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FINDING HIDDEN TREASURES: INVESTIGATIONS IN US ASTRONOMICAL PLATE ARCHIVES

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Abstract. We report here on an ongoing investigation of US astronomical plate archives and tests of the suitability of transportable scanning devices for in situ digitization of archival astronomical plates.

Keywords: astronomical data archives, astronomical photography, astronomical photographic archives.

1. Introduction

There are numerous important astronomical plate archives in the USA, including plate collections that are little known to the community and that have been little investigated in the past. Within the framework of a Czech-US collaborative project, we have recently analysed some of them, obtaining test scans with the use of a portable digitizing device. Digitization is a necessary step for an extended evaluation of the plate data using dedicated programs and powerful computers.

2. The plate archives

The US astronomical archival plate collections that we recently visited include those housed in the following 14 institutions:

(1.) Carnegie Observatories Pasadena, CA;
(2.) Lick Observatory, CA;
(3.) Yerkes Observatory, WI;
(4.) Mt Palomar Observatory, CA;
(5.) PARI, Rosman, NC (which has a collection of plates from many observatories);
(6.) KPNO Tucson, AZ;
(7.) CFHT Waimea, HI;
(8.) IfA Manoa, HI;
(9.) USNO Flagstaff, AZ;
(10.) USNO Washington, DC;
(11.) Steward Observatory Tucson, AZ;
(12.) NMSU, Las Cruces, NM;
(13.) Rosemary Hill Observatory, University of Florida, Gainesville, FL;
(14.) Leander McCormick Observatory, University of Virginia, Charlottesville, VA.

Our estimate is that there are more than 1 million astronomical archival plates in these archives. We performed a quality check and analyzed these plate archives with emphasis on their scientific, historical and cultural value, which we have found to be enormous.

Figure 1. Digitizing plates with a transportable device in the plate vault of the Steward Observatory, Tuscon, AZ. This digitization technique can be used even in very small rooms.

3. Transportable digitizing device

Most of the plate archives that we visited have no plate scanners and lack modern instrumentation in general. As our study includes plate digitization, it was necessary to find a solution. Since we were going to travel from Europe to the US by air, the obvious option was a transportable digitization device based on a digital camera with a high-quality lens and a stable tripod. This solution has the following advantages over other techniques: the device is easily transportable, and offers much faster scanning and higher repeatability than commercial flatbed scanners, because there are no moving scanner parts. The equipment that we used was as follows: Camera: 21 MPx Canon EOS 5D

Figure 2. Storage of archival plates at the McCormick Observatory.

Mark II, Lenses: Canon EF 24–70 f/2.8 L USM and Canon 70–200mm F4, a stable tripod, and a Fomei LP-310 professional photographic light table. More recently, we have been working on the design and development of a better custom-made light table based on highly homogeneous LED illumination, and also a further improved camera and lens. The recorded images are then corrected for lens image distortions and for other effects, in order to store research-grade digital images.

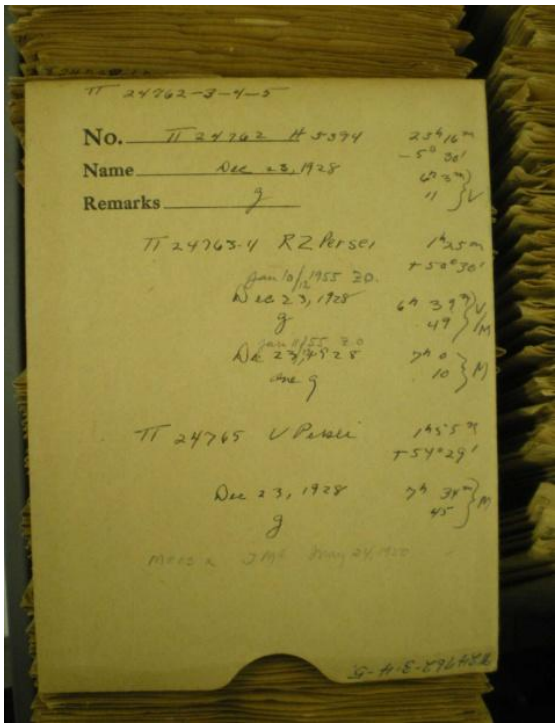

Figure 3. Example of metadata on the plate envelope (McCormick Observatory plate archive). In numerous US plate archives, the plate envelopes are the only source of metadata information.

