

# Images of comets on archival photographic plates from the Jagiellonian University Observatory

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The Astronomical Observatory of the Jagiellonian University produced a large number of photographic plates of various types and sizes over many decades. With the demise of emulsion-based photography as an observational technique in the latter years of the 20th century, the plate collection was neglected, and many plates have been destroyed or damaged by water or accidents, while written records have been lost. As part of the AstroGrid-PL project we were able to scan the surviving plates and (known) records and are in the process of identifying and publishing the images, some of which record observations of comets. Here we present some examples from plates made with the Zeiss Tessar Astrograph.

## 1 Introduction

In common with many other observatories, the Astronomical Observatory of the Jagiellonian University in Kraków, Poland, produced a large number of photographic plates of various types and sizes over many decades. With the demise of emulsion-based photography as an observational technique in the latter years of the 20th century, the plate collection was neglected, and many poorly-stored plates have been destroyed or damaged by water or accidents, while written records have been lost. As part of the AstroGrid-PL project (Kundera et al., 2014), we were able to scan the surviving plates and (known) records (Kuligowska et al., 2014) and are now in the process of identifying and publishing the images.

## 2 Comet images on Astrograph plates

Out of the several thousand surviving plates scanned, just under four hundred are 13×18 cm plates from the 60 cm focal length Zeiss Tessar Astrographs. In most cases, the plates are marked with only the observation date (without the time) and plate serial number, with no further information. As yet we have not uncovered the associated log files or observing books.

46 of the 13×18 cm plates are associated with observations of comets, though not all of them show the *classical* image of a bright comet with a clear tail. One which does is No. 56, of C/1969 Y1 Bennett, taken on the night of 10–11th April 1970 (Fig. 1 left panel).

Enlargement of the scanned image of No. 56 shows that the plates recorded a considerable amount of detail and a large number of stars, in this case down to

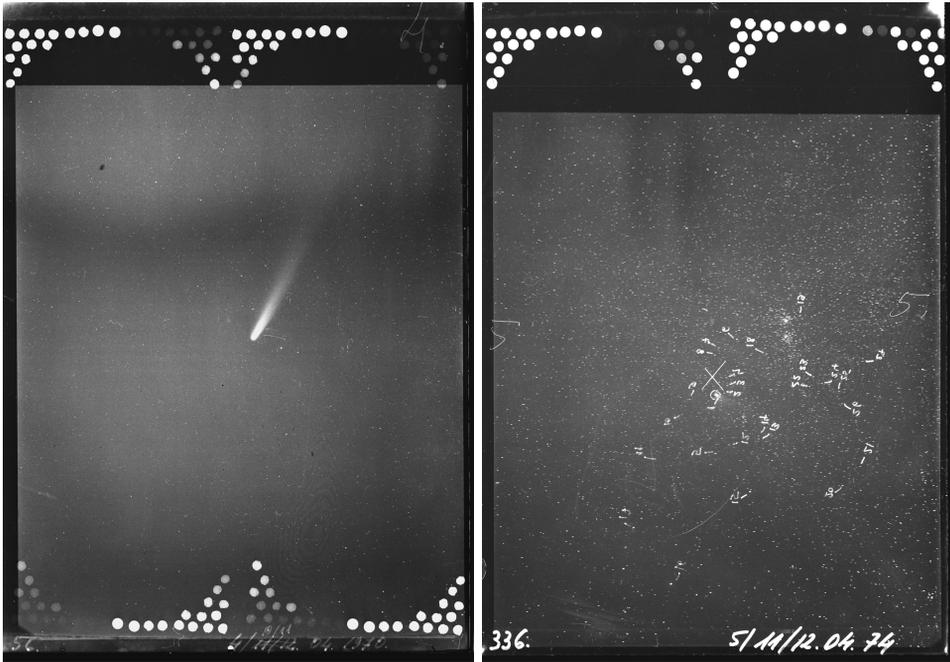


Fig. 1: Left: 13×18 cm Astrograph plate No. 56 (number visible at bottom left), showing C/1969 Y1 Bennett. According to the inscription this was the 4th plate taken on the night of 10/11.04.1970 – the observer originally wrote 11/12. The circles are for exposure calibration. North is to the right. Right: Plate No. 336 dated 11/12.04.[19]74. The Double Cluster in Perseus is easily recognizable to the upper right of the centre. 26 of stars in Perseus have been marked with numbers, and comet C/1974 C1 Bradfield is marked with a circle just below the large X marking the centre of the plate.

10–11th magnitude. Also visible is damage to the emulsion due to scratches and dust.

Although in this case, we do not have the original record of the exact time of observation, due to the fairly rapid motion of comets across the sky we can work backwards using a modern ephemeris to deduce when the photograph was taken. In this case, the position of the head of the comet relative to the identified field stars (o, 2, 6, 14, 15 and 16 And) indicates the image must have been taken at about 02:26 UT on the morning of 11 April 1970.

Available literature indicates that Comet Bennett was observed a few nights later from Poznań (Świerkowska, 1973) and probably from Warsaw (Bielicki, 1971), but the Kraków observations of Comet Bennett do not appear to have been published prior to this paper.

### 3 Plate markings

Aside from the date and serial number common to all plates, quite a few have been marked after being developed to indicate the target object (for example, a comet), and the comparison and reference stars. An example of this among the 13×18 cm

Astrograph plates is No. 336, shown in Fig. 1 right panel.

The observing log for this plate is again unavailable, however the field is easily recognized due to the presence of the Double Cluster,  $h$  and  $\chi$  Persei. Together with the date, 11–12th April 1974, this enables us to identify the comet unambiguously as C/1974 C1 Bradfield, and determine that the photograph was taken at about 21:55 UT on 11 April.

On the plate, the comet has been circled, a little below the large X marking the centre of the plate. Surrounding stars from the constellation of Perseus have been marked with numbers (reversed in this image as they are written on the other side of the plate). Close inspection of the stellar images shows that they are elongated, indicating the telescope was tracking the moving comet during the exposure, rather than the background stars.

Observations of Comet Bradfield made in Kraków were published (Kreiner et al., 1975), however these used the 340 cm focal-length Maksutov-Cassegrain telescope and the times do not match the derived time of observation of plate No. 336. It is not yet known if the observations presented here were ultimately published.

## 4 Conclusions

The photographic plate archive of the Astronomical Observatory of the Jagiellonian University has yielded a small collection of images of comets taken on 13×18 cm photographic plates using the Zeiss Astrograph. Many more images are known (from published papers) to have been taken on smaller plates, using the still-in-use Maksutov-Cassegrain telescope, however these plates have not yet been identified and may, unfortunately, have been lost. Nonetheless, the known plates form an interesting collection with a few unique properties compared to images of more typical *stellar* fields, such as the possibility of working backwards from a modern, precise ephemeris to determine the now-lost time of observation. This method could be useful for other archives with images containing moving Solar System objects.

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