The Finance Committee offered the following resolution which was adopted:

*Resolved*, That J. Sergeant Price, Treasurer, be and he is hereby authorized to sell and transfer three thousand dollars of the loans of the City of Philadelphia now standing in the name of the Society.

And the Society was adjourned by the presiding member.

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## *On Muscular Contractions Following Death by Electricity.*

*By Prof. Edwin J. Houston.*

(*Read before the American Philosophical Society, February 7, 1890.*)

Accurate data are wanting as to whether death resulting from accidental contact with electric conductors conveying the powerful currents employed in systems of electric lighting or power distribution is, or is not, practically instantaneous. Certain facts, however, are known which show that when the nature of the contacts is such that the discharge passes through the respiratory, the cardiac or the brain centres, that true physiological death, as evidenced by the complete failure of these centres to perform their normal functions, and their inability to afterwards perform these functions, is practically instantaneous.

In cases of death from a lightning bolt, for example, instances are on record where death has been so nearly instantaneous that the bodies have remained so nearly in the positions occupied during life that passers-by have failed to recognize the presence of death.

On the regaining of consciousness lost by a lightning discharge or a contact with an electric conductor, the subject as a rule has no memory of pain or suffering, and in many instances is even ignorant of the cause of the accident.

A fact, however, which appears to disprove that practically instantaneous physiological death follows a powerful electric discharge, should be alluded to. In some instances, it has been observed that the body of the person receiving the discharge showed prolonged convulsive muscular contractions and contortions. The question thus arises, Do such muscular movements necessarily prove actual suffering on the part of the subject? Do they even necessarily prove the existence of life while they are taking place? While, of course, the answer to this question must necessarily be to a certain extent uncertain, the following considerations are offered to show that in all probability such muscular contractions follow physiological death, and are, therefore, unattended by consciousness or suffering.

Two general cases of contact resulting in death may occur, viz.:

1. A momentary contact, where the discharge is only temporary, as in the case of the lightning discharge, or the case of a person falling against the wires and remaining in contact therewith but a few seconds or fractions of a second.

2. A prolonged contact where the current continues to pass through the body for some time after death.

In cases of death by the first class of contacts, no convulsive movements occur. Death results from physiological shock, or possibly from changes in the nervous or muscular tissues.

In the second class of contacts, death in many cases probably occurs practically instantaneously. The question then arises, How can the muscular contractions be explained ?

The classic experiments of Galvani with the excised legs of recently killed frogs prove conclusively that the passage of an electric current causes convulsive muscular movements. The same phenomena, too, have been observed in the human subject, as numerous experiments with the bodies of criminals shortly after their execution have shown.

It would seem, therefore, probable, to say the least, that when the electric current continues to pass through the body of the subject after physiological death has occurred, such convulsive muscular movements may occur, and that, therefore, their existence do not prove suffering.

When a powerful current traverses the body, tetanus occurs, and muscular movements in such parts cease. The nerve loses its sensibility, and, if the current is too strong, changes occur in its structure or composition, either as a result of polarization, or electrolysis, or otherwise, which prevent it from being further affected by the electric discharge. Since such changes presumably occur in cases of death by electric discharges, it would appear that muscular contractions would therefore be impossible after death. A brief consideration of the manner in which an electric current traverses the human body will show that such a conclusion is unwarranted.

When the electrodes of any source are applied to any two parts of the human body, a current passes through the body from the positive to the negative electrode. The density of current that passes, or the current strength per unit of area of cross-section, is different at different parts of the body. Those portions that lie in the paths of least resistance, which, in general, are situated in paths of least distance between the electrodes, receive the denser and more powerful current, while those lying in paths of greater resistance, receive weaker currents. In other words, in the passage of the electric current through the human body, a diffusion of the current occurs.

While, therefore, the nerves and muscles lying in the direct path of a fatal discharge may be almost instantly deprived of their sensibility by the passage of the powerful and fatal discharge through them, the nerves and muscles which lie in the paths of less powerful currents may still retain their power of electric excitation.

It is therefore probable, that in cases of prolonged fatal contact with electric conductors, the ensuing convulsive muscular contractions do not of necessity prove suffering.

I offer these views with some diffidence from the standpoint of an electrician rather than that of a physiologist.