

## 24. PHOTOGRAPHIC ASTROMETRY (ASTROMÉTRIE PHOTOGRAPHIQUE)

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Ce rapport est limité aux études d'astrométrie photographique relatives aux parallaxes, aux positions et aux mouvements propres. On a écarté les travaux particuliers relatifs aux nébuleuses et aux mesures d'étoiles doubles. Après analyse des travaux publiés et en cours, la situation générale de l'astrométrie photographique et son avenir sont examinés.

### 1. INSTRUMENTATION – OBSERVATIONS

C. A. Murray (10.112.018) stresses the advantages of using a large telescope for proper motion and parallax programmes, even if the telescope is not a dedicated one, such as the USNO 61-in. reflector. Large Schmidt telescopes with fast automatic plate measurement may possibly be used for surveys of nearby stars.

W.F. van Altena (11.041.060) also suggests some astrometric uses of large wide-field reflectors.

C.G. Wynne (10.032.009) shows that a three-lens corrector can be designed for a paraboloid like the Isaac Newton telescope to give a very similar performance to the Ritchey-Chretien triple corrector. M.A. Sosnina (12.032.019) studies the possibility of application of the Ritchey-Chretien mirror systems for photographic astrometry with a series of different correctors. P. Fellgett (11.032.028) compares the performances of Schmidt and field corrected telescopes for the quality of images; this comparison is in favour of Schmidt telescopes.

Les essais de résolutions astrométriques globales des clichés de Schmidt étant décevants, sauf si on se limite au centre du champ, P. Lacroute and P. Bru (11.041.056) suggèrent l'emploi d'un réseau appliqué sur la plaque courbée pour connaître les défauts dus à la courbure irrégulière des plaques. Les premiers essais sur plaques prises au Mont Palomar et mesurées à Washington sont encourageants.

Ch. de Vegt reports (11.041.057) that a newly developed astrographic zone for the yellow spectral region has been set in operation at the Hamburg Observatory which will be available for a new fourfold coverage of the northern hemisphere. The technical description of the instrument is given, and a final positional accuracy  $\sigma = 0''.07$  of the new catalogue is expected.

The qualities of the astrographs in use are studied: L.W. Fredrick, alone (09.032.010) and with F. A. Yanna (12.032.043) on the scale of the 26-in. MacCormick; J. L. Hershey (09.041.020) on a variation in time of the lens of 24-in. refractor of Sproul; K.G. Steinert (11.032.033) on the AFR-1 Astrograph of the Moscow Observatory; N.N. Kiselev (11.032.019) investigation on a 40-cm astrograph; A.A. Latypov on the magnitude equation of the Tashkent normal astrograph.

A special astrometric telescope for experimental relativity is now operative at Tucson (11.032.023) for daytime astrometry of objects near the Sun. The design goal was to achieve accuracies of the order of  $0''.001$  in measurements of stars.

W.F. Altena (11.111.007) describes a photoelectric scanner for the measurement of trigonometric parallaxes. A high-contrast photographic positive of the parallax field is used as a mask and the modulated light from the parallax star and the reference stars is viewed separately by two photomultipliers.

E. Høg and C.A. Murray report on a project to move the Carlsberg automatic meridian circle from Brorfelde to a good climate. This project giving a much greater number of positions for

reference stars, more accurate on fainter stars, will be very useful for the necessary reference stars in photographic astrometry.

Some projects of space astrometry are presented (11.04.059) and (11.041.060), and thereafter in an international colloquium (ESRO, SP-108 March 1975). Using the LST, W.F. van Altena and others show the possibility of obtaining very accurate relative positions ( $0''.001$ ) on faint objects (to  $m < 20$ ) with applications on angular diameters of stars and planets, on binary stars, on parallaxes and proper motions of faint stars, etc.