4. General picture

After visiting the 14 US plate collections mentioned above, we offer a (subjective) list of the major problems found in these archives:

(1.) The list of US plate collections provided by Dr. Wayne Osborn (Robbins and Osborn, 2009) was found to be incomplete. We have found valuable plate collections with plates from important telescopes that are not listed, e.g. the two Hawaii plate collections in Manoa (Institute of Astronomy) and in Waimea (Canada-France Hawaii Telescope CFHT). Some plate archives have been completely hidden, as their home institutes were in some extreme cases not even aware that they have plate stacks.

(2.) In numerous collections, only a very rough estimate of the number of plates can be given, as no exact information about the total number of plates, etc., is available. Usually, the real number of plates is higher than the previously available estimate. In general, it is very difficult to give the exact number of plates, due to lack of observation logs and inadequate organization of the plate archives.

(3.) In many cases, there is no contact person responsible for the plate archive, and it is difficult to make contact. In some places, it is even difficult to get access. This situation very has a serious adverse effect on efforts to exploit these plate collections for scientific purposes.

(4.) For some archives, no information is available, not even an approximate number of plates. In many archives, no plate logs are available; they have either been removed or are lost. The only available information is what is written on the plates or on the envelopes (in some cases, there is not even adequate information on the envelope). We guess that there were originally observation logs, but that these were later separated from the plates and archived in a different location. Example: Carnegie Observatories Pasadena (nearly 0.5 million plates), where the logs are probably located in the attic above the library, with difficult access.

(5.) Damaged plates in some archives (mostly due to a partly-released or even complete released emulsion layer), probably due to improper storage (or changes in humidity/temperature over time). We point out however that even these plates can be restored using suitable chemical methods and procedures.

(6.) Lack of electronic records — no lists of plates, the only information is on the plates and/or plate envelopes

(7.) Many of the archives that we visited suffer from inadequate funding, lack of devices, e.g. no scanners.

(8.) We have revealed that many plates have been removed from their home: these plates are usually scattered in private homes and offices, or are being kept by observers (often abroad). Numerous plates taken at US observatories have been found in European plate archives.

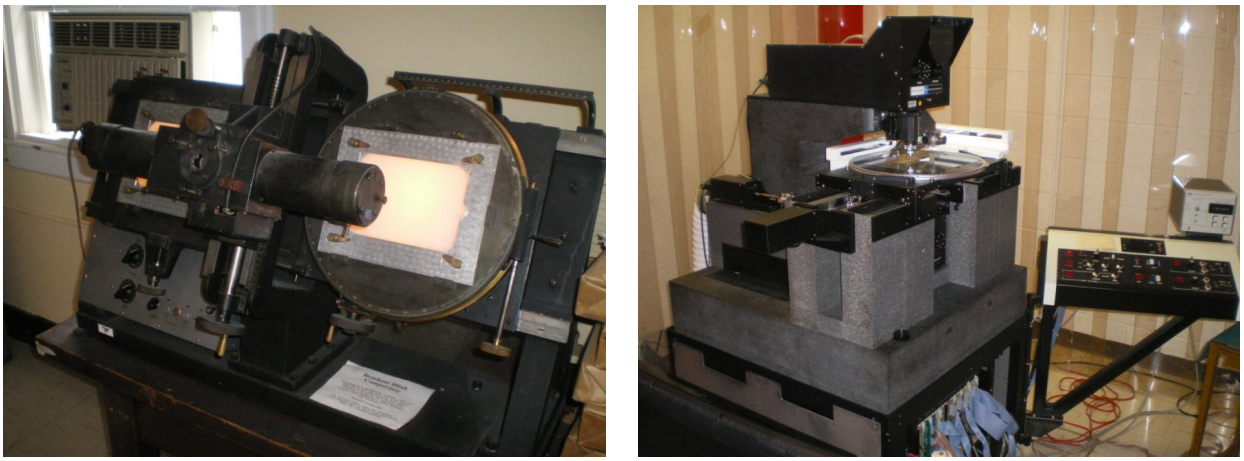

FIGURE 4. Historical plate evaluation instruments at the McCormick Observatory: blink microscope (left) and the PDS machine (right).

