SCAN–IT

The IAU Working Group for the

Preservation and Digitization of Photographic Plates

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Page

Editorial

Up and Running

Elizabeth Griffin, HIA/DAO, Canada (elizabeth.griffin@nrc.gc.ca)

Welcome to another SCAN-IT Newsletter! I am ashamed to think that three full years have passed since the last one (which was brought out to coincide with the 2006 IAU *General Assembly* in Prague), but if any individual has felt the burning need to announce things at more frequent intervals, s/he could always take over the Editorship from me!

While there certainly *are* items of great import and interest to be circulated to the PDPP group, this kind of medium may not be the most efficient. Latex was originally proposed as a lowest common denominator, since that is what most Journals require to publish papers, and our community is broadly spread both in geography and in technology. I believe it could now serve the PDPP better if the Newsletter became more like a Wiki: an interactive Web-site where one can place one's own articles in whatever format, and where discussions can be pursued in real time. It would obviate the need for fiddly conversions from *.doc to Latex, or *.jpeg files to *.eps ones. Access to a Wiki would of course be login/password restricted. With a Wiki we could also maintain a reference list of papers that make use of photographic observations.

Despite SCAN-IT's silence, a lot HAS been happening, as this Newsletter reflects. New projects are up and running (I could equally well have said "alive and kicking", but it is somehow the wrong epithet!). Since 2006, North Americans have designated PARI (the Pisgah Astronomical Research Institute in North Carolina) as the 'ultimate' plate repository for N American plates; a Workshop to discuss issues related to that decision was held at PARI in 2007, and a census of plates in N American observatories was carried out in 2008. The Workshop established at PARI the *Astronomical Photographic Data Archive* (APDA), which has been accumulating plates as and when observatories wish to relinquish them. The APDA is also the proud new owner of the two *GAMMA* PDS machines from STScI, one of which is again in working order and needs but money to upgrade it so that scanning of the APDA holdings can commence. This is Progress!

On the spectroscopic front, the *Spectroscopic Virtual Observatory* (SVO) at the DAO in Canada has taken a major stride towards realization, with the commencement of a Scanning Service. Presently working under the auspices of the Canadian charity (*World Spectra Heritage*), which is a grant-handling interface, the SVO can entertain requests to digitize either plates from its own archive or ones sent from elsewhere. A negotiable fee is presently asked of customers, but as the Service grows in popularity it is hoped that the costs of the service will be absorbed by the Observatory itself. The service creates 1-D spectra, calibrated in intensity and wavelength, normalized, and delivered as FITS files with the reference arcs. The spectra will also be placed in the public domain via the CADC, though respecting a proprietary period for the Investigator if required. This, too, is Progress!

Not everything is going well. Some projects have had their funding cut back just when they needed to be completed, or put into operational mode. That is an exceedingly frustrating situation, to which the only constructive response is "Persevere". Even the Harvard scanner (DASCH), whose development and initial performance were highly acclaimed, is being challenged to fund the programme for which it was built. In any funding request we need to emphasize that these scanning programmes are not draining, on-going costs for ever; the plates to be digitized need only be digitized once – provided, of course, that the digitization is as comprehensive and error-free as can be managed!

The PARI Workshop

Wayne Osborn, Central Michigan University (Wayne.Osborn@cmich.edu)

A two-day Workshop devoted to discussions of how to ensure preservation of astronomical photographic plates located in North America was held November 1-3, 2007 at the Pisgah Astronomical Research Institute (PARI) in Rosman, North Carolina, U.S.A. PARI had previously been identified as potentially an excellent site for an archive for plates that can no longer be adequately stored at their original institutions. The Workshop location therefore gave the participants, most of whom were not familiar with PARI and its facilities, an opportunity to see and evaluate critically its suitability as a plate repository and archive.

Thirty-two people, representing different perspectives of the importance of preserving astronomical plates, took part in the Workshop. They included astronomers who make use of archived photographic data in their research, archivists and librarians who are in charge of plate collections, members of teams engaged in plate digitization projects, and individuals representing two groups with specific interest in plate preservation: the IAU's Task Force for the Preservation and Digitization of Photographic Plates (PDPP) and the American Astronomical Society's Working Group on the Preservation of Astronomical Heritage (WGPAH). The participants were from sixteen institutions in the USA and Canada and four in Europe (Bulgaria, the Czech Republic, Italy, and the United Kingdom).

After starting with a tour of the PARI facilities, the Workshop held a series of one- to two-hour discussions, each focusing on a question relating to the central topic of how to handle astronomical plate collection in North America. These sessions were not a series of presentations, but spirited debates in a round-table format. The eight questions were:

1. What is the current situation, i.e. where are the significant collections of photographic data in North America?
2. Why are astronomical photographic records worth preserving?
3. What should be the priorities for archiving?
4. What can be learned from other plate-preservation initiatives?
5. How should a plate-preservation initiative be supported?
6. Can PARI be recognized as the national photographic plate repository, and can the preservation plan be built around that decision?
7. What should be the recommended protocols for preserving photographic data, and what should be the archiving standards?
8. How should the Workshop findings and recommendations be disseminated, and who shall be responsible?

The Workshop produced a series of recommendations (see below) regarding the preservation of astronomical photographic plates for future scientific and historical use. Five were recommendations to the general astronomical community, and seven were more for the benefit of those engaged in plate archiving efforts. One was that PARI be endorsed as an astronomical photographic data repository, and PARI has since created the Astronomical Photographic Data Archive (APDA); plates from the Cerro Tololo Observatory, Warner and Swasey Observatory, the University of Michigan Observatory and elsewhere are now in that center.

A full description of the Workshop is included in the forthcoming book, "Preserving Astronomy's Photographic Legacy: Current State and the Future of North American Astronomical Plates" which is scheduled for publication in mid 2009 as part of Astronomical Society of the Pacific's Conference Series. Anyone interested in ordering the book should contact one of the Editors: Lee Robbins (robbins@astro.utoronto.ca) or Wayne Osborn (Wayne.Osborn at cmich.edu).

A. Recommendations to the astronomical community

Recommendation 1. Given the eventual need for a database of astronomical photographic data, a census of North American astronomical photographic plates should be carried out. This would be done by conducting a survey of observatories and other institutions known or expected to hold plates.

Recommendation 2. Given its extensive available physical space and support facilities, PARI's Astronomical Photographic Data Archive (APDA) should be developed as an astronomical photographic data repository.

Recommendation 3. PARI should be designated as collection point for orphan plates, defined as those plates an observatory holds that are from some other institution, and will arrange for return or file them, as appropriate. Astronomers with plates they no longer need should return them to the appropriate observatories; if an observatory is unwilling to accept them, the astronomer should contact PARI about archiving.

Recommendation 4. A special session on time-domain astronomy should be proposed to the American Astronomical Society for the January 2009 meeting.

Recommendation 5. Institutions with collections of astronomical photographic plates are encouraged to compile a computer-based catalog of their holdings.

B. Recommendations to those engaged in plate archiving efforts

Recommendation 1. Those engaged in plate archiving should emphasize the importance of this work for time-domain astronomy research as well as for ensuring the preservation of historical records.

Recommendation 2. When transferring plates from their home institution to an archive,
(a) the receiving organization should obtain a letter or agreement on letterhead and signed by Department chair or other designated person of the transferring organization, authorizing the transfer and listing conditions, if any; (b) the storage cabinets and the associated log books and other records should accompany the plates whenever possible; and
(c) a catalog of the transferred plates should be prepared, preferably by the donating institution

but otherwise by the recipient as soon as possible.

Recommendation 3. In general, plates from the same origin should be stored together. Subsets of a collection may be kept separate, but should be cataloged so it is clear where each portion of the collection is housed.

Recommendation 4. The importance to astronomy of these historic data should be brought to the attention of those conducting the next decadal survey and the astronomical community in general.

Recommendation 5. Catalogs of plate collections should include as much information as necessary to adequately describe their content. For direct plates, records should conform to the Wide-Field Plate Database (WFPD) template; spectroscopic ones should follow the template developed by the IAU Working Group for Spectroscopic Data Archives.
(a) Catalog information for direct plates should include at a minimum the plate number (and observatory series), equatorial coordinates (equinox), object (if relevant), date and time of exposure (time system used), and length of exposure. Other useful information includes the emulsion type, filter, plate size, area photographed, and if there are multiple exposures.
(b) Catalog information for spectroscopic plates should include the plate number (and observatory series), equatorial coordinates (equinox), object, date and time of exposure (time system used), length of exposure, approximate central wavelength and dispersion. Other useful information includes the camera focal length, emulsion and grating characteristics.
(c) On-line catalogs should be available through Vizier and associated with the Wide-Field Plate Database (WFPD) when appropriate.

Recommendation 6. The archiving of both photographic and paper records should adhere to accepted archival standards as far as possible.

Recommendation 7. In order to acquire the necessary financial resources needed for archiving, it is necessary to identify and explore every reasonable source of revenue.

Recent Steps towards Ensuring the Preservation of Astronomical Photographic Plates in North America

Wayne Osborn, Central Michigan University (Wayne.Osborn@cmich.edu)

In January 2007 the American Astronomical Society (AAS) established a Working Group on the Preservation of Astronomical Heritage (WGPAH) (http://members.aas.org/comms/wgpah.cfm). The WGPAH is charged with "developing and disseminating procedures, criteria and priorities for identifying, designating, and preserving astronomical structures, instruments, and records so that they will continue to be available for astronomical and historical research, for the teaching of astronomy, and for outreach to the general public." Astronomical photographs were specifically mentioned as needing protection and preservation.

