METHODS

CINEMATOGRAPHIC RECORDING OF VISUAL REFLEXES AND ITS DIAGNOSTIC SIGNIFICANCE

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Visual reflex disorders are one of the main symptoms in neurosyphilis and certain other nervous diseases. But the absence of a light reflex observed in the Argyll Robertson syndrome is the final stage. A number of intermediate stages are frequently encountered in clinical practice, from those which are slight and scarcely perceptible by eye up to complete absence of reflexes (eyes immobilized). The subjective evaluation of visual reactions, even when various pupilloscopes are used, cannot give exact data on the nature of the disorders.

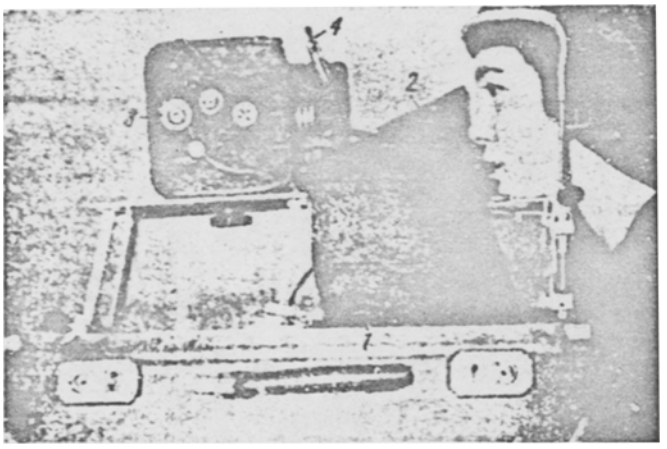


Fig. 1. General view of the apparatus (explanation in text).

Bellyarminov's principle [2], used in Glezer's apparatus [3] and by Zelondzhev [4] and the photoelectric methods of Martes [9], Cuppers [6] and Ataev [1] require extremely rigorous conditions, the head and eye of the subject having to be immobilized.

Loewenfeld's special check experiments [7] showed the photoelectric method to be inaccurate.

We used a cinematographic method of serial recording for the visual reflexes in neurosyphilis. An advantage of cinematography is that it is reliable. It also, unlike other methods, does not require the head and eye to be strictly stationary. This is very important for studying visual reflexes under clinical conditions.

But several difficulties occur in using cinematography: high illumination is required; the apparatus is cumbrous; the noise and the apparatus constitute additional disturbances; transcribing the curves from the frames is laborious and time-consuming [8].

These shortcomings were eliminated in our method. A portable apparatus was constructed. Here a weakly illuminated background (25-lux at eye level) is lit by two light sources (Figure 1,1) separated by a special baffle (Figure 1,2) so the light from a source fell only on the eye on the same side. The direct and conjoint reflexes could then be studied.

To apply a light stimulus either source could be brightened by a factor 10, to give 250 lux, the frames being taken at 10 per sec. The gaze of the subject was fixed on a small lamp reflected in a mirror (Figure 1,4), this preventing convergence reactions. The noise of the apparatus (Figure 1,3) was eliminated by fitting a sound-absorbing shield.

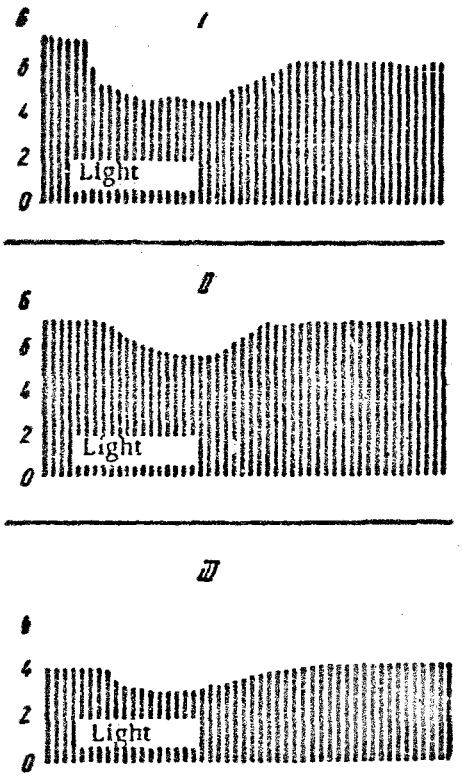


Fig. 2. Pupil reflexes to light.
The traces marked "light" indicate when the light stimulus is operative. The left hand scale is the absolute pupil diameter in mm.
I) Light reflex in normals (latent period 0.2 sec). II) Light reflex in a patient with neurosyphilis (latent syphilitic meningitis). Increase in latent period of light reflex (to 0.5 sec). III) Light reflex in a neurosyphilis patient (syphilis of the brain). There is myosis, increase in light reflex latent period (to 0.4 sec) and reduced reaction amplitude.

The pupil diameters can be measured on the frames and plotted on a graph. An apparatus to do this automatically has been built [5] to record photographically the visual reactions directly from the frames. In this the pupil image is set to have the same diameter as the outlet slit. The pupil diameter is printed on photographic paper or film via this slit, the photographic material running in a film camera. The sequence of readings gives the pupil diameter as a function of time. The curve (Figure 2,1) so obtained consists of vertical lines representing the pupil diameter. The marks are at $1/_{10}$ second intervals (at 10 frames per second in the original camera).