P. Lacroute and P. Bacchus: A very stable complex mirror reflects the images of two fields at about  $90^\circ$  into a 40-cm diameter telescope. A photoelectric device with a grid gives the precise relative positions of the stars in the common field. We obtain precise values of arcs, near  $90^\circ$  between the stars and it is possible to build a precise reference sphere. An option on space-lab seems able to give, with 8 weeks of observations in two years, about 40 000 stars with a precision of  $0''.001$  on positions and parallaxes,  $0''.001$  by year on the proper motions for  $m < 10$  and errors increasing to  $0''.005$  for  $m = 16$ . Another option, TD option, with a free flyer satellite scanning the sky seems able to give, in two years, about 300 000 stars at  $m < 11$  with mean square errors of the order:  $0''.002$  and  $0''.002$  per year to  $m = 10$ . But, we have no choice of the stars. These projects are studied by ESA. The projects seem able to provide a real revolution in astrometry. But, at the best, the possibility to observe will not be before 1982.

## 2. INSTRUMENTATION – MEASUREMENT

The proceedings of a conference on image processing techniques in astrometry held in Utrecht in March 1975 are very interesting for the present state of measuring machines (Astrophysics and Space Science Library, 54). We have for astrometry: p. 160 by J.S. Newcomb a description of the control data machine used by W.J. Luyten. Some improvements are possible. The use of a different density level either by a different scan or by one scan by changing the hardware. Measurements on one plate are possible by changing the software. In this case some tests show that the mean square error of the measures is  $0.97 \mu\text{m}$  on the positions and  $1.32 \mu\text{m}$  on the diameters with Schmidt plates.

- p. 171. C.A. Murray and W. Nicholson report in detail on the use of the Galaxy machine at the Royal Greenwich Observatory. Now the original paper tape input/output system is being replaced by a nova 2/10 control computer system including magnetic tape and disc units.
- p. 185. A microdensitometer-comparator built for the Astronomical Institute at Utrecht for the reduction of stellar spectrograms.
- p. 199. The Grant measuring machine of Hale Observatory is described by E.W. Dennison.
- p. 209. The new 'Starscan' machine built by Optronics International to specifications drawn by the U.S. Naval Observatory. The speed and the precision are better than with the SAM machine (11.034.061).
- p. 211. The two-coordinate Grant machine of Sproul Observatory is described by J.L. Hershey. S.L. Lippincott reports: In terms of accidental accuracy this machine appears to extract twice as much positional information as the old machines.
- p. 127. The new Cosmos facility at the Royal Observatory Edinburgh was described. The goal was to detect and measure all the images for statistical studies on a 355-mm square plate in a time not exceeding one day. In addition, to obtain very precise measurements of selected stars and galaxies at lower speed; and measurements on positions and densities of lines in the spectra of all stars and galaxies on plates with objective prism.
- p. 223. The ESO S-3000 measuring machine in the Sky Atlas Laboratory is described by R.M. West. It is a raster-scan machine built by Optronics International which is interfaced and controlled by an Alpha 16 Computer. It permits recognition and accurate measurement of stellar and extended images, as well as filtering of plate faults. Some improvements in speed are studied by the use of a diode-array for the scan.

pp. 229–253. Some machines for automatic measuring in two dimensions, first for measurements of spectra but utilizable on stellar and galaxy fields, are described: IRIS from Saab-Scania, an automated measuring system built by the Institute of Astronomy of Cambridge and the computer-controlled comparator Astroscan.

Otherwise G.F.O. Schnur (*Mitt. Astron. Ges.* 36, 121, 1974) studies, for comparison, the IRIS, Kosmos and Starscan machines.

A.R. Klemola reports: At the Lick Observatory the upgrading of the Gaertner automatic measuring machine has been completed. The errors of Screws of the Yale Mann measuring engine are investigated by D. Hoffleit (09.034.101).

J. Dommanget avec une Ascorecord de Zeiss associée à un PDP8 avec télétype tend vers une automatisation complète de la mesure à la résolution des plaques avec consultation automatique du catalogue repère sur bande magnétique.

### 3. MODELS OF REDUCTION

These problems are studied with many other things in H. Eichhorn's book *Astronomy of star positions*.

H. Eichhorn (11.031.002) studies the case of least-squares adjustment with relatively large observation errors and inaccurate initial approximations, and (11.031.055) the influence of the reduction model on the systematic accuracy of adjusted parameters.