For well over a decade, concerns have been raised about ensuring the preservation of archived astronomical photographic plates in the United States and Canada. In the past four years has there been a systematic effort to take positive action. The first step in developing a preservation plan is to have a clear idea of the current situation. With that in mind, a census of the astronomical photographic plates in North America was carried out under the auspices of the WGPAH. The objective was to learn the numbers of existing plates and to record the locations, present conditions, availability for research and and future plans for the various collections.

204 census forms were distributed to observatories, astronomy departments and some individual astronomers known to have an interest in plates. There was a 50% overall response rate, which included full or partial responses from all of the major U.S. and Canadian astronomical institutions. The census determined that over 2.4 million photographs exist in North America. 44 institutions reported having at least some plates, but 16 large collections hold 97% of the total between them. Canadian institutions hold roughly one third of the spectral plates. The archived photographic material is being used regularly for research, but there is an urgent need for on-line, searchable catalogs to facilitate the location of plates of interest to researchers.

A number of institutions which hold plates no longer have the means to archive them adequately. The Pisgah Astronomical Research Institute in Rosman, North Carolina (USA) has now established the Astronomical Photographic Data Archive (APDA) where institutions can deposit plates that they no longer wish to retain. The APDA has so far received over 100,000 astronomical plates and films that have been deposited in that way.

Astronomical Photographic Data Archive (APDA)
at the Pisgah Astronomical Research Institute
Plate Archive and Facility Update

Michael Castelaz and Thurburn Barker, PARI (mcastelaz@pari.edu)

USNO Plates

In mid-June, 2009, Dave Clavier and Thurburn Barker of PARI drove to the United States Naval Observatory (USNO) in Washington, DC, for the purpose of transporting the first of two shipments of astrographic plates from the USNO to APDA at PARI. Those plates were used in the production of the USNO CCD Astrograph Catalog (UCAC) program. A description of the plates and plate-scanning activities at USNO was given in SCAN-IT #3, 2005, pp. 17–18.

The StarScan machine at the U.S. Naval Observatory (USNO) measured the astrograph plates in order to allow proper motions to be determined for the USNO–UCAC program. The plate scanning was completed by June, 2008, as reported in arXiv:0806.0256v1.

The USNO astrograph plates now archived at APDA include:

(1) 2200 plates from the Hamburg Zone Astrograph, a Zeiss system with 206 mm aperture, focal length of 2060 mm and a 5-element lens; the observations date from ∼ 1972, using a visual bandpass;
(2) 900 plates from the USNO Black Birch 8-inch Twin Astrograph, using the "yellow lens" (a 4-element lens made in about 1980); and,
(3) 300 plates from the Lick 20-in Astrograph, using a visual lens.

GAMMA II

The Guide Star Automatic Measuring Machine (GAMMA) is a laser-illuminated multi-channel scanning microdensitometer, modularly built upon the substrate of the modified PDS used in other work at the Space Telescope Science Institute. The latter donated its two GAMMA scanners to PARI in March, 2008. PARI has since re-assembled the one known as GAMMA II, and its mechanical system is now operational. Presently, PARI is researching options to replace the laser scanning transducer system with a modern CCD imaging system, image processing software and computer hardware. That will allow much faster scanning of photographic plates (minutes versus hours per plate).

Photographic collections at the APDA

The initial sets of plates at the APDA included:

(1) objective-prism plates taken with the Michigan Curtis Schmidt telescope at Cerro Tololo Inter-American Observatory (CTIO) in Chile and the Case Burrell Schmidt telescope at the National Optical Astronomy Observatories (NOAO) in Arizona;
(2) ∼22,000 plates of about 472 stars observed with the Ann Arbor 37.5-inch telescope and spectrograph between 1911 to 1972;
(3) ∼22,000 plates from the Warner Swasey Observatory Collection (1944-1994) from Case Western Reserve University, and
(4) Palomar Observatory Sky Survey (POSS-I) prints and overlays.

The following collections have now been added:

Harvard Meteor Films

In the fall of 2007, the Harvard College Observatory Plate Stacks donated two sets of astronomical photographic to APDA. One set, on film, is from the Prairie Meteor Network (McCrosky & Boeschenstein 1965) which was in operation from 1964 to 1975. That collection was photographed with a system of Baker-Nunn camera stations located in the Midwest U.S.A. The system was designed to image extremely bright meteor events. The total number of films in that collection is 11,000.

The second set is the product of the Harvard Meteor Project (Jacchia & Whipple 1961), for which observations were made between 1953 and 1958. The project had two stations, each with a Baker Superschmidt Telescope, and data were recorded on moulded 18-cm diameter circular film. The observing stations were originally at Soledad canyon and Dona Ana, and were later moved to Sacramento Peak and Mayhill. The total number of films in that collection is 42,000. The combined number of meteor films at APDA is thus over 50,000.

CTIO, KPNO & Las CampanasPlates

The Institute of Astronomy, Cambridge (UK) shipped three crates of plates to APDA last spring. One contained objective prism plates (most of which were originally from the University of Michigan); the other two contained direct plates from Cerro Tololo, Kitt Peak and Las Campanas. Included with the shipment was also a number of Palomar plates which needed to be sent to Palomar Observatory in California. PARI is happy to accommodate such a request to forward plates to home institutions.

Montreal-Cambridge-Tololo (MCT) Survey

In the winter of 2008, The Physics Department of the Universit de Montral shipped to PARI the Montral-Cambridge-Tololo (MCT) collection of plates resulting from the survey of blue subluminous stars. The survey consisted of about 400 doubly exposed U and B photographic plates coveringalmost 7000 sq. deg. centered on the South Galactic Pole. The plates were exposed during the late 1980s and early 1990s, with a limiting magnitude of 17–18 mag. A description of the survey is available in Lamontagne et al. (2000).

For more information on the APDA collections now held at PARI, please visit our Website at http://www.pari.edu/library/apda .

Jacchia, L. G. & Whipple, F. L., 1961, Smithsonian Contributions to Astrophysics, 4, 97
Lamontagne et al., 2000, AJ, 119, 241
McCrosky, R. E. & Boeschenstein, H., Jr., 1965, SAO Special Report #173

Status of Plate Scanning Projects at the USNO

N. Zacharias, G. Wycoff, D. Pascu, USNO (nz@usno.navy.mil)

The USNO StarScan machine completed scanning of over 5000 plates for astrometry:

1930 plates 160 mm sq. AGK2 (epoch about 1932)
874 plates 8 × 10 in USNO Black Birch Astrograph (1990)
2330 plates 240 mm sq. Hamburg Zone Astrograph (1978-1995)
350 plates 240 mm sq. Lick Astrograph (Hamburg program)

Measurements are accurate to about 0.5μ. For details about the StarScan machine, reduction procedures and program overview, see Zacharias et al., PASP, 120, 644, 2008 or astro-ph 0806.0256.

For about a year StarScan has not been used regularly. However, double star plates of the Sirius system will be measured this year, supported by a summer student program. There are plans eventually to relocate the machine to PARI.

In a joint program between Paris Observatory, the Royal Observatory Belgium (ROB) and USNO, photographic plates of the moons of Mars, Jupiter and Saturn are being measured on the new ROB measuring machine, which is accurate to 0.1 μ. These plates have been taken over several decades with the USNO 26-inch refractor. The goal is to improve the models of the motions and internal physics of these solar system bodies, which in turn will improve their ephemerides.

Digitizing photographic plates, particularly ones with fine-grain emulsions, is still a challenging task. It is important to optimize performance towards your own goal, which is likely to be different for photometric and for astrometric applications. Just digitizing a plate and saving the pixel data is by itself not sufficient in order to extract all astrometric information. The geometric calibration of the machine and measurements need to be performed at the same time. Of particular importance is the mapping model between the detector (pixel coordinates) and the measure table coordinates, the determination of those parameters, the correct model equations, and the stability of it all. Without those additional calibrations the pixel data alone are insufficient to derive high-accuracy star positions.

For course-grain emulsions, StarScan was able to extract all positional information on all detectable stellar images. For fine-grain emulsions, like the modern Kodak Tech-Pan and those used for the early-epoch AGK2 plates, we are at the limit of the instrument, and a measuring engine of greater precision than StarScan would have been of some benefit. The new machine at the ROB is capable of extracting all astrometric information on any given plate material. Nevertheless, all measuring machines that incorporate a CCD camera lack the dynamic range of a microdensitometer (e.g. PDS machines), so the latter has the advantage for photometry.

Scanning the Vatican Observatory Schmidt Plates & CdC Plates

A. Omizzolo, SJ & Richard De Souza, SJ; alessandro.omizzolo@oapd.inaf.it

A few years ago we became really aware of the wealth of information contained in the plate archives of the Vatican Observatory in Castle Gandolfo, which dates back a whole century. The Vatican Carte du Ciel collection together with the plates from the 65-cm Schmidt telescope in the Vatican Gardens, amounts to ~9800 plates, still in relatively good condition.

Alexandro Omizzolo from the Vatican Observatory, along with collaborators from the many Italian Observatories, started the process of scanning the plates. To date, all the plates from the Schmidt telescope, totalling nearly 2000, have been scanned and the images stored both on DVD and on hard disk at Castle Gandolfo. The only remaining task was to make the images available to the general public.