To test this method we studied the light and convergence reflexes in 40 apparently normal individuals and in 30 patients with neurosyphilis.

With this method pupil reactions and eyeball motion in convergence can be recorded simultaneously. It was found that the pupils do not contract instantly in convergence, there being a definite latent period, contrary to the opinion so far current (Figure 3).

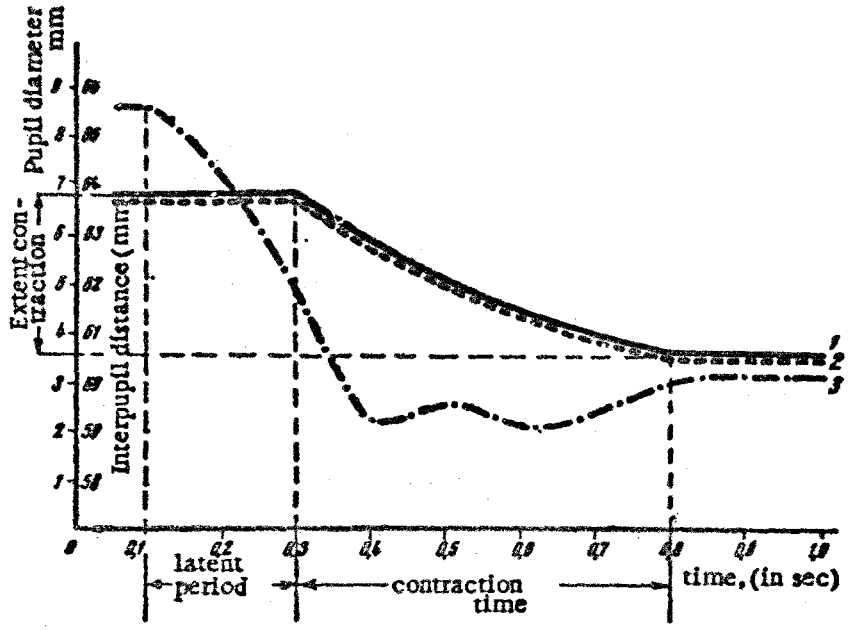
Using cinematography minor disturbances in the visual reflexes not detected by eye were found in pathological states. The duration of the latent period cannot be determined visually, or the rate at which the pupils react to light. Objective recording shows that the pupil reflex to light has a latent period lasting from 0.2 to 0.3 sec. in normals (Figure 2,1).

In neurosyphilis patients the latent period was found to be raised to 0.4-0.6 sec. (Figure 2,II), which shows the diagnostic value of this index. The amplitude of the pupil reaction varies from 1 to 2.5 mm in normals. The patients we studied gave various degrees of amplitude reduction (Figure 2, III) as far as complete absence of the reflex. The light reaction time varied from 0.5 to 0.8 sec. in normals.

By dividing the amplitude of pupil contraction by the reaction time we get the rate of the light reaction.

Using cinematography and weak background illumination we could not only record pupil contraction on light stimulation for one eye but also how the pupils enlarged after closing one eye. We could also determine the pupil state in complete darkness. To do this the camera began to run before the lights were switched on. The dark diameter of the pupils could be judged from the first frame exposed. The dark diameter varied from 6.7 to 9 mm after 3 minutes in darkness with normals.

Since cinematography makes it possible to record direct and conjoint pupil reactions to light the relation between these reactions can give one information on the location of damage to the reflex arc. Finally, our method makes it possible to detect minor disturbances not seen by eye, and it may be of diagnostic value in various nervous diseases.



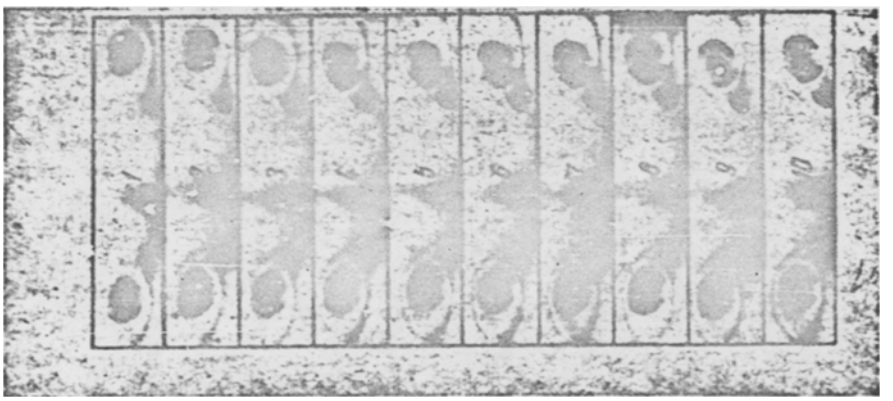


Fig. 3. Reaction of pupil to convergence.
1) right eye reaction; 2) left eye reaction; 3) convergence.
The ordinates are the pupil diameters and interpupil distances, which represent the degree of eyeball and visual axis rotation in convergence. The abscissae are times in seconds; the bottom plate shows the frames from which the graphs were drawn.

SUMMARY

An objective method was developed of cinematographic recording of pupil reflexes in weak light. An apparatus has been constructed for objective photographic recording of pupil reaction curves from motion picture frames. The changes of pupil reactions to light and convergence were investigated in normal conditions as well as in patients with neurosyphilis.

* In Russian.

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