Rediscovered astroplates from 1911 at the Kraków Observatory

Greg Stachowski¹, Katarzyna Bajan, Elżbieta Kuligowska²,³ and Tomasz Kundera²

¹ Mt. Suhora Astronomical Observatory
Pedagogical University of Cracow, Podchorąży 2, 30-084 Kraków, Poland
² Astronomical Observatory of the Jagiellonian University
Oria 171, 30-244 Kraków, Poland
³ The Institute of Meteorology and Water Management, ul. Podleśna 61, Warszawa, Poland

In the plate archive of the Kraków Observatory we have found some plates dated to 1911, which was very curious as, at that time, there was no instrument in the observatory (or even in the country) able to make them. We have now identified these plates and present their interpretation and history.

Previously [1] we described the current state of the photographic plate archive at the Astronomical Observatory of the Jagiellonian University in Kraków, Poland, including some plates dating from 1911 which had been recently rediscovered. Since then we have been able to identify these plates and place them in their historical context. While our initial assumption that the plates recorded astronomical photographs taken in Europe was incorrect, the plates turned out to be more interesting than we expected and closely linked to the early years of the Kraków Observatory.

At the beginning of the 20th century, the motions of Solar System bodies and their satellites were still a primary area of astronomical research, now aided by the precision allowed by photographic plates. Pluto had not yet been discovered, and Jupiter only had five known moons until the discovery of Jupiter VI, now known as Himalia, by Charles Perrine in 1904.

In this context there was great interest in occultations of stars by Solar System bodies, as these observations could provide very precise timings and positions which could be used to verify orbital elements and supply information on the dimensions of the objects. Predicting occultations requires careful calculation of the orbit, and thus it is not surprising that it drew the interest of Tadeusz Banachiewicz, who would go on to invent a form of matrix algebra known as cracovians and calculate an initial orbit of Pluto following its discovery by Tombaugh.

In 1911 Banachiewicz [2,3] predicted the occultation of the star BD $-$12° 4042 (HD 126363), also known as Librae 6 G., by Jupiter on 12 August 1911. This event was successfully observed near Shanghai, China and Perth, Australia. More interestingly, in the same paper Banachiewicz predicted that, 13 hours later, the same star would also be occulted by the third moon of Jupiter, Ganymede. This was a remarkable prediction considering the required precision and the relative size of Ganymede compared to the planet. This event, visible from South America, was observed by the same Charles Perrine, now Director of the National Observatory in Córdoba, Argentina. Perrine used photographic plates to record multiple images of Jupiter once per minute over the predicted duration of the event, and it is these plates which we present here.

The set consists of four 16 x 15 cm glass plates numbered 3439 to 3442 (fig. 1 shows plate no. 3442), made in France by Lumière and etched with a grid pattern. Annotations record the date, event, plate number and the order of the images (fig. 2). Each plate records from 7 to 10 images of Jupiter shifted vertically (fig. 3). The exposure times of the individual images vary between 2s–30s, with each plate starting and ending with shorter exposures. In addition to Jupiter, the four Galilean moons and the star Librae 6 G. / BD $-$12° 4042, each of the four plates also records the stars BD $-$12° 4036 and BD $-$12° 4055 for use as positional references. On the third plate (3441) the images of Librae 6 G. and Ganymede coincide (see fig. 4).

Perrine sent the plates from Argentina to Banachiewicz, who was then working in Kazan, Russia. In turn Banachiewicz, not having the necessary equipment, sent them to a privately-owned observatory in Przególny Duze in Poland, which had a precision plate measuring device manufactured by Repsold of Berlin. Initial measurements were made, however further work was interrupted by World War I. The plates were not fully analysed until Josef Witkowski used all the available observations of both occultations of Librae 6 G. in 1927 [4] using the same Repsold device, which the Kraków Observatory had acquired after the observatory in Przególny Duże closed.


Fig. 1: Plate 3442 (original size 16 x 15 cm). The ovals mark the reference stars: I = BD $-$12° 4055, II = BD $-$12° 4036, III = BD $-$12° 3891. (North.)

Fig. 2: Enlargement of the left margin of plate 3442 showing the annotation numbering the sequence of images of Jupiter (inverted relative to the plate image).

Fig. 3: Enlargement of plate 3442 showing the sequence of images of Jupiter with the Galilean moons Callisto, Europa, Io and Ganymede and the occulted star Librae 6 G. (N.)

Fig. 4: Sequence of images of Jupiter from plates 3439 ~ 3442 showing the motion of the Galilean moons and the relative position of the star Librae 6 G. during the occultation.

References
3. T. Banachiewicz, 1911, Astronomische Nachrichten, vol. 188, issue 20, p. 233