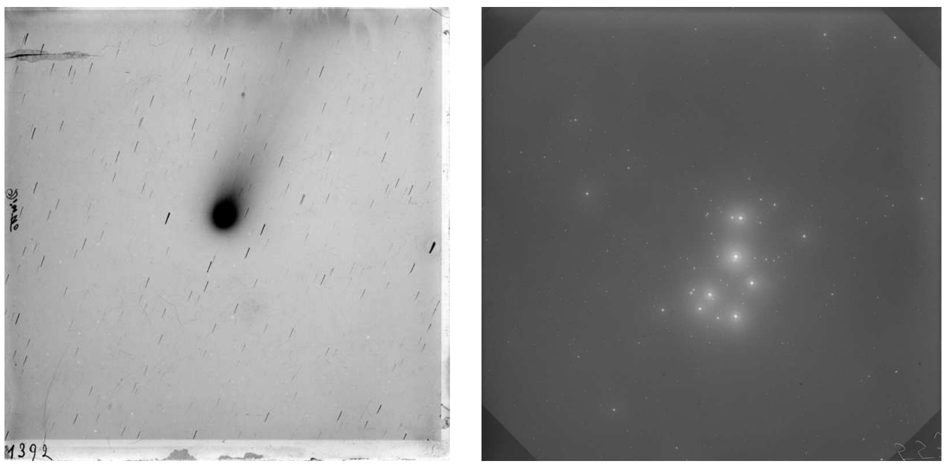


Figure 1. *Left:* An image of Halley's Comet on a Vatican CdC plate.
Right: An image of the Pleiades exposed with the Vatican Schmidt in January 1965.

An image data archive (http://saccheri.as.arizona.edu) was set up at the Vatican Observatory Research Group (VORG) at Steward Observatory, Tucson; it was constructed following the Simple Image Access Protocol (SIAP) of the IVOA. The astrometry of each of the nearly 460 direct images was recalculated by Richard De Souza using http://astrometry.net, which serves both FITS and JPEG images of the plates. A simple web-based SIAP client was also constructed. The images can be queried with any SIAP-compliant client.

We have experimented with new software for the SIAP service. Our primary criterion was that the software code be easy to maintain and to update in the future. For that reason, the code was written in python, using a lightweight web framework called Pylons (http://www.pylonshq.com). We also use an object-relational mapper (ORM) called Storm (https://storm.canonical.com) to access our database stored in SQLite (http://www.sqlite.org).

When the first stage of the project has been completed, work will start on providing access to the set of nearly 1300 objective-prism plates from the Schmidt telescope. We are presently studying the feasibility of offering a Simple Spectral Access Protocol (SSAP) for those plates to the public. It is our intention to make all our data compliant with IVOA standards.

Please visit the archive (http://saccheri.as.arizona.edu) and send us your feedback.

Status of the Digitisation Projects at the Royal Observatory of Belgium, Brussels

J.P. de Cuyper (Jean-Pierre.DeCuyper@oma.be)

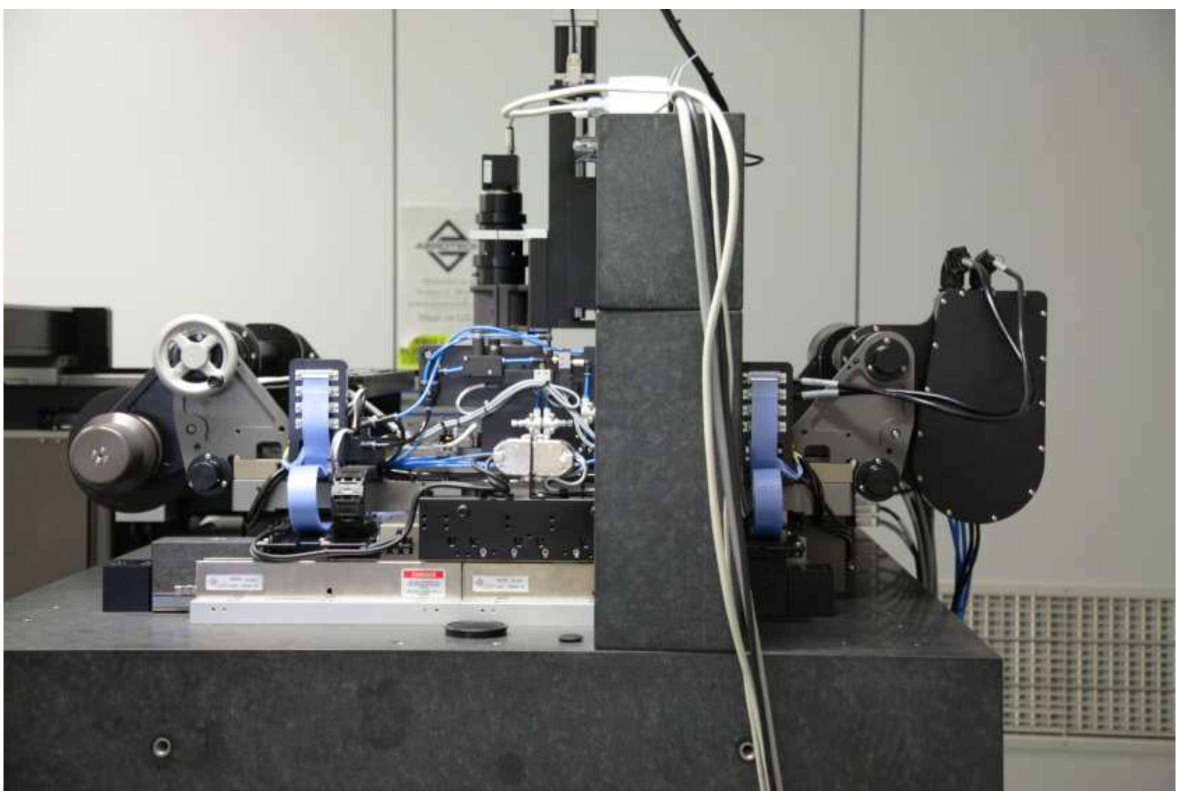
The DAMIAN (Digital Access to Metric Images Archives Network, former D4A) digitiser, delivered at the end of 2007 and started up in 2008, is being used for digitising astrometric plates and aerial photographic images.

Placed on an isolated foundation block in a temperature and humidity controlled clean room (kept within 0.1°C and 1%RH), it can digitise glass plates, film sheets and film rolls up-to 14 inches wide. The loading into focus, the exchange of plates/sheets and the film roll transport are fully automated and computer controlled. The mechanical positioning accuracy and repeatability of the XY-table is of the order of nanometers. The actual combination of optical set-up and digital camera ($7\mu \times 7\mu$ pixels) delivers extracted astrometric positions on the plates to better than 0.1μ.

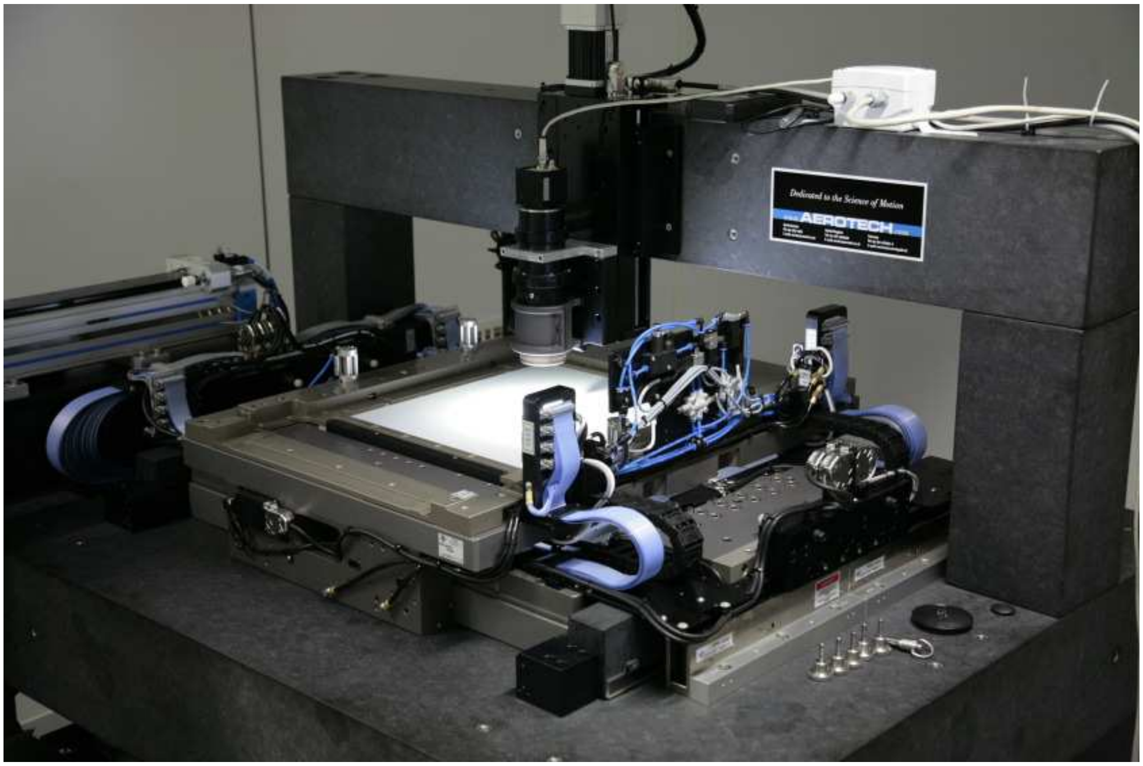
In 2008 an international collaboration was started up [*see page 8*] between the US Naval Observatory in Washington, DC (D. Pascu & N. Zacharias), the Observatoire de Paris (J.-E. Arlot, V. Robert & V. Lainey) and the Royal Observatory of Belgum (J.-P. De Cuyper, L. Winter & G. de Decker) to digitise the USNO collection of photographic plates of the moons of Mars, Jupiter and Saturn taken by D. Pascu over a period of 30 years. The goal is to improve the ephemerides and the internal structure models of these solar system bodies. At present a series of a thousand plates of the Galilean satellites of Jupiter is being digitised. The first results were presented at the ADASS XVIII Conference in Quebec in November 2008.

