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THE JOCR PROGRAM

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Introduction

The principal goal of the Joint Observatory for Cometary Research (JOCR) is to obtain observational data on large-scale plasma structures in comets. This data is of value in (1) analyzing the interaction between the solar wind and comets, (2) using comets as solar wind probes, and (3) using comets as an astrophysical plasma laboratory with the CO^+ plasma serving as tracers of the magnetic field.

Such a program needs a good site and a telescope tailored to the problem. Our site is on South Baldy in the Magdalena Mountains west of Socorro, New Mexico, at an altitude of 10,615 feet. The observatory (Figure 1) commands an excellent view of the east and west horizons and the night sky is exceptionally dark. The telescope is a 14" f/2 Schmidt camera which records an $8^{\circ} \times 10^{\circ}$ field onto 4 x 5 inch plates. The camera is designed for fixed focus operation, i.e., within design limits, the focus is not a function of temperature. A vacuum platen system allows the use of film for color photography. The camera and a schematic diagram are shown in Figures 2 and 3. Also see Brandt et al. (1971) and Brandt et al. (1975).

The Observatory has been in operation since late 1973 and was dedicated in August 1974. Observations have been made of several comets with emphasis on the brighter ones. Examples of the coverage obtained are given in the next section.

Sample Observations

Extended sequences of observations have been obtained for comets Kohoutek (1973f), Kobayashi-Berger-Milon (1975h), and West (1975n). One of the first spectacular photographs from the JOCR showed comet Kohoutek on January 11, 1974 (Figure 4). Note the "Swan"-shaped structure with dimension of about 5 million kilometers located some 15 million kilometers (0.1 a.u.) from the head. This structure is probably a disconnection event (DE) in a late stage of its evolution (Niedner and Brandt 1980).

The spectacular "bend" found in comet Kohoutek's tail on January 20, 1974 (Figure 5) illustrates an aspect of plasma tails used as solar wind "socks". Solar-wind data from IMP-8 can be used to predict the shape of the plasma tail (Niedner, Rothe, and Brandt 1978) and a good fit in terms of position angle is obtained (Figure 6). The bend can be associated with a specific feature in the polar velocity component of the solar wind.

The superior observing conditions on South Baldy are illustrated by a ten-day-long sequence showing comet Kobayashi-Berger-Milon (Figure 7). The sequence covers the interval July 29 to August 7, 1975. Note the distinctive appearance of the plasma tail on July 31, 1975. A sequence taken on this day (Figure 8) clearly shows the phenomenon of tail rays lengthening and turning toward the main body of the tail, ultimately coalescing into the main tail. The turning rate with respect to the main axis was measured at 3° per hour.

Comet West was an impressive sight in the morning sky during March of 1976 as shown in a mosaic of JOCR photographs (Figure 9). We have added a Hasselblad camera with wide-angle lenses to enable photography of comets with this apparent size without having to mosaic. Figure 10 is the head region from the mosaic on which are marked the astrometric quantities used to derive global models of the solar-wind velocity field (e.g., Brandt and Mendis 1979). A sequence of photographs of comet West on April 1, 1976 (Figure 11) illustrates the general phenomenon of tailward movement of features. The sequence covers an interval of $1^{h}10^{m}$ and shows the motion of a kink with velocity of 97 km/sec.

