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BY THE RÖNTGEN RAYS,

*With the Results of Microscopic Examination  
of the Affected Skin.*

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A CASE OF  
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DURING the first week in September I devoted considerable time to experimenting with an X-ray apparatus, endeavoring to ascertain under just what conditions of tube, coil (giving an eight-inch spark), and actuating energy, storage battery, or incandescent current with make and break connection on electric motor, I could obtain the best results. In general, the current strength used was about ten ampères.

Naturally, the most convenient manner of testing the working of the tube was by using my left hand in front of the fluoroscope, and this I did frequently; but as this method gives less sharp and well-defined pictures than by using a sensitive plate and taking radiographs, the fluoroscope was solely used to test the activity of the tube in producing the radiations, and, when the latter were satisfactory, radiographs of the hand, wrist, and arm were taken with exposures varying from thirty sec-

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onds to five minutes. Just how often the hands were exposed I am unable to say, but certainly not less than twenty times for the left with the fluoroscope, and at least five for the right, placed on the plate holder; in no instance, however, for a longer period than five minutes. The results having been satisfactory, it was my intention to obtain a series of plates showing the elbow, shoulder joint, knee, etc. With this in view, my elbow joint was placed about four inches below the tube, which was of the ordinary focus pattern, the cathode a cup-shaped aluminum disc, the anode a plate of platinum set at an angle of forty-five degrees to the long axis of the tube. The focus I endeavored to have directly over the joint. The arm was partly flexed and resting in a semiprone position on the plate holder. The result not proving to be as perfect as I had hoped, a second exposure, lasting seven minutes, was tried a day or two later, and a third, lasting ten minutes, on the evening of the following day. This last was on the 8th of September. At the time a slight tingling of the skin was noticed, so slight, however, that I was not certain that it was not due to the effects of imagination, as during the "sitting" I was going over, mentally, Tesla's arguments in favor of the assumption that the so-called rays are really due to minute particles thrown off from the cathode. In each instance the arm was covered with my usual clothing, consisting of heavy woolen underclothing, shirt and coat sleeve.

A day or two later my attention was attracted to the appearance of the dorsal surfaces of both hands by a slight sensation of irritation and itching. At first sight the appearance suggested sunburn, but, as the weather had been cloudy for a number of days, and further, as my skin has

always been more than ordinarily free from any of the common affections—eczema, etc.—I half jokingly attributed it to the X rays. The day following my discovery of the condition of my hands the tube was accidentally broken, and pending the receipt of a new one the experiments were discontinued. On September 18th I felt a slight itching near the elbow of that arm, the right, which had been exposed to the rays, and on retiring that night was astonished to find an extensive discoloration of the skin, extending from a point two inches above the joint to a distance of about six inches downward toward the wrist, and including about one third the circumference of the arm. In color it was of a brownish red, punctuated at the upper and lower borders and ends and more confluent at the centre. Examination with the lens showed the punctated area to be due to an apparently greater hyperæmia around the hair follicles. No vesicles were apparent, and there appeared to be no tendency to their formation. Pressure caused the redness to disappear to a great extent, but not entirely. There was no sensitiveness, but the temperature was decidedly raised above that of the adjacent healthy skin. Traction on the hairs showed no loosening.

On September 20th, the affection showing no tendency to become worse, I excised a piece of skin, a centimetre square, from the most deeply discolored area, without using a local anæsthetic, fearing to interfere with the structures by injecting cocaine. The piece so removed was fixed in three-per-cent. formalin, hardened in alcohol, imbedded in celloidin, and cut in the usual manner. Sections were stained in hæmatoxylin and eosin and in lithium carmin. The histological changes were as fol-

lows: The stratum corneum was apparently unchanged; stratum lucidum not clearly visible, excepting over small areas, where the underlying disturbance was seen to be slight. The outer layers of the cells composing the rete mucosum presented the most striking alterations, particularly in their nuclei. Taking the stain both with hæmatoxylin and lithium carmin very feebly, the nuclei showed in addition a peculiar granular change, which was first indicated in those retaining a



