EFFECT OF REPEATED SERIAL STIMULATION OF THE VESTIBULAR ANALYZER IN RABBITS ON THE QUANTITATIVE RELATIONSHIP BETWEEN THE DURATION OF NYSTAGMUS AND THE NEGATIVE ANGULAR ACCELERATION

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To study the function of the vestibular analyzer in man, a method based on the recording of the nystagmic reaction to a series of adequate stimuli of increasing strength (cupulometry) has been successfully applied [8, 6, 14]. Parallel investigations, so far few in number, conducted on dogs, pigeons and fishes (skate) have shown that in principle cupulometry may also be used in experiments on animals [7, 11, 12]. The problem is complicated, however, by the familiar tendency of vestibular nystagmus to grow shorter during repeated stimulation of the analyzer [1, 5, 10, 13]. The multiple application of serial stimulation, moreover, creates conditions favoring a modification of the nystagmic reaction.

In the present investigation we examined the effect of repeated serial stimulation of the vestibular analyzer of rabbits on the duration of nystagmus, using a range of stimuli of twice the cupulometric strength.

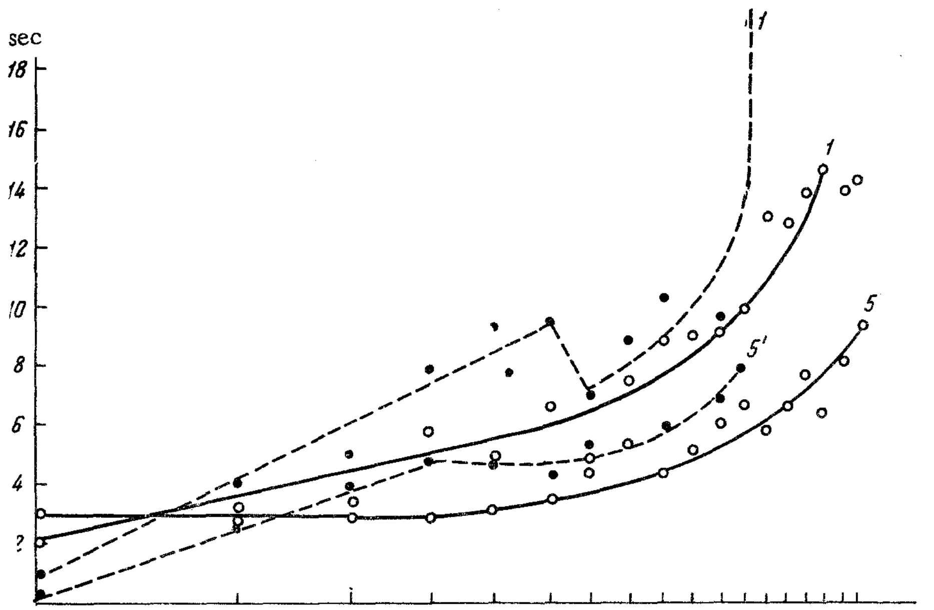

Fig. 1. Relationship between the duration of nystagmus and the magnitude of the angular velocity of uniform rotation before stopping. Ordinate) duration of nystagmus (in sec); abscissa) natural logarithms of the angular velocity. The numbers 1 and 5 denote the curves of the first and last tests of series of stimuli of increasing magnitude; the numbers with strokes denote series of stimuli of decreasing magnitude.

