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THE

# PHYSICAL REVIEW.

## SOME NEW DIFFRACTION PHOTOGRAPHS.

By Mason E. Hufford.

IT is well known that if monochromatic light from a point source is made to pass through a circular opening and fall upon a screen and if the size of the opening is chosen so that the difference in optical paths by way of the boundary and by way of the center of the opening is some whole number of half wave-lengths of the light used, then in the illuminated area where the paths end there will be interference. At the center of the area the interference will be constructive or destructive depending upon whether the path difference is an odd or an even number of half wave-lengths of the light. Openings of this sort may be considered as being made up of a series of annular rings or half period elements—due to a point source of light at a finite distance—similar to the Huyghens half period elements in the case of a plane wave. When the number of half period elements is even they destroy the effect of one another in pairs and the center of the area is black. When the number is odd the effect of one ring is not destroyed and the center is white.

Photograph *b* shows how this theory is verified by a photograph of the diffraction patterns from a series of openings varying consecutively from one to twenty-five half period elements in size. The light chosen to obtain Photograph *b* was the intense fluting beginning at wave-length $3{,}880 \times 10^{-8}$ cm. in the spectrum of the carbon arc. This region appeared most effective on the photographic plate used. It was isolated by means of a spectrometer as shown in Fig. 1.

Light from an arc *A* was focused on the slit of a spectrometer *Sp* from which the eyepiece was removed. The desired spectral region was focused on an opening .3 mm. in diameter through which the light passed along the axis of a light tight box 12.3 meters long and 20 cm. by 20 cm. in cross section. At the center of the length of the box and at right angles to the light rays was placed a brass plate .8 mm. thick through which had been drilled twenty-five circular holes ranging from 2.185 mm. to 10.927 mm. in diameter. Since it is difficult to drill accurately circular openings in a plate so thin, the plate was first bolted securely at the corners and

soldered at the edges to another plate of equal thickness. Thus burring of the drills was prevented. The desired diameters were indicated on long accurately gauged tapering reamers and these used to finish the drilling. The diameters of the holes were measured by means of a dividing engine. It is probable that the calculated and actual diameters did not differ by more than .0005 cm. Photograph *a*, reduced to one half,

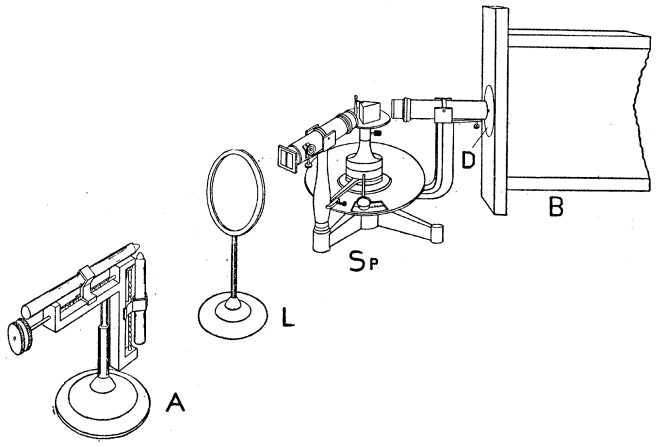



Fig. 1.

shows the arrangement of these holes. Photograph *b* (actual size) shows the resultant diffraction patterns. The alternate light and dark centers show clearly the constructive and destructive interference depending upon an odd or even number of half period elements in the openings.

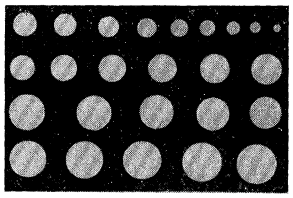
In order to photograph the Arago white spot at the center of the geometric shadow of large discs and spheres, apparatus was arranged as shown in Fig. 2.

Here *S* represents the disc or sphere suspended by fine wires in the box previously mentioned. Reflection from the walls was prevented by diaphragms *Sc*. The discs ranged from 2.55 cm. to 6 cm. in diameter and the spheres from .382 cm. to 6.35 cm. in diameter. The bright spot was obtained using any one of the discs or spheres and varied in diameter from .3 mm. to 1 cm. depending upon the size of the aperture which admitted light to the box.

