

# !COMMENT!

## The Ongoing Controversy Over Rocky Flats: A Response to Carl Johnson's Response

The letter by Dr Carl J Johnson in *Ambio* Vol 11, No. 6 referred to a preliminary study of mortality of Rocky Flats Plant (RFP) workers done by the epidemiology group at the Los Alamos National Laboratory. I was the senior author of the paper. This study is of interest because some of these workers are exposed to external radiations and/or internal depositions of plutonium. The paper, entitled "An Update of Epidemiologic Studies of Plutonium Workers," was presented at the International Meeting of The Radiobiology of Radium and the Actinides in Man (Lake Geneva, Wisconsin, October 15, 1981). It was also presented at the University of Colorado School of Medicine, Denver, Colorado, because of the local interest in the RFP which is close to Denver.

Dr Johnson states the following in his comment. "The author was asked to explain why the study reported only 8 deaths from brain tumors in 7112 current and former RFP workers, when the RFP medical director had earlier reported 16 brain tumor deaths among only 3937 current and retired RFP employees (the balance had left RFP to

seek other employment and had been lost to follow-up). The author did not have a satisfactory explanation for this discrepancy, but indicated that the DOE study of cancer incidence would be completed in 15 to 20 years."

The response given to the question was clear and simple: I am sorry that Dr Johnson went away unsatisfied. The causes of death, taken from death certificates, were coded to the 8th Revision of International Classification of Diseases (ICD) for this study. This is a formal classification method which was performed for our study by independent nosologists. Our data showed 8 deaths coded in "Cancer of the Brain and Other Central Nervous System" (ICD No. 191, 192) and 8 deaths, all intracranial tumors, coded in "Benign and Unspecified Neoplasms" (ICD No. 210-239). The paper, a copy of which was sent to Dr Johnson at his request, lists these latter 8 deaths as "one pituitary adenoma, one acoustic neuroma, and six unspecified brain tumors." Thus we had 16 deaths due to intracranial tumors. I do not know the classification codes or the time period for the data from the RF medical director.

Since no formal study was done by them, it is also impossible to know the number of workers covered. Our study ended in December 1979. It is clearly possible that the RFP medical data may have included brain tumor deaths after that date. To my knowledge, however, there is no substantive difference in our data.

At the meeting, I indicated that the latent period for induction of cancer after high level exposure to radiation is many years. Our mortality and incidence studies must, therefore, also be long-term. We will continue to report on the progress of this study periodically as new data become available.

It is unfortunate that communication and understanding is so difficult. I hope this brief comment on these points is helpful.

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## Glioblastoma, Other Brain Tumors, and Melanoma in Plutonium Workers

The official news release (October 15, 1981) by the Los Alamos National Laboratory (LANL) of the University of California states that their report "reveals plutonium workers at Rockwell International's Rocky Flats Plant (RFP) near Denver had fewer cancer deaths than expected, based on the national average", and "deaths from cancers of the brain and other central nervous system malignancies are predicted to cause 6.5 deaths. Eight Rocky Flats workers died of this cause, for a slightly elevated mortality ratio. Statistical analysis indicates the number of cases as too small, the difference too slight, to suggest a significant finding, according to Voelz" (1). The LANL study, supported by the Department of Energy (DOE) included 7112 current

and former employees of the DOE facility, comprising some 3200 RFP workers terminated for various reasons, and 3985 still working at RFP or retired (2). The terminated group may be different than those retained at the plant or retired. The population of workers studied by the LANL group differs from that described in a 1980 RFP report which listed a total worker population of 9985 in the period 1953-1979, including 6000 who had been terminated (3).

The 1980 report by RFP on cancer among employees (now at work or retired) gave a cancer incidence over the period 1953-1979 of 128 cases (excluding skin cancer not melanoma) (3). Among these 3985 workers there were 12 cases of brain cancer. However,

when presented at a public meeting, RFP spokesmen noted that the number of brain cancers was now 14, with 12 dead. One year later, when the 1981 RFP report was presented at a public meeting, the RFP medical director was questioned and reported that there were now 17-18 employees dead from brain tumors, including 12 gliomas, an undifferentiated carcinoma and an acoustic neuroma (4). At a symposium at the University of Colorado last September a member of the DOE-funded LANL research team reported to me that there were now 14 glioblastomas, an acoustic neuroma, an adenocarcinoma of the pituitary and a primary undifferentiated neoplasm among the workers at the plant (5).

