by Dr. Rosalie Bertell

Introduction:

I first heard about the military using depleted uranium for bullets from the Native Americans for a Clean Environment (NACE) in Gore, Oklahoma. Kerr Magee was operating a factory there, and in a liquid waste spill a young man, about twenty-one years old, was sprayed with the mixture and died. Many members of the public were also exposed, and were taken to the University in Oklahoma City for medical examination and feces analysis. It seems that the liquid waste contained primarily uranium and other heavy metals.

Local people had found this factory to be very polluting. When I visited the town to see what was happening and to decide whether or not I could help, they showed me rust marks scattered over the surface of their automobiles where the toxic corrosive spray released from the factory routinely had impacted on the paint. People complained of burning throats and eyes, some with even more serious complaints, but little systematic information which would show that the factory was the source of their problem.

I met a young boy who showed me a frog he had caught--the frog had nine legs. It was in a bottle of formaldehyde. I wanted to take it for some tissue and bone analysis but it was his prize possession and he would not part with it.

I learned that the Kerr Magee plant had been disposing of its waste by deep-well injection in this rural, primarily farming area. The people, becoming alarmed at this practice which threatened the water table, got a court injunction to stop it. In an action, which seemed to the local farmers to be a retaliation, Kerr Magee had applied to the Nuclear Regulatory Commission to call their waste an "experimental fertilizer" and just spread it over the top of the land. The stories were quite strong evidence that this so-called fertilizer was sometimes just released into the local river, or released in one place on the factory property, with no pretense even to spread it.

The young boy had found his nine-legged frog on the hill which served as the "experimental plot." Hunters had found a rabbit with two hearts, and the local taxidermist told me that he had tried to mount two deer heads and the fur came off in his hands in clumps. He had never seen anything like it in his whole career.

As local people became sick and started to complain, Kerr Magee bought them out, and took over their land. The Native people, who were determined to preserve their land, formed a Coalition of White and Natives Concerned, and began the long legal

fight with the company. They learned about environmental assessment hearings, licensing hearings, etc. and began to seriously participate. They also undertook a human health survey of all families -- there were about four hundred of them -- living within four miles of the factory. Every family was included in the survey, which was very comprehensive and carefully administered.

The International Institute of Concern for Public Health agreed to analyze this data for the citizens. The outstanding illnesses in the area were respiratory and kidney problems. There were significantly more persons with respiratory illnesses down wind of the plant, and significantly more with kidney problems down stream of the plant.

We intended to do a clinical follow-up of this survey, and designed the study with the cooperation of the Occupational Health and Respiratory Units at the University Medical School of New Jersey. We were not able to obtain funding for this study. Nevertheless, with the health survey and a great deal of local perseverance, Kerr Magee moved out. A second multinational tried to take over the factory--I think it was General Dynamics--but it failed.

I learned many things about the uranium bullets in the process of this research:

- They are incendiary, that is after piercing the object they can burst into flame.
- They are fragmentary, they disintigrate into small fragments inside the body, and cannot be removed.
- They are more dense than lead, and can pierce a bullet- proof vest, or a light armored car or tank.
- Because the "enemy" might also use them, the military made uranium armor as a protection.
- They were cheap, because the depleted uranium was a waste product of the nuclear-bomb program.
- They were radioactive, which meant that even handling them was risky, but no one seemed to be worrying about this!

Research into Gulf War Syndrome

Six years after the Gulf War there is still deep controversy over the causes of the severe health problems observed in the veterans. Reluctantly, the U.S. government has been slowly releasing data on possible Iraqi chemical exposures of the veterans, but many physicians, some of whom have reported that their jobs are being threatened, have said that this information does not explain the variety of symptoms observed.

Shortly after the Gulf War, at the request of Staff Sargeant Carol Picou, San Antonio, Texas, who was herself a victim, Patricia Axelrod undertook research into the possible causes of this illness.