[*The four images that follow show DAMIAN from different angles*].

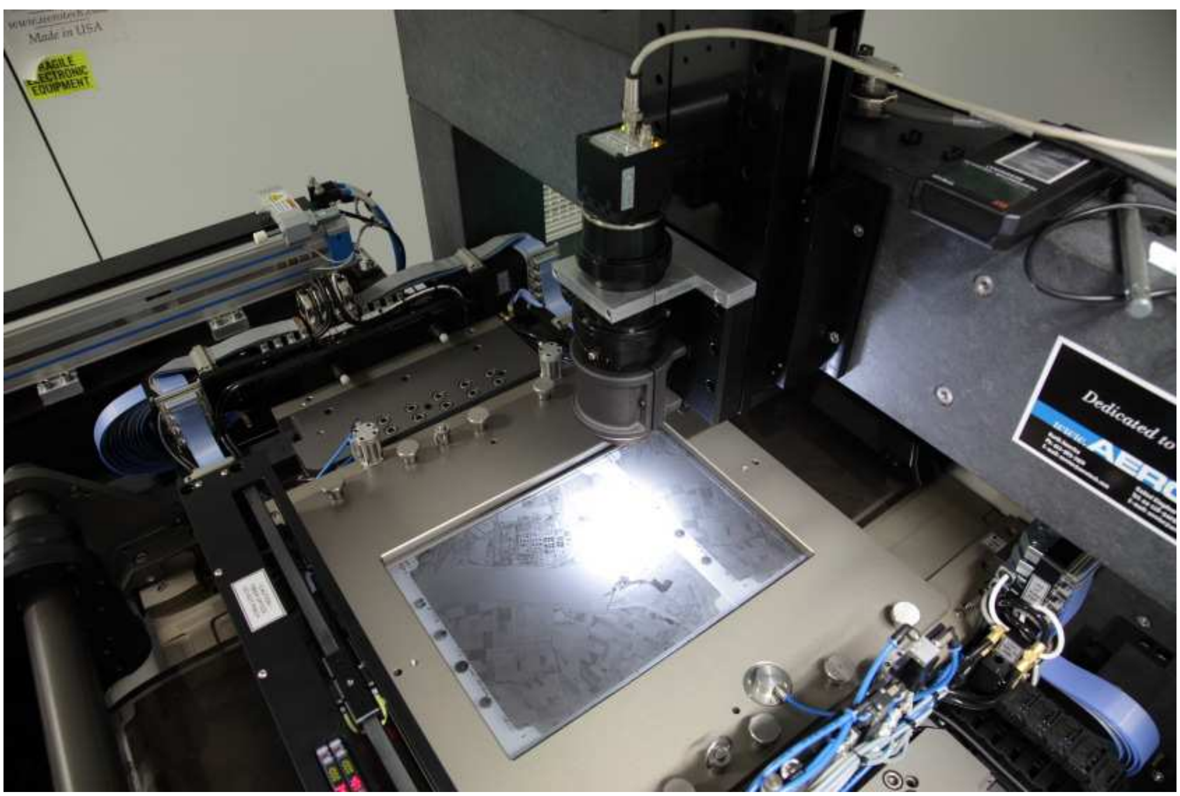
DAMIAN digitiser with automatic plateloader and mobile platewagon



DAMIAN digitiser with full automatic filmroll transport system



DAMIAN digitiser, detail of air bearing XY-table and granite bridge with Z-axis, telecentric objective and CMOS camera



DAMIAN digitiser, detail of counter pressure plate with vacuum suction, the CMOS camera and telecentric objective with alignment plate and the diffuse illumination.

The Potsdam Wide-Field Plate Archives
Integration in Distributed Databases and Scientific Applications

M. Tsvetkov[1], *K. Tsvetkova*[1], *K. Stavrev*[1], *P. Boehm*[2], *M. Steinmetz*[2], *H. Enke*[2], *I. Niccelt*[2]
R. Budell[3], *D. Kalaglarsky*[4] *(milcho@skyarchive.org)*

1) Institute of Astronomy, Bulgarian Academy of Sciences, Sofia, Bulgaria
2) Astrophysikalishes Institut Potsdam, Germany
3) Physikalisches Institut, Arbeitsgruppe Arlinghaus, Münster, Germany
4) Space Research Institute, Bulgarian Academy of Sciences, Sofia, Bulgaria

Abstract

The objective of this present work was to extend the inventory and cataloging of the wide-field plate collection of some 9900 plates at the Astrophysical Institute Potsdam (AIP), obtained during the period 1879–1970 at the Potsdam Astrophysical Observatory and at Babelsberg, by preparing computer-readable catalogues of the plate archives and on-line access to their contents. Access to those files was through an updated version of the Wide-Field Plate Database (WFPDB, http://www.skyarchive.org) in Sofia and its mirror at the AIP, and to the actual plate images. With the plate catalogues and the plate images now on line, it is possible to use the valuable astronomical information contained in the plates just like a virtual telescope in time, and to apply it to different astronomical investigations.

1. Potsdam Carte du Ciel Plate Inventory

The first photographic all-sky survey, the Carte du Ciel (CdC), was begun in 1887 to map the sky down to 15$^{\rm th}$ magnitude (CdC charts) and to measure positions of stars to 12$^{\rm th}$ magnitude (AC catalogue) . Potsdam Astrophysical Observatory was involved in it from the first, and was assigned the zone between +32 and +39°. The observations were carried out with the double Steinheil and Repsold refractor (32-cm photographic objective and 24-cm visual objective).

Proper-motion determinations of stars in CdC zones have standard errors of ∼100–120 mas in position, according to Rapaport et al. (2006), while the precision in position at the mean epoch ranges from 50–70 mas, according to Ducourant et al. (2006). According to Fresneau et al. (2001) there are also rapid brightness changes (time-scales up to 20 mins) with amplitudes larger than 0.5 mag in stars with V (photographic) in the range 10–14 mag. Considering the potential present and future uses for such material, a detailed examination of the the Potsdam CdC plates (now stored at the AIP) was undertaken.

The Potsdam CdC zone was divided into areas overlapping each other, in order to assure good sky coverage, making 1232 areas altogether. Both the observing programme (known at Potsdam Observatory as the "Potsdamer Himmelskarte" project) and the plate measurements were led by J. Scheiner. 1244 plates were obtained during 1893–1900, of which 406 plates were fully measured; the results were published in 7 volumes (Publicationen des Astrophysikalischen Observatorium zu Potsdam, Photographische Himmelskarte, Catalog, Band I, Potsdam 1899; Band II, 1901; Band III, 1903; Band VI, 1907; Band V, 1910; Band VI, 1912; Band VII, 1915). After the death of J. Scheiner the observing was continued by W. Münch, K. Jantzen and O. Birck. Owing to lack of funds and manpower, the observing programme was terminated in 1924. However, at the IV$^{\rm th}$ IAU GA in 1932 an official decision was taken to complete the Potsdam zone – the part concerning the CdC sky atlas – by Uccle, Oxford and Hyderabad Observatories.

The Potsdam CdC plates had been stored with other plates from Telegrafenberg and Babelsberg in the AIP library. They are now kept under special conditions to control humidity, dust, strong illumination and sudden temperature change (Fig. 1. Access to the plates is restricted in order to avoid any non-professional treatment of the plates. Only such controls can ensure the long-term preservation of the material for possible re-use.

Figure 1: A cabinet of Potsdam CdC plates at the AIP

The Potsdam CdC plate inventory was completed between Autumn 2006 and Autumn 2008; details can be found in Tsvetkova et al. (in preparation). In order to create an appropriate environment for the CdC plates the old, often damaged plate envelopes were replaced with new ones (but the old envelopes were stored in the Library archive). The plates are now ordered according to their original numbers, and it is easy to find any given CdC plate.

The total number of all the Potsdam CdC plates from the first- and second-epoch observations is estimated to be about 2200. 977 plates (about 44%) are now stored at the AIP; the rest were lost during two World Wars. The first-epoch plates had been obtained during the period May 1893–February 1900 by A. Schwassmann, G. Eberhard, H. Ludendorff, J. Scheiner, H. Clemens and A. Everett. As a rule those plates have a single 5-minute exposure of one area. Only 33 of those first-epoch plates are now available. Some have emulsions that are detached from the glass, or have begun to detach, or have yellow spots of various sizes.

