



National Ground Intelligence Center



Date of Publication: 2005-08-17

(U) China: Medical Research on Bio-Effects of Electromagnetic Pulse and High-Power Microwave Radiation

(U) Purpose

(U) The purpose of this report is to explore the possible meanings and relevant implications of China's medical research on the bio-effects of intense high-power microwave (HPM) and electromagnetic pulse (EMP) radiation.

(U) Key Points

- (U) A team of Chinese medical researchers has recently reported (open forum) research activity related to studies of the bio-effects of high-power microwave (HPM) and electromagnetic pulse (EMP) radiation.
- (U) Animals studied included mice, rats, rabbits, dogs, and monkeys. Dose-related effects on eyes, brain, heart, bone marrow, reproductive, and other vital organs were reported. The researchers' interest in potential human effects is apparent.

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(U) The Medical Experiments

(U) Chinese medical researchers presented three briefings at the Asia-Pacific Electromagnetic Fields, Research, Health Effects, and Standards Harmonization Conference in Bangkok, Thailand (26 to 30 January 2004), on the bio-effects of intense HPM and EMP radiation. Although the data presented related only to animal experiments (mice, rats, rabbits, dogs, and monkeys), all three briefings made it clear that the real purpose was to investigate potential human effects of exposure to these specific radiations. One briefing, "Effects and Mechanisms of EMF and HPM on Optical Systems in Monkey, Dog, and Rabbit," dealt mostly with eye injury. "Bio-effects of S-Frequency High Power Microwave Exposure on Rat Hippocampus" dealt mostly with brain injury. The third and final briefing, "The Species Specificity and Sensitive Target Organs of Injury Induced by Electromagnetic Radiation (BIO-EFFECTS OF EMP AND HPM)," dealt with species-related injury thresholds for all affected organs. Dose-effects relationships were established in all three studies. Abstracts for these presentations are available on the Internet.⁵ Members of the research team are affiliated with the Institute of Radiation Medicine of the Academy of Military Medical Sciences, Beijing. A senior member of the team is involved in organizing The Fourth International Seminar on Electromagnetic Fields and Biological Effects, scheduled to be held in Kunming, China, 12 to 16 September 2005.

(U) Exposure Levels

~~(S//NF)~~ Exposures ranged up to 16 W/cm² (HPM) and 60 kV/m (EMP) for whole body single-pulse irradiation with 20 ns rise-time and 30 μ s duration. (This rise-time is too slow and the duration is too short for a real nuclear EMP, but these parameters may be as close as these researchers could come to simulating a real EMP.) These levels of exposure could only have resulted from close-range irradiation with powerful radiation sources. [redacted] b1

[redacted] b1 From the nature of the reported organ injuries, it is likely that the frequencies for these sources ranged from the tens of MHz to the low GHz range (EMP falls primarily in the lower range while HPM occupies the upper range). This sensitivity is a recent phenomenon because these same researchers published the results of related experiments in 2001 in which full details of sources and radiation parameters were provided. An EMP simulator developed jointly by the Academy of Military Medical Sciences and the National University of Defense Technology was the source for the 2001 publication [redacted]

[redacted] b1

(U) Vision Experiments

~~(c)~~ [redacted] b1

(U) Brain Study

~~(c)~~ [redacted] b1

(U) Species Specificity and Mortality Study

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By a process of extrapolation, one might be able to use these data to set danger thresholds for human exposure. The high mortality rates of animals (especially for primates) exposed to EMP radiation in the recent Chinese experiments are in graphic contrast to the lack of reported bio-effects associated with EMP exposures during the period of atmospheric nuclear testing (1950s/1960s) by the United States and other nations. This is probably a consequence of the extremely high field strengths used in the Chinese experiments.

(U) Antipersonnel RF Weapons?