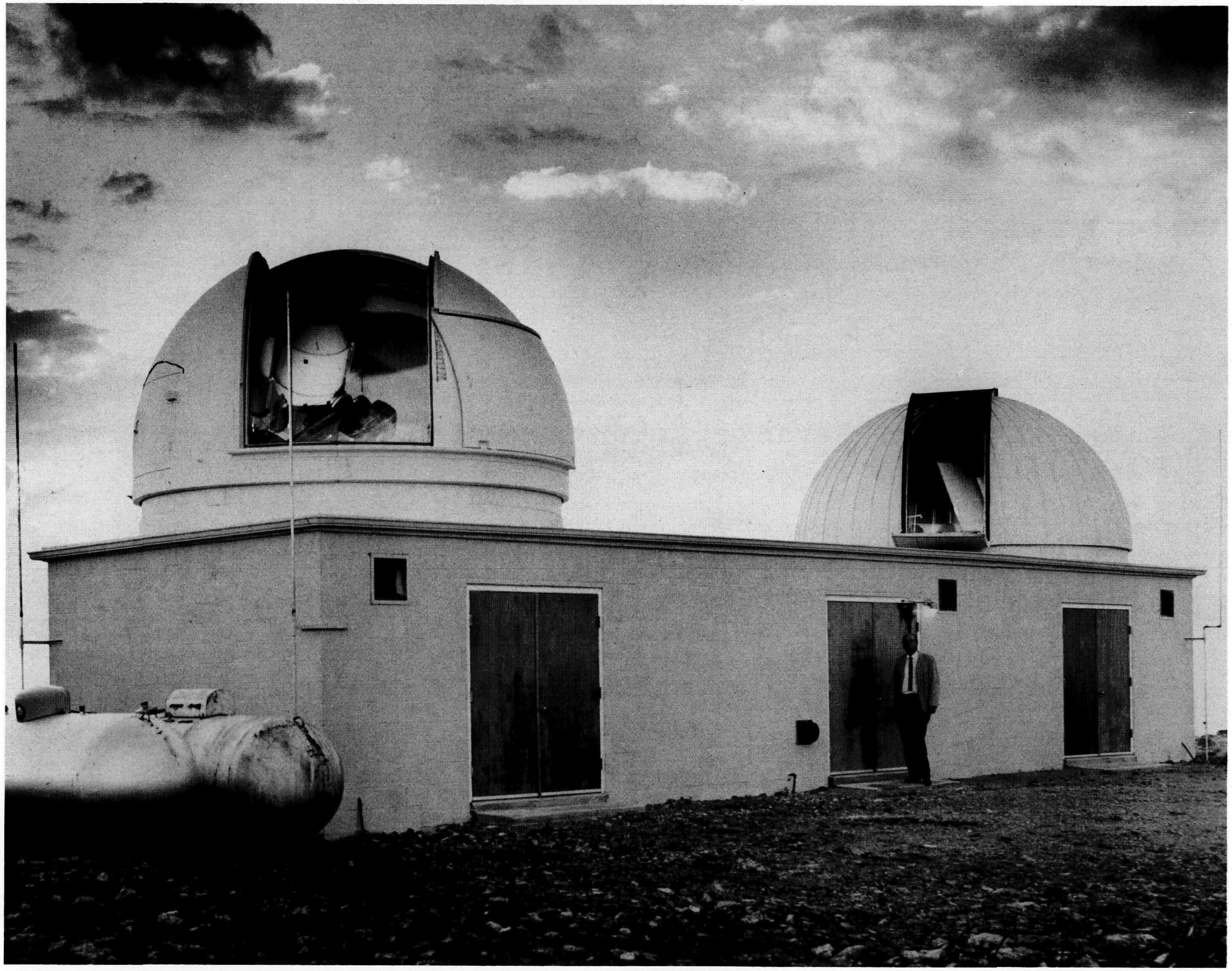

Figure 1. The Joint Observatory for Cometary Research and Co-Director, E. P. Moore.

Figure 2. The comet Schmidt camera and Ralph Zacharias.

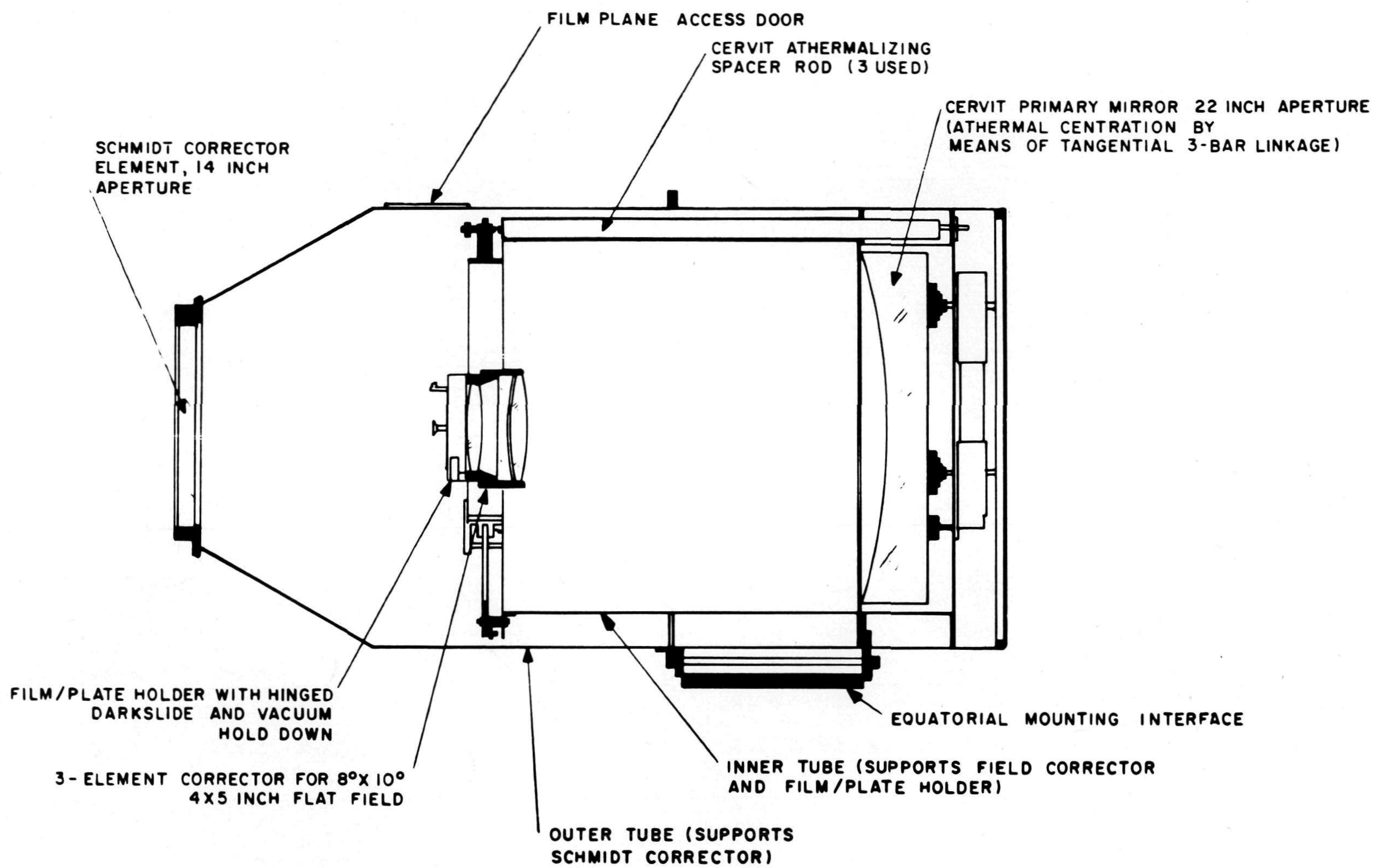

Figure 3. Schematic diagram of the comet Schmidt camera.