The second-epoch plates were obtained between August 1913 and February 1924 (we have not included one CdC plate obtained in 1902). They can be separated into two time-intervals according to the principal observer and the observing method (the number of areas and the number of exposures made). The first time-interval was from August 1913–July 1914, with observers W. Münch and K. Jantzen; 581 plates are now available, each having one or two exposures of the same area with different exposure times, but less than 10 min. In July 1914 W. Münch interrupted his work for war service. The second time-interval was from February 1916–February 1924, with observer O. Birck in charge; those plates have two exposures of every area, with different exposure times; sometimes as many as 6 areas had been exposed on the same plate on one night, or even on two different nights – actions that were necessitated by post-war shortages. 362 plates from that set are now to hand.

The preserved log-books, together with the sheets of observers' notes which were made during the observing, helped us to understand the methods of observing employed since 1916 for that final set of plates. We therefore decided to preserve all the information contained in the existing log-books. We prepared low-resolution JPEG images, intending to rely on modern technology to locate objects in scanned binary images, and to digitize the handwritten register of astronomical observations. When processing each image we saved the plate attributes (meta-data) separately, thereby creating a relation between database element (the plate) and its record.

II. Potsdam Carte du Ciel Plate Catalogue and its Analysis

The Potsdam CdC archive has been added to the Catalogue of the Wide-Field Plate Archives (CWFPAs) of the Wide-Filed Plate Database (WFPDB, http://www.skyarchive.org), where it can be found with the WFPDB instrument identifier POT032. The next step was preparing a computer-readable catalogue of the archive in the required format of the WFPDB (as described in http://vizier.u-strasbg.fr/cats/VI.htx - catalogue number VI/90). The WFPDB format is accepted as direct plate standard for the North American National Plan For Preserving Astronomical Photographic Data (see http://www.pari.edu/library/apda/workshop/Summary.pdf). Adding the POT032 catalogue to the WFPDB now offers on-line access to those data to all the astronomical community.

Analysis of the newly-added WFPDB catalogue within the framework of the Astronomical Virtual Observatory (AVO) requires as input the observing parameters date, time, object name, number and duration of exposures, type of the emulsion, etc., and has been described by Tsvetkova et al. (in preparation).

III. Potsdam Carte du Ciel Plate Digitization

The only way to ensure the longevity of the scientific information on the plates is to digitize them. Prior to our Potsdam project we had already had some experience with the CdC plates at the Royal Observatory of Belgium (Uccle). In the Autumn of 2006 we commenced installing, testing and scanning selected CdC plates with the AIP EPSON 10000XL flatbed scanner (Fig. 2). In order to complete the CdC plate digitization on time a second EPSON flatbed scanner (EPSON PERFECTION V700 PHOTO) was brought in.

After numerous tests, a workable scanning procedure was established. A description of that procedure, together with instructions for operating an AIP EPSON 10000XL flatbed scanner (Manual book), were prepared and were left for future users.

Figure 2: The AIP EPSON 10000XL flatbed scanner complex

Our systematic digitization of the CdC plates commenced in October 2007 when the right parameters for scanning had been decided upon. Our rule was to scan the Potsdam CdC plates using one and the same orientation - North up, East left. For guidance we made use of the observer's marks; the number of the plate was usually written in the same corner, though there was no guarantee that the marks were always correctly oriented. To clean the plates, we used 99% alcohol on cotton pads for stubborn dirt or ink on the glass sides, and a soft brush to remove any cotton débris from the emulsion.

Each CdC plate was scanned twice with a resolution of 1200 dpi, in order to give preview scans for plate visualization and to preserve the observer's marks. After the glass sides had been cleaned, they were then scanned at high resolution (2400 dpi) for astronomical applications. The preview scans were stored in TIFF and JPEG file formats, each TIFF file occupying about 160 MB, and each JPEG one about 22 MB. The high-resolution scans were stored as FITS files, each occupying about 440 MB. The JPEG files were also compressed to a resolution of 318 dpi (2000 × 2000 pixels). The preview scans will be available to users of the WFPDB.

The headers of the FITS files contain all the necessary information: equatorial coordinates of the plate centres in the original epoch, name of the Carte du Ciel area, name of the observer, etc., thus conforming to the WFPDB requirements. Further details about the Potsdam CdC plate digitization can be found in Tsvetkov et al. (in preparation).

The raw scans of the plates are stored on the hard-disk directories of the German Astrophysical Virtual Observatory (GAVO) servers in Potsdam: three scans (JPG, TIFF and FITS formats) for each of 977 plates. On-line access for further applications will be provided for the astronomical community via the AIP servers. The POT032 plate previews were added to the WFPDB at once, so as to give on-line access to the plates as soon as the work had begun.

For better on-line access to the raw scans of the Potsdam plates, a mirror ftp-site of the WFPDB was added at the AIP (vodata.aip.de/WFPDBsearch) in 2007 December. This is the version installed in the Sofia Sky Archive Data Center, and is regularly updated. In the framework of our collaboration with the WFPDB project, an international "Info-Workshop" was held in Sofia (Bulgaria) in January 2008 under the auspices of the European Virtual Observatory Date Centre Alliance. Participants in the project described above reported the results of their work.

IV. Future Work

Our future work will concentrate on (a) continuing the preparation of computer-readable versions of the Potsdam wide-field plates, (b) making on-line access to the Potsdam wide-field plate collection through the International Virtual Observatory (IVO), (c) installing at AIP a server that gives better on-line access to the raw scans, (d) starting a programme to digitize the Kapteyn plates obtained in Potsdam, and (e) further development of the Website for the Potsdam plate archives hosted on the AIP's home-page.

Acknowledgements

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Observatory Plate Collections - 2

Wayne Osborn, Central Michigan University (Wayne.Osborn@cmich.edu)

[SCAN-IT #4, p. 38, commenced a series of status reports about observatory plate collections. There was no design regarding which collections were included; it merely relayed what had been sent in. We therefore rely on readers to offer information for this section, particularly in the case of collections which were not represented in the recent Census of North American Plates (see p. NN). Readers are therefore strongly urged to keep up the supply of information – however brief, however patchy or however distasteful! –Ed.]

Yerkes Observatory

Yerkes Observatory of the University of Chicago was established in 1897 and is well known for its 40-inch (1-m) refracting telescope, still the largest of this type in the world. Soon after it was established, Yerkes became one of the leaders in the then emerging field of astrophysics, and over the years it has accumulated a collection of over 130,000 plates.

An inventory of the Yerkes plate collection is now being completed. It reveals that a wide variety of telescopes and instruments were used to obtain the images. The 40-inch refractor produced about 30,000 direct plates, 35,000 stellar spectra and 10,000 photographs (images and spectra) of the Sun during the period 1900–2000. There are also 18,000 direct plates and 9,000 spectra observed with the former 24-inch reflector from 1901–1956, 2400 wide-field plates exposed with the Bruce 10-inch f/5 refractor (Barnard 1905) from 1905-1949 and 1500 plates exposed with the 41-inch reflector from 1970–1997, as well as numerous smaller plate series from instruments of lesser aperture.

The archive also contains the plates taken by Yerkes astronomers at the McDonald Observatory, operated jointly by the Universities of Chicago and Texas from 1939–1960. They include about 4000 direct plates, 15,000 low-dispersion spectra and 3000 high-dispersion coudé spectra from the 82-inch reflector, and 2500 wide-field Cook telescope images (Kuiper et al. 1958) exposed between 1950–1952.

Three partial collections of plates from other observatories are now archived at Yerkes. They include over 10,000 slit spectra from the 72-inch Perkins reflector (1939–1986), 1000 plates from the former 4-inch Ross camera (16 × 20 degree field) of the University of Illinois (1939–1950), and 500 of the Dearborn Observatory red-star survey plates of 1939–1947 (Lee 1943; Lee et al. 1947).

Anyone requiring further information about the Yerkes plate collection can write to the Observatory (373 W. Geneva Street, Williams Bay, WI 53191, USA) or contact me at the e-mail address above.

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Cambridge Observatories' Plate Archive

R.W. Argyle, IoA, Cambridge, UK (rwa@ast.cam.ac.uk)

The Solar Physics Observatory complex at the Institute of Astronomy is being demolished to make way for a new building, so in 2007/8 the contents of the plate store which was housed there were sorted, moved and culled.

a) About 10,000 narrow-band plates of the solar disk, taken between 1906 and 1946 in Kodaikanal, India, were returned to their home institution.

b) Various series of stellar and solar spectra exposed at Cambridge were moved into storage at the Mullard Radio Astronomy Observatory at Lords Bridge.

c) About 1100 plates, borrowed for use in various research projects, were shipped to PARI. They included objective-prism plates taken with the Burrell Schmidt, and a range of direct plates exposed with 2 to 4-m class telescopes in North and South America. Another batch of about 60 original plates exposed with the Palomar Schmidt is also at PARI, awaiting transfer to Palomar Mountain.

d) A trunk-full of small-format spectra, bequeathed to Cambridge by the original Solar Physics Observatory in South Kensington, London, when that closed in 1913 and exposed under the directorship of Sir Norman Lockyer, were donated (fittingly enough) to the Norman Lockyer Observatory (NLO) in SW England, which Sir Norman himself founded and equipped upon his retirement from London. The NLO is operated by a team of enthusiastic volunteers, several being retirees from the RGO when *that* was closed in 1998. An image of the original Solar Physics Observatory in London (see Observatory 36, 355, 1939; Bibcode 1913Obs....36..355) shows how astronomically unsavoury the London site had become for observational work.