A. Valbousquet (*Ann. Obs. Stras.* 3, fasc. 1) compare en détail l'efficacité théorique de l'emploi des recouvrements de clichés en posant correctement le problème ou en employant des méthodes approchées plus simples.

Ch. de Vegt and H. Ebner show the possibility of a general computer programme for the application of the rigorous block adjustment solution in photographic astrometry. A solution for the full sphere with multiple overlap can be provided within 3 h for 48 000 unknown plate constants on CDC 7600.

J. Dommanget (11.041.063) montre l'intérêt qu'il y a à n'introduire dans les formules de résolution que des constantes ayant un sens physique, ceci particulièrement pour les clichés à grand champ et fixe à 11 le nombre minimum de paramètres indispensables, et (11.041.058) indique la manière de tenir compte de la réfraction sans introduire plus de paramètres qu'il n'est indispensable.

H. Debehogne, in some papers (09.031.028) (10.041.046) (12.031.167) (12.041.005) (12.041.021), studies in the application of the mean square method the effects of the errors on the reference positions, on the errors in different parts of the field.

### 4. TRIGONOMETRIC PARALLAXES

P.M. Routly reports: The USNO Program of determining the Trigonometric Parallaxes and Proper Motions of Low Luminosity Stars has been continued using the 155-cm astrometric reflector at Flagstaff, Arizona. Approximately 31 000 plates have been obtained since the start of the Program in 1964, about 7000 since the last report. A third catalog containing astrometric and photographic results for 88 stars has appeared (USNO Publ. XXIV, Part I, 1975), and a fourth is in preparation. Several stars of special interest have been discussed individually in the literature. The current program consists of approximately 235 stars, with emphasis upon intrinsically faint degenerates.

At Herstmonceux, C.A. Murray reports:

(a) *26-in. refractor*. Observations for this programme have continued. Parallaxes for a further 25 stars, of which 15 are Vyssotsky stars, have been determined, and the results are being prepared for publication. Observation on the seven Hyades fields are nearing completion; one field, containing five of van Altena's candidate stars, has been measured.

(b) *Isaac Newton telescope*. The pilot observing programme has continued and is planned to finish in 1976. Two fields have been measured and reduced.

(c) *UK Schmidt telescope*. A survey programme intended to search for nearby stars in a  $5^\circ \times 5^\circ$  field near the South Galactic Cap, has been started; plates will be measured on the Galaxy machine at Herstmonceux. From a preliminary search of the field, it is estimated that parallaxes for some 20 000 stars brighter than  $M_V < 18$  will be measured.

At Yerkes Observatory, van Altena and K. Cudworth report that the measurement and reduction of plates taken during the first phase of the new Yerkes Observatory parallax program described in previous reports is continuing. To date, the results have been published for 42 of the original 52 stars. Observations are progressing in the second phase where the emphasis has been placed on the determination of the Pop I and Pop II distances scales through parallax measurements of Hyades members and subdwarfs respectively. The parallax program is being continued under the general direction of Cudworth.

For Lick Observatory, S. Vasilevskis and A.R. Klemola report that the Lick parallax program with the 36-in. refractor is being continued. Several departures from traditional procedures have been tried. The principal departures that remained after many experiments, are: (a) observing at much larger hour angles than traditionally, and (b) introducing additional plate constants with the consequence of increased number of reference stars.

In general, 20 plates of average quality yield parallaxes with a standard error of 0".005. Vasilevskis has completed the determination of trigonometric parallaxes for 91 of the 212 active fields of the general parallax program and a list of more than 100 parallaxes is published in 1975. Trigonometric parallaxes have also been measured for 16 fields in the Hyades by Klemola, Harlan, MacNamara and Wirtanen.

The astrometric program of the Sproul Observatory as described in previous reports is continuing. From Nov. 1, 1972 to Nov. 1, 1975, 15 600 plates were taken with the 61-cm refractor and some 25 000 plates were measured on the Grant two-screw machine installed in 1971. 16 papers giving parallaxes on various objects are published by van de Kamp, S.L. Lippincott, W.D. Heintz, J.L. Hershey and others.

