

## ARGONNE NATIONAL LABORATORY

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Telephone 312/972-

October 1, 1980

U.S. Nuclear Regulatory Commission  
799 Roosevelt Road  
Glen Ellyn, IL 60137

ATTENTION: Dr. C. Paperiello

Dear Carl,

I attach a copy of a memo to our Records Room setting out the results of our measurements of the 15 subjects who worked in contaminated rooms at the former Lindsay plant in West Chicago. The list includes the two ( ) the results for whom were reported to you earlier this year.

Although all but one of the subjects show positive results for the "apparent emanating  $^{226}\text{Ra}$  contents" I am fairly certain that they do not contain elevated levels of  $^{226}\text{Ra}$ , and that the results merely reflect the exhalation of radon from a reservoir in body fluids and tissues, due to exposure to atmospheres containing slightly higher concentrations of radon than the average value assumed by us in making the corrections for environmental levels. This conclusion is reinforced by the values for the results of the gamma-ray measurements of  $^{214}\text{Bi}$  (reflecting retained radon in vivo), which average  $\sim 0.2$  nCi.

As far as the probably more relevant measurements of  $^{232}\text{Th}$  daughters are concerned, the results suggest that no subject other than (and possibly ) has a detectable content of thorium. Since the breath measurements are so much more sensitive than the gamma-ray ones, I prefer to rely on them as the primary indicator of the presence of thorium in vivo, although as I have explained to you the quantitative interpretation of the numbers is obscure. With the result for excluded, the equivalent amounts of freely emanating  $^{226}\text{Ra}$  at the mouth range from zero to 1.2 pCi. Compare this range with the corresponding range of zero to 2.4 pCi for 13 residents of West Chicago who never worked at the Lindsay plant. One cannot but conclude that the subjects of the present series contain no more thorium than do those 13 subjects.

The conclusion that probably does contain a tiny excess of thorium remains, although due to the use of a new calibration factor for the gamma-ray measurements based on more data, the result is a little lower than I quoted previously. Whether or any of the subjects showing a  $^{214}\text{Bi}$  content in excess of 120 pCi ( $2\sigma$ ) also contain an excess of thorium is equivocal. Note that a prior exposure to an atmosphere containing  $^{220}\text{Rn}$  and

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especially its granddaughter 19.6-hour  $^{212}\text{Pb}$ , could give a positive gamma-ray result in a measurement in vivo, but without a corresponding positive result for emanating  $^{226}\text{Ra}$ . We tried to rule this out a priori by asking that the subjects only present for examinations on Mondays, i.e. after at least 60 hours away from the contaminated rooms. Eight of them did in fact come on Mondays, but the following did not: LX0001, 0002, 0005, 0008, 0010, 0011 and 0012. Note that the gamma-ray measurements for the first three of these gave results which were statistically significant, while for the other four they did not. It may be noteworthy that not one of the residents of West Chicago showed a statistically significant result for the gamma-ray measurements.

On the basis of a single examination on each subject we can say little more. All this really does is to point up the difficulties and complications of trying to determine quantitatively very small amounts of thorium in vivo. I hope that the data will be adequate for your purposes.

Yours sincerely,

JR/ns

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