

# ON THE COMPARATIVE DANGER OF ASCENDING AND DESCENDING DIRECT CURRENT

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One of the first problems in the study of electric trauma resulting from the action of direct current is the problem of the significance of the direction of the current through the body of the affected object. Usually in physiotherapy it is customary to consider as descending that direction of the current which occurs if the positive electrode lies on the upper part of the body (i.e., nearer the head), while the negative one is on the lower part of the body (i.e., nearer the feet). Thus, the discussion is of the technical, not electronic, direction of the current.

In other words, these concepts are conventional and inexact. However, since they are generally accepted, we will use them.

The fact that the physiological action of direct current of opposite directions varies has long been known to Russian researchers [Uspensky, Tarkhanov, V. Yu. Chagovets]. They showed that ascending current increases the excitability of the central nervous system and strengthens reflex reactions, while descending current has the opposite effect. In 1951, I. K. Zyuzina's [1] paper appeared in which the different action of direct current of different directions (when passed through the spinal column) was demonstrated by the change in the antitoxic function of the liver: its stimulation by ascending current and inhibition by descending. N. V. Shipova and I. Ya. Dymshits [2] showed that the stability of the spinal reflex arcs of the frog to ascending current is less than to descending current (the electronarcotic threshold is equal to 4 mA on the average in the first case, and correspondingly in the second it is 6 mA. All these data were obtained, however, in experiments with weak currents, and the differences in the action of stimuli which are evident with a weak degree of stimulation are smoothed out (and sometimes completely disappear) when strong stimuli are applied. Therefore the facts mentioned above should be checked under conditions in which strong stimuli are applied ("extreme" in their intensity), typical of the electropathological experiment.

## EXPERIMENTAL METHODS

The work was carried out on white mice according to A. U. Aitkulova's method. The mice were included in the circuit in pairs and in parallel, but so that the current was ascending in one and descending in the other. This was ensured by a quadripolar switch. Thus, 2 mice participated in each experiment. In all, 75 experiments (on 150 mice) were set up, with the same weight and sex in each pair and at a constant surrounding temperature (18-19°). A voltage of 120 v was used, the duration of the action was 2 seconds.

In this work we made somewhat more precise the gradation of the reactions obtained, a gradation which we appraised earlier, based on the equipment of F. M. Danovich [3], whose method was used by A. U. Aitkulova as the basis of her work. F. M. Danovich considered that, under the conditions of the fixation and inclusion of the animal into the circuit as suggested by him, electric trauma of the I degree (in the four-stage classification of G. L. Frenkel) could not develop since the current passes through the entire body (as in a complete loop), and the entire body is included in the convulsions, if they occur. Therefore F. M. Danovich made appraisals beginning with the II degree only. Thus did we also act before. But we noticed one form of reaction which, although it

did not fall into the I degree according to G. L. Frenkel's classification, still differed markedly (at least among mice and under our experimental conditions) from the II degree reactions. In these cases, markedly evident convulsions did not develop, which do not always have the classic extensor nature of opisthotonus in mice, but can be flexing also ("rolled up in a ball"), while a generalized "shivering" of the animal was observed with clearly evident polypnea. Sometimes this "shivering" presented the impression of clonic spasms. However, since the animal's death was never observed in connection with this, while their original condition (judged by the duration of the motor reaction) was re-established more quickly than after the typical reaction of the II degree, we considered it correct to relate such cases to I degree affection.

## EXPERIMENTAL RESULTS

If the reaction of the animals is appraised only at the IV degree (fatal affection), then substantial differences between the pathogenicity of ascending and descending direct current were not observed: out of 75 mice subjected

to ascending current, 8 died; when the current was changed to descending, 9 out of 75 died. However, when the materials are treated by the principle of "weighting" i.e. taking into account the significance of all degrees of affection, a distinct difference developed (Fig. 1 and 2).

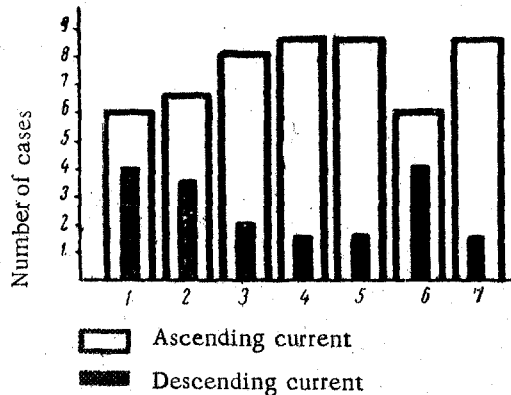


Fig. 1. Difference between the danger of direct and alternating current including all stages of affection. Numerals below the columns are the numbers of the tens.

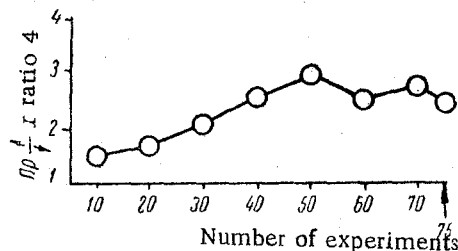


Fig. 2. Explanation in the text. The ratio of the danger of 120 v direct current to alternating current of 36 v (multiple).\*

In Fig. 1 are shown the data for each ten experiments. We see that in all cases the ascending current proved more dangerous. In Fig. 2 it is seen that with an increase in the number of experiments, the observed difference in the danger of the currents has a definite tendency to increase. The curve shown in Fig. 2, which expresses the multiple of the ratio of the danger of ascending current to descending, stops increasing, after the 5th ten experiments (i.e., after 50 experiments on 100 mice), so that a further increase in the number of experiments (up to 75) did not change its direction: the curve varied between the ordinates 2.5-3.

Thus, as is evident from our experiment, 120 v direct current ascending and descending has the same lethal effect on white mice exposed for 2 seconds.

A distinct difference with respect to the danger of currents of different directions is evident when all degrees of affection are taken into consideration: ascending current is 2.5-3 times more dangerous than descending.

### SUMMARY

The author studied the effects of direct current (120 v, duration of action -2 sec.) of various directions during electropathological experiments on 150 mice.

It was established that the ascending current is 2-3 times more dangerous than the descending one.

### LITERATURE CITED

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- [2] N. V. Shipova and I. Ya. Dymshits, Byull. Eksptl. Biol. i Med., 1952, vol. 33, No. 8, pp. 13-16.
- [3] F. M. Danovich, in the book: The Mechanisms of Pathological Reactions,\*Leningrad, 1947, issue 9-10, pp. 51-56.

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\* In Russian.

\* \* Exact Translation - caption does not agree with explanation in the text.