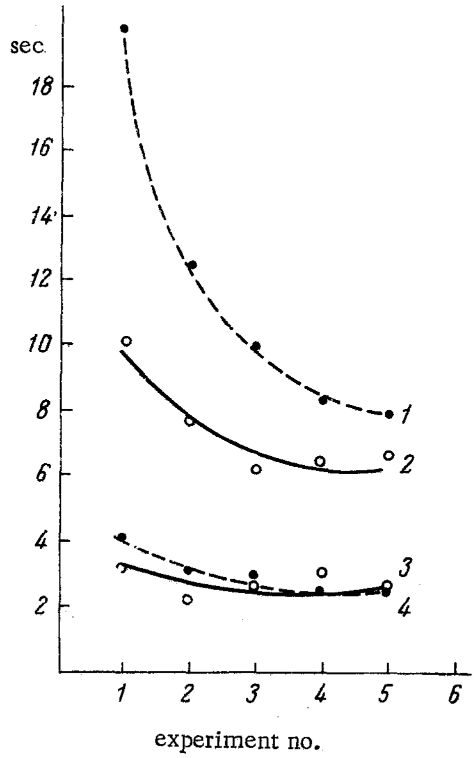

Fig. 2. Change in reaction from one experiment to the next to stimuli of 120°/sec (1, 2) and 20°/sec (3, 4). The continuous curves belong to increasing series, the broken curves to decreasing. Ordinate) duration of nystagmus (in sec); abscissa) serial numbers of experiments.

EXPERIMENTAL

The experimental method has been described fully in an earlier paper [2]. In all the experiments the rabbits were rotated clockwise. The axis of rotation passed through the animal's head. The adequate stimulus was negative angular acceleration, created by the sudden stopping of a uniformly rotating table. The starting acceleration (5°/sec^2), the duration of rotation at uniform velocity (1 min), the interval between two successive rotations (1 min) and the time of stopping rotation (0.15 sec) remained unchanged throughout the experiments. The animals were divided into three groups with five rabbits in each. The animals of group 1 received 18 stimuli of increasing magnitude in the course of the experiment (minimal 10°/sec, maximal 180°/sec); those of group 2 received 12 diminishing stimuli (maximal 120°/sec, minimal 10°/sec); those of group 3 received 12 stimuli of an increasing series (120-10°/sec). In all the groups the experiment was repeated five times at intervals of between 2 and 6 days.

DISCUSSION OF RESULTS

The results of the first and last observations of the first two groups of animals are shown in Fig. 1. It is clear that during the repeated action of both the increasing (Curves 1 and 5) and the decreasing series of stimuli (Curves 1' and 5') a shortening of the nystagmic reaction took place, and because of the steeper fall of the reaction to strong stimuli the curve of the duration of nystagmus moved fanwise in relation to the abscissa. A clear idea of the change in the reaction from one experiment to another to strong and weak stimuli is given by Fig. 2, which shows that the most marked shortening of nystagmus was observed between the first and second experiments.

The fifth application of a combined series of stimuli (increasing and decreasing) also led to a shortening of the reaction. With all three types of serial stimuli, the curves of the duration of nystagmus had a kink in the region of the stimuli amounting to 70-80°/sec in magnitude.

The experiments in which the vestibular analyzer of the rabbits was subjected to the action of series of stimuli of increasing and decreasing strength, and also of stimuli whose strength at first rose and then fell, showed that with all three types of stimuli the character of the relationship between the duration of nystagmus and the logarithm of the magnitude of the stimulus remained essentially unchanged. This fact may be regarded as confirming the hypothesis put forward earlier [2], that the graduated nystagmic reaction extends within wider limits.

The fanwise shift of the curve observed on repeating the experiments was reminiscent of the similar shift of the nystagmus curves (cupulograms) of persons whose work entailed periodic exposure to various levels of acceleration [4, 9, 15, 16], in relation to the cupulograms of untrained individuals. However, vestibular stimulation during games, dancing or boating did not give rise to nystagmus. Consequently, the shortened nystagmus observed in these cases during the rotation test was the result of training, the effect of which spread to the whole "functional system" [3] of the semicircular canals. In other words, the state of general training of the vestibular analyzer was probably extended to all stimuli producing nystagmus (and especially to the stop stimulus).

In order to judge the function of the vestibular analyzer of rabbits from the nystagmus curves, the best method is to use the data starting with the 4th or 5th serial stimulus, when the curve has become comparatively stabilized. This conclusion is also applicable to cases in which the duration of nystagmus was lengthened instead of shortened, as was observed in the experiments in which a combined series of stimuli was applied repeatedly to two rabbits.

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All abbreviations of periodicals in the above bibliography are letter-by-letter transliterations of the abbreviations as given in the original Russian journal. *Some or all of this periodical literature may well be available in English translation.* A complete list of the cover-to-cover English translations appears at the back of this issue.