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Letters to the Editor

Changes in the shape of stria-induced wavefront during its propagation

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In the theory of material aberrations ocurring in the optical instruments the values of the imaging quality factors are calculated by assuming the shape of the wavefront in the pupil to be known. However, the wavefront deformations occur at different places of the optical system, for instance at the striae positions. Then it is usually assumed that these deformations are transferred to the exit pupil without any changes in their shape, relative area (the ratio of the area covered by deformation to the whole cross-section area of the light beam) and the maximal deformations [1]. Thus this practice has to be justified. As the respective theoretical calculations are tedious we have made a simple experiment. The purpose of this experiment was to determine the distance of propagation along which the striae-induced wavefront does not suffer from essential changes.

The measurements have been performed with the help of shearing interferometer equipped with an optically uniform wedge (fig. 1). A plate with a stria (the case A)

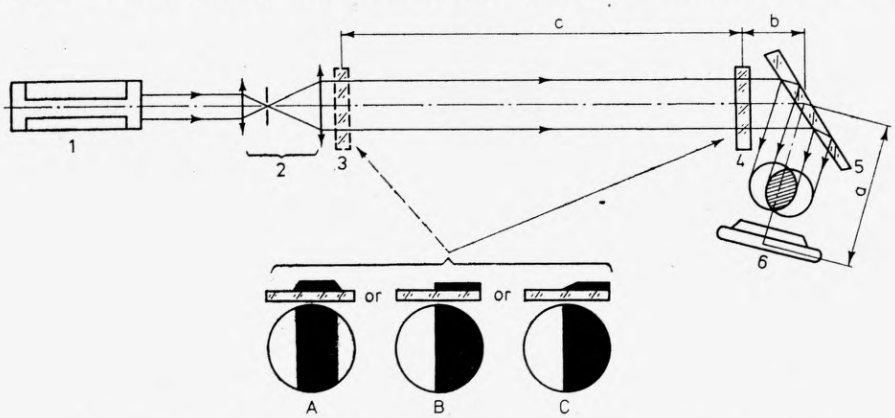

Fig. 1. Shearing interferometer with an optically uniform wedge
1 — laser, *2* — colimator, *3* — plate with the striae in the end position, *4* — plate with the stria in the origin position, *5* — optically uniform wedge, *6* — camera (a = 90 mm, b = 60 mm, $0 \leqslant c \leqslant 1400$ mm)

or an edge (the case B or C), which caused a respective wavefront deformation was inserted in the light beam before the wedge. The sheared wavefronts occured due to the wedge action. Consequently, a intensity distribution, resulting from the superposition of two partial waves sheared with respect to each other, appeares on the screen. The examined plate (A or B or C) was shifted along the distance c within the interferometer arm. It is evident that the eventual invariancy of the wavefront shape in the course of the said shifting would be manifested by the invariancy of the intensity distribution on the screen and vice versa any changes in the observed intensity distribution would indicate the respective changes in the wavefront.