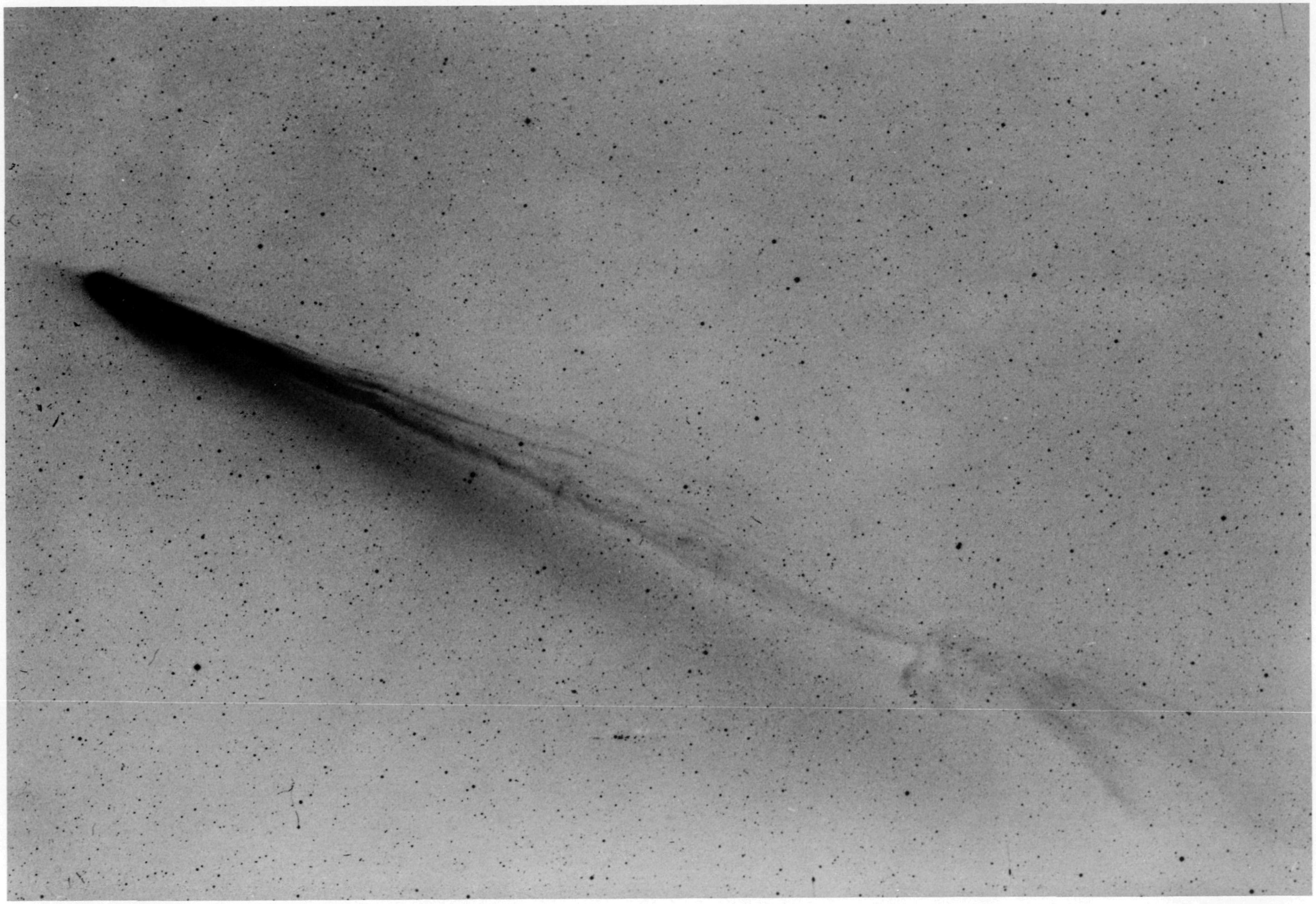

Figure 4. JOCR photograph of comet Kohoutek on January 11, 1974.