The research was jointly sponsored by the U.S. National Institutes of Health, Office of Women's Health. It was submitted to the Department of Health and Human Services on May 10, 1993, and was labeled: for internal distribution only. The research was intended to be a guide to further research into the problem, so its limitation to internal distribution did not make sense.

Our journal, International Perspectives in Public Health, published the document in full in 1994.

At the time, the U.S. Department of Defence was treating this illness as Post Traumatic Stress Disorder (PTSD) and advising military doctors to treat it with muscle relaxants and sleeping pills, while ordering a mental illness assessment. Most of the information in Ms. Axelrod's Guide to Gulf War Sickness comes from interviews with Dr. Thomas Callender, a toxicologist; Dr. Barry Wilson, of Battelle Pacific Northwest Laboratories; and Commissioner Rudy Arredondo, Maryland's Commission on Black and Minority Health. Ms. Axelrod also interviewed many veterans and reviewed the journal articles and reports available in the public press. Information on leishmaniases was provided by the World Health Organization.

Potential Causes of Gulf War Syndrome

In this complex situation, any or all of the following factors may have interacted to bring about specific symptoms in veterans. Obviously, the combinations of factors differ with individuals, hence it is likely that there is not one single explanation of the whole spectrum of symptoms. However, the following main categories are candidates for causal relationships with illnesses reported by veterans:

- Administration of three vaccines intended as protection against nerve and biological warfare agents. These were:
    1. Pyridostigmine, normally prescribed for myasthenia gravis and known to have serious side effects, especially when the person taking it is exposed to heat. It is also known that exposure to pesticides and insecticides (Baygon, Diazinon and Sevin) should be avoided when taking pyridostigmine because they can accentuate its toxicity. Some women who took this drug during pregnancy and have breast-fed infants have seen side effects in their child.
    2. Botulinum Pentavalent, an unproven vaccine intended to counteract botulism. It is unlicensed in the United States.

3. Anthrax, to protect against the disease anthrax. This was apparently selectively administered to troops during the war, and women receiving it were warned not to have children for three or four years.

- Depleted uranium was used for the first time in this war. It was incorporated into tank armor, missile and aircraft counterweights and navigational devices, and in tank, anti-aircraft and anti-personnel artillery. The scientific information on this deadly chemical has been reported in "Radium Osteitis With Osteogenic Sarcoma: The Chronology and Natural History of Fatal Cases" by Dr. William D. Sharpe, Bulletin of the New York Academy of Medicine, Vol. 47, No. 9 (September 1971). There was no excuse for this human experimentation because the effects of this exposure were known.
- Smoke and chemical pollutants released by the continuous oil- well fires. Levels of soot, carbon monoxide and ozone have been studied by an Environmental Protection Agency Task Force. The National Toxics Campaign, Boston, Massachusetts, found five different toxic hydrocarbon products in the smoke (1,4-dichlorobenzine, 1,2-dichlorobenzene, diethyl phthalate, dimethyl phthalate and naphthalene), any one of which could induce serious health effects.
- Old World leishmaniasis, a parasitic disease transmitted by the bite of many species of sand fly indigenous to the region. Non-indigenous people who enter an infected area are known to be more seriously affected by this parasite than the inhabitants. If left undiagnosed, and therefore untreated, it can be fatal. Diagnosis requires bone and spleen biopsy, and the disease can have a three-year incubation period without causing symptoms. It can be transmitted by blood transfusion, and transmitted by a woman to her unborn child. Leishmaniasis was reported as widespread in Iraq and Saudi Arabia. This disease is thought to be responsible for the Pentagon ban, November 1991, against blood donations from Gulf War veterans. This ban was lifted, for unknown reasons, on January 11, 1993.
- Pesticides and insecticides were used extensively throughout the war to protect against pestilence. It is known that large quantities of DDT, malathion, fenitrorthion, propuxur, deltamethrin and permethrin were used. They are all toxic nerve agents, and many are suspected carcinogens and mutagens.
- Destruction by allies of Iraqi chemical, nerve and biological warfare weapons resulting in widespread distribution of these toxins in the environment. This problem has now been, at least in part, documented by the U.S. Department of Defense. They are focusing on this potential cause as if it were the only candidate cause.
- The electromagnetic environment which permeated the battlefield during the war. Veterans were exposed to a broad spectrum of electromagnetic radiation created by electricity generated to support the high-tech instruments, thousands of radios and radar devices in use. This intense electromagnetic field causes both thermal and non-thermal effects, and potentially interacts with the other hazardous exposures and stresses of the battlefield. Electromagnetic radiation can alter the production of hormones