Thoughts on Designing a Digitizer for Spectroscopic and Direct Plates by Modifying Existing PDS Machines

R.J. Simcoe (rjsimcoe@cfa.harvard.edu)

Having spent some time understanding digitizers for direct wide-field astrophotographic plates, X-ray plates and films of art works, as well as evaluating commercial scanners both for direct and for spectrograms, I thought it might be worthwhile to brainstorm a design to digitize spectroscopic and direct plates using a modified PDS machine or other precision X-Y stage.

Spectroscopic plates seem to have quite a variety of shapes and sizes. They vary from large wide-field wedge prism plates (8 x 10 inches) to long narrow plates (0.5 × 8 inches or 2 × 10 inches), and many sizes in between. For this exercise I will focus on plates or films that are either small rectangular plates (2 × 3 inches) or long narrow ones (5/8 × 8 inches).

Direct plates vary in dimension from Schmidt plates that are about 12 × 12 inches (300 × 300 mm) to ones that are 8 × 10 inches, 5 × 7 inches, and a few smaller sizes.

The machine that has been the gold standard for measuring spectroscopic plates (and direct plates) has been the PDS 1010 or PDS 2020. I had the opportunity to examine thoroughly two of the PDS 2020 machines in the summer of 2008 when I participated in reconditioning the *GAMMA I* and *Gamma II* machines at PARI. They obtained the machines from the STScI when they were surplused. The machines had been used to generate the Hubble *Guide Star Catalog.* That work also introduced me to Larry Avril (PDSMicroD.com), who has serviced PDS machines since they were first designed. He filled me in on some of the history and capabilities of PDS machines, and he also told me that he has designed an interface and software that allow the basic mechanical movements of a PDS to be controlled by any PC running XP.

The PDS 2020, which can scan an area measuring 20 × 20 inches, is constructed on a granite base with two granite L shaped risers on each side of a central opening. In the central opening there is a granite C-section that moves in and out. The light source and light sensor are mounted to the ends of the C-section. A traveling aluminum plate fixture moves from left to right on another set of the granite risers, the combination giving the (X, Y) scan capability. *Gamma II* has a “one of a kind” optical system that uses a laser and a modulator to create a 5-spot scan; it also employs the output from a laser interferometer positioning system to modify the location of the 5 spots on the fly, compensating for any inaccuracies in the mechanical positioning system.

The PDS 1010, which is by far the more common version of the PDS, is sometimes on a granite base with a design similar to the 2020 and sometimes on a metal base with a steel X-Y stage. Some of the PDS machines (e.g. *GAMMA II*) use laser interferometer feedback, but most use a Heidenhain (or equivalent) glass scale as the feedback for a servo system which can position the stages to $\pm 1\mu$ in both X and Y. The PDS machine must typically move a larger mass containing the parts of the optical path, light source, and detector in the Y-direction. In the X-direction the machine will move a lighter-weight plate holder. For that reason, scans are typically made in the X direction, with small, slower steps in the Y direction between the longer movements in X. The PDS would scan the long distance using a small aperture, often a small slit, which is thus in constant motion.

The drive system for the PDS is a clever arrangement of ball bearings which rest at an angle on a precision-ground round rod. The rod is turned by a servo motor, and the ball bearings turn in a way that applies a linear motion to the stage that it is connected to. That provides a very smooth motion as long as the friction of the bearings on the rod is great enough to prevent slippage under load. Even if there is slippage, the feedback from the linear encoders provides absolute position feedback to close the loop for the servo-motor. Unlike the stepper-motor drives in most other commercial scanners, which provide a 'step, stop then integrate' action, the PDS's servo drive with feedback provides a well controlled, continuous motion. It does come at a price, however, since the light source and detector are not in a stable position while a measurement is occurring. A paper by S.S. Hong (1992) shows that that causes the detection of edges to shift a few microns depending on the direction of the scan, because there is a difference between where the machine interprets its position and where the detector electronics sample and hold each pixel. Its also shown to be speed dependent, so pixel positional accuracy goes down as the speed goes up. Further, there is evidence (Hanson 1986) that the servos on the two axes can interact, causing a wander in Y of the order of $\pm 4\mu$ while scanning in the X direction.

A spectrum can be thought of as a series of lines and spaces of variable width in the X-direction and covering a small distance in the Y-direction (assuming that the X-direction is the long one, i.e. the one which will be the scan direction (see Figure 1). The PDS machine would scan it in the X-direction with an aperture often on the order of (for example) $\sim 10\mu \times 140\mu$ in X and Y, respectively, Frequently the 10-μ aperture would be half stepped to 5μ to try to increase resolution in the X-direction. Aperture size is chosen to increase the dynamic range of the light reaching the single photo-multiplier detector tube while maintaining high resolution in the X-direction. An asymmetric slit also reduces noise by effectively averaging the variation in the grains at the edge of the image in the Y-direction. The down-side is that it requires that the X-axis of the scanner and the plate be in very good angular alignment, because if the slit and the line are at an angle then the averaging will be detrimental.

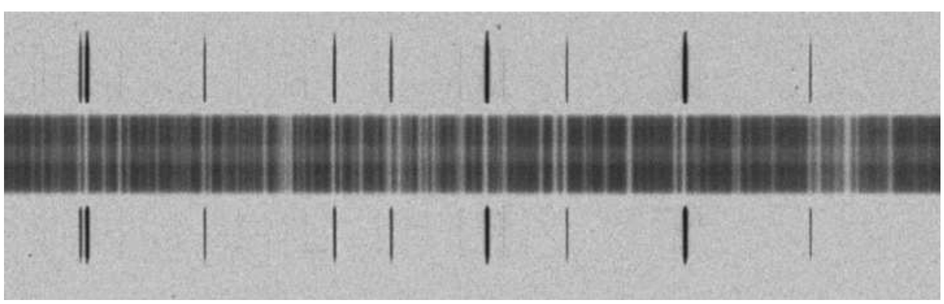

Figure 1: A stellar spectrum flanked by a wavelength calibration exposure

Figure 1 shows both the central spectrum and the calibration lines (often from an Fe-arc lamp) on either side of the spectrum. Figure 2 is an expansion of the calibration exposure, showing how the photo-density of the line is non-uniform; a single pixel measurement with (say) a 5-10μ square aperture horizontally could easily fall in a way that would miss one or more lines that are clearly visible to the eye on the 2D image. It is clear, from looking at Figures 1 and 2, that collecting all the information in the vertical stripes would increase the signal-to-noise of the data by adding the information from many samples. That is the reason for using a slit on the PDS machine, but it is also the reason why scanning with an area imaging device would allow better data processing. In addition, if the area imager captures both of the calibration spectra at the same time as it captures the object spectrum, then there is no issue with the repeatability of scanning mechanism over multiple passes and there is also good information about the rotation of the plate with respect to the scanning axis; post-processing could rotate and extract the information on the plate with more accuracy.

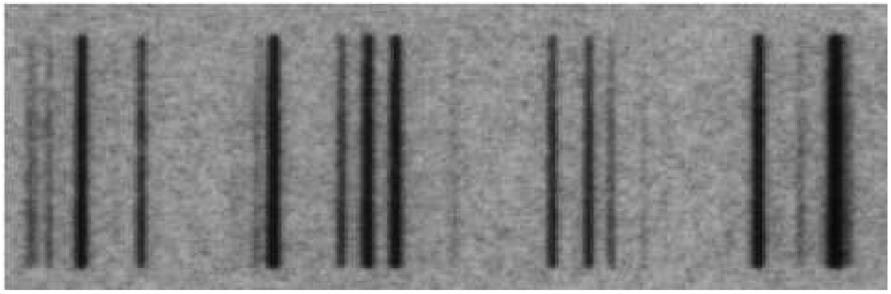

Figure 2: Close-up of a wavelength calibration exposure

Selecting a Camera and Optics

Starting with the premise that, for spectra, it would be good to have a small pixel size with a large dynamic range, I would select a CCD camera with large pixel size (using binning) for the dynamic range and a magnifying telecentric lens to magnify the photo image so that the large (binned) pixels of the camera were imaging on the order of a few (4–5μ) of the target. Since telecentric lens systems are harder to find and get more expensive the larger the field of view, I would propose in this case to investigate a CCD chip and lens combination that will just cover both the spectral and the calibration lines on either side of the spectrum. The limited sample of plates I have seen suggests that a scan width of 6 mm or so would capture all of the data in one scan for most plates.

Using the above criteria, a paper design might use a camera like the Dalsa Pantera 6M8 (~$1K with frame grabber and software). The CCD in that camera has 12-μ square pixels. With 2 $\times$ 2 binning, the pixel area is 24-μ square. That camera can record 7–10 frames per second with two taps, and half that with one tap. The camera has 3076 $\times$ 2048 pixels; it has a 14 bit A–D converter, which matches well with 2 $\times$ 2 binning. With no binning, the 12-μ pixel would support a true 12-bit dynamic range.

For a lens for this camera, there are not too many options since most commercially-available lenses are designed for CCDs in the size range 2–inches and under. Sill Optics makes two that are interesting to consider: model S5LPJ0494 and model S5LPJ7255. The first lens magnifies by a factor of 4, and the second images 1:1. The first lens costs ~$US 3500 and the second one ~$US 6200 (2009 prices).

