THE POLARIZATION OF THE CRAB NEBULA ON PLATES TAKEN WITH THE 200-INCH TELESCOPE

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The results obtained by OORT and WALRAVEN in the first paper of this *Bulletin* make a more detailed investigation of the polarization in the continuum of the Crab nebula highly desirable. In a first attempt in this direction I have photographed last fall at the 200-inch telescope the continuum of the Crab nebula through a polaroid filter with 8 different orientations of the plane of vibration for the electrical vector.

The observations were made in the wavelength range λ 5400 to λ 6400 (on Eastman 103aD plates behind a Corning 3484 filter) for the following reasons. In order to suppress the strong outer filamentary system of the Crab nebula a wavelength range had to be selected which contains only a few weak emission lines of the filaments. The range λ 5400 to λ 6400 fulfils this condition, as a comparison of the two photographs in Figures 1 and 2 shows. Even the strongest filaments only faintly appear on the λ 5400 to λ 6400 exposure. Because of the high speed of the 103aD plates in the yellow and red the exposure times necessary to bring out the Crab continuum in measurable strength are quite short, 7 to 10 minutes with the Corning 3484 filter and 20 minutes if in addition the light has to pass through the polaroid filter, which was of the glass-laminated HN 32 type. These short exposure times are important if it becomes desirable to obtain an extended series of photographs during the same night. Finally the range λ 5400 to λ 6400 coincides with the best performance range of the polaroid filters which in strongly convergent beams offer so many advantages over crystal analyzers.

So far two sets of polarization plates have been obtained. The first, with the plane of electrical vibration of the transmitted light in position angles 0°, 45°, 90° and 135° was obtained in the two nights 1955 September 22 and 23. The exposure times were 20 minutes. The necessary photometric standards for this set are provided by a plate of S.A. 68, taken 1955, September 23, with the same exposure time and through the same two filters, but 15 mm intrafocal. All plates of this set received the same development under temperature controlled conditions. Since both nights were perfectly clear changes in the transmission were probably negligible.

The second set, with the plane of electrical vibration in position angles 22°.5, 67°.5, 112°.5 and 157°.5, was obtained 1955, December 8. Exposure times were the same as for the first set. The photometric standards are provided by an intrafocal plate of S.A. 94, taken the same night. All plates of this second set were developed together.

Enlargements of the first set are given in Figures 3 to 6. North is on top, the scale is 1 mm = 2″.20. The arrows indicate the direction of the electric vector of the light recorded. The plates show in a most striking manner the strong polarization effects predicted by the new theory of the Crab continuum (synchrotron mechanism). But one can go a step farther. As the λ 5400 to λ 6400 picture in Figure 2 shows the mass emitting the continuum of the Crab nebula can be described as an agglomerate of structures which in projection appear as wide bands (sometimes curved), long streamers and wisps. Select any of these structures in the λ 5400 to λ 6400 picture and then follow its intensity changes in Figures 3 to 6 as the analyzer is turned in position angle. One notices at once that the structural features disappear when the electric vector is parallel to them. They obviously reflect the run of the underlying magnetic field. In Figure 15 (facing p. 289) Prof. OORT has sketched for a number of structures the run of the magnetic lines which one obtains in this way. The sketch demonstrates beyond any doubt that the observed structures in the Crab continuum are determined by the structure of the magnetic field.

Because of my own heavy commitment to other programs Prof. OORT generously offered the help of the Leiden Observatory in evaluating the two sets of plates described above. Since October of last year this work is in the hands of Mr WOLTJER, who will report on it in due time.

Pasadena, Calif., February 19, 1956.