(neurotransmitters), interact with cell membranes, increase calcium ion flow, stimulate protein kinase in lymphocytes, suppress the immune system, affect melatonin production required to control the "body clock," and cause changes in the blood-brain barrier.

The Hazards of Low Level Radiation

In the past few years the information available on the health effects of exposure to low levels of radiation has increased. We are no longer dependent on the commercial or military nuclear researchers who since 1950 have claimed that studies of the effects of low-level radiation are impossible to undertake. The new information is unsettling because it proves the critics of the industry to have been correct as to its serious potential to damage living tissue.

There have also been significant new releases of findings from the atomic bomb research in Hiroshima and Nagasaki, the self-acclaimed "classical research" of radiation health effects. I will list these findings toward the end of this article, along with studies from the nuclear industry.

In reviewing these research papers one is struck by the high-dose response when the radiation is delivered slowly, with low total dose. The conventional wisdom has claimed that at low dose/slow-dose rate the body is well able to repair most of the harm caused by the radiation. Some nuclear apologists go so far as to claim such exposures are "beneficial."

Because the nuclear industry has always maintained that the effects of low-dose radiation exposure are so small that it is impossible to study them, they proposed extrapolating the effects from those observed at high dose, using a straight line to zero (zero dose, zero effect), together with "correction factors" for low dose/slow-dose rate.

The effect of this "correction" is to reduce the fatal cancer estimates calculated by D.L. Preston, then Director of the Radiation Effects Research Foundation at Hiroshima, using the new dosimetry, from seventeen fatalities per million people per rad exposure, to five fatalities per million people per rad exposure. The corresponding estimates based on actually observed rates for nuclear workers is between ten and thirty fatalities per million per rad. Obviously, for the adult healthy male, the dose-response estimate should be about twenty for fatal cancers per million per rad.

However, although we can make a strong case for increasing the "official" estimates of harm by a factor of four, this fails to deal with non-fatal cancers, depressed immune systems, localized tissue damage (especially the respiratory, digestive and urinary tracts), damage to skin, and reproductive problems. Radiation

can cause brain lesions, damage to the stem cells which produce the blood and, when the radiactive material is carried in a heavy metal (uranium) it can be stored in bone, irradiating body organs and nerves within its radius.

A Book by Dr. E.B. Burlakova

Detailed studies of dose-response at the low dose/slow-dose rate level:

Dr. E. B. Burlakova has provided me with a copy of the book, of which she is editor: Consequences of the Chernobyl Catastrophe: Human Health. In one Chapter of this book, Dr. Burlakova and fourteen other scientists publish their findings on animal and human studies of the health effects of low dose/slow- dose rate, exposure to ionizing radiation. They examined carefully the following biological phenomena under ionizing radiation exposure situations:

- alkaline elution of DNA of lymphocytes and liver
- neutral elution and adsorption of spleen DNA on nitrocellulose filters
- restriction of spleen DNA by EcoRI endonuclease
- structural characteristics (using the ESR spin probe technique) of nuclear, mitochondrial, synaptical, erythrocyte and leukocyte membranes
- activity and isoforms of aldolase and lactate hydrogenase enzymes
- activity of acetycholine esterase, superoxide dismutase, and glutathione peroxidase
- the rate of formation of superoxide anion radicals
- the composition and antioxidizing activity of lipids of the above mentioned membranes
- the sensitivity of cells, membranes, DNA, and organisms to the action of additional damaging factors.

