NOTES ON X-LIGHT.

BY WILLIAM ROLLINS, BOSTON.

VACUUM TUBE BURNS.

The first report I saw of burning from a vacuum tube was by Hawkes, in *The Electrical Review* for Aug. 12, 1896. He stated that the burns were produced by x-rays. Tesla, in the same journal for Dec. 2, 1896, said they were not due to x-rays but to ozone, and possibly to nitrous acid. In the number for Jan. 5, 1898, I reported that these burns could be produced by electricity when no x-light was present. In the *Boston Medical and Surgical Journal* for Feb. 14, 1901, it was stated that when guinea pigs were protected from all electrical effects they could be killed by x-light without any "x-ray burns" appearing. In the issue for Feb. 28 it was reported that abortion had been produced by x-light. These results were not accepted. That a motion of the ether, of whose existence none of our senses made us conscious, could kill animals was too new and remarkable a fact to be believed. I was told by physicians that guinea pigs were delicate, therefore the experiments proved nothing; that the precautions taken to exclude the participation of electricity in the results were inadequate, that x-light could not kill a cryptogam, therefore it was not probable that it could affect one of the higher animals. Lastly, the pathologist to whom some of the material was given appears to have made no use of his opportunities.

Emerson once said that what was excellent was permanent. These were excellent experiments, therefore I report another of them:

Four strong guinea pigs were used. Two were exposed to x-light under the conditions mentioned in my notes of Feb. 14 and 28, and March 28, 1901, for protecting them from the effects of ultraviolet light, electric induction and convection. The others were subjected to the same treatment and handling, except that no x-light was allowed to shine upon them. By making the exposures shorter than those mentioned in my earlier notes, it was possible to burn the animals before they were killed.

I have, therefore, certainly proved that "x-ray burns" can be produced by x-light when no electricity is present, and by electricity when no x-light is present.

The generator used in the experiments was an influence machine with 16 glass plates, averaging 2 metres in diameter. The speed was 120 revolutions a minute. The tube had an oxygen vacuum. The diameter of the aluminum cathode was 51 mm. Its mass was 14 gms. Its radius of curvature was 35.5 mm. The target was of the rotary type. It was made of a disk of platinum-iridium 28 mm. in diameter and .28 mm. thick. Its distance from the cathode, unless otherwise stated, was 71 mm. The target was kept red hot with a white hot area where the cathode stream struck. The resistance of the tube with the target at 71 mm. was 14 mm. Fresh oxygen was introduced from a regulator, containing manganese dioxide, when the resistance of the tube rose above 14 mm.

The double Faraday chamber employed to contain the pigs was made of tinned iron, .40 of a mm. thick. The side of each chamber toward the vacuum tube was made of aluminum .26 mm. thick. Air was admitted through iron wire gauze with spaces .70 mm. square between the wires. The gauze was on the side away from the tube.

When a pig was being exposed his nearest side was 14 cm. from the radiant area of the target. It will be observed that before the x-light could shine on a pig it passed through two thicknesses of aluminum, the outer one connected with the earth by a metal wire. It should also be remembered that Tesla and others have stated that a single thickness of aluminum was a complete protection against "x-ray burns." These experiments showed that not only could burns be produced through such a screen, but that animals could be killed by the light after it had passed through two aluminum screens. What an aluminum screen is able to do is to protect from ultraviolet light, from the ether strain surrounding an excited tube, from electric convection, and from whatever rays it can absorb. The following table gives details of the experiment. The weights are gross. To find the net weights deduct the weight of the inner chamber, 357 gms. It will be observed that Pig 2 showed practically no external signs of burning though abortion and death resulted. This illustrates that animals vary in susceptibility to the external action of x-light and warns us to consider these differences when patients are treated by x-light. What may be a harmless exposure to one patient may cause a burn in another. Pigs 3 and 4 were placed in the same Faraday chamber as Pigs 1 and 2, remaining there for the same length of time. They were therefore exposed as long to ozone and nitrous fumes and handled as much, yet they remained in perfect health. All the pigs lived in the same pen, received the same care and food, the latter in unlimited amount. The whole series of experiments showed we had in x-light, after excluding the participation of all other agents in the results, a force of great power, whose action was not understood, whose effects on the tissues were unknown. I failed in my attempt to get a pathologist interested, and as my knowledge of the normal microscopical appearances of the tissues of guinea pigs is insufficient to make my observations worth publishing, I hope some clear-eyed observer will realize that here is a new field where some useful original work can be done.

TABLE SHOWING EFFECTS OF X-LIGHT ON GUINEA PIGS.

