can be proven, it is reasonable to look forward to the possible reduction of the irritation by desensitization with a suitable antigen.

Summary. An antigen has been prepared by grinding chiggers and extracting with distilled water. Certain individuals gave a positive skin reaction to this antigen. Heat seems to destroy a portion of the antigen so that it becomes less irritating and induces less reaction. A passive transfer was done with positive results.

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Pathology of Irradiation Sickness: A New Method for Inducing Shock.

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It is well known that exposure of the abdominal region to massive Roentgen therapy produces severe illness. Nausea, vomiting, oliguria, bloody diarrhea, rapid feeble pulse, low blood pressure and profound prostration follow. The metabolism is low, the blood sugar and N.P.N. are increased, the blood chlorides and the alkaline reserve decline. These clinical features are identical in character with those of shock. Illness does not develop immediately, but after an interval of 2 or 3 days. Death occurs about 4 days after exposure.

Irradiation sickness was produced in dogs in order to make observations on hemoconcentration and on the visceral changes. From 1400 to 2800 Roentgen units were given in divided doses over different parts of the abdomen. Severe illness developed after an interval of 60 to 72 hours and hemoconcentration, ranging from 15 to 50%, appeared. The urination was decreased and traces of blood were seen in the urine, feces and vomitus. This blood apparently came from capillary hemorrhages in the mucosae. It was not of sufficient amount to affect significantly the total blood volume. The illness progressed rapidly, and death by circulatory failure occurred within 24 hours.

The gross and microscopic findings were those characteristic of shock.[1, 2] These included capillo-venous congestion of the viscera, petechial hemorrhages in mucous and serous surfaces, edema of

[1] Moon, V. H., *Shock and Related Capillary Phenomena*, Oxford University Press, New York, 1938.

[2] Moon, V. H., *Arch. Path.*, 1937, **24**, 642, 794.

lungs and of mucosae, and parenchymatous degeneration of liver and kidneys. The results were concordant in 12 animals so treated.

In one series, the animals were treated as described, but were killed at intervals of 2, 2½, and 3 days after exposure. This was done in order to make examinations of the intestinal mucosae at earlier stages after the injury. Sections of bowel and of other tissues were placed in fixative within 5 minutes of the death of the dogs.

Microscopic study of such sections confirmed the findings of Whipple[3, 4] and others who have made similar studies. The evidences of damage were most marked in the mucosa of the small bowel. The epithelium lining the crypts and covering the villi, showed all stages of disintegration and destruction. Some crypts contained nuclear and cellular debris, others were empty. Some of the villi retained their epithelial covering while that in the crypts showed necrosis and disintegration. Other villi were completely denuded of their epithelial covering.

Our results and interpretations confirm those of Whipple and his associates: Exposure of the abdomen to prolonged deep X-ray treatment causes delayed necrosis of the intestinal mucosa. The development of irradiation sickness apparently is due to the absorption of products of disintegrating tissues.

These experiments have a significant bearing on the mechanism of shock. Some writers assign this to local hemorrhage and loss of fluid, or to sympatho-adrenal hyperactivity, and disregard absorption of products from damaged tissues as a factor. Injury to the intestinal mucosa by irradiation eliminates pain, emotional reactions, sympatho-adrenal hyperactivity, hemorrhage and anesthesia as factors. In the experiments described it appears that the disturbance of circulation resulted solely from absorption, independent of other factors.

Summary. Exposure of the abdomen to deep Roentgen irradiation causes physiologic disturbances like those of shock arising from other causes. This is accompanied by progressive hemoconcentration. The visceral findings post mortem are those characteristic of shock regardless of its origin. Deep Roentgen irradiation causes delayed necrosis of the intestinal mucosa. The resulting signs of illness are likewise delayed in onset.

Irradiation provides a new method for inducing shock by injury to living tissues. This method eliminates the confusing effects of other factors including pain, emotional reactions, sympatho-adrenal hyperactivity, hemorrhage and anesthesia.

[3] Hall, C. C., and Whipple, G. H., *Am. J. Med. Sc.*, 1919, **157**, 453.

[4] Warren, S. L., and Whipple, G. H., *J. Exp. Med.*, 1923, **38**, 713.