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NOTE TO: T. Murphy, Chief, Radiological Assessment Branch, DSE

THRU: F. Congel, Leader, Radiological Impact Section, RAB

FROM: R. Gotchy, Radiological Impact Section, RAB, DSE

SUBJECT: ARTICLE OF DR. GOFMAN

I have briefly reviewed Dr. Gofman's Nov. 1979, article in the Health Physics Journal as requested in your letter of December 26, 1979.

As yet, we find no quarrel with Dr. Gofman's mathematics; however, his analysis (like that of Mancusco, et al) has some inherent weaknesses. We feel that it is meaningless to calculate a single value for a doubling dose when that value is based on the mean dose for a wide range of doses. For example, Dr. Gofman used the mean dose for groups of workers who had doses ranging from low to 10 rads, and from 10 rads to the maximum dose observed. It would have been more honest to calculate a range of doubling doses based on the actual data. For example, it would have been more meaningful to calculate doubling doses by comparing other ranges (e.g., <2 rem and >2 rem, <5 rem and >5 rem, <20 rem and >20 rem, <50 rem and >50 rem) to provide a distribution of doubling dose estimates. We feel such analyses would help to characterize the uncertainty in the estimate of doubling dose. However, it is possible Dr. Gofman has been limited in the same manner as others, by being unable to get the raw data from Mancusco, et al.

As mentioned earlier, the staff feels that the concept of doubling dose estimates for total cancer induction may be questionable, since both latency periods and frequencies of various types of cancer (i.e., it is a variety of diseases) per rem of dose are believed to be as different for man as they are for various animal species. Such things as dose rate will almost certainly also affect the final outcome of exposure, and other things, such as cigarette smoking or exposure to toxic chemicals, can also result in variations in latency and perhaps increase the effects being studied due to synergistic effects.

Dr. Gofman's statement, "While the best estimate from the current study is 43.3 rad for the doubling dose for cancer, overall, it must be stressed that the 95% confidence are 18.0 rad and infinity (in rads)" simply means that the actual effects per rem may be zero which is consistent with the conclusions of others (e.g., BEIR-I and UNSCEAR, 1977).

However, most health professionals feel the actual risk is never zero. It is interesting to note that the results of Dr. Gofman's analysis, while statistically weak, nevertheless, do fall within some of the relative risk estimates in the BEIR I report. Since the doubling dose calculation is a variation on the relative risk model, it is possible to convert from one to the other: e.g., 100%/43.5 rad is 2.3% per rad. BEIR (p. 185, Table III-2) clearly demonstrated that doubling dose is quite variable for different cancers. For example, among A-bomb survivors, lung cancer was 0.45% per rad, breast cancer was 3.0% per rad, all GI (less the stomach) was 0.12% per rad, and leukemia was 3.0% per rad. According to Dr. Gofman's Table 13, about 30% of the total cancer deaths observed among males (greater than 10 rad exposures) was due to lung cancer and 21% were GI cancers (including pancreas and liver). In other words, the majority of cancers might be expected to have average relative risk coefficients on the order of 0.3% per rad. That is about a factor of eight less than the BEIR I estimates seem to suggest. Since BEIR I shows up to a factor of 30 variation in relative risk coefficients for various cancers, a factor of eight difference would not seem outlandish or unreasonable. However, it was perplexing to note that while leukemia might have been expected to account for 20% to 30% of the total cancers (based on BEIR I), leukemia only accounted for a few percent of the observed cancers. Some additional and interesting comments on the work of Mancusco, et al appears in the Health Physics Journal: Vol. 37 (August) pp. 249-253 and Vol. 37 (December) pp. 791-792.

It will be most interesting to see what letters Dr. Gofman's article generates in the months ahead.

For your information, there will be an NIH conference regarding the biological effects of the low level ionizing radiation March 10 and 11, 1980 (Bldg. 10, Mazur Auditorium). Fourteen papers from some of the best authorities will be presented, representing the output of an Federal Interagency committee participated in by 14 different federal agencies.

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