more normal reaction to the stain by the formation of a fine nucleolus, which could be seen here and there in the process of division. Near the stratum granulosum the bodies of the cells were apparently becoming converted into keratohyalin as a first step to the increase in bulk, as it were, of the stratum granulosum by a development in their interior of coarse granules, staining

deeply with hæmatoxylin, and also with carmin. With the former they appeared like blotches of India ink; in some places giving the impression as though the cells had been charred by heat. This was particularly the case around the hair follicles. The corium exhibited the ordinary changes found in a mild dermatitis: capillary dilatation, with collections of round cells scattered through its structure, particularly around the hair follicles. No extravasations of blood were noticed.

The entire absence of pain, in spite of the pronounced symptoms of inflammation over so wide an area, and the length of time elapsing between the last exposure and the appearance of the discoloration, are both remarkable. Were it not for the appearance of a somewhat similar affection on the back of each hand, and the cases reported by Marcuse\* and Fuchs,† the connection between the exposure to the rays and the dermatitis might be doubted, but the case of the former corresponds in so many particulars with my own that I think there can be no question as to the cause.

In Fuchs's case the disease manifested itself after exposing the hand continuously for an hour to the rays from a Hittorf tube, actuated by a sixteen-centimetre spark coil carrying twenty ampères of current through its primary. The following changes were observed at the expiration of the hour, when pain necessitated the interruption of the exposure.

The skin, at a point directly opposite the cathode, was colored brown.

The hand was greatly swollen, with large folds in the skin. Examination with a magnifying glass showed

\* *Deutsche medicinische Wochenschrift*, No. 30, S. 481.

† *Idem*, No. 35, S. 569.

fine fissures over the surface acted upon by the rays, the appearance in many respects resembling that of a frozen limb.

Fifteen minutes later vesicles formed in diverse places, some of which were of perceptible size. The contained fluid was similar to that found in burns.

In the case reported by Marcuse, no details of the strength of current or spark-length of coil are given. The tube, however, is spoken of as a Hittorf. The discoloration of the side of the face a brownish red was first noticed while looking in the glass fourteen days after the commencement of the experiments. Later an extensive and deep-seated affection was discovered on the back. Here the skin seemed to have been involved throughout its entire depth, as the corium, which was bared by extensive desquamation, showed numerous hæmorrhages and was covered by a seropurulent exudate. Owing to the entire absence of pain in the affected area the process was not discovered until desquamation and consequent exposure to friction had taken place. At the present time, October 3d, desquamation of the entire discolored area on my arm is going on, with absolutely no pain, excepting in the locality from which the skin was exsected. A slight itching is all that annoys me. Where the flakes have been detached the hairs seem to be as abundant and as firm as in the healthy skin. There appears to have been no interference with the healing process of the raw surface produced by the exsection, further than what might have been expected in removing a piece of skin over a joint where every movement would tend to delay cicatrization.

The deductions to be drawn from my experience, as

well as from the cases mentioned, are too apparent to require mention. It is probable that individual susceptibility to the rays exists, as with all the experiments which have been made during the months since Röntgen's discovery was made public very few cases of injury following exposures have been published. Those to which I have referred are all that have come under my notice.

The histological changes appear to be simply a dermatitis, with degeneration of the cells of the rete, but, as I have before stated, the point of greatest interest is why the process should have so long a period of incubation. It would seem as though a process of retrograde metamorphosis was set up by the rays which required a number of days for its completion.

This point, in addition to being difficult of explanation, has a bearing on the question of the germicidal action of the rays, or, more correctly, possibly on the question of whether or no changes may be induced in the protoplasm of pathogenic bacteria which would ultimately lead to their death, or possibly to a modification or destruction of their power to induce disease.

The experiments of Minck \* and others have demonstrated beyond a doubt that with the tubes then in use no germicidal action was manifested, but whether any change in virulence was produced is not stated. Whether any similar experiments with the latest type of tube have been made I do not know. In order to test these questions a series of experiments is now under way, the results of which I hope to publish later.

\* *Münchener medicinische Wochenschrift*, 1896, p. 202.