At Leander MacCormic Observatory the 26-in. refractor is used for some determinations of parallaxes: L.W. Fredrick and P.A. Yanna determined 23 parallaxes (10.111.004).

At Van Vleck Observatory of Wesleyan University, the program of parallaxes is continued by A.R. Uppgren and co-workers: 20 parallaxes of dwarf stars of class K 2, and later, and many parallaxes on the faint stars in the Hyades (11.111.001).

At the Allegheny Observatory, with the Thaw refractor, G.D. Gatewood and co-workers published 25 parallaxes and some studies on very near stars; H. Eichhorn and G.D. Gatewood on Barnard's star (10.041.017), G.D. Gatewood on Lalande 21185 (11.111.003).

With the 26-in. refractor of the Yale Observatory, Kimbell (10.111.001) obtained 35 parallaxes.

The South African Astronomical Observatory reports that the stellar parallax work is still continuing.

At Wien, Prochaska, Meurers and Auer have studied the field of the 60 in. to obtain parallaxes, and begin the work on the field of  $h$  and  $\chi$  Persei, and of the Pleiades.

Some general problems of the trigonometric parallaxes are studied by A.R. Uppgren (09.111.003). The significance of the published errors in trigonometric parallaxes is evaluated for several observatories from their correlation with the parallax predicted from the color for K3-M2 main sequence stars, by A.R. Uppgren (09.111.003). A.R. Uppgren with others (09.111.009 and 10.111.005) study the significance of parallaxes in  $x$  and  $y$  coordinate and some effects of  $m$  and color on  $\pi$ . W.D. Heintz notes some inconsistencies in long-term parallaxes series (11.111.008).

## 5. PHOTOGRAPHIC CATALOGUES

At Hamburg-Bergedorf Observatory, W. Dieckvoss reports that for the zones Helsingfors, Catania, Rome-Vatican, Greenwich of the Astrogaphic Catalogue (*Carte du Ciel*), by means of a computer programme, members of polynomials in the coordinates were derived and punched on cards (one card for each plate) that will be used to allow for differential refraction and

aberration in order to transform the published rectangular coordinates of the stars into a truly orthogonal system. Thus the value of the catalogues may be enhanced by applying plate-solutions with a minimum number of parameters. In 1954 (*Astron. J.* 59, 143, O. Heckmann, W. Dieckvoss, H. Kox) the zones  $21^{\circ}$  to  $24^{\circ}$  of the Astrographic Catalogue Paris were handled in a similar way.

At the Center of Stellar Data of Strasbourg P. Lacroute and A. Valbousquet give on tape the positions for all the stars of the Astrographic Catalogue, from  $+31^{\circ}$  to  $-2^{\circ}$  on the basis of AGK2-AGK3. The fields corrections for all the zones, as functions of the dates, are evaluated and applied. A new solution below  $+12^{\circ}$  will be prepared after corrections of AGK2.

W. Dieckvoss published the AGK2-AGK3 catalogue. The positions are the AGK3 positions, the proper motions come from the differences between AGK3 and AGK2 on the FK4 system. For each star the magnitudes from AGK2, the spectral type, mainly from H.D. and Vyssotsky, and the number in the B.D. are given. A different solution by P. Lacroute and A. Valbousquet uses the overlapping of the plates, but the same measures are on tape at Strasbourg (Center of Stellar Data). A study of the two solutions, by de Vegt, shows sometimes noticeable differences. A publication in preparation, by Lacroute and Valbousquet, shows the possibility of noticeable differences, and, below  $+10^{\circ}$ , there are some systematic errors coming from the measures in AGK2 in the solutions without overlapping. A new reduction of AGK2, below  $+10^{\circ}$ , is in preparation.

## 6. SOUTHERN HEMISPHERE

The first epoch plates of the Yale-Columbia Southern proper motion programme have been completed under the direction of A.J. Wesselink. It has been decided that the 51-cm double astrograph will remain at El Leoncito until the time for taking the second-epoch plates.

