ASTROMETRIC DESIDERATA FOR NEARBY STARS

Wilhelm Gliese
Astronomisches Rechen-Institut, Heidelberg, F.R.G.

ABSTRACT

Astrometric desiderata for nearby stars concern, in first line, the parallax measurements, avoidance and elimination of effects of bias in trigonometric parallax programs: Bias towards large proper motions, preference of parallaxes with positive accidental errors, the Malmquist bias. For some of the nearby stars we do not yet know accurate positions, for some other objects no reliable proper motions were measured. Finally, for calibrating color-luminosity relations the necessity to observe further precise trigonometric parallaxes is demonstrated and emphasized.

1. INTRODUCTION - NEW CATALOGUE OF NEARBY STARS

In the near future we expect completion of the new General Catalogue of Trigonometric Stellar Parallaxes (GCTSP) by van Altena and we give our attention to this excellent work. We shall be glad to learn more about this project here at this symposium. Its predecessor, the Yale catalogue by L.F. Jenkins, was published in 1952. Based on these trigonometric distance data we have compiled a catalogue of stars nearer than 20 parsecs (Gliese, 1957). A second edition (Gliese, 1969) was extended to 22.5 pc and one year later the "Catalogue of Stars within twenty-five parcecs of the Sun" (Sir Richard Woolley et al., 1970) became available. In all these lists of nearby stars the trigonometric parallax results were supplemented by spectroscopic and photometric parallaxes.

It seems recommendable to start at Heidelberg now with the compilation of a third edition of the Catalogue of Nearby Stars (CNS), based on van Altena's catalogue of trigonometric stellar parallaxes. We are greatly indebted to Professor van Altena for making available to us a preliminary list of his parallax objects. Our new catalogue shall be limited to the stars nearer than 25 pc of the Sun - so it will be comparable to the catalogue published by Woolley et al. in 1970. A preliminary inspection shows that the number of stars with trigonometric

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parallaxes $\pi_t \geq 0\overset{''}{.}040$ was increased by nearly 20 per cent. Nevertheless, we do know according to results obtained by trigonometric observations, probably not more than 30 per cent of the total number of all objects nearer than 25 pc.

That is one reason for not extending a nearby-star catalogue in 1984 to larger distances; our knowledge would be too incomplete in its outer regions. Furthermore, a first inspection of van Altena's new material shows that the number of objects, which enter our list close to the lower parallax limit unjustly because of positive accidental errors, increases remarkably near to $\pi = 0\overset{''}{.}040$.

Again, the new edition of the CNS shall give positions, parallaxes, motions, types, magnitudes and colors, and notes on peculiarities. The heading of my paper here is "Astrometric Desiderata for Nearby Stars". So let me point out stellar quantities given in the CNS which are obtained by astrometric measurements or which are derived from astrometric data:

1) Positions
2) Trigonometric parallaxes
3) Proper motions
4) Data of stellar systems - double and multiple stars
5) Trigonometric parallaxes as basic data for the calibration of spectral type-luminosity relations and of color-luminosity relations (for the derivation of spectroscopic and photometric parallaxes).

The final goal of a CNS, the compilation of all objects existing in the solar neighborhood, is not yet attainable. Last year, even in the small volume nearer than five parcecs, another faint star was detected (Harrington et al., 1983), an object of B magnitude 17.7 with a proper motion of $1\overset{''}{.}6$/yr which corresponds to a moderate tangential velocity (TV) of 36 km/s. Further stars with parallaxes exceeding $0\overset{''}{.}200$ probably are still undiscovered.

As the size of the parallax of a star decides for or against its inclusion in the CNS, the parallax is the most important quantity for our work. But today the parallax material is not only incomplete but even not representative for the total number of nearby stars.

Instead of saying now such a trivial sentence "We need more and better parallaxes" I shall show some results and conclusions derived from the sample of already known parallaxes exceeding $0\overset{''}{.}039$. I restrict my considerations to trigonometric distance determinations. The calibration of relations for the derivation of spectroscopic and photometric parallaxes is based on such astrometric measurements. Spectroscopic and especially photometric parallaxes of late-type stars of low luminosities are an extremely valuable supplement for lists of nearby objects which means for the completion of our knowledge of the star density and mass density in the solar neighborhood. However the number of objects with remarkable discrepancies between their photometric and their trigonometric parallaxes is not negligible. Furthermore, only reliable trigonometric distance determinations allow us considerations on the width of the main sequence and on its fine structure.

Therefore I emphasize the superiority of astrometric measurements to such second order distance determinations in a volume in which the percentage of the trigonometric errors σ_π/π can be kept small.

From van Altena's data and a few additional measurements published in 1983 we know today 1872 stars with trigonometric parallaxes $\pi \geq 0''.040$. Choosing the star density in the nearest volume from 0 to 5 pc as an arbitrary unit 1.00, our knowledge decreases in the next volume (from 5 to 10 pc) already to 0.58, and between 20 and 25 pc not even to a quarter (see Table 1, 3rd line). Well, the knowledge decreases but we ask, why do such fairly large samples not be representative for the whole population ? What are the effects which introduce a bias ?

2. BIAS IN TRIGONOMETRIC PARALLAX PROGRAMS

1) Many trigonometric programs have preferred the stars with large proper motions. The mean tangential velocity (TV) of our catalogue stars is too large. A preference of large velocities means also preference of stars lying somewhat below the mean main sequence. Such a sample is representative neither for the true velocity distribution nor suitable for calibrating the mean main sequence.

2) Among the stars of our sample there are more objects with positive accidental parallax errors than with negative errors of measurements, especially close to the parallax limit of $0''.040$. The mean luminosity of the catalogue stars will be too low which disturbs the calibration of mean luminosity relations. This morning T. Lutz has discussed how such effects can be eliminated or, at least, diminished by applying the "Lutz-Kelker correction" (Lutz and Kelker, 1973). But we emphasize once more: "It is meaningless to apply Lutz and Kelker's correction to individual stars" (Upgren and Lutz, 1979). Therefore we have to include in our CNS all objects whose parallax observations gave values $\pi \geq 0''.040$ in spite of knowing that probably part of them will be outside of 25 pc. We assume that a noticeable number of stars will enter our catalogue unjustly; their TV will be given too small.

3) The Malmquist bias (Malmquist, 1936) which appears in magnitude limited samples of stars produces preference of the more luminous objects of a certain type or color. Calibrating mean luminosity relations from trigonometric parallaxes, the Malmquist bias works opposite to the preference of the large proper motions. T. Lutz has demonstrated that corrections of these effects can be computed but in many cases a lower magnitude limit is not strictly defined which complicates the situation in some way. We learn, also the Malmquist bias disturbs our search for a representative sample of luminosities and space velocities.

3. TANGENTIAL VELOCITIES IN DIFFERENT DISTANCES FROM THE SUN

Do we detect the above mentioned effects in the distribution of proper motions and tangential velocities after subdividing the 1872 stars into five groups of different distances around the Sun ?

We cannot expect to see more than very rough indications of the characteristic features. I remember that the velocity dispersions vary with the spectral type along the main sequence, somewhat increasing from A to G dwarfs but then being essentially constant until the later dM stars (considering mean dispersions and not splitting into groups of different ages). As the percentage of A