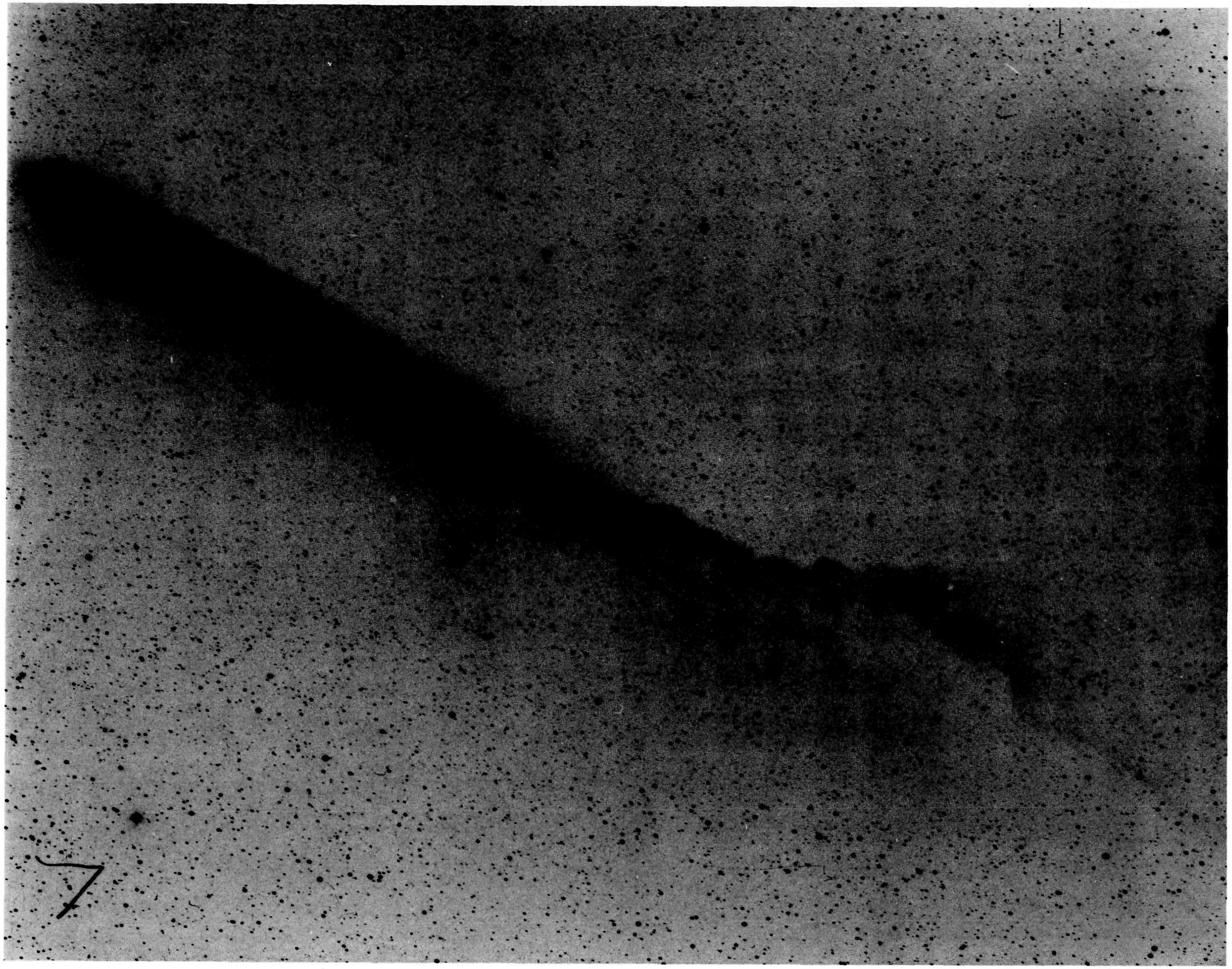

Figure 5. JOCR photograph of comet Kohoutek on January 20, 1974.

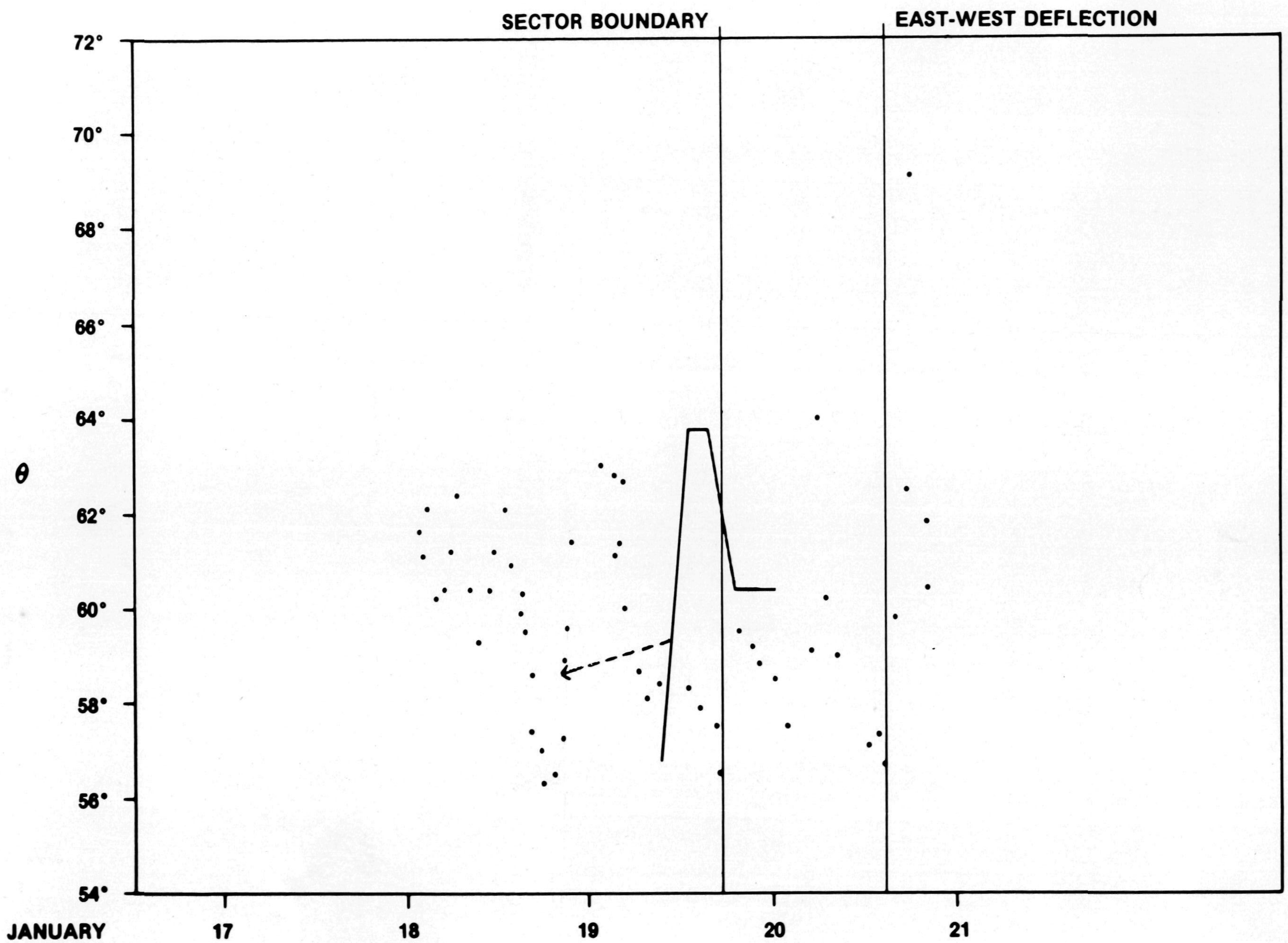

Figure 6. Explanation of the "bend" feature shown in Figure 5. The dots are position angles calculated from IMP-8 measurements of the solar-wind velocity and the solid lines represent the measurements along the length of the tail. Because the comet was well away from the earth and IMP-8, a shift in time had to be included for the comparison. A minor adjustment of 0.6 day in the time shift and 6 km/sec in the polar component of the solar-wind velocity brings the two different calculations into good agreement, as indicated by the dashed arrow.

