

the therapeutic measures are instituted. Roentgen-cancers are in general slow to involve the regionary nodes, that is, in most of the professional cases, the lymph nodes of the cubital and axillary regions. However, metastases into remote organs have been observed repeatedly (Hesse; Krause; and others). Hesse recorded the presence of metastases in 26 per cent of his cases. Flaskamp noted an incidence of metastases in 24 to 26 per cent, while Walischewski stated that in 11 out of 55 cases of occupational roentgen-cancer metastases were found. In Brown's series metastases were recorded in 19 out of 28 cases. The development and spread of the secondary growths is sometimes very sudden and early, and, occasionally, of an explosive character (Hesse). Similar observations were made by Walischewski in 5 of his 55 cases. Roentgen-cancers may display thus a high degree of biological malignancy.

The information concerning the mortality rate of roentgen- and radium-cancers is unreliable. The ultimate fate of many of the recorded cases of these types of occupational cancers is unknown. Hesse noted a mortality rate of 20.3 per cent; Porter of 25 per cent; Rowntree of 23 per cent; Coenen of 24 per cent (including cases of lupus cancer); Gutzeit of 19 to 25 per cent.

XIV. EXPERIMENTAL ROENTGEN- AND RADIUM-CANCER

The first attempts to produce experimentally roentgen-cancer were made by Rowntree (1909), who exposed the tails of rats and the ears of rabbits to one or one and a half erythema doses of roentgen-rays, but obtained only changes characteristic of chronic roentgen-dermatitis (alopecia, hypertrophy of hair follicles and sebaceous glands, fibrosis of the subcutaneous tissue). In the same year Marie, Clunet and Raulot-Lapointe succeeded in obtaining a malignant tumor of spindle cellular structure in the cutis of a rat following repeated application of roentgen-rays for 18 months.

The first actual roentgen-carcinomas were produced by Bloch (1924), who exposed the ears of four rabbits to repeated administrations of roentgen-rays. While two rabbits died early with evidence of chronic roentgen-dermatitis (hyperpigmentations and depigmentations, alopecia, atrophy of skin), two survived and developed carcinomas of the ears after 25 months from the start of the experiment and after an exposure to 1,270 r and 2,000 r given within 13 months and 3 years, respectively. The administration of 888 r to the ear of one of these rabbits elicited only chronic dermatitic reactions. Subsequently, the cancerous ears exhibited complete alopecia 10 months after the start of the treatments and, later, atrophy of the skin; depigmentations; angiectases; diffuse desquamation of a horny membrane, circumscribed, partly follicular, partly verrucous hyperkeratoses. In one of the two rabbits, malignant lesions appeared 13 months after cessation of exposure. The rabbit which received the higher dose and which was irradiated while the cancer was already in existence died four years after the start of the experiment with metastases in the regionary lymph nodes and lungs, whereas the carcinoma produced with the