At the Sydney Observatory, W.H. Robertson reports: The plates from  $-38^{\circ}30'$  to  $-68^{\circ}30'$  are being taken. We have begun on the zones centred on  $-71^{\circ}$  and  $-73^{\circ}30'$ . We plan to continue northwards when a definite arrangement is made about measuring the plates. The plates,  $5^{\circ} \times 5^{\circ}$ , were taken with a grating which gives first order images 2.3 mag. fainter than the central image. The plates are examined and retaken, if necessary. Part of the examination is to verify that the central image of a star of magnitude 11.5 would be measurable in our measuring machine which has an electronic scanning device.

The South African Astronomical Observatory reports that scan-positions have been obtained from plates of the wide-angle lens overlap programme assigned to the Cape. The positions have been sent to Herstmonceux for further editing before the plates are measured on the 'Galaxy' machine. S.V.M. Clube gives the star positions from overlapping plates in the Cape zone  $-40^{\circ}$  to  $-52^{\circ}$ .

## 7. PROPER MOTIONS

At Lick Observatory, A.R. Klemola reports that in the proper motion relative to galaxies program second-epoch photography has been completed for over 50% of the fields, while measurements and reductions are concentrated on a zone with centers at declination  $+25^{\circ}$  to  $+35^{\circ}$  and lying outside the zone of avoidance by Junes, Klemola and Wirtanen.

In the Pulkovo program of proper motions relative to the galaxies, the following papers were published: A.V. Bolbochanu (09.112.003) on SA.52 relatively to 152 galaxies, Fatchikin (11.112.006) for 14 600 stars on 85 selected areas with 281 galaxies, N.N. Bronnikova (11.112.007) for 1474 stars in SA 32 around  $\alpha$  Cyg, Latypov at Tashkent has studied NGC 457, NGC 663 and 10 other areas with clusters.

At San Fernando, Luis Quijano reports reductions of nebulae for the first epoch plates with the Carte du Ciel by Lopez Palacios.

A comparison between the results of the programmes of Lick and Pulkovo is made by A.N. Deutch and A.R. Klemola (12.112.021). The results show agreement in some instances and



disagreement in others. The analysis suffers to some extent from absence of proper motions in the zone of avoidance and in the southern part of the sky.

N.V. Fatchikin compares the results of the secular parallaxes of stars. The comparison is difficult because the results of Lick Observatory will be interpolated for each area of the Pulkovo Catalogue. The largest difference in parallaxes is as follows: Lick-Pulkovo  $\approx +0''.004$ . The secular parallaxes obtained at some other observatories (Groningen, MacCormick, Radcliffe and others) in high galactic latitudes ( $b = 67^\circ$ ) appear to be larger than the values obtained both at the Pulkovo and Lick Observatories.

W.J. Luyten reports that he has completed the proper motion analysis of 800 plates from the Palomar survey, which include 28 plates in the Whiteoak Extension at  $-36^\circ$  and  $-42^\circ$ . More than 50 000 motions from the hand-blinked plates have been published, while from the machine-processed data 30 000 new motions, mostly larger than  $0''.18$  annually, have been published. On magnetic tapes the data for 250 000 stars with motions between  $0''.18$  and  $0''.09$  annually are being prepared for the NASA data Center at Greenbelt, Maryland.

From the Bruce and Palomar Surveys have now come more than 1900 new motions larger than  $0''.5$  annually (considerably more than half the total known so far).

Data for more than 4500 double stars with common proper motion, for some 5000 probable and possible white dwarfs, and for 3000 low-luminosity stars have been published, including a special list of 123 stars with luminosities smaller than one ten-thousandth of that of the Sun.

A catalogue giving proper motions for more than 11 000 stars near the North Galactic Pole has been published; this does not support the claims made for the existence of large numbers of nearby M dwarfs with small proper motions.

Discussions of motions in the Hyades region and of proper motions measured relative to galaxies have shown the existence of a number of spurious motions, and some doubt about some results of Lick Observatory relatively to the galaxies.