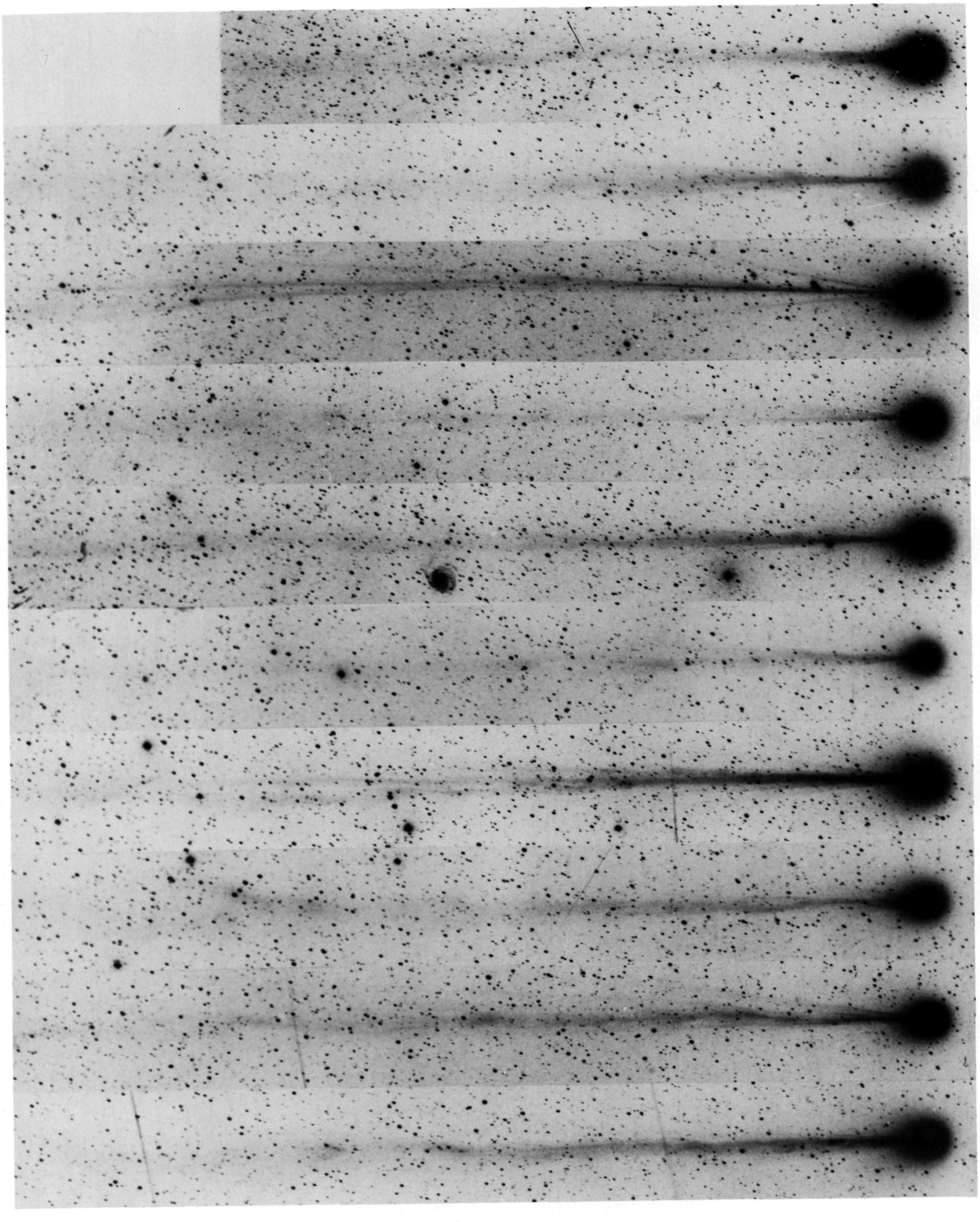

Figure 7. JOCR photographs of comet Kobayashi-Berger-Milon for each day from (top) July 29, 1975, to (bottom) August 7, 1975.

