

## **DIVISION I / COMMISSION 8 / WORKING GROUP ASTROGRAPHIC CATALOGUE AND CARTE DU CIEL PLATES**

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### **PROCEEDINGS BUSINESS MEETINGS on 17 and 21 August 2006**

#### **1. Introduction**

Various experiments have definitely demonstrated that one-micron accuracy ( $0.''06$ ) on the definition of stellar images on CdC plates cannot be claimed, as it was speculated back in 1999. More realistically, a 2-3 micron accuracy is achievable, getting worse toward the survey magnitude limit, with an average magnitude error of 0.3. The level of astrometric accuracy corresponds to a  $0.''2 - 0.''3$  error in position at Epoch 1900, which, once used as first Epoch for proper motion determination in combination with modern epoch observations, can produce errors at the level of 2-5 mas/yr, thereby allowing to detect stellar motions larger than  $0.''01/\text{yr}$ , which at a distance of 500 pc from the Sun correspond to  $\sim 25\text{-}60$  km/s tangential velocity. Therefore, the AC/CdC heritage collection can be regarded as a highly valuable first-epoch material, e.g., for the realization of a Tycho-2 extension to fainter magnitudes ( $\sim 15$  photographic), especially in selected areas where radial velocity data are available, for the exploration of stellar kinematics beyond our solar neighborhood.

In the following I present a possibly non-exhaustive list of efforts that, since the last IAU in Prague, have been undertaken to digitize parts of the AC/CdC collections pertaining to the different zones, with the twofold intent of exploiting the scientific potential of these plates and making the digitized images available to the community.

#### **2. Cordoba zone**

The AC/CdC plates of the Cordoba zone have been digitized with a commercial scanner (UMAX Astra1220P) at low resolution for identification and quick-and-raw measurements (Calderón *et al.* 2004); positional accuracy is  $\sim 1''$ , photometric accuracy not yet determined. The digitized plates are available to the community; digitization of selected images at high resolution can be made available upon request.

Moreover, Bustos Fierro & Calderón (2003), have developed a method for the measurement and reduction of AC/CdC plates with the use of a CCD camera, which has been tested on a plate of the Cordoba zone. Their results indicate an astrometric error of  $0.''2 - 0.''25$  for stars covered by the Tycho-2 catalog, but possibly worse for fainter stars.

### 3. San Fernando zone

As a result of the collaboration between the institutions CIDA (Venezuela) and ROA (San Fernando, Spain), and after several exploratory tests with other techniques and methods to digitize the plates, ROA has completed the scan with a commercial flatbed scanner (AGFA DuoScan F34) of its collection of AC/CdC plates (declination zone  $-3^\circ$  to  $-9^\circ$ ). Every plate has been digitized in two positions (rotated by 90 degrees unto each other) in order to detect possible systematic trends in the measured coordinates. The two images of every plate have been recorded in FITS format on CD-ROM. The data are recorded on CD-R media located at ROA, under control of both collaborating institutions until the resulting astrometric catalog is completed and made available. The reduction of the Carte du Ciel plates is being accomplished in a two-step process. First, the reduction procedures have been developed based on a subset of the plates, covering eight hours in Right Ascension. The reduction pipeline, from raw pixel data to final stellar coordinates, which includes correction for the distortion introduced by the scanner, is completed. Based on the  $\sim 400$  plates included in this first stage, the internal precision is 3 microns ( $\sim 0.''18$ ). External comparison with the Tycho-2 Catalog indicates a range of accuracy from  $0.''2$  up to  $0.''4$ , depending on the magnitude of the star as well as its distance from the center of the plate.

### 4. Toulouse zone

Lamareille *et al.* (2003) investigated the use of a commercial scanner to digitize CdC plates of the Toulouse collection for stellar photometry. The tested scanner is an AGFA SNAPSCAN 1236S with resolution  $600 \times 600$  dpi. Having calibrated the density-to-intensity transformation with the use of about 100 standard stars per plate, the reported accuracies are of the order of 0.2 to 0.4, depending on the location of the target star on the plate.

### 5. Bordeaux zone

Ducourant *et al.* (2006) have published the PM2000, a catalog of proper motions for 2,670,974 stars, complete to  $V = 15.4$  mag. The proper motions were derived from the reduction of 512 CdC plates of the Bordeaux zone scanned at the APM in Cambridge (Rapaport *et al.* 2006) plus modern-epoch observations with the Bordeaux CCD meridian circle. Reported errors are from 1.5 to 6 mas/yr, depending on magnitude.

### 6. Sydney zone

Fresneau *et al.* (2003, 2005) have selected, measured (with the APM machine in Cambridge) and analyzed a set of 650 CdC astrographic plates of the former Sydney Observatory along the 4th galactic quadrant. When compared to the GSC 1.2, stars with total annual p.m. larger than  $0''.015$  can be considered as 'high' p.m. stars and their distances are derived in order to investigate the differential rotation in the galactic plane up to 500 pc from the Sun. The use of the first Epoch positions provided by these plates in the framework of the Virtual Observatory is currently investigated in order to provide a 'hands-on' experiment when scanning the legacy of the CdC programme in the far southern hemisphere at Macquarie University with a fast scanner.

### 7. Closing remarks

The Cart du Ciel plate material deserves to be salvaged and digitally recorded to the best accuracy for those astrophysical investigations which can exploit this unique, 100 year-old picture of the sky. In this respect, the scientific interest of such collection is potentially equivalent to that of all the other world-wide astronomical plate archives. For this reason, the goals and objectives of our WG and those of the PDPP task force attached to the IAU Commission 5 on *Astronomical Data* are shared; therefore, to the best interest of both groups, only one WG/Task Force dealing with the preservation and digitization of this heritage from the past should be preserved.

Finally, a sensible issue not yet clearly answered, which would be decisive for a realistic estimation of project resources and timelines, is the level of accuracies achievable from the fits images of AC/CdC plates scanned with commercial scanners. This issue is equally relevant to all astronomical plate collections.

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