Let's consider the system with the "494" lens and using 2 $\times$ 2 binning. The binned pixel size at the image plane would be 6μ, which is then scanning at a true 4233 dpi. The un-binned pixel would be 3μ, scanning at 8400 dpi. The binned pixel can support 14 bits or potentially 16,384 linear (>4D) steps between white and black levels. The image area in either case would be 8mm $\times$ 6mm. With the CCD aligned to have its long side parallel to the Y-axis, each frame would capture the central spectrum and the spectral calibration lines on either side of the spectrum. If we overlapped the framed by 4 mm, for example, then it would take 50 frames to capture the entire spectrogram twice. That would allow processing to average out somewhat any lens distortions, and also to provide more data to help reduce the noise level. If we allowed 2 seconds for each frame and move, it would take less than two minutes to scan a 200-mm spectrogram. In the X-direction, if we assume (for instance) that the central spectrum is about 1.4 mm wide, then there will be more than 200 pixel value samples (or 400 un-binned) to add up. That should allow for much better estimations of the location and sharpness of the spectral lines because the large sample size can average out grain and emulsion noise near the transition.

The locations of the calibration lines on either side of the spectrum can also be used to detect the angular misalignment of the plate to the scan axis. The data would now be collected in a way that allows using the accuracy of the pixels on the CCD chip to correlate between the calibration lines and the spectrum rather than relying on the mechanical repeatability of the scanner using multiple passes.

Alternatively, the camera with the 1:1 lens could be used for direct plates, and possibly for spectroscopic plates. In that case the dynamic range and the resolution would be less than ideal for spectrograms plates but the 12-bit range and 12-μ pixels would be quite good for the direct plates. The frame on the image plane would be 36 $\times$ 24 mm. With some overlap, the required $8 \times 7 = 56$ frames would be sufficient to cover a 8 $\times$ 10 inch plate. Overlapping by half and taking two full mosaic images would require perhaps 120 frames which (with the same 2 seconds to move the plate between each frame) it would take about 4 minutes to scan the plate. The resolution of 12μ pixels would be about 2100 dpi.

It should be noted that the lens distortion for the 4X magnifying lens is specified to be less than 0.05%, while the distortion of the 1:1 lens is 0.01%. It is easier to manufacture low distortion 1:1 double sided telecentric lens systems because the two sides of the lens systems (symmetrical about the stop that makes the lens double telecentric) are identical. These lens distortions can overwhelm the accuracy of the table movement, but they can also be mapped and calculated out during computer-processing of the images. We also found from the Harvard DASCH design (Simcoe 2006) that controlling flare in the lens system is critical to achieving high system contrast (MTF). We had the manufacturer make sure the edges of the lenses were blackened and had the interior of the lens mount coated with black flock paper in order to minimize internal reflections and flare. The lens is the one piece of the system where it is wise *not* to sacrifice quality in the hope of saving money.

Mechanical Scanning

For spectroscopic plates, with an optical system as described above there is only the need to scan along a single axis. A new mechanical design for a spectrum-only digitizer could use a modern air-bearing axis design or even a less expensive high-quality mechanical bearing stage. Both of those kinds of stages can even be found on Ebay at reasonable prices as equipment from the semiconductor industry is surplused.

However, some groups may already own a PDS machine (or perhaps can acquire one that is surplus), so it makes sense to consider a design that simply modifies them by updating the control and computer system. The interface into the PDS servo positioning system is relatively straightforward. A short serial data stream commands the servo system to go to a particular X-Y position at a particular speed. That allows the complete drive system of the PDS to be reused. A new computer system running the XP$^{\text{TM}}$ operating system can be used both to run the PDS table and to capture the images from the camera. The camera system mentioned above included a frame grabber that works on the modern PCI-e I/O bus available on most motherboards today.

Light System

The final piece of the system that must be changed is the light source. The light source of the PDS and its optics can be discarded and replaced by an LED source. The basic principles used in the DASCH design can be followed. A diffused source that can be controlled by the computer would allow a wider range of exposure control than the mechanical shutter which the camera provides. The source can also be cooled to maintain it at a constant temperature.

Software

Most of the software is available for this project. It would have to be integrated into a working whole, however. In addition, some software would need to be developed or modified to analyze the spectra.

Hardware design needed

Most of the hardware in this paper design exercise is readily available. It does require replacing the entire optical system of a PDS machine. The critical replacement parts (e.g. camera, lenses and computer) are available commercially, but some mechanical design and some custom parts would need to be manufactured to mount all of the new optical components and to create the light source. There would also probably need to be some specialized fixture development for each site to hold whatever variety of direct and/or spectrograms was being used.

Conclusion

From this paper design exercise, it seems to be quite feasible to develop a standardized design to retrofit PDS 1010 and PDS2020 machines to do high-quality digitization of both spectra and direct astronomical plates. I would estimate the conversion cost to be of the order of $ US 50K (for parts and labor) to upgrade a machine once a basic design is established and proven . Modifying each machine might incur additional expense to bring it up to standard if it has not been properly maintained. The resulting machine would be fast enough to digitize most collections, accurate enough to capture the information on the plates, and would be more affordable than any totally new design by reusing the X-Y table and servo system of existing PDS machines.

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Some Comments on the Previous Article

E. Griffin (elizabeth.griffin@nrc.gc.ca)

(1) The present bottleneck in deriving digital spectra from spectrograms is not the slow speed of a traditional PDS but the thorough analyses of the output. The most critical stage is deriving the intensity calibration, which is crucial to the quality of the end product. The statement, "some software would need to be developed or modified to analyze the spectra" (see **Software**, p. 23) rather understates that challenge.

(2) Intensity-calibration exposures must also be scanned, if available. Low-dispersion spectra, and some older ones, may carry spot-sensitometer dots, but spectrograms exposed in an off-axis spectrograph should show a raster of strips whose variation in intensity bears vital information about the response of that emulsion to light, and its wavelength dependence. Those strips occupy physically at least as much space on the plate as does the star spectrum plus arcs, and often there are two such sets supplementing each other. The time (and instrument design) to scan "spectrum plates" will therefore be somewhat longer (and more complex) than is proposed here. Most on-axis spectrograms will have separate calibration exposures, usually from a lower-dispersion spectrograph.

(3) The point (top of p. 21) that the grainy nature of an arc line can cause problems in centroiding on it applies just as much to an image. Graininess is inherent, and provided one captures the available information at appropriate Y-positions, maximal results can be extracted whatever the scanning technology.

(4) It seems to have been assumed that spectrographs (and astronomers) take perfect spectrograms. Unfortunately that is rarely true. The arc lines really can be displaced with respect to one another if the spectrograph lacks collimation, the star/arc lines can be slightly slanted to the orthogonal, or the calibrations can be incorrectly exposed. Overlooking those problems could cause unwanted effects to become translated into an attribute of the stellar spectrum. Errors in the focus, for instance, which are usually introduced through the camera being tilted wrongly, can show up as a radial-velocity variation with wavelength. This is not to say that the design proposed above will not cope, but rather that one cannot judge a PDS on its output alone.

(5) PDS machines are less common nowadays among observatories than the article supposes, and since the things are obsolete, observatories are not about to acquire them. Plate-scanning may therefore best be limited to specialist 'centres' (e.g. Harvard Observatory, ROB Brussels (p. 10), the SVO (p. 29).

Digital Archiving at Haute Provence Observatory

Sergio Ilovaisky (sergio.ilovaisky@oamp.fr)

Three years ago a news item about OHP archiving efforts appeared in this newsletter. Here I wish to bring you up to date on our efforts.

Spectroscopic observations at Haute Provence have been one of the traditional observatory activities since its founding before Word War II. During the photographic plate era, an effort was made by Dr. Fehrenbach, then OHP director, to maintain a current list of all spectra taken with the instruments available. The policy was to grant the observer exclusive use to his/her data but to ask for return of the plates after analysis so that they could be made available to other users, the data taken at the Observatory being ultimately the property of OHP.

A series of booklets was issued in mimeograph, listing all the spectroscopic plates taken in order of sky coordinates. The plate collection, called the *Clichothèque*, was maintained and the booklets were prepared by Observatory staff until the 1980s, when everything fell into a state of neglect (which continues up to the present day, in spite of my efforts). It was further aggravated by the loss of the magnetic tape, holding the entries, that was used to print out the Clichothèque listings, and culminated in a flood of the plate stack in 1987 and consequent loss of an unspecified number of plates. More than 37,000 plates were exposed with the coudé spectrographs of the 1.93-m and 1.52-m telescopes between 1957 and 1989, but I do not know the numbers of missing plates. Plates still keep returning to OHP from time to time.

The arrival of digital detectors in the 1980s brought about a revolution in astronomy, but resulted in a serious loss of past data because no systematic efforts were made to keep long-term backup copies of the files; 1600-bpi data tapes were over-written repeatedly owing to budget restrictions, a situation similar to what was happening at other observatories.

A serious effort to "save the bits" started in 1994 when the *ELODIE* échelle spectrograph, featuring complete on-line data reductions, came into operation at the 1.93-m telescope. Its beginnings were handicapped by the use of different, unreliable media (magneto-optical disks and DAT tapes), but a good solution was finally found in the form of affordable CD-ROM burners, which became the default backup media as of October 1995.