An earlier study reported an eight-

fold excess of brain tumors (13 cases observed, 1.66 expected) among RFP workers then currently employed (3324) or retired (661) (6). In a more recent report the ratio of glioblastomas to all cancer in this group (about 10 cases of glioblastoma per 100 cases of all cancer) was contrasted with data published by the National Cancer Institute (7, 8). Among 72 003 microscopically-confirmed cancers of all types among white males (all areas combined, 1969-1971) there were 1290 brain tumors of all types and 767 cases of glioblastoma multiforme (9443) (9). This is an expected ratio of glioblastoma to all cancer of 1.06 cases per hundred. The workers currently employed at Rocky Flats or retired apparently have a risk of contracting glioblastoma about ten times greater than for US white males.

While gamma radiation can induce brain tumors, can alpha radiation from plutonium (Pu) and other actinides induce glioblastoma and other brain tumors? An Argonne National Laboratory study reported a 30 percent greater concentration of plutonium in the bones of the skull of a 20 year-old human subject than in the rest of the skeleton (10). Plutonium is noted for its ability to concentrate directly under the periosteum and endosteum. The alpha radiation that plutonium constantly emits (5.1 million electron volts) strikes heavily-ionized paths about 40 to 60 micrometers ( $\mu\text{m}$ ) in length through tissue, and in traversing a cell 10  $\mu\text{m}$  in diameter may generate doses of the order of 10 rads within a nucleus with a diameter of five  $\mu\text{m}$  (11). Within the alpha track itself the dose is much greater, about 7.4 million rads (11). Certainly, small amounts of Pu on the interior surface of the bones of the skull will injure and kill cells in nearby tissues within the skull. Ions will be generated in circulating blood and cerebrospinal fluid. What is the uptake of Pu by the brain itself? In cases of intoxication with some heavy metals, such as lead and mercury, there is sufficient affinity for the brain that central nervous system signs are predominant. Are gliocytes in the brain able to concentrate actinides like the melanocyte? Plutonium, when inhaled, is present chiefly in lung, liver and bone. Analysis of the Pu concentration of the brain of a Pu worker found concentrations to range from 7 to 23 percent of that in the lung (12). The greater concentration was found in the brainstem. Of a series of thirty autopsies of Pu workers, 11 died of cancer, including one brain tumor (astroblastoma), one melanoma and two cases of leukemia (one acute lymphoblastic leukemia) (12). Interestingly, of the 19 who died from causes other than cancer, three were suicides.

The viewpoint of those in public health is that investigations of cancer induced among radiation workers should focus on cancer incidence, not on cancer deaths, since the latter are confounded by variation in survival

periods among individuals and among types of cancer. The incidence studies are more sensitive and will yield better information much earlier than studies of cancer deaths. Further, we believe that studies of health effects among workers or the general population are best supported by agencies whose mission is the protection of health, such as the National Institutes of Health and the US Centers for Disease Control, rather than by nuclear agencies whose mission is quite different, and whose personnel have a "revolving door" relationship with the nuclear industry and with such heavily-subsidized universities as the University of California, which receives about 500 million dollars annually from the Department of Energy.

In considering population effects downwind from RFP, the amount of surface soil and dust blown about on windy days is of interest, since as much as 50 000 femtocuries (or 50 picocuries) of Pu per gram of airborne soil has been reported (13). Dust concentrations of 2 to 998  $\text{mg}/\text{m}^3$  of air correspond with visibility of 14.5 to 0.1 km, respectively (14). Visibility of less than 0.1 km has been observed during the more severe dust storms in the western part of the Denver area near RFP. At times the winds along the foothills of the Rocky Mountains exceed 150 kilometers per hour ( $\text{km}/\text{hr}$ ) and blow large amounts of surface dust and soil downwind, forming windrows of dust along fence rows as far as 10 km west of RFP. However, velocity during such windstorms usually ranges between 20 to 100  $\text{km}/\text{hr}$  and the ambient concentration of surface dust and soil suspended in air is more likely to be 10 to 20  $\text{mg}/\text{m}^3$  (15). Dust storms occur in the Denver area at an average of 9.1 days per year and are more severe near the foothills (14).

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