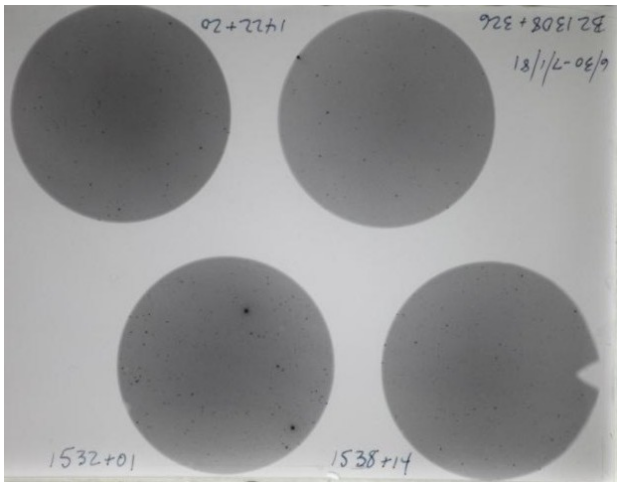

FIGURE 5. Example of a digitized direct plate (blazar program, full area), Rosemary Hill Observatory.

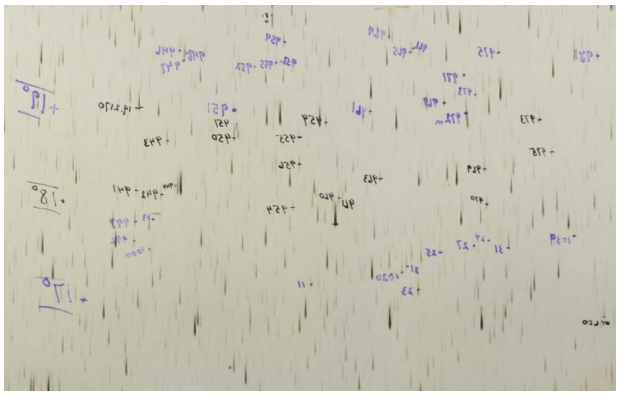

FIGURE 6. Example of a digitized low-dispersion spectral plate (small selected area), McCormick Observatory. This is one of many plates taken with a 10-inch Cooke camera and an objective prism for the long spectral survey program (lasting over 20 years) set up by A. Vyssotsky.

Nevertheless, we found highly valuable plates almost everywhere, and the quality of the plates (and hence their scientific potential) is mostly high or even very high, in comparison with the plates in European archives. This is true both for direct images and for spectral images (taken with an objective prism). In addition to stellar images, some of the archives that we visited also include extensive collections of solar images (e.g. Carnegie Observatories in Pasadena) and/or planetary images (unique collection in Las Cruces). The storage conditions were found to vary from archive to archive, from proper temperature and humidity conditions, to less proper conditions. The main degradation sources found in the plate collections were high levels of humidity and probably also temperature variation, resulting in partial or complete release of the emulsion layer. The scientific use of the plate archives is negatively impacted by poor access to the plates at some places, and also by the fact that the plates have in most cases not yet been cataloged.

5. SUGGESTED STRATEGY

Our suggested strategy for data mining and plate digitization in US plate archives is as follows.

(1.) Digitize the plate archives using a fast and transportable scanning device, as described above. This scanning method is fast and inexpensive. These are important considerations, as the archives are scattered and there are very large numbers of plates.

(2.) Create electronic catalogs.

(3.) Include these catalogs into search programs like WFPD, operated by our Bulgarian colleagues (e.g. Tsvetkov et al., 2005, and Tsvetkov, 2009).

6. SUMMARY

Fourteen US astronomical plate archives were visited within the AMVIS Czech-US collaborative project. The quality of the plates and their scientific, historical and cultural value were investigated for possible

inclusion in the US astronomical plate repository at PARI, NC. Some of these archives (CFHT Waimea and IfA Manoa) were unknown to the astronomical community before our study.

Selected plates were digitized using a transportable scanning device. All the archives that we visited have plates that are scientifically valuable, and in many cases unique. The plates are however mostly hidden from the astronomical community, and the plates have not yet been catalogued.

The total number of plates is higher than expected – in many of the locations, the actual number of plates is unknown. As no catalogs exist, the real number of plates is very difficult to estimate, but for sure the places that we visited have more than a million photographic plates in their collections.

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