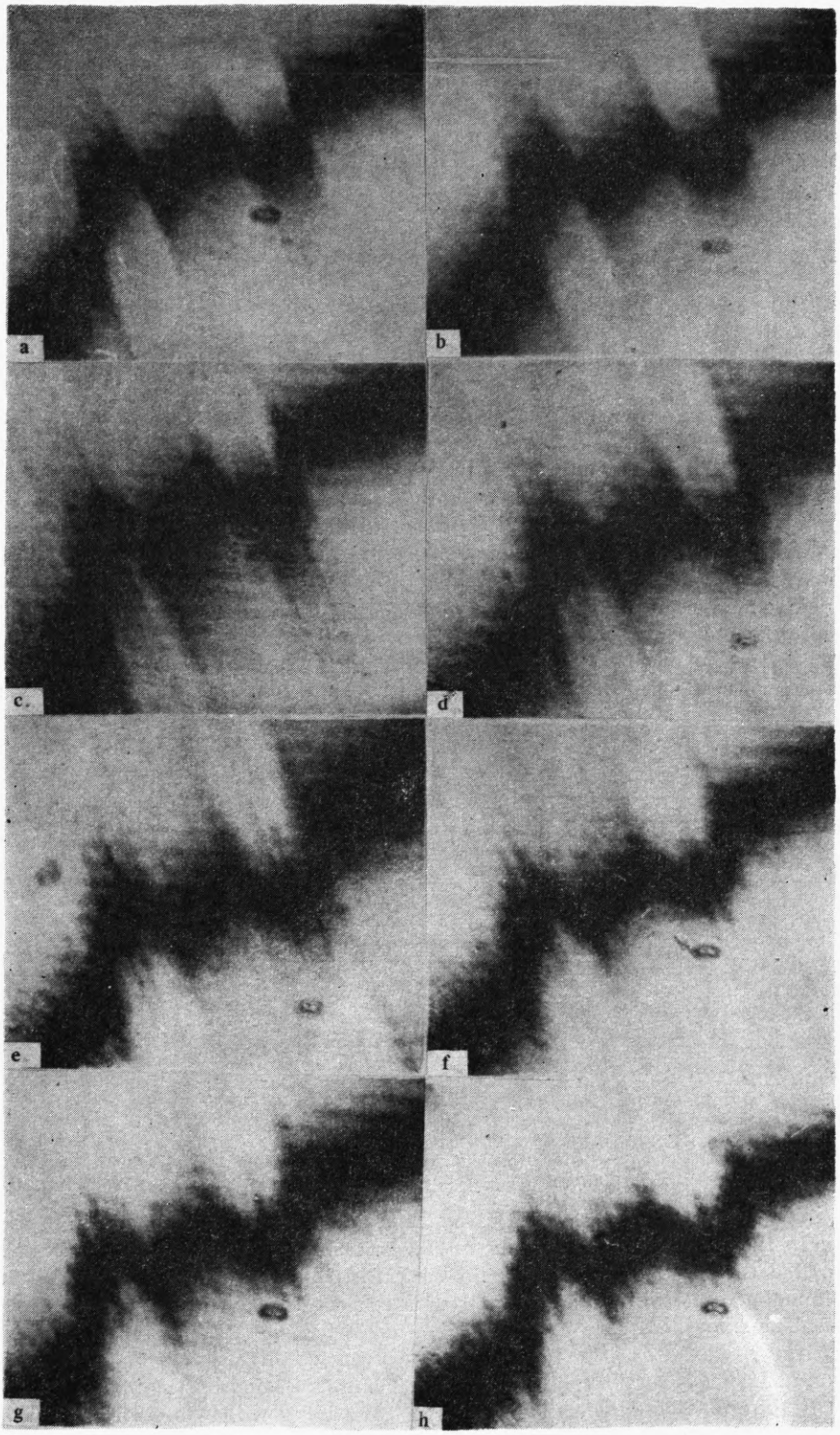

Fig. 2. Interferograms of the trapezium stria of 3 mm width:
a) x = 15 cm, b) x = 35, c) x = 55 cm, d) x = 75 cm, e) x = 95 cm, f) x = 115 cm, g) x = 135 cm, h) x = 155 cm