Giclas reports that the Lowell proper motion survey with the 13-in. astrograph of stars between magnitudes 8 and 17 with motions larger than  $0''.19 \text{ yr}^{-1}$  is continuing in the southern hemisphere to declination  $-30^\circ$ . Data for 725 program stars, 637 white dwarf suspects with motions less than  $0''.20 \text{ yr}^{-1}$  and 241 very red stars with similar small motions have been published in *Lowell Obs. Bulletins 160 and 162*. Measurements of position and motion directly from the plates on the blink comparator have now been digitized.

C.A. Murray reports that preliminary proper motions for some 3000 stars in seven Kapteyn areas have been determined from measurements on Galaxy of old Radcliffe and modern Hermonceux plates. Final results in Sa 57 have been derived by the plate overlap technique.

## 8. PARTICULAR WORKS

Hanson has completed an investigation of the Hyades convergent point and distance based on proper motions within a  $6^\circ$  field and is extending the study to the more extended surrounding region. K. Cudworth has completed a study of the motions, statistical parallaxes and kinematics of planetary nebulae. Stone is completing a proper motion study of the young open cluster NGC 654, and of OB stars to investigate the secular parallaxes of the reference stars. K. Cudworth, after a study on the proper motions of the faint blue stars found by Rubin, concludes that very few of the stars are nearby white dwarfs. From a study of photometry and proper motions in a few fields at very low galactic latitude, K. Cudworth has reached the preliminary conclusion that the secular parallaxes at these latitudes are smaller than expected from previous work.

B.F. Jones (09.112.002) did important work on the relative motions of the Pleiades to improve the definition of the main sequence.

Ch. de Vegt reports: The cluster p.m. programme has been continued. Next epoch plates have been taken for the clusters Stock 2, NGC 1039, 1502, 1528, 1545, 1C 4665, NGC 6633, IC 4765, NGC 6709, 6871, 6940, 7092, 7160 and 7209 with the new zone-astrograph. The achieved m.e. for the new epoch positions is  $0''.07$ . The reductions of the old epoch plates (from the Carte du Ciel catalogue) has been continued.

W.H. Robertson has been working on proper motions in the region of galactic cluster NGC 6025. The study is almost ready for publication. K.P. Sims has published a paper on proper motions of variable stars in the Sydney astrographic zone. This gives measures of 30 variable stars chosen from the Groningen list.

At Bonn, Pendl and Geyer have studied the proper motion in NGC 1245, 7044 and Pendl 1819 stars near NGC 7789.

A new proper motion is given by G.D. van Albada for the Hyades white dwarf eclipsing binary B.D. + 16° 516.

Bouigue donne les mouvements propres des étoiles de référence de la zone de Toulouse de la Carte du Ciel.

N.M. Artyukhina and A.P. Kalinina (11.112.014) give 5468 proper motions ( $m < 13.0$ ) for stars in the region with radius  $4.5$  around the center of the  $\alpha$  Per Cluster. The bases are the astrographic catalogues and 6 plates from the astrograph of the Sternberg Astronomical Institute. The mean square error is about  $0.006 \text{ yr}^{-1}$ . The catalogue is complete to 12.0 mpg. Probable members of the cluster are indicated in a table.

## 9. SITUATION ACTUELLE ET PROSPECTIVE

### A. Parallaxes trigonométriques

Jusqu'ici les instruments utilisés étaient des réflecteurs à long foyer. Cependant, le grand succès du réflecteur de 155 cm de Flagstaff incite à utiliser des grands réflecteurs; un télescope de 1 mètre à Turin, le télescope Isaac Newton à Herstmonceux et peut-être les grands télescopes de Schmidt dans l'hémisphère sud. L'emploi de grands télescopes sur des champs notables aurait le grand avantage de déplacer les magnitudes limites d'environ 13 à 18 et de donner des résultats en nombre suffisant pour des recherches statistiques.