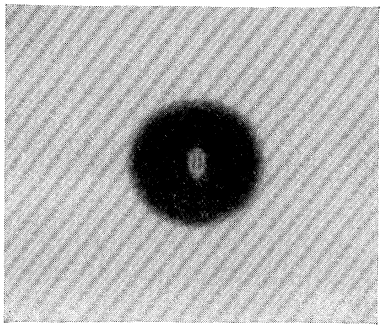
The very large bright spots thus obtained show that each point in the aperture produces a corresponding effect in the shadow. This suggests therefore, that the aperture may be any sort of figure and in the shadow of the disc or sphere there should be an inverted image of it.

To test this conclusion an aperture 1.4 cm. high by .8 cm. wide, of the form of a monogram of the letters *I* and *U* was made in a thin aluminium

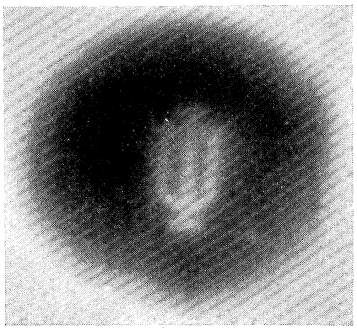
e. This aperture was mounted over the opening in the box and the



*a*

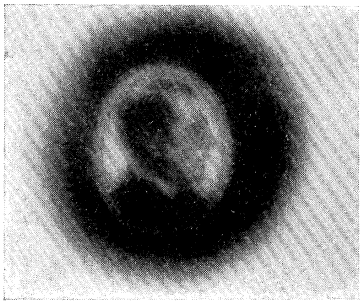


*c*



*d*

*e*



*f*

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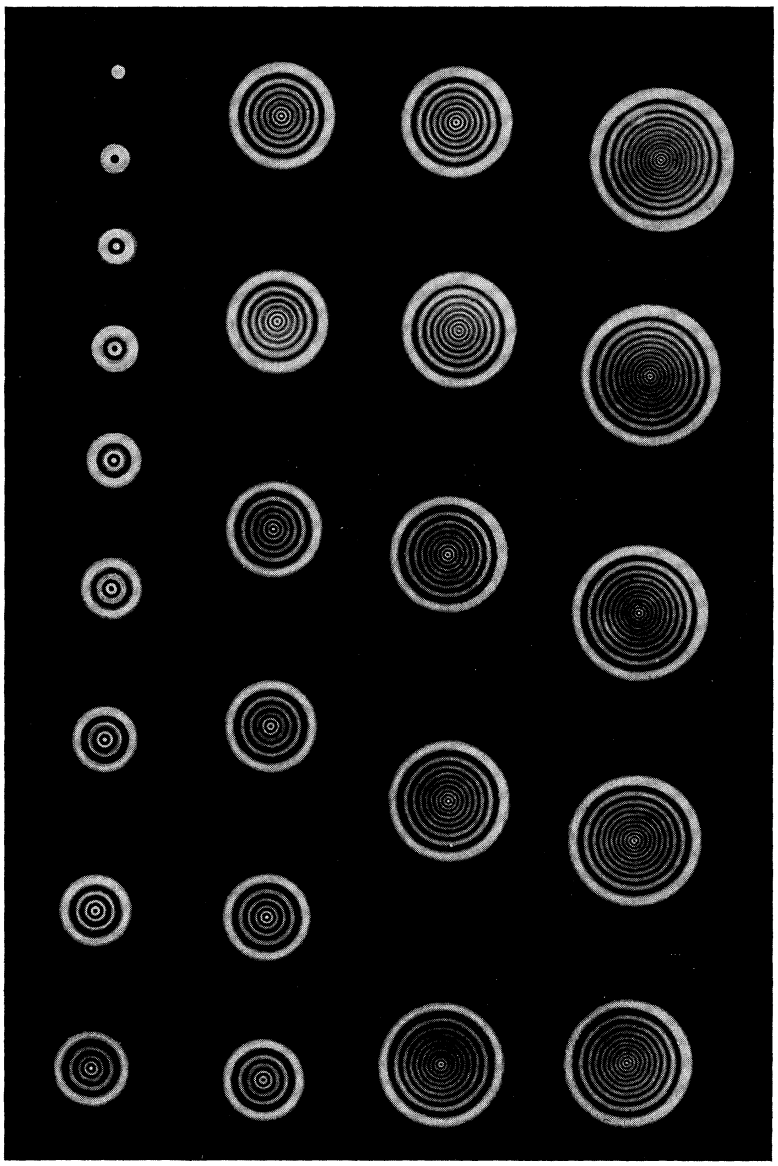