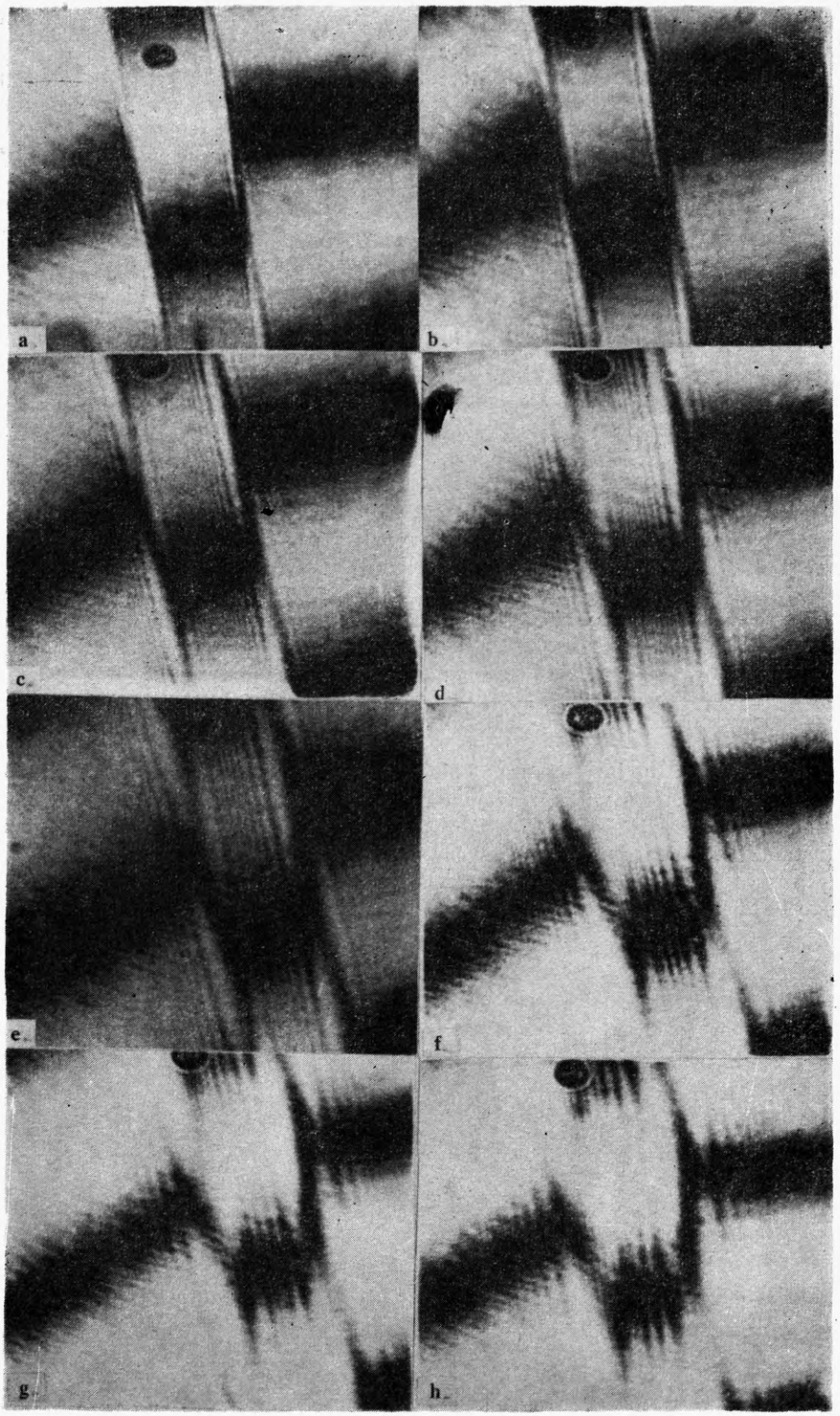

Fig. 3. Interferograms of the plate with rectangular edge deposited:
a) $x = 15$ cm, b) $x = 25$ cm, c) $x = 35$ cm, d) $x = 55$ cm, e) $x = 85$ cm, f) $x = 115$ cm, g) $x = 135$ cm, h) $x = 155$ cm

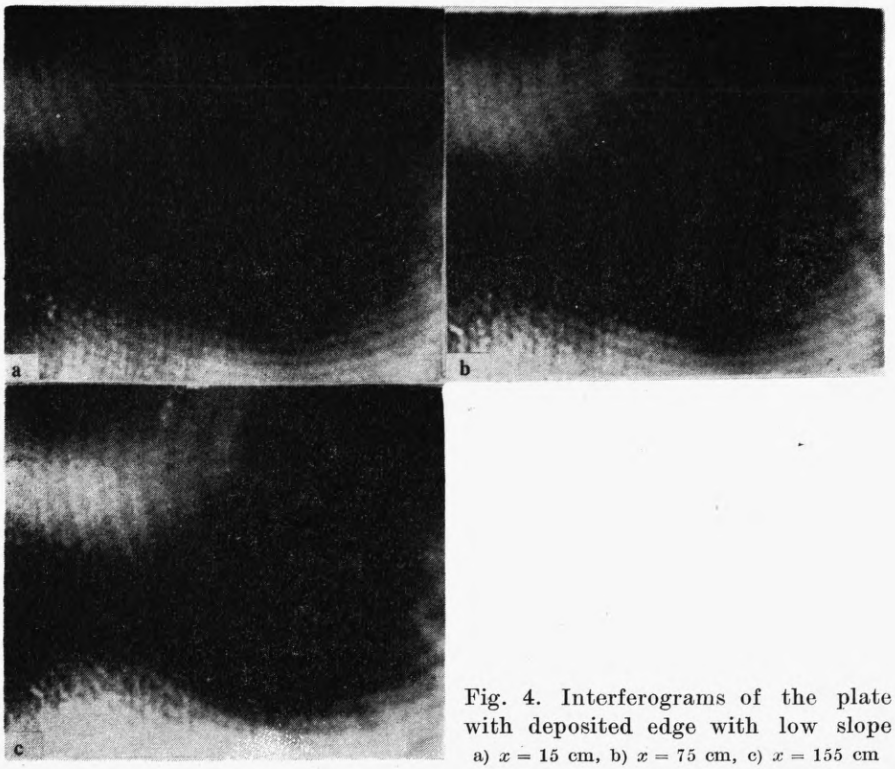

Fig. 4. Interferograms of the plate with deposited edge with low slope a) $x = 15$ cm, b) $x = 75$ cm, c) $x = 155$ cm

On the base of the interferograms obtained (figs. 2,3,4) it may be stated that the change in the wavefront with the change in the stria location with respect to the exit pupil occurs only in the case of striae causing the discontinuities of the wavefront (for instance the triangle, rectangular or trapezium striae). In the face of this experimental results the typical assumptions accepted in the theory of material aberrations seem to be justified up to the 35 cm distance of the stria from the pupil.

References

[1] RATAJCZYK F., Scientific Papers of the Institute of Physics of Wroclaw Technical University, Monographs (in press).

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