W. Gliese (ESRO, SP. 108) indique qu'il y a à peu près 7000 étoiles avec parallaxes trigonométriques mesurées, mais l'incertitude quadratique moyenne est de l'ordre de  $0.009$  et seulement 5% sont connues à 10% près. En outre, les différences systématiques que l'on constate entre les mesures des observatoires, jusqu'à  $0.005$  entre ceux du nord et du sud, rendent douteux l'emploi statistique des parallaxes qui ne sont pas individuellement significatives, W. Gliese (07.111.002). Sur la base de l'incertitude des mesures actuelles,  $\pm 0.005$ , et de l'inventaire de Gliese sur les étoiles proches, le nombre des parallaxes qu'on pourrait obtenir à 10/100 près est d'environ 900 jusqu'à la magnitude  $m_v = 13$ . Il y a donc encore un très important travail efficace possible, soit en complément, soit en révision des mesures actuelles, même sur les étoiles assez brillantes et de grandes parallaxes. Des mesures nouvelles seraient particulièrement utiles dans l'hémisphère sud où, actuellement, seul Le Cap est peut-être encore actif. Il existe aussi à Yale, D. Hoffleit (11.041.052) des plaques de parallaxes qui attendent d'être mesurées.

Mais le champ à explorer sur les étoiles faibles est encore beaucoup plus large et moins exploré. Aussi, en fait, les travaux actuels sont essentiellement consacrés aux étoiles faibles signalées par leurs grands mouvements propres, travail essentiel pour préciser la fonction de fréquence des étoiles du côté des masses faibles et partant la densité en étoiles.

Il est évident, C. Turon-Lacarrière (ESO, SP. 108), que des mesures spatiales diminuant les incertitudes par un facteur de l'ordre de 5 apporteraient une véritable révolution dans l'évaluation des magnitudes absolues en multipliant par plus de 100 les échantillons utilisables et en améliorant leurs précisions. Si, comme il est prévu, ces parallaxes qui sont absolues, étaient en outre sans erreurs systématiques, leur emploi statistique serait très valable.

### B. Positions

En sus des catalogues publiés sous forme devenue classique, imprimés, ou mieux sur bandes magnétiques, utilisables rapidement, on doit considérer que nous possédons un inventaire complet du ciel jusqu'à une magnitude de l'ordre de 20 avec les clichés du Mont Palomar et,

prochainement, avec ceux des télescopes de Schmidt de d'ESO et d'Australie. Les données stellaires sous cette forme ne sont pas utilisables de façon aisée pour des buts d'ordre statistique, mais pour des travaux particuliers sur champs restreints, elles peuvent donner des mesures relatives précises en des temps réduits, grâce aux machines de mesures automatiques.

### C. *Mouvements propres*

Pour obtenir beaucoup de mouvements propres précis, la répétition d'une entreprise du genre de la Carte du Ciel serait très importante. Une telle entreprise est moins séduisante que l'exécution de travaux particuliers qui sont plus susceptibles de donner rapidement des résultats interprétables. Cependant, grâce à l'emploi d'astrographes à champs plus grands qu'autrefois,  $5^\circ \times 5^\circ$  au lieu de  $2^\circ \times 2^\circ$ , à la mesure automatique des plaques et à l'emploi des calculateurs, le travail devient accessible.

H.W. Wood (11.041.053) étudie les conditions qui lui paraissent favorables pour une telle entreprise; il pense qu'avec un astrographe de 40 cm, une distance focale de 5 m, des champs de  $4^\circ \times 4^\circ$ , l'emploi du recouvrement des plaques, on obtiendrait des incertitudes de 0".05. Cependant, l'emploi de télescopes de Schmidt apparaît aussi intéressant (H. Eichhorn) en allant jusqu'à la magnitude 15 pour avoir une première époque; ceci à condition qu'on sache obtenir sans grande difficulté des réductions globales précises sur des champs de l'ordre de  $5^\circ$  (P. Lacroute, 11.041.056).

Sans être une véritable reprise de la Carte du Ciel, un certain nombre de travaux du même genre ont été entrepris. On doit regretter que la résolution des 6000 clichés récents pris au Cap avance lentement, bien que S.V.M. Clube ait mis au point une méthode de résolution. On doit signaler avec plaisir, une nouvelle couverture quadruple du Ciel entreprise par Chr. de Vejt, à Hambourg, avec un nouvel astrographe, entreprise qui ira jusqu'à  $m = 12$  et sera associée à une remesure des clichés de l'AGK2 jusqu'à  $m = 12$ . Les clichés pris à Sydney dans l'hémisphère sud seront aussi fort précieux.