*b*

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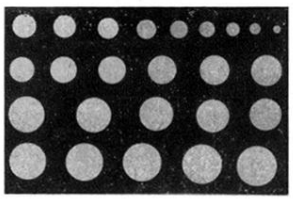
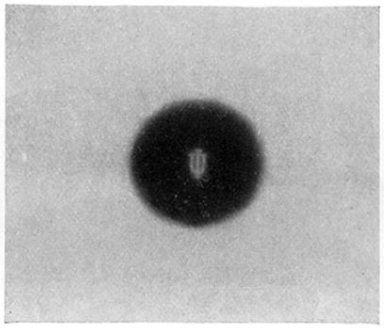
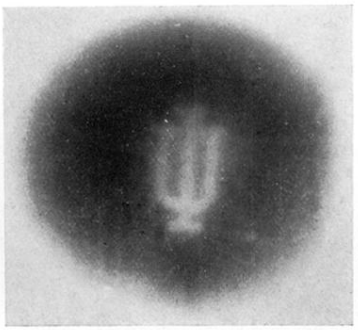
THIS IS A
PLACE HOLDER
IMAGE



*a*

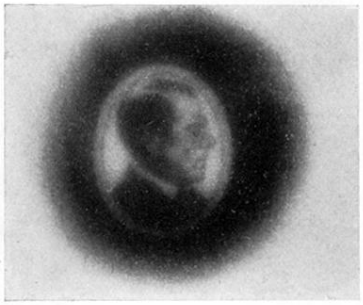


*c*

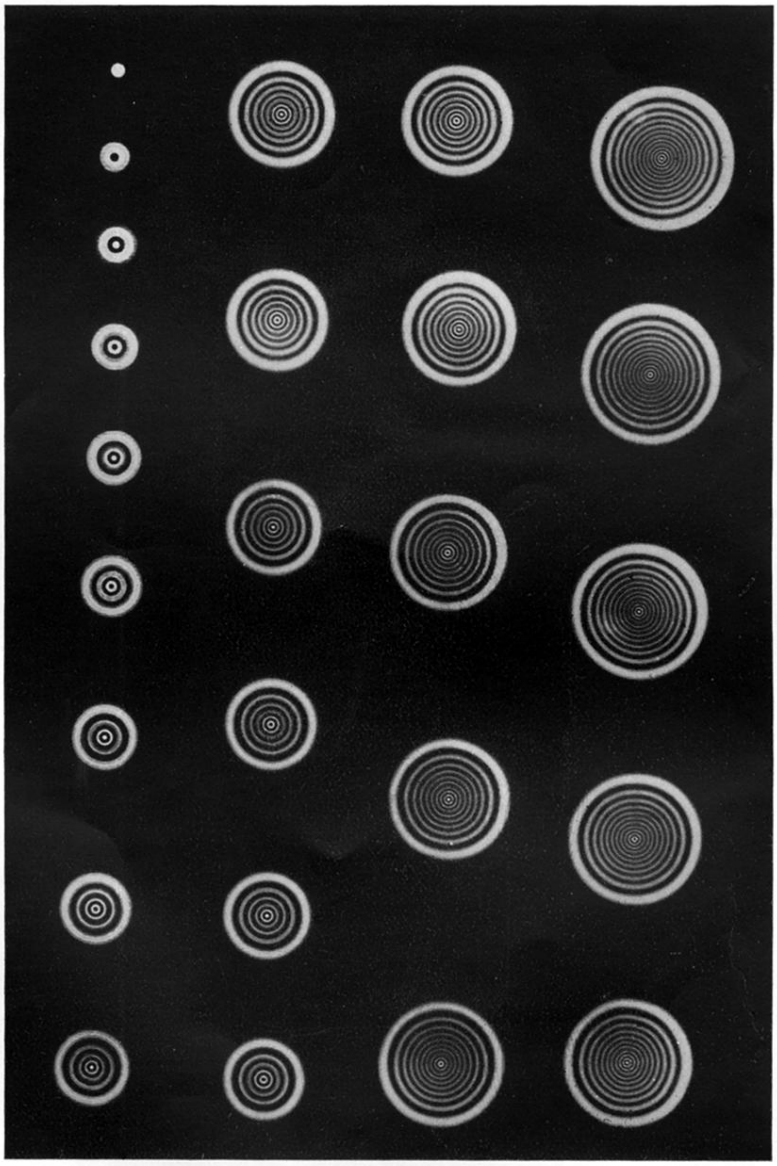


*d*

*e*



*f*



*b*