discovered on China's Territory*, video by the Government of China, 1995.

[34] "Japan to Send Chemical Weapon Survey Team to China," *Jiji Press Newswire*, May 20, 1997.

[35] The value of such a distinction is questionable when non-lethal agents are used a method of warfare. Yasuji Kaneko, a former soldier of the Japanese Army, recalls one operation where a "sneezing agent" (diphenylcyanoarsine) was used to flush 130 civilians and soldiers into the open where they could be shot. Tomoko Otake, "Veteran Rues his Atrocities in China," *Japan Times*, September 26, 1996, p. 3.

[36] "Kagaku Heiki Shori Gun no Kyoroku Yosei [A Request for Military Cooperation for the Disposal of Chemical Weapons]," *Asahi Shimbun*, January 27, 1997, p. 3.

[37] "Chugoku ni Shori Kojo" [Destruction Plants in China], *Nihon Keizai Shimbun*, January 3, 1996, p. 1; "98 Nen made ni Shori Chakushu" [The Beginning of Destruction Plants by 1998], *Asahi Shimbun*, August 16, 1996, p. 3; *Chemical Weapons Convention Bulletin*, September 1996, p. 34.

[38] *Kyodo News*, April 11, 1997; in FBIS-TEN-97-101 (11 April 1997); *Jiji Press Newswire*, April 11, 1997.

[39] Jennifer Lin, "Years After War Atrocities, Chinese Citizens Sue Japan," *Inquirer*, February 15, 1997.

[40] *Kagaku Heiki o do Shori Suru no ka?* [How to Dispose of Chemical Weapons?], broadcast by Nippon Hoso Kyokai (NHK), September 22, 1996

[41] *Ibid.*

[42] *Ibid*.

[43] Deng Jifu *et al.*, *Environmental Science*, Vol. 17, Issue 2, 1996, p.1.

[44] Ji Xueren, *Riben Qinghua Zhanzhen de Huaxuezhan* [Chemical Warfare of Japanese Invasion of China] (Beijing: Junshi Yiwen Press, 1995), p. 267.

[45] *Some Information on Discovered Chemical Weapons Abandoned in China by a Foreign State*, Conference on Disarmament document CD/1127, CD/CW/WP.384, February 18, 1992

[46] Aberdeen Providing Ground, *Chemical Stockpile Disposal Program Final Programmatic Environmental Impact Statement*, Vol. 1, January, 1988, pp. 4-5.

[47] Ronald G. Manley, Chemical Demilitarization Branch Head, OPCW, personal communication to Professor J.F. Bunnett, August 23, 1996; in International Union of Pure and Applied Chemistry, Committee on Chemical Weapons Destruction Technologies communiqué, September 12, 1996.
[48] Kenji Yuasa, "70 Manpatsu Risetsu to Suitei [700,000 Shells Unearthed, Estimated]," *Nihon Keizai Shimbun,* June 3, 1996, p. 38; Yoshito Horie, "Kagaku Hodan, Suitei 70 Manpatsu [Chemical Shells Estimated at 700,000]," *Asahi Shimbun,* June 3, 1996, p. 1; "Japan's Chemical Weapons Confirmed Found in China," *Japan Times Weekly International Edition,* June 10-16, 1996, p. 3; *Kyodo News,* June 2, 1996; in FBIS-CHI-107 (2 June 1996).
[49] Kenji Yuasa, "70 Manpatsu Risetsu to Suitei [700,000 Shells Unearthed, Estimated]," *Nihon Keizai Shimbun,* June 3, 1996, p. 38; Yoshito Horie, "Kagaku Hodan, Suitei 70 Manpatsu [Chemical Shells Estimated at 700,000]," *Asahi Shimbun,* June 3, 1996, p. 1.
[50] *Xinhua News,* July 24, 1996; in FBIS-CHI-96-144 (24 July 1996).
[51] The Japanese produced several weapons whose fill contained arsenic: lewisite, mustard/lewisite mix, diphenylcyanoarsine, and a phosgene and arsenic trichloride mix (Gakujin Ki [Xueren Ji in Chinese], *Nihongun no Kagakusen* [The Japanese Army's Chemical Warfare], (Tokyo: Otsuki Shoten, 1996), Table 4, pp. 28-31).
[52] National Research Council, *Review and Evaluation of Alternative Chemical Disposal Technologies* (Washington, D.C.: National Academy Press, 1996), p.19.
[53] "Report of the NATO Advanced Research Workshop on Destruction of Military Waste (http: //www.opcw.nl/chemhaz/arwnaal1.htm)," Naaldwijk, The Netherlands, May 22-27, 1994, pp. 8-12.
[54] *Ibid.,* p. 9.
[55] Ronald G. Manley, "European Experience with the Disposal of Old Chemical Weapons," paper presented to NATO Advanced Research Project, Brno, Czech Republic, 1996.