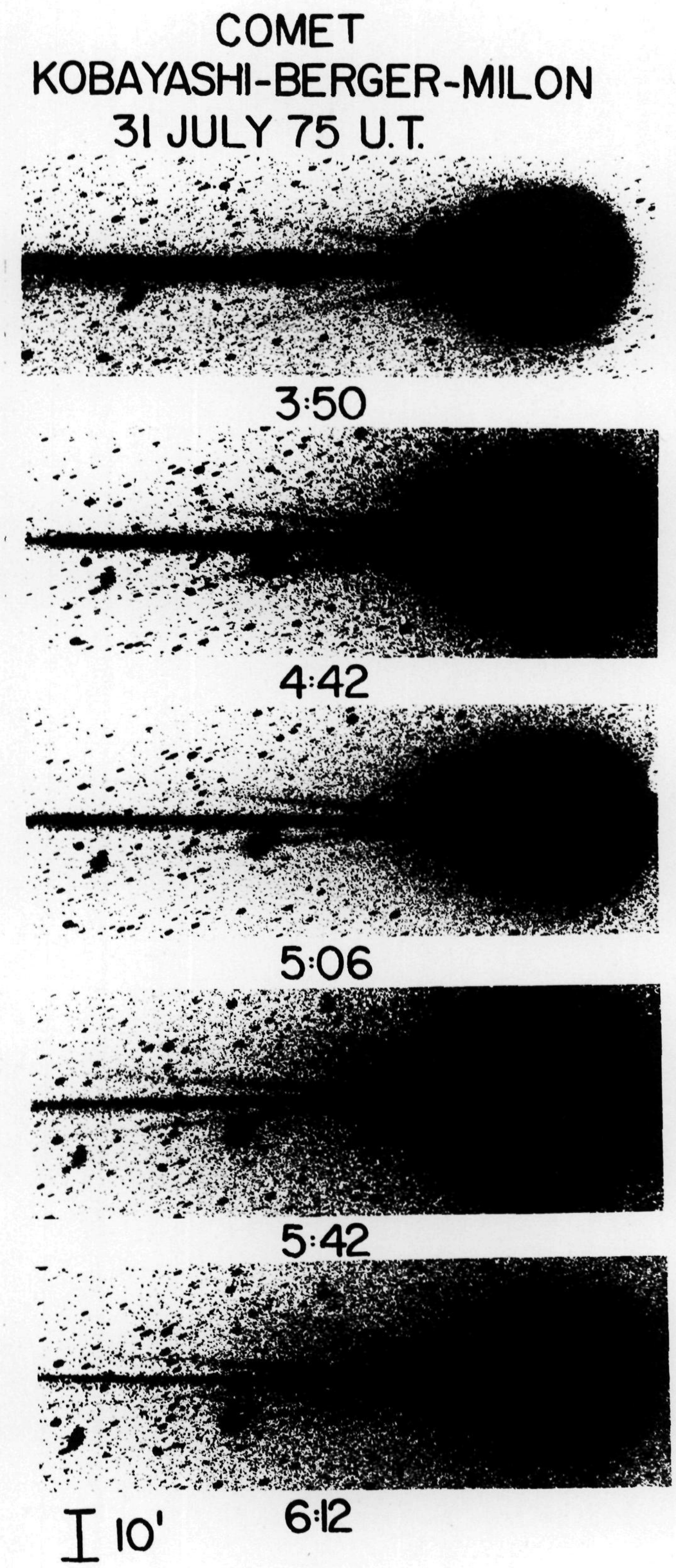

Figure 8. JOCR photographs of comet Kobayashi-Berger-Milon on July 31, 1975, showing the ray-folding phenomenon.

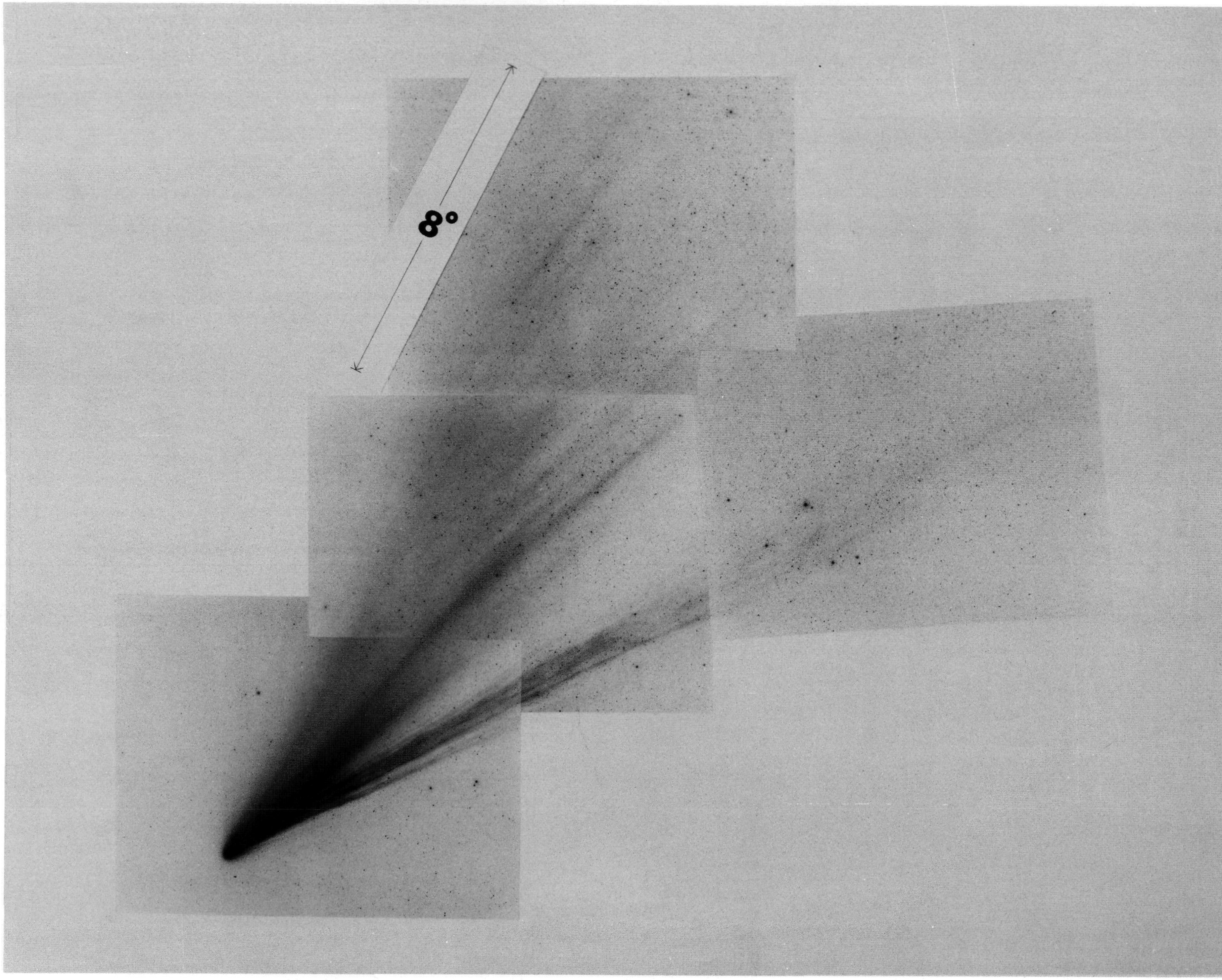

Figure 9. Mosaic of JOCR photographs showing comet West on March 9, 1976.

