

ACCIDENTAL ELECTRICAL STIMULATION OF THE HUMAN
RETINA IN SITU. — BY, D. FRASER HARRIS, M. D.,
D. Sc., F. R. S. E., Professor of Physiology in Dal-
housie University, Halifax.

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In the summer of 1912 I had a lower left molar tooth filled with a temporary stopping consisting of an amalgam of at least three metals, silver, mercury, and tin. Within half an hour of having this inserted I noticed that each time I clenched the jaws at all forcibly, there appeared a bright flash of light in the left eye; all through the rest of the day flashes of light, getting fainter and fainter, kept recurring. I noticed that the tooth in the upper jaw which touched the amalgam in the lower was gold-capped. The light experienced was of a canary yellow and more like the sensation of a vivid lightning flash (forked lightning) than of any mere luminosity or diffusion of light. So vivid were these subjective flashes that my first thought was that there had been lightning, but on the day in question there was no lightning, thunder or rain.

The first explanation that occurred to me was that this was a case of "contact electricity" (Kelvin), that the dissimilar metals—the gold of the upper tooth and the amalgam of the lower—having been in contact in the liquid saliva, produced sufficient current to stimulate the retina heterologously. But the following experiment seemed to be against this; I held between the teeth a copper rod in contact with a silver rod, but no flash of light was experienced when these metals were pressed together.

The next explanation which occurred to me was that the crystallization of the amalgam could give rise to currents sufficiently intense to be the cause of physiological stimulation. Dr. Frank Woodbury kindly told me that he had

known of currents caused in this way being sufficiently intense to give pain in the upper gold-covered tooth when that tooth had an unduly sensitive nerve. I therefore suggest that the electric current thus produced was conducted through the bones and tissues of the head and, encountering the retina en route, stimulated it to give rise to the subjective sensations of light. The possibility of stimulating the retina in situ by electric current was discovered by Ritter in 1800; a constant current passed either transversely across the head in the temporal regions or from the eyelid to the neck will, both at make and break, stimulate the retina causing flashes of light to be perceived. I renewed my acquaintance with these effects by passing the constant current from one dry cell through the eyes transversely across the head; at the make and break the flashes due to this current were slightly less vivid than the flashes due to the tooth-current. On using two dry cells, I obtained flashes closely resembling those from the tooth-current. I am assured that the current from two dry cells would be painful to the inflamed nerve of a tooth.

It is well known that pressure on the eye-ball produces the sensation of light—the phosphene. I noticed that the subjective flashes from two dry cells were not quite so vivid as the phosphene from moderate (non-painful) pressure on the eye-ball. The electrically produced flashes are more diffuse than the phosphene which has a circular outline; the sensations from dry cells or the tooth-current are more truly flashes.

Based on these considerations, I make an attempt to estimate the amount of the tooth-current, say, during the first few seconds of its production. Assuming that the resistance of the head is about 3000 ohms, and that each dry cell can develop 1.5 volts; then, for two cells, we have

$$C = \frac{1.5 \times 2}{3000} = \frac{1}{1000} \text{ of an ampere or one milliampere.}$$