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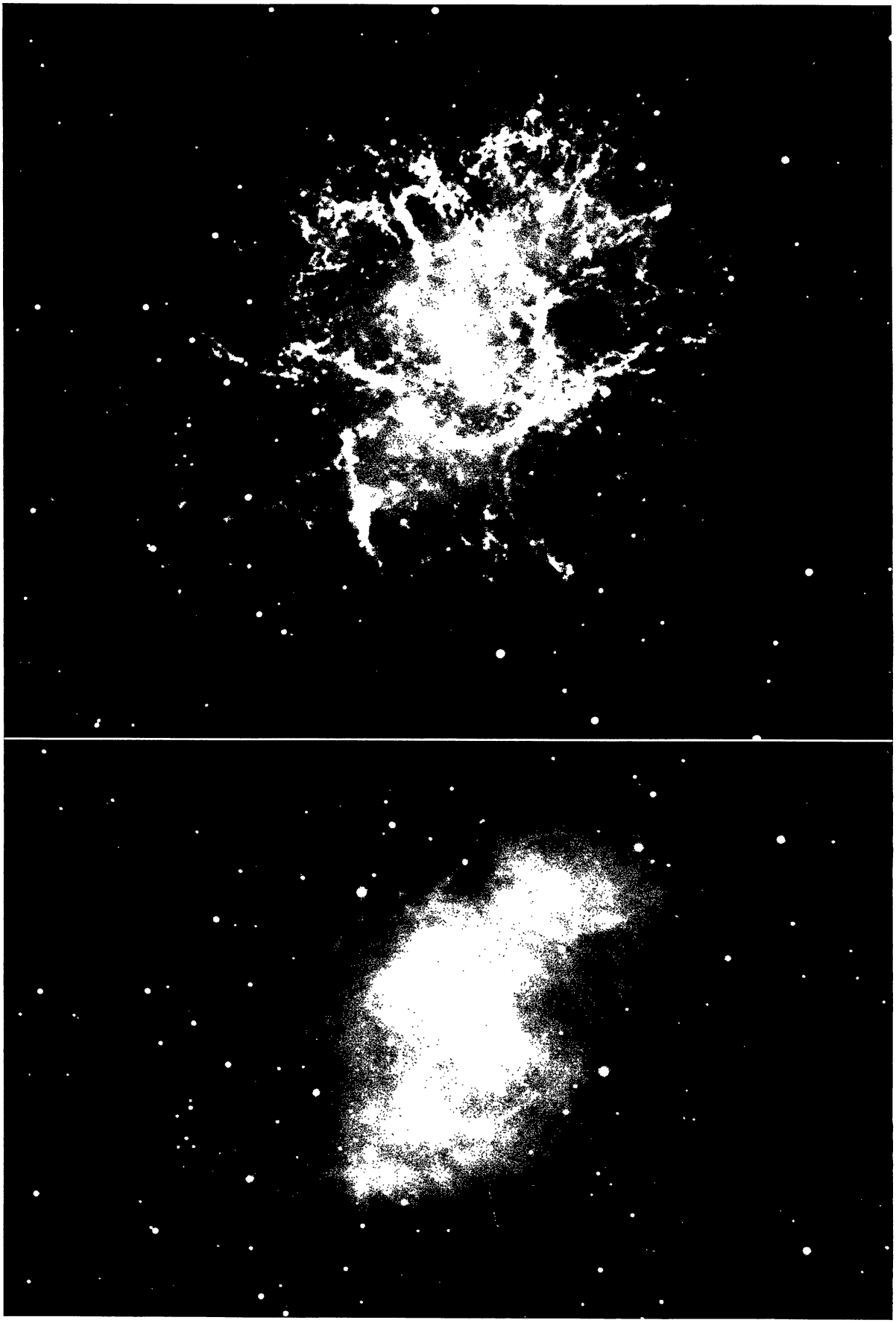
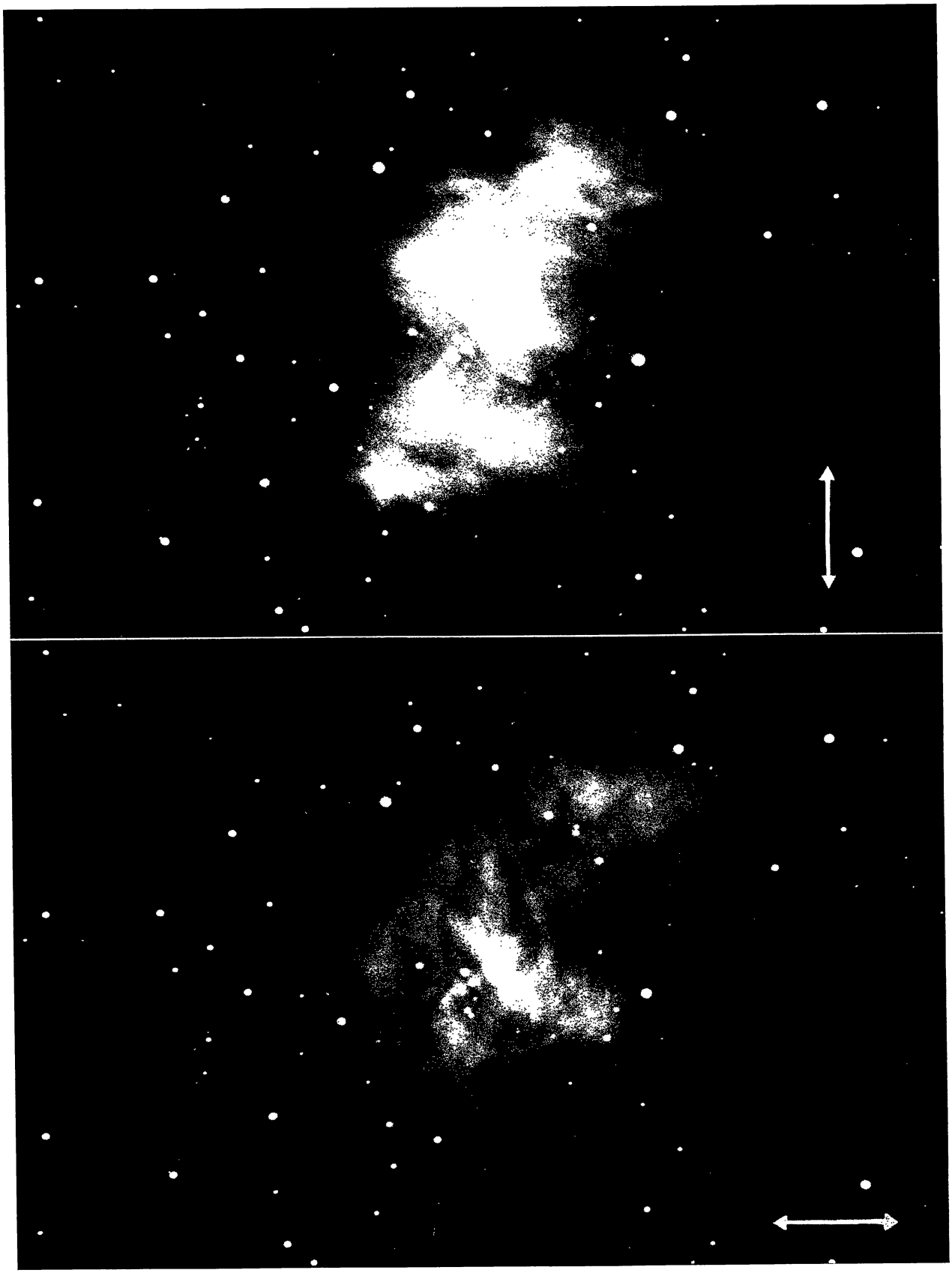


Top: Exposure on Eastman 103aE emulsion behind a Schott RG2 filter (λ 6400 to 6700). Bottom: 10-minute exposure

FIGURES 3 and 4



FIGURES 5 and 6