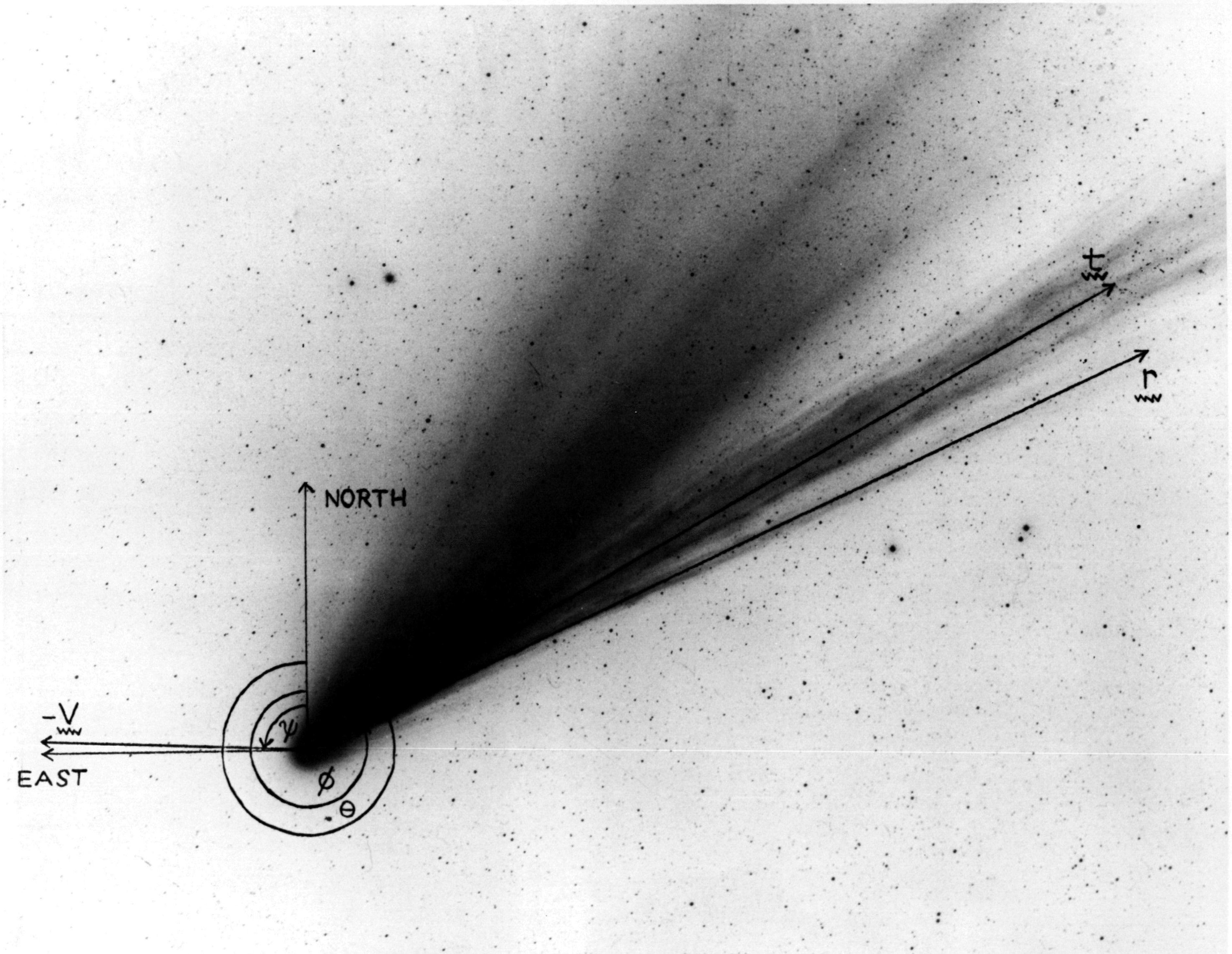

Figure 10. Head region of comet West on March 9, 1976. Position angles to the prolonged radius vector r, the tail axis t, and the comet's negative velocity vector -V are marked. These are the astrometric quantities used to derive global models of the solar-wind velocity.

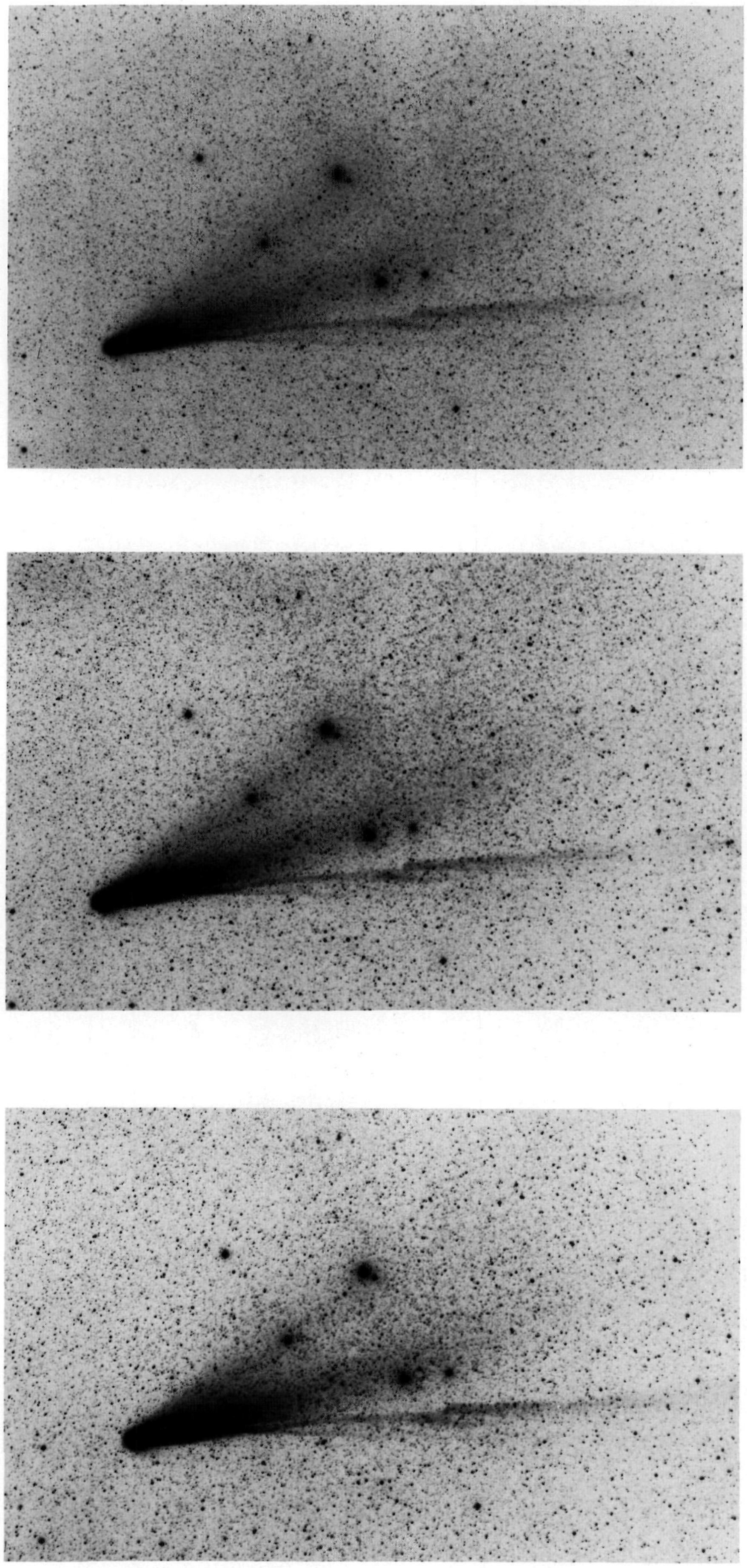

Figure 11. JOCR photographs of comet West on April 1, 1976, showing tailward motion of a kink. See text for discussion.