~~(S//NF)~~ Although it is clear that the real purpose of the Chinese medical experiments is to learn the potential human effects of exposure to powerful EMP and HPM radiation, an antipersonnel RF weapon system falls short of an adequate explanation for this activity (unless one assumes it is intended primarily for torturing prisoners). The absence of prompt effects, coupled with the close range requirement, renders the Chinese sources used in the medical experiments militarily useless as antipersonnel devices. Sources with these frequency and pulse characteristics would make more effective weapons against unshielded electronic targets (whose sensitivity to these radiations is much greater than that of the human body). b1

b1 and it is possible that the HPM-related medical studies are being conducted to establish safety and shielding standards for the future human operators of these systems (and possibly also for radar operators). This could explain the Chinese researcher's reluctance to specify the radiation frequencies used in their medical experiments.

(U) Active Denial Technology

(U) An RF antipersonnel weapon that does result in prompt bio-effects is being developed in the United States. This non-lethal "crowd control" weapon is called the Active Denial System (ADS). Unclassified details of this technology are readily available on the Internet^c and in the open press.^d Unlike the sources used in the Chinese medical experiments whose radiation readily penetrates deeply into animal tissues, ADS uses 95 GHz (location of an atmospheric transmission window) radiation that only penetrates about 1/64 inch beneath the skin surface (where most nerve endings are located). The skin surface is heated (130° F after 2 sec exposure) but not sufficiently to cause burns. Because the increase in skin temperature is very rapid, however, the (psychophysical) sensation is one of intense pain (like being hit by a blow torch) and the body responds reflexively by immediately attempting to exit the beam (the radiation is delivered in brief few second pulses to prevent injury to anyone physically unable to exit the beam). Because the frequency is high, the radiation can be confined to a narrow beam so individuals or small groups can be targeted at militarily significant distances. The flux of radiation required to elicit the pain sensation is also quite low so the ADS source and antenna are small enough to be mounted on a small mobile vehicle like a HMMWV. The ADS is intended to be used to prevent intrusion of civilians into sensitive areas (area denial) and to deter potentially hostile forces from coming within small arms-range of ADS protected facilities. There is no information suggesting that the Chinese are pursuing a similar antipersonnel RF

weapon system.

(U) The Chinese "Electromagnetic Bomb"

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(S//NF) [Redacted] b1

(U) Explosively Powered Radiofrequency Radiation Sources

~~(S)~~ In Western military science, the term "Electromagnetic Bomb" (or E-Bomb) usually means an explosively powered, magnetic-flux compression generator driving some type of microwave source attached to an RF antenna. Some Chinese uses of the term are consistent with this conventional definition. [Redacted] b1

[Redacted] b1 Some designs are compact enough to fit in conventional artillery projectiles, while others require missile or bomb platforms of various sizes, but all are of limited range. The most advanced program is probably that of Germany. In their estimate, the German program is not likely to result in a fielded system before 2011. It is widely acknowledged that (conventional) explosively powered RF radiation sources with militarily significant applications are a difficult technological hurdle (despite some overly hyped Internet articles on E-bombs to the contrary), and it is very unlikely that China could have already overcome these hurdles.

(U) Carbon or Graphite-Fiber Bomb

(U) During the recent conflict with Yugoslavia (over Kosovo) there were press reports of the United States using bombs that dispersed conductive carbon (graphite) fibers over wide areas causing short circuits that brought down the power grids in regions of Yugoslavia. Some Chinese sources, reacting to these reports, have used the term that translates as "Electromagnetic Bomb" for these devices. Other Chinese sources^e claim that the PLA has their own version of the graphite bomb and even discuss its potential use during a conflict with Taiwan.

(S) [Redacted] b1

[Redacted] It was assessed that such a warhead could be fielded within 5 years of a successful test.

(U) High Altitude Nuclear Electromagnetic Pulse

(U) Other Chinese writers have used the term that translates as "Electromagnetic Bomb" to describe

a nuclear explosion detonated at high altitude that is employed for its electromagnetic pulse (HEMP) effects on electronic equipment. The HEMP effect was discovered in 1962 when the United States conducted a high-altitude nuclear test (codenamed "STARFISH PRIME") over the Pacific that affected electronics and radio transmissions on Hawaii (over 1200 kilometers away).

