

11/1/77

## CENTER FOR HUMAN RADIOBIOLOGY

Fact Sheet on

Studies of the Health of Former Thorium Workers

Interest in the health of thorium workers stems mainly from the potential importance of thorium as an energy source. Several thorium decay products can be considered as potential health hazards, by analogy with known effects of uranium (and radium) decay products, plutonium and Thorotrast. The studies outlined below involve analysis of mortality and morbidity in former workers in a company concerned with the production of thorium (and rare earth) chemicals.

Study Group. The study population is comprised of employees of the Lindsay Chemical Company (later, known as the American Potash Chemical Company, and finally as a division of Kerr-McGee Chemical Corporation). Our study is limited to persons (mostly males) who worked at the West Chicago plant. Copies of all employment records at the company have been obtained, covering the period from the mid 1930s until 1973. Full name, year of birth and social security number are available for about 4230 of the 4800 employees.

Information on job classifications was obtained from company records. Classification (e.g., "laborer", "operator", "mechanic", "office worker"), and duration of employment in each classification, can be related to data on exposure to thorium dust and thoron obtained in a 1953 industrial hygiene survey (Klevin and Fresco, 1953, unpublished; Albert et al., 1955, Arch. Indust. Health 11, 234).

Methods and Status of Studies

Mortality. From a search conducted by the Social Security Administration, about 660 persons are known dead and their probable place of death has been identified. Copies of death certificates are being obtained from the appropriate states; 591 certificates are now on hand. Causes of death from death certificates are coded according to "Eighth Revision, International Classification of Diseases Adapted for Use in the United States" (U. S. Public Health Service, 1968).

For a group of 2,981 males, a preliminary analysis (Table 1) of cause-specific mortality has been done using person-years of observation, beginning with entry of each person into the company. This analysis involves comparison of observed deaths with expected deaths, specific for age, time and cause for U. S. white males (Monson, 1974, Computers Biomed. Res. 7, 325). Similar analyses will be carried out for job-classification subgroups. Several duration-of-exposure subgroups will be identified, and separate analyses performed by similar methods. Preliminary analyses have been completed for a subgroup of 558 men who worked for one year or longer in occupations involving probable exposure to thorium chemicals.

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REPOSITORY Argonne / CHR  
 COLLECTION Records Relating to Industrial / medical exposure to radium  
 BOX No. Box 121 / 65H  
 FOLDER Binder #33 - CHR Fact sheets Review Committee History of CHR from ANL Report

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**Morbidity.** The initial study group consists of 558 men who worked at the Lindsay Chemical Company for one year or longer, in occupations involving probable exposure to thorium chemicals—i.e., laborers and maintenance and repair workers. Of this group, 131 are known to be dead. A questionnaire on medical history, respiratory symptoms, and smoking and alcohol consumption has been sent to most of the group believed to be still alive, and 264 have been completed and returned.

Radioactivity Levels

Significant amounts of daughter products of  $^{232}\text{Th}$  have been found in several of the Lindsay workers examined at CHR (Figs. 1 and 2). These are stable levels, not the result of current exposure. The bulk of the radioactivity appears to be in the chest region, and, since loss of  $^{232}\text{Th}$  daughters (Table 2) may have occurred, the observed levels for  $^{212}\text{Bi}$  may be only the lower limits of the actual  $^{232}\text{Th}$  lung burdens. Comparison may be made with the current maximum permissible lung burden of 16 nCi for occupational exposure to  $^{239}\text{Pu}$ . The emission rate of alpha-particle energy from 2.3 nCi of  $^{232}\text{Th}$  in equilibrium with its decay products (35.9 MeV per disintegration) is equal to the rate from 16 nCi of  $^{239}\text{Pu}$  (5.1 MeV per disintegration).

The retention and distribution of  $^{232}\text{Th}$  and its daughters will be determined by radiochemical analysis of autopsy tissue, and comparisons will be made with  $^{220}\text{Rn}$  and  $^{212}\text{Bi}$  measured in vivo.

Fig. 1

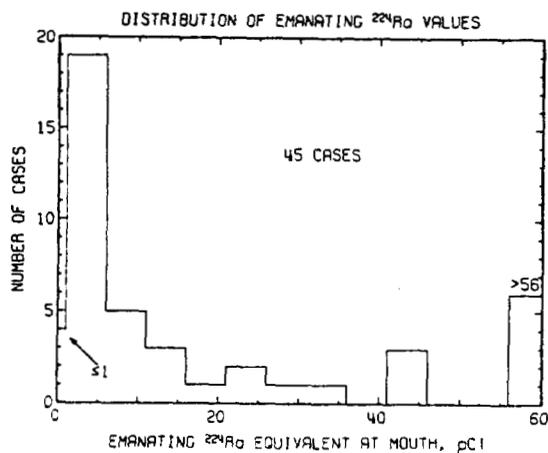


Fig. 2

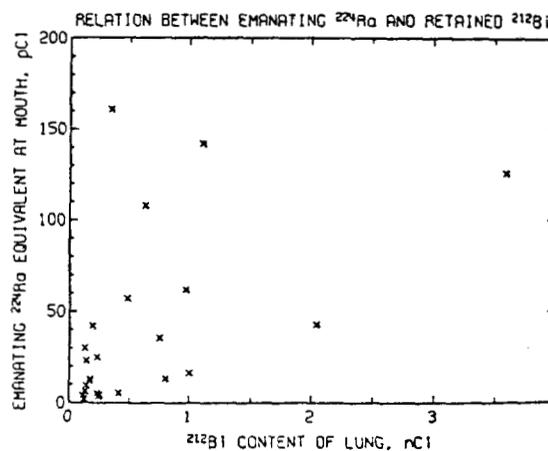


Table 1. Observed and expected deaths (selected causes) in thorium workers  
(males, N = 2981)

ICD No. (Seventh Revision) and cause	Observed	Expected	Observed Expected
All causes	505	463.2	1.09
001-139 Infective and parasitic	3	9.0	0.33
001-019 All tuberculosis	2	5.7	0.35
140-205 All malignant neoplasms	102	75.0	1.36**
150-159 Digestive organs, peritoneum	33	24.6	1.34
151 Stomach	7	5.9	1.18
153 Large intestine	8	7.0	1.15
154 Rectum	6	3.1	1.94
155 Liver	0	2.2	—
157 Pancreas	9	4.2	2.17*
160-165 Respiratory system	31	19.8	1.56*
162, 163 Lung	30	18.2	1.65**
177 Prostate	5	5.7	0.88
180 Kidney	2	1.8	1.13
181 Bladder	4	2.5	1.62
190 Skin	3	1.6	1.86
193 Brain and C. N. S.	2	2.4	0.83
194 Thyroid (1950- )	0	0.2	—
196 Bone	1	0.6	1.81
200-203 Lymphatic and myeloma	5	3.5	1.43
204 Leukemia and aleukemia	5	3.5	1.43
260 Diabetes mellitus	6	6.6	0.92
290-299 Blood and blood-forming	0	1.4	—
330-334 Vascular lesions of C. N. S.	29	36.5	0.80
400-468 Circulatory system (all)	161	205.2	0.78**
420 Arteriosclerotic heart disease	141	151.4	0.93
470-527 Respiratory system (all)	30	22.2	1.35
530-587 Digestive system (all)	23	22.0	1.05
581 Cirrhosis of liver	8	9.7	0.83
590-637 Genitourinary system (all)	4	9.8	0.41
810 Motor vehicle accidents	40	21.4	1.87***

\* P < .05 (chi-square, Mantel-Haenszel)  
 \*\* P < .01  
 \*\*\* P < .001