

months, did not result in any local irritation or changes of the jaw nor in an irritation of the gastro-intestinal tract.

In spite of these numerous arguments advanced by Flinn against the possibility of an occupational origin of the bony lesions observed, he had to reverse his opinion and concede this fact, when one year later two cases of jaw necrosis were observed among girls employed in a luminous dial plant in Connecticut. While the electroscopic examination of the bodies and respiratory air of the workers of the Orange plant had been negative as to radioactivity, one of the cases from Connecticut showed radon in the respiratory air. There existed a profound anemia (35 per cent hemoglobin; 3,100,000 erythrocytes; and 6,100 leucocytes) and a fracture of the femur following a fall. Similar symptoms were exhibited by the second case found in the Connecticut plant.

Any doubt concerning the occupational origin of these conditions, which may have lingered on, was dispelled definitely and thoroughly by the evidence presented and the analyses made by Martland in 1929, and by the investigative survey conducted by Stewart (1929) under the direction of the United States Department of Labor. The observations made and conclusions reached by these investigators were confirmed and extended by Schwartz, Knowles, Britten, and Thompson (1933), who examined by order of the Surgeon-General the present and former workers employed in the seven dial painting factories, employing 14 men and 228 women, located in the United States.

IV. INCIDENCE

While some of the workers in the luminous dial plants succumbed early to the effects of a refractory, incurable, leukopenic anemia or septicemia ensuing from the necrosis of the jaw (death usually occurred in these cases during the first four to six years after cessation of exposure), others escaped these sequelae for a period of six to seven years and developed, after an intervening period of apparent good health usually accompanied by a milder type of regenerative anemia, crippling bone lesions of the type of radiation osteitis, which ultimately were transformed into malignant osteogenic sarcomas. These neoplasms caused the death of two dial painters from 1924 to 1927. Three additional cases were observed during the following years (up to 1930) (Martland) and two new cases were reported in 1934 (Flinn), so that there are at present seven cases of osteogenic radium sarcoma on record, representing approximately 30 per cent of the total number of fatalities from radium injury found among this group of workers. It may be mentioned that there exist four additional cases in which an osteogenic malignancy was suspected. The neoplasms occurred in female workers in all instances.

V. SYMPTOMATOLOGY

The ingestion and inhalation of radioactive substances as well as the exposure to penetrating external radiation present in workers of the American