No. 1. Male. Exposed to X-Light in Faraday Chamber.					No. 2. Female. Exposed to X-Light in Faraday Chamber.				
Day.	Weight in Grammes.	Length of Exposure. M.	Spark-Length of Tube. Mm.		Day	Weight in Grammes.	Length of Exposure. M.	Spark-Length of Tube. Mm.	
1	1,078	15	14		1	746	15	14	
2	1,033	15	14		2	740	15	14	
3	1,045	15	14		3	755	15	14	
4	1,047	15	14	Hair losing gloss	4	755	15	14	
5	1,012	15	14		5	751	15	14	
6	?	0	....		6	?	0	....	
7	?	0	....		7	?	0	....	
8	1,001	15	14	Loss of hair on flank next the tube. Area 2 sq. cent.	8	758	15	14	Hair losing gloss
					9	?	0	....	
					10	?	0	....	
					11	747	15	14	
9	?	0	....		12	772	15	14	
10	?	0	....		13	750	15	14	
11	991	15	14	Exudation on bare area.	14	757	15	14	
					15	752	15	14	
12	990	15	14		16	769	15	14	
13	971	15	14	Area enlarging.	17	762	20	14	
14	976	15	14		18	762	20	14	
15	982	15	14		19	763	20	14	
16	999	15	14	Scabs forming.	20	?	0	..	
17	984	20	14	Improving.	21	781	30	14	
18	975	20	14		22	765	30	14	
19	981	20	14		23	779	30	14	
20	?	0	...		24	778	30	14	
21	994	30	14		25	781	60	14	
22	971	30	14		26	771	60	14	
23	986	30	14		27	?	0	..	
24	964	30	14		28	777	60	14	
25	976	60	14		29	746	60	14	
26	959	60	14	Bare area suppurating.	30	726	90	14	Eye closing on side next tube.
27	?	0	1		31	697	90	2	Slight paralysis of hind leg next tube.
28	980	60	14						
29	954	60	14						
30	945	90	14		32	667	90	2	Blood from vaginal opening.
31	936	90	2	Area 7.5 sq. cent.					
32	908	90	2	Partial paralysis of hind leg on burnt side.	33	643	90	2	Aborted.
					34	?	0	...	Died. No external or X-Ray burns.
33	886	90	2						
34	?	0		Died.					

No. 3. Male. Not Exposed. Control.				No. 4. Female. Not Exposed. Control.			
Day.	Weight in Grammes.	Length of Time in Faraday Chamber. Min.		Day.	Weight in Grammes	Length of Time in Faraday Chamber. Min.	
1	931	15		1	756	15	
2	931	15		2	756	15	
3	920	15		3	772	15	
4	926	15		4	771	15	
5	930	15		5	781	15	
6	?	0		6	?	0	
7	?	0		7	?	0	
8	930	15		8	792	15	
9	?	0		9	?	0	
10	?	0		10	?	0	
11	917	15		11	804	15	
12	945	15		12	830	15	
13	930	15		13	823	15	
14	918	15		14	827	15	
15	918	15		15	827	15	
16	926	15		16	852	15	
17	921	20		17	841	20	
18	909	20		18	850	20	
19	915	20		19	860	20	
20	?	0		20	?	0	
21	930	20		21	893	20	
22	925	20		22	886	20	
23	931	20		23	906	20	
24	932	20		24	908	20	
25	926	60		25	923	60	
26	925	60		26	917	60	
27	?	0		27	?	0	
28	939	60		28	941	60	
29	930	60		29	925	60	
30	932	90		30	941	90	
31	949	90		31	956	90	
32	950	90		32	943	90	
33	953	90	Good health, fine coat, bright eyes.	33	956	90	Good health, etc.

When the spark-length was 2 mm. the target was 35 mm. from cathode. The exposures are given in minutes. Length of spark gap of tube in millimetres.

CASE OF ATTEMPTED CRIMINAL ABORTION IN EXTRA-UTERINE FETATION.[1]

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E. B. P., married woman, 25 years old. Had one child living. Was seized with violent pains in the abdomen on the morning of Feb. 9, 1898. She told her husband that on Feb. 7, two days previous, she had visited a certain female physician in Boston who had examined her and introduced instruments into the womb for the purpose of "bringing her round." Her last menstruation was on Dec. 20, or about 7 weeks previous.

She was attended in the afternoon of the ninth by two physicians, who examined and curetted the uterus. She died in the afternoon of the following day.

Autopsy.— Sixteen hours after death. Body of a well-formed and well-nourished young woman. Anterior surface and mucous membranes generally pale. Back livid purple, except where subjected to pressure. There was a small discharging sinus on each side of the neck, and enlarged lymphatic glands about them. There was a purple spot on the outside of the left thigh from hot applications. Breasts and nipples small; areolæ pale; abdomen distended; thin, reddish, odorless discharge from the vagina. Vaginal mucous membrane shows small excoriations about the cervix and os uteri; a small old recto-vaginal fistula. On opening the abdomen, the peritoneal cavity was found to contain three pints of dark fluid and clotted blood. Peritoneum everywhere smooth and glistening. The left lung contains a few hard cicatricial nodules in the apex. Other organs contain little blood, otherwise normal.

The uterus and its appendages removed for examination. Dr. W. F. Whitney reports on these as follows: "The specimen consists of the uterus and appendages. The uterus is slightly enlarged, the upper portion of its cavity for a distance of 1½ cm. being covered with a thin soft membrane. The tube on the right side, about 3 cm. from the uterus, has a ruptured swelling from which protrudes a mass of clotted blood and fine filaments. The tumor measures 3 cm. in diameter. The right ovary contains a corpus luteum. On the other side the tube is adherent to the ovary, and covered with a more or less dense membrane."

There was no appearance of sepsis.

The police stood ready, on the completion of my autopsy, to cause the arrest of the female physician mentioned above, if my report warranted it. The direct evidence of a criminal operation having been destroyed by the attending physicians who introduced instruments into the uterus, I reported that death was due to spontaneous rupture of a tubal pregnancy and the resulting hemorrhage, and that there was no evidence of a criminal operation, there being only the unsupported statement of the husband. That ended the case.

If there had been good evidence of a criminal operation the case would have been prosecuted

[1] Read before the Massachusetts Medico-Legal Society, Oct. 2, 1901.