INTRODUCTION

Tinea capitis is one of the most common fungal diseases of children. It has been a major public health problem in many countries and is especially prevalent in low socioeconomic groups (1). In the United States, tinea capitis was relatively uncommon until a major epidemic occurred throughout the country during World War II (2). Treatment for ringworm of the scalp by X-ray epilation was introduced by Sabouraud in 1904 and standardized by Kienbock in 1907 (3) and Adamson in 1910 (4). The purpose of the epilation was to permit effective fungal decontamination of the scalp. Before the Adamson-Kienbock X-ray procedure was introduced, epilation was done manually. Exposure of the scalp produced complete epilation in approximately two to three weeks which lasted one to two months (5). X-ray epilation proved to be much superior to the alternative forms of topical therapy and was widely used until the introduction of griseofulvin in 1958. No accurate figures exist for the total number of children treated by X-ray epilation during the one-half century of its use. On a worldwide basis, it is possible that as many as 200,000 children have received this form of irradiation (1).

In spite of the large population and the substantial radiation exposures of scalp, bone marrow, brain, and other head structures associated with X-ray epilation, until recently only a few follow-up studies have been made to characterize the nature and magnitude of delayed radiation damage; such studies have been concerned almost entirely with the effects on the scalp. Amongst the early studies a one-year follow-up by Beare (6) and a 5-year follow-up by Thorne (7) reported no evidence of scalp damage. Studies involving longer post-treatment periods by Berlin (8) and Symann (9) did show a low incidence of hair damage and Symann's study raised the possibility of mental retardation in the irradiated cases.
A follow-up study of irradiated and nonirradiated tinea capitis cases treated at the Skin and Cancer Unit of the New York University (NYU) Hospital between 1940 and 1959 was initiated in 1962. The purpose of the study was to determine whether X-ray epilation produced chronic radiation injury and to relate the nature and magnitude of any observed effects to the radiation dose received by the various structures of the head.

**DOSIMETRY (10, 11, 12)**

The X-ray treatment was given using the standard Adamson-Kienbock procedure (4), in which an exposure of 300-380 R of 180 KeV, unfiltered X-rays was given to five overlapping fields on the scalp so as to cause complete temporary epilation. The treatment protocol was highly standardized, with all five exposure being administered in a uniform order within the space of 10-20 minutes. Nearly all treatments at NYU were given by one technician, who was highly skilled and methodical in her procedures. The child was prone for all treatments and rotated as necessary for different exposure fields. Correct placement of the X-ray port was achieved with the aid of a "tinea treatment cap" fashioned from steel bands, each field being joined together. Three different sized caps were used to accommodate different head sizes. The position for each field was then marked on the child's shaved head before treatment. Sandbags were placed around the head to help minimize the child's potential for movement during the exposure. Head surfaces other than the scalp were protected by lead shielding. Lead foil 0.36 mm thick was taped over the ears and eyes. A large sheet of the same foil was cut to shape around the edge of the hairline to protect all except the scalp from the direct X-ray beam in the anterior and lateral positions. For the vertical and posterior irradiation positions the lead foil was not present, but a lead impregnated rubber apron was placed over the lower neck and shoulders for all five positions.

X-ray equipment operating between 60 and 100 kvp was used for this treatment. In order to achieve high output, which was very important since short treatment times were essential, and also a rapid fall-off in depth dose only the inherent filtration of the X-ray tube was employed. Treatment distances varied between 20 and 30 cm mainly in order to retain high output. Inasmuch as epilation had to be complete for successful results, the X-ray field sizes were sufficiently large so that there was considerable overlapping of adjacent treatment fields. All of these factors combine to make the radiation dosimetry of the tinea capitis treatment quite complicated.

The head phantom used in the estimation for the doses to the head structures consisted of the skull of a 7-year-old child covered with a tissue-equivalent wax to simulate the head and neck. The top section of the skull was removable and a simulated brain filled the entire skull volume. The simulated brain was constructed of masonite and tissue-equivalent wax. The average doses to the head structures are shown in Table 1. The effects of the lead shield placed below the hair line and the unbalanced vertical field produced a dosage gradient from about 75 rad at the base of the brain to 165 rad at the apical region. The average dose recorded by the 15 dosimeters for the standard five field treatment, 370 R exposure per field, was 140 rad. The scalp doses were measured at 30 locations. The regional distribution of the scalp dose is shown together with the skin tumor locations in Figure 1.