Inhibition of the off-effect in the optic nerve and its relation to the equivalent phase of the retinal response. By RAGNAR GRANIT and P. O. THERMAN. (*Physiology Institute, Helsingfors.*)

It has been shown by Granit and Riddell [1934] that the first effect of a flash of light, delivered during the off-effect of the retinal action potential of a light-adapted frog's eye, is a large negative dip, the size of which increases and diminishes with the level of the (positive) off-effect above the base line. The negative dip is followed by a positive swing. Granit and Riddell further showed that this negative dip is identical with the likewise negative *a*-wave initiating every response to light and that these negative deflections are parts of the large negative component, P III [Granit, 1933], of the retinal action potential.

The off-effect in the retinal action potential is mirrored in the optic nerve as a renewed outburst of impulses at the cessation of the illumination [Adrian and Matthews, 1927]. This makes it particularly interesting to find out what happens in the nerve when a flash of light temporarily suppresses the off-effect in the retina, as it does by activating the negative component. Are the impulses temporarily inhibited?

Using a Cossor cathode ray oscillograph with a condenser-coupled amplifier we have recorded (monophasically) the impulses in the optic nerve of the large Hungarian frog (*R. esculenta*). Light-adaptation and strong stimuli have been used as these are optimal conditions for the effect described by Granit and Riddell.

Controls: For nerve records a condenser of 0·02 μF has been used in the input of the second stage of the amplifier which then becomes too rapid to give more than a minute deflection at "on" and "off" with direct recording of the slow retinal action potential from electrodes on the excised bulb. There is no leakage of the retinal response to the electrodes on the nerve as can be shown by lightly pinching the nerve in front of the electrodes and as near to the bulb as possible. The reaction to light disappears completely from the nerve whereas the retina still is as active as before (direct retinal recording with large condensers).

The upper record of Fig. 1 shows the off-effect in the nerve. The cessation of the illumination is marked by an electric artefact in the oscillograph record and also by the end of the line drawn in Indian ink to the left in the figure. After a latent period of 35–40σ there follows a very brisk discharge in which numerous fibres take part, to judge from the displacement of the cathode ray upwards in the picture. There are small oscillations and somewhat irregularly synchronized impulses which continue to form waves in the record for some time in the dark.

The lower record starts in the same fashion with the off-effect in the nerve, but after an interval of 120σ there follows a flash with a duration of 120σ. The first effect of the flash is actually to inhibit the activity in the nerve. There is a rapid drop towards the base line, the waves of grouped impulses disappear and the small oscillations become less definite and may even be absent. The inhibition is followed by a phase of renewed activity in the nerve.

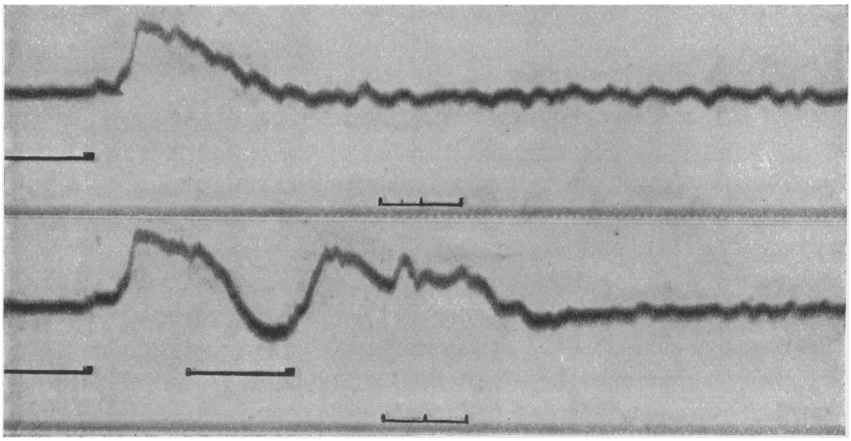

Fig. 1. Records of impulses in the optic nerve of the frog. Lines in Indian ink mark illuminated periods, also marked by electric artefacts in the oscillograph records. Tuning fork of 100 periods is marking the time; an interval of 100σ marked in Indian ink just above time record. Explanation in text.

Thus, with strong stimuli, the first effect of a flash upon the off-effect of the retinal action potential is a large negative dip, the equivalent effect in the nerve is cessation or diminution of the discharge. In the retina the negative dip is followed by a positive swing, the equivalent effect in the nerve is renewal of the discharge.

In view of the fact that the retina ontogenetically is a nervous centre it is interesting to find that slow retinal potentials of opposite sign in some way are associated with the opposite effects of excitation and inhibition.

The results confirm the suggestion [Granit, 1933] that the negative component, P III, of the retinal action potential is associated with inhibition.

REFERENCES.

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