A SIMPLE MODEL OF THE CENTRAL MECHANISM OF THE OPTOKINETIC NYSTAGMUS OF THE RABBIT

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The most simplified input-output-relations of optokinetic stimulation in the rabbit are realised, when one, seeing eye is immobilised and stimulated by contrasts moving at a uniform velocity, while the movements of the other, covered eye are recorded. After a certain lapse of time a steady state is reached, during which an optokinetic nystagmus with a uniform velocity of the slow phase is maintained. This velocity is not equal to the velocity of the moving contrasts and in most instances higher. (TER BRAAK, 1936; COLLEWIJN, 1969).

We assume that the firing frequency of the (retinal) velocity detectors is constant in the steady state, which is also suggested by experiments of OYSTER (1968). Again we will assume that the eye position depends on the force of the eye muscles which in turn is determined by the overall firing frequency of the oculo-motor motoneurones. Then a uniform (and not too high) velocity of the eye should depend on a uniform increase of motor impulse frequency, which could find support in experimental work e.g. that of ROBINSON (1970) and FUCHS & LUSCHEI (1970). If during the steady state the impulse frequency at the input of the central apparatus is constant, whereas the output frequency is uniformly increasing, we may assume a central integrating stage. This model, however, is too simple for two reasons:

At the beginning of the stimulation, before the steady state is reached, the eye velocity is not at once at the steady state value, but increases gradually from zero and reaches the uniform velocity after a considerable lapse of time only (10-20 sec. at least), (Fig. 1).

Secondly, when after the steady state is reached the stimulation is discon-
O.K.N. (open loop situation) at the beginning of the stimulation with uniform contrast velocity (10'/sec.).

Continued (by switching off the light), the eye velocity does not drop immediately to zero, but declines gradually, causing the eye to come to zero position after a period of several seconds (o.k. 'after-nystagmus'), (Fig. 2). This calls for another integrating stage in series with the one already mentioned. The constant impulse frequency at the input will then be transformed by the first integrator.

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Fig. 1
O.K.N. (open loop situation) at the beginning of the stimulation with uniform contrast velocity (10'/sec.).

Fig. 2
O.K.N. after-nystagmus. (vertical line indicates end of stimulation).