Le Centre de Données Stellaires de Strasbourg, qui rassemble les données publiées lorsqu'elles sont accompagnées de positions précises permettant les identifications et les regroupements, a des mouvements propres sur 357 660 étoiles. Ce catalogue est probablement assez complet jusqu'à 9.5 et comprend peu d'étoiles plus faibles que 11. Il y a donc un grand nombre de mouvements propres, mais ils sont de qualités très inégales et c'est surtout l'amélioration de ces mouvements propres qui est à faire, car on a souvent d'autres informations sur ces étoiles et l'exploitation des mouvements propres exige d'autres informations pour être efficace.

Beaucoup de mouvements propres ne sont pas individuellement significatifs et leur emploi statistique souffre beaucoup des erreurs systématiques qui subsistent dans notre système fondamental et dans les catalogues repères méridiens en usage. L'amélioration du système fondamental d'une part, l'emploi d'instruments méridiens plus précis et plus efficaces pour les positions repères (E. Høg) d'autre part, sont nécessaires pour qu'une grande partie des mouvements propres soit plus efficacement utilisable. Des mesures spatiales, à  $0''.001 \text{ an}^{-1}$  permettraient d'éliminer immédiatement les erreurs systématiques de nos catalogues de mouvements propres et de bien utiliser tous les mouvements propres actuels. Si on complétait les mesures spatiales par des observations méridiennes précises, on disposerait d'un système de référence beaucoup plus précis que les mesures sur les plaques, 0".005 comparés à 0".12, ou même dans des cas spéciaux 0".002. Un tel système conviendrait donc bien à l'astrométrie photographique.

Les études de mouvements propres relativement aux nébuleuses tendent aussi à étudier les erreurs systématiques de notre système fondamental et de nos catalogues repères basés sur lui. Ces études sont très précieuses et doivent être poursuivies et étendues. Il y a encore quelques désaccords à comprendre. Ces études permettront l'élimination des erreurs systématiques des mouvements propres de notre système fondamental. Même si des mesures spatiales, encore en projet, apparaissent devoir être plus précises à l'avenir, la comparaison des résultats serait très utile et, dans un premier temps, la référence aux nébuleuses servirait à rendre le système spatial absolu.

Les inventaires des grands mouvements propres étendus aux étoiles faibles (W.J. Luyten,



H. Giglas) doivent être étendus à toute la sphère, car ils donnent des résultats qui souffrent peu ou pas des erreurs systématiques du catalogue fondamental, permettent beaucoup d'études statistiques et nous signalent des étoiles probablement proches.

Pour que les aires sélectionnées sur lesquelles on a déjà beaucoup de renseignements rendent réellement les services d'échantillon qu'on en attend, il importe de prolonger avec les moyens actuels, les études sur les mouvements propres des étoiles faibles comme le fait C. A. Murray.

A défaut d'inventaire d'ensemble et pour pouvoir aller plus loin en magnitude, des inventaires sur des directions particulières sont très utiles; pôle galactique, anticeutre, etc.

Beaucoup de travaux d'astrométrie photographique sont limités à des champs réduits; ils sont essentiellement destinés à tester l'appartenance à des amas. L'emploi d'astrographes plus précis et la multiplication des plaques peuvent améliorer les tests. Cependant, les incertitudes sur les positions des étoiles de repères utilisées interdisent pratiquement l'étude de mouvements d'ensemble, rotation ou expansion dans les amas. Pour obtenir avec sécurité ces mouvements, il est indispensable de réduire les erreurs systématiques locales dans les catalogues de repères utilisés, qui sont encore au moins de l'ordre de 0".07 pour les catalogues photographiques (P. Lacroute et A. Valbousquet 12.041.004).

P. LACROUTE

*Président de la Commission*