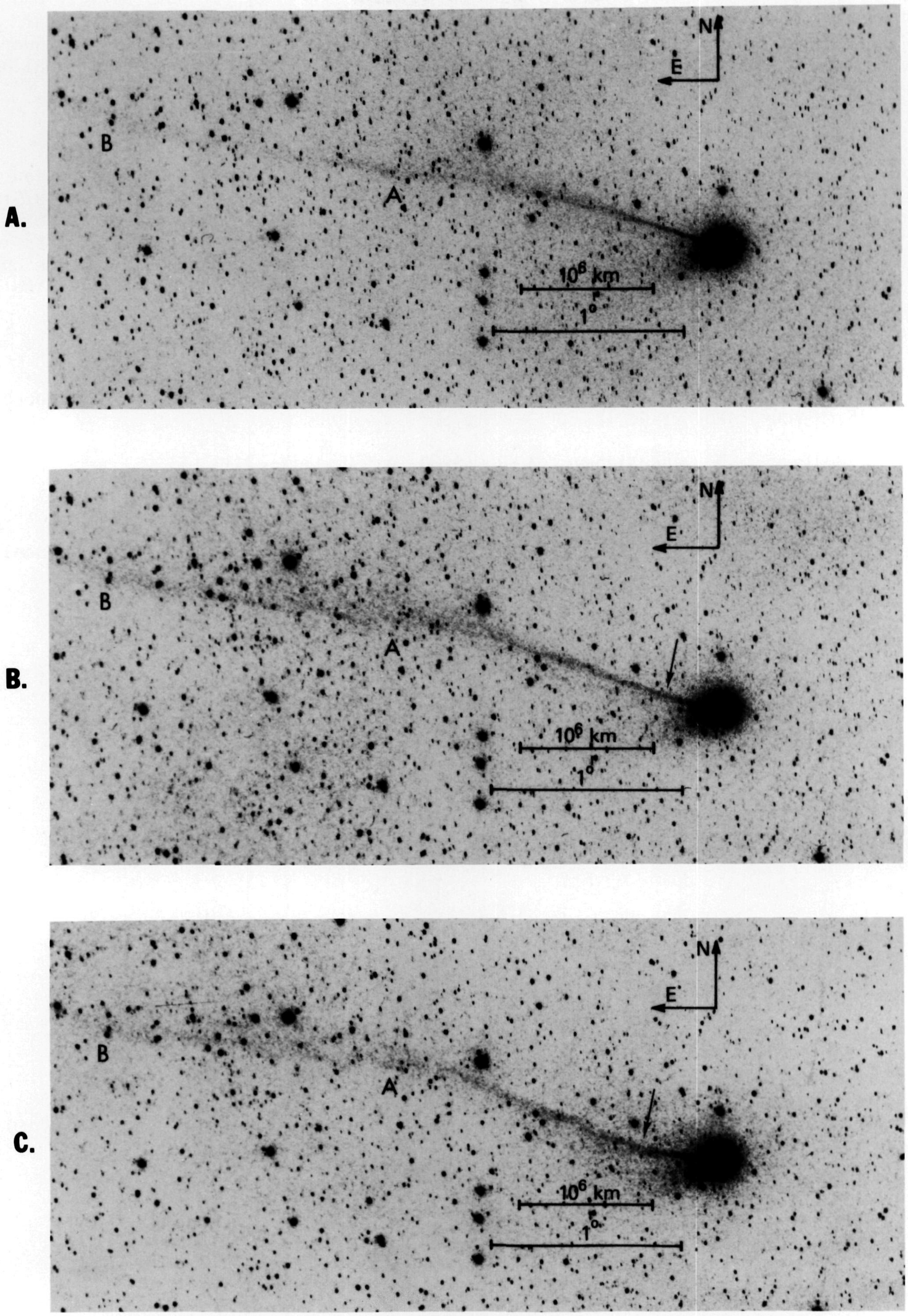

Figure 12. JOCR photographs of comet Bradfield on February 6, 1980. Midpoints of the exposures are: (a) $2^h32^m30^s$ UT; (b) $2^h48^m00^s$ UT; and (c) $3^h00^m00^s$ UT. See text for discussion.

Finally, we illustrate the need for extended period coverage with short intervals between exposures. Figure 12 is a sequence of photographs of comet Bradfield (1979l) taken on February 6, 1980. The sequence covers 27.5^{m} and shows a change in the position angle of the inner tail (marked by the arrow), which corresponds to a turning rate of 22^{o}/hour (Brandt, Hawley, and Niedner 1980). The tail can be considered a wind sock responding to a change in the polar component of the solar wind; the sequence began with a polar component of 30 km/sec northward and changed to 20 km/sec southward. Spacecraft data is expected to be available which will allow this result to be checked.

Conclusion

This paper has concentrated on the observations, and several atlases are in preparation. Examples of possible physical interpretations and uses are given in Brandt and Mendis (1979) and by Niedner (1981, these Proceedings). Future plans for the JOCR include upgrading the 16" telescope with an image intensifier so that the coverage can be extended to fainter comets. Non-cometary guest investigator programs are considered on a non-interference basis. The JOCR is operated jointly by NASA-Goddard Space Flight Center and the New Mexico Institute of Mining and Technology, Co-Director, Dr. Elliott P. Moore.

References

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