(U) EMP radiation is caused by the currents created when gamma rays (resulting from a nuclear explosion) ionize the atoms and molecules of the atmosphere with which they interact. All atmospheric bursts create some EMP, but the most significant is that created by high-altitude bursts (#30 km). The EMP resulting from near surface bursts (#5 km) does not penetrate beyond the blast damage radius, so it is not normally the subject of study. For intermediate heights (10 km #h #25 km), the resulting fireball is so close to being spherically symmetrical (because it is confined entirely to the atmosphere) that the current distribution lacks a significant dipole moment and EMP radiation is thereby greatly reduced. Only the high-altitude bursts (where the resulting current distribution is nonsymmetrical due to the exponential decrease in atmospheric density with height) result in a strong EMP signal that can extend for thousands of kilometers (see (U) Worldwide: Nuclear Electromagnetic Pulse Primer).

(U) In 2001, the U.S. Congress commissioned a study of the U.S. vulnerability to an HEMP attack. In 2004, a threat assessment and a final commission report were released. Quoting from the threat assessment:

(U) "The threat of an attack against the United States involving EMP is hard to assess, but some observers indicate that it is growing along with worldwide access to newer technologies and the proliferation of nuclear weapons. In the past, the threat of mutually assured destruction provided a lasting deterrent against the exchange of multiple high-yield nuclear warheads. However, now a single, specially-designed low-yield nuclear explosion high above the United States, or over a battlefield, can produce an EMP effect that results in a widespread loss of electronics, but no direct fatalities, and may not necessarily evoke a large nuclear retaliatory strike by the U.S. military."

(U) The Congressional report discounts the potential for EMP bio-effects. Its authors, however, were concerned primarily with extremely high altitude bursts (high enough that a single burst above Kansas would cause electronics damage on both coasts and all points in between). For bursts at such extreme altitudes (#400 km ?) the gamma rays would have spread significantly before coming in contact with the atmosphere (at # 40 km altitude) and the resulting EMP would cover an extremely large area with reduced intensity radiation (probably no more than 5 to 10 kV/m).

(U) Taiwan Scenario

~~(S//NF)~~ For use against Taiwan, China could detonate at a much lower altitude (30 to 40 km, according to some recent speculations) to confine the EMP effects to Taiwan and its immediate vicinity and minimize damage to electronics on the mainland. The result would be a more intense EMP in a localized area. [redacted] b1

[redacted] b1 A critical issue then would be the danger threshold for human exposure since human casualties (either Taiwan or U.S. military) would greatly increase the likelihood of a U.S. nuclear response. [redacted]

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(U) Nuclear Warhead and Missile Requirements for the Taiwan Use Scenario

~~(C)~~ Although Chinese military analysts (both on Taiwan and the mainland) have frequently speculated about China's development of these special low-yield EMP warheads, it is not known whether they have actually done so. [redacted] b1

[redacted] b1 It is possible that China has also conducted similar research. However, these developments are not a prerequisite for

an EMP attack against Taiwan. Any low-yield strategic nuclear warhead (or tactical nuclear warhead) could be used with similar effects. The DF-21 medium-range ballistic missile has been mentioned as a platform for the EMP attack against Taiwan.

(U) Trump Cards/Assassin's Mace Weapons and Taiwan Reunification

(S//NF) [redacted] b1 [redacted]
b1 [redacted] are consistent with what the mainland Chinese have described as "Trump Card" or "Assassin's Mace" (Sha Shou Jian in Chinese) weapons. After the United States responded to Chinese missile test flights over Taiwan, in 1996, by moving two Aircraft Carrier Battle Groups (CVBG) to the vicinity of Taiwan, Chinese political and military leaders began to use the terms Trump Card and Assassin's Mace weapons to describe modern weapons that would permit China to prevail over the United States in a conflict over a forced reunification with Taiwan. In this modern usage, Assassin's Mace refers to weapons based on older or existing technology that is used in a new or unconventional way, while Trump Card refers to weapons based on newer technology that has been developed in high secrecy. Both are viewed as weapons that could permit the "weak" to defeat the "strong" in certain limited scenarios. The element of surprise is critical to both. These modern Trump Card and Assassin's Mace weapons will permit China's low-technology forces to prevail over U.S. high-technology forces in a localized conflict, according to these political pronouncements. These issues are discussed in greater detail in an Internet posted-briefing¹ by Jason Bruzdinski (MITRE Corporation).