In spite of that, and because the *ELODIE* project did not include any systematic indexing of the spectra in a database, retrieval of existing observations from the original CD-ROMs was a fully manual-only exercise in book-keeping and disc duplication until 2003, when a joint project with Philippe Prugniel (Observatoire de Lyon), Caroline Soubiran (Observatoire de Bordeaux) and I produced an easy-to-use Web interface which queries a PostgreSQL database, named the *ELODIE Archive* (http://atlas.obs-hp.fr/elodie/). It necessitated loading all the data from the existing DAT tapes and the 400+ CD-ROMs into a DELL PowerEdge server with enough disk space in the form of a RAID5 array, a system purchased with a grant from OAMP/Marseille (The complete *ELODIE* data-set takes only 150 Gb).

That computer database[1], holding almost 35,000 spectra of which 90% are now public, has seen increasing use during the last couple of years, with 27 refereed publications appearing between 2005–2008 that were based on data retrieved from the *ELODIE Archive*. We are happy to see that not only are the *ELODIE* data now safe in a secure computer environment (with backup

[1]http://atlas.obs-hp.fr/elodie/Archival_ELODIE_Pubs.html)

duplication) but also that they are actually useful to astronomers the world over! A subset of the best data for 1962 stars, packaged as the *ELODIE Library* by Prugniel and Soubiran, have also been used extensively by the international community (26 refereed papers published between 2005–2008). It is interesting to reflect that stellar red-shifts from the Sloan Digital Sky Survey are based on templates from the *ELODIE Library*.

When the *ELODIE* spectrograph electronics unexpectedly failed on 2006 18 July, the replacement instrument, *SOPHIE*, was in the final phases of integration and testing. We decided not to commit manpower to repair the faulty electronics but instead to go full speed ahead and bring *SOPHIE* to operational status as soon as possible. First light at the telescope on 2006 31 July was followed by a testing and scientific validation period which led to the spectrograph being opened for public used in October of the same year. With much better throughput than its predecessor, *SOPHIE* has already been a very successful instrument (25 refereed papers published between 2006 and March 2009). It is mainly being used in the hunt for extra-solar planets, as was *ELODIE* and for follow-up work of *COROT* targets, but also for stellar seismology studies and for preparations for the *GAIA* space mission.

From the start of the *SOPHIE* échelle spectrograph project I wanted to associate it with a powerful digital archiving system. This is now fully operational, with the data, both raw and fully reduced, entering the database automatically on the afternoon following data acquisition, and completely by-passing manual archiving to CD-ROM. More than 30,000 spectra have already been indexed in that way, and are available on-line at http://atlas.obs-hp.fr/sophie from a dedicated Apple Xserve machine and associated XRAID array, which now also hosts the *ELODIE* data. The property period for new data is one year, but key projects benefit from a 5-year protection period. (Those data are still made available after one year, but have the time information masked). The database was created as a joint project with Prugniel, but it still needs additional software development to bring it to the same level of completeness as the *ELODIE* database.

Digital data from the OHP 1.52-m and 1.20-m telescopes are still regularly copied to CD-ROM/DVD-ROM but are not yet available on-line. There are vague plans to do so, but funding has not been forthcoming. Of course, those data are all in raw format, so it would be necessary to reduced them before making them available. That in itself is, as you all know, a formidable task.

My requests for funding to clean, preserve and inventory the OHP plate stacks have not yet been successful, but the Observatory Director, Michel Boer, is supportive of my efforts. We are currently looking into several possible sources, in particular the French Ministry of Culture, by linking the fate of the plates with the preservation of historic spectrographic instruments, some of which we hope will be presented to the public in an appropriate setting.

In preparation for this, I am currently working on a Web site which deals with the development of astrophysics in France based on OHP facilities. The first pages describing the two first small prism spectrographs used at OHP are now available[2], [3], but only in French for the moment.

The impending demise of the OHP photographic laboratory renders it particularly urgent to save and preserve the historic photographs of instruments and building construction from the 1940s. I have already scanned photographs and plates to serve both for a planned 'history'

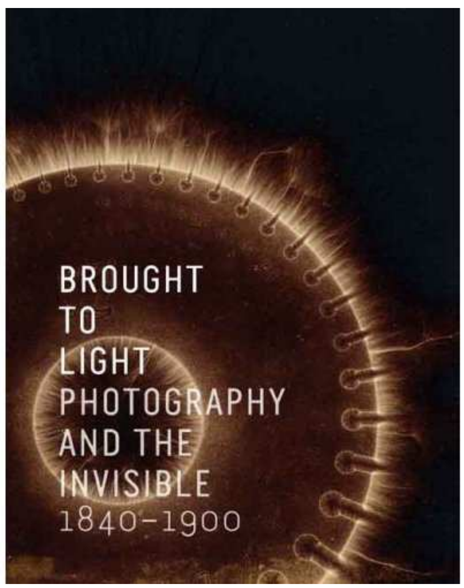
[2]http://www.obs-hp.fr/www/histoire/tremblot/tremblot.html
[3]http://www.obs-hp.fr/histoire/spectroC/spectro_C.html

Web-site and for the Ministry of Culture efforts, which also involve an official inventory of our historic buildings. I regret to have to announce that the 1.52-m coudé spectrograph has been disassembled and the mechanical parts discarded. The 1.93-m coudé spectrograph has already suffered a similar fate, but the mechanical parts are still kept somewhere in the woods.

Book Review: "Brought To Light"

Reviewer: A.C. Davenhall, Edinburgh University (acd@roe.ac.uk)

Corey Keller (Ed.), 2008, San Francisco Museum of Modern Art and Yale University Press, New Haven and London, Hardcover, ISBN: 9780300142105, ISBN-10: 0300142102, pp. 215, 207 illustrations. $(US)50.00.



Brought to Light is the catalogue of an exhibition of the same name on the subject of early scientific photography in the period 1840–1900. The exhibition ran at the San Francisco Museum of Modern Art from January to October last year and then transferred to the Albertina in Vienna. Both exhibition and catalogue are divided into a number of thematic sections: microscopy, astronomy, motion studies, electricity and magnetism, X-rays and finally spirit photography. The astronomy section is of most immediate interest, and includes a selection of arresting early photographs of the Moon, Sun, eclipses, planets, star fields and nebulae. However, the non-astronomical sections contain many unfamiliar and unusual images that are also likely to be of interest. The inclusion of a section on spirit photography seems odd now, but in the nineteenth century the subject was approached scientifically, at least in some quarters.

Brought To Light is a sumptuously produced hardback. It is full of striking photographs, excellently reproduced, many of which would be otherwise difficult to obtain. There are four introductory essays and each section also has its own shorter introductory essay. The one for the astronomy section is by Marie-Sophie Corcy of the Musée des Arts et Métiers, Paris. The volume seems likely to be of interest to many readers of *SCAN-IT*.

Unexposed Photographic Plates Available

N. Zacharias (nz@usno.navy.mil)

The US Naval Observatory is the proud owner of about 200 Kodak glass plates. They are unexposed, “fresh” plates, ready to be used at a telescope, if there is a plate holder. The following table gives the inventory:

Plate Size (inches)	Emulsion type	Number of plates
$8 \times 10 \times 0.060$	TMP113	24
$8 \times 10 \times 0.060$	TCF1A5	12
$8 \times 10 \times 0.060$	103a-O	144
$8 \times 10 \times 0.060$	103a-G	36
$8 \times 10 \times 0.250$	103a-G	12

Interested parties who have the capability to use these plates should please contact me at nz@usno.navy.mil; *Tel:* +001-202-762-1423. If you know someone who might be interested, please pass on this message. The plates are from the 1990s and have been kept in a freezer. They should therefore still be of good quality for taking pictures of the sky.

This might be the last opportunity in history to do so!

Scanning Service for Photographic Spectra

Elizabeth Griffin (elizabeth.griffin@nrc.gc.ca)

I am pleased to announce the commencement of a modest service to digitize photographic spectra. The plates can either be from the DAO/HIA archive, or sent from elsewhere; in the latter case they need to be accompanied by relevant observing details (log-book pages or equivalent). The routine output consists of 1-D spectra in relative intensity units, in equal wavelength steps and with the continuum normalized to 100%.

The scanning is carried out on the DAO's PDS microdensitometer. The scanning and part of the data reduction is being done by a trained technician under my supervision, under the auspices of the World Spectra Heritage (WSH). Since we are both volunteers, some payment for this service is in order. The rate is fully negotiable, since the work-load depends on the type of plate and the nature of the spectra to be extracted, and will be in contract with the WSH. As a rough guide, at present it may take 4 hours to digitize, calibrate, process and extract a spectrum; a suggested rate is around 40 $CAN per hour. However, a pipeline for data reductions is being developed, and large quantities of plates of the same physical format should then be processed considerably more quickly. At present a small proportion of any income needs to be set aside by the WSH for maintenance and any repairs of the PDS.

All extracted spectra will be loaded on the CADC Website, but access to spectra that have been specifically requested will be limited to the Investigator for a proprietary period (to be negotiated).

This is the first major stride towards realising the SVO (the Spectroscopic Virtual Observatory). One long-term objective is to digitize a major part of the DAO's own collections (which include 16000+ high-dispersion spectra from the 1.2-m coudé and 93000 spectra from the 1.8-m cassegrain) using two PDSs, one giving priority to requests and the other steadily scanning large quantities of similar-format plates.

2009 July