"For all of the parameters a bimodal dose-effect dependence was discovered, i.e. the effect increased at low doses, reached its [low-dose] maximum, and then decreased (in some cases, the sign of the effect changed to the opposite, or "benefit" effect) and increased again as the dose was increased" (Burlakova, page 118). Dr. Burlakova has speculated that at the lowest experimental doses used in this research, the repair mechanism of the cells was not triggered. It became activated at the point of the low- dose maximum, providing a "benefit" until it was overwhelmed and the damage began again to increase with dose. This may well be the case.

However, the unexpected effects of low dose/slow-dose rate exposure to ionizing radiation can also be attributed to biological mechanisms, other than the direct DNA damage hypothesis usually used by radiation physicists. These secondary mechanisms are specific to the low-/slow-dose conditions. Three such secondary

mechanism have been observed by scientists: the Petkau effect, monocyte depletion, and deformed red blood cells.

- The Petkau effect: discovered by Abram Petkau at the Atomic Energy of Canada Ltd. Whiteshell Nuclear Research Establishment, Manitoba, Canada in 1972 (Ref.1). Dr. Petkau discovered that at 26 rads per minute (fast-dose rate) it required a total dose of 3,500 rads to destroy a cell membrane. However, at 0.001 rad per minute (slow dose rate), it required only 0.7 rad to destroy the cell membrane. The mechanism at the slow-dose rate is the production of free radicals of oxygen (O_2 with a negative electrical charge) by the ionizing effect of the radiation.

  The sparsely distributed free radicals generated at the slow-dose rate have a better probability of reaching and reacting with the cell wall than do the densely crowded free radicals produced by fast-dose rates. These latter recombine quickly. Moreover, the slight electrical charge of the cell membrane attracts the free radicals in the early stages of the reaction (low total dose). Computer calculations have shown that the attraction weakens with greater concentrations of free radicals. The traditional radiation biologist has tested only high-dose reactions, and looked for direct damage to the membrane by the radiation.

- Monocyte depletion: Nuclear fission produces radionuclides which tend to be stored by humans and animals in the bone tissue. In particular, strontium-90, plutonium and the transuranics have this property. Stored in bone, near the stem cells which produce the white blood cells, these radionuclides deliver a chronic low/slow dose of radiation which can interfere with normal blood- cell production. A few less neutrophils or lymphocytes (the white blood cells which are most numerous, and are usually "counted" by the radiophysicist) are not noticeable. In the normal adult, there are about 7,780 white cells per microlitre of blood. Of these, about 4,300 are neutrophils and 2,710 are lymphocytes. Only 500 are monocytes.

  If, for example, stem cells in the bone marrow are destroyed so as to reduce total white blood count by 400 cells per microlitre due to the slow irradiation by radionuclides stored in the bone, this would represent a depletion of only five percent in total white cells, an insignificant amount. If all of the depletion was of neutrophils, this would mean a reduction of only 9.3 percent, still leaving the blood count well in the normal range. The lymphocytes would also be still in the normal range, even though they were depleted by 400 cells per microlitre, or 14.8 percent. However, there would be a dramatic depletion of the monocytes by 80 percent. Therefore, at low doses of radiation, it is more important to observe the monocytes, than to wait for an effect on the lymphocytes or neutrophils (as is now usually done). The effects of serious reduction in monocytes are:

    - Iron deficient anemia, since it is the monocytes which recycle about 37-40 percent of the iron in the red blood cells when they die;
    - Depressed cellular immune system, since the monocyte secretes the substance which activates the lymphocyte immune system. [2]
- Deformed red-blood cells: Dr. Les Simpson, of New Zealand, has identified deformed red-blood cells, as observed under an electron microscope, as causing symptoms ranging from severe fatigue to brain dysfunction leading to short-term memory loss. He has identified such cells in elevated number in chronic fatigue patients, and speculated that because of their bloated or swollen shape, they are obstructed from easily passing into the tiny capillaries, thus depriving muscles and the brain of adequate oxygen and nutrients. The chronic fatigue syndrome has been observed both at Hiroshima and Nagasaki, called bura bura disease, and at Chernobyl. [3]