(C) Several Chinese authors (both on Taiwan and the mainland) have specifically discussed HEMP as a Trump Card or Assassin's Mace weapon (Trump Card would be applicable if the Chinese have developed new low-yield, possibly enhanced, EMP warheads, while Assassin's Mace would apply if older warheads are employed). Within this context, [redacted] b1 [redacted]

b1 [redacted] The medical research contribution would help insure that China's use of HEMP against Taiwan and any vulnerable U.S. CVBG assets would not push the U.S. across the nuclear-response threshold. China's HEMP capability could be used in two different ways: as a surprise measure after China's initial strike against Taiwan and after U.S. CVBG assets have moved into a vulnerable position, and as a bluff intended to dissuade the United States from defending Taiwan with the CVBG. One article describing the bluff scenario suggests that China might announce a resumption of atmospheric nuclear testing and warn of tests during a specified time period, then strike Taiwan with the conventional infrastructure attack during the specified period. They would then wait to see whether the United States would call their bluff by moving the CVBG to defend Taiwan. This bluff scenario would be accompanied by prior announcements/leaks of their intentions (which seems to be the case as sources for this article confirm).

(U) Conclusions

(C) [redacted] b1 [redacted] suggests that China may consider (as an option) the employment of HEMP as a Trump Card or Assassin's Mace weapon against the Taiwan electronic infrastructure or against a U.S. CVBG (or at least to threaten such actions), should a conflict break out in the Taiwan Strait. The minimization of military casualties on CVBG assets is calculated to lessen the likelihood of a U.S. nuclear response to a Taiwan strike employing nuclear EMP. The minimization of casualties on Taiwan is calculated to lessen the animosity among Taiwan's populace over forced reunification.

Footnotes

- a. (U) The term Assassin's Mace harkens back to Chinese antiquity. The original Assassin's Mace was a small club that could be hidden in the folds of clothing that would permit an assassin to move into

close range of a well-protected victim before revealing his intentions. Since the club had to be small (for purposes of concealment) the blows had to be delivered to particularly sensitive points on the body in order for the attack to be lethal. Thus the weapon was normally employed by practitioners of the martial arts whose knowledge of anatomy included the locations of particularly sensitive nerve centers. The term "Trump Card" weapon has the obvious connotation associated with card games.

- b. (U) http://www.who.int/peh-emf/meetings/archive/en/bangkok04_proceedings.pdf.
- c. (U) Vehicle-Mounted Active Denial System (V-MADS)
<http://www.globalsecurity.org/military/systems/ground/v-mads.htm>.
- d. (U) "Sci-Fi Weapons Going to War," Los Angeles Times, 8 Dec 2002, article by William M. Arkin, also (U) "Pentagon Looks to Directed-Energy Weapons," Newport News Daily Press, 2 Aug 2004, article by Michael P. Regan.
- e. (U) "Zhang Wannian Says There Will Be War in Taiwan Strait in 5 Years," 19 Nov 2000, Hong Kong Tung Fang Jih Pao (FBIS Document ID: CPP 20001120000091).
- f. (U) "Demystifying SHASHOUJIAN: China's 'Assassin's Mace' Concept," Copyright 2003, The MITRE Corporation, www.mitre.org/employment/employee_spotlight/jason_bruzdinski.html.

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Information Cutoff Date: 2005-06-20

External Coordination:

DIA/AFMIC

Derived From: Multiple Sources

Declassify on: Source marked X1; date of source, 20040912

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Regraded UNCLASSIFIED on

13 September 2010
by USAINSCOM FOI/PA
Auth para 4-102, DOD 5200-1R

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