In the official approach to radiobiology, only direct damage to DNA has been recognized as "of concern," and only high dose/fast-dose rate experiments or observations have been accepted for use in estimating the dose-response rate. As was noted, it is the "common wisdom" that effects of low doses/slow- dose rates cannot be studied, but must be extrapolated from the officially accepted high dose/fast-dose rate studies. This approach is rejected by the work of Dr. Burlakova, and the other research noted below.

Basing one's theory on claims that is impossible to study the phenomenon is certainly a peculiar way to do science! This myth has now been clearly shown to have been rash and criminally negligent.

Unfortunately, the Desert Storm veterans were victims of one of the latest military experiments on human beings. The people of Iraq and Kuwait were also the victims of this misguided experiment. I believe that the ignorance was culpable and criminal.

Recent Reports on Low-Level Radiation

I would like to bring your attention to the following significant new reports on the effects of low-level radiation:

- Health Consequences of the Chernobyl Accident, Results of the IPHECA Pilot Projects and Related National Programs, Scientific Report, World Health Organization, Geneva 1996.
- Consequences of the Chernobyl Catastrophe: Human Health, E.B. Burlakova, ed. Co-published by the Center for Russian Environmental Policy and the Scientific Council on Radiobiology Russian Academy of Science, ISBN 5-88587-019-5, Moscow 1996.

- Volume 137, Supplement, Radiation Research 1994, which published for the first time the dose-response data on cancer incidence rate observed in the atomic bomb survivors of Hiroshima and Nagasaki. Prior to this publication, only cancer death data was reported.
- Biological Effects of Ionizing Radiation V (BEIR V), U.S. National Academy of Sciences, Washington 1990. This provides new radiation risk estimates based on the newly assigned doses of radiation in this atomic bomb survivor study.

Also available now are the long term follow-up of workers in the nuclear industry. This industry has now been operating more than fifty years in the United States and about fifty years in the United Kingdom. These include:

- "Inconsistencies and Open Questions Regarding Low-Dose Health Effects of Ionizing Radiation", by R. Nussbaum and W. Kohnlein. Environmental Health Perspectives, Vol. 102, No. 8, August 1994.
- RERF Technical Report TR9-87, by D.L. Preston and D.A. Pierce, Hiroshima 1987.
- "The Effects of Changes in Dosimetry on Cancer Mortality Risk Estimates in Atomic Bomb Survivors" Radiation Research, Vol. 114, 1988.
- "Mortality and Occupational Exposure to Irradiation: First Analysis of the National Registry for Radiation Workers" by G.M. Kendall. British Medical Journal, Vol. 304, 1992.
- "Mortality Among Workers at Oak Ridge National Laboratory" by S. Wing. Journal of the American Medical Association, Vol. 265, 1991.
- "Reanalysis of the Hanford Data, 1944-1986 Deaths" by G.W. Kneale and A. Stewart. American Journal of Industrial Medicine, Volume 23, 1993.

References:

1. The Petkau Effect, Revised Edition, 1990, by Ralph Graeub, Translated from German by Phil Hill, and Published by Four Walls Eight Windows, New York, 1994. ISBN: 1-56858-019-3.
2. Bertell, R. "Internal Bone Seeking Radionuclides and Monocyte Counts", International Perspectives in Public Health, Vol. 9, pp 21-26, 1993
3. Les Simpson has published several papers in the New Zealand Medical Journal, and wrote a Chapter in the Medical Textbook on Myalgic Encephalomyelitis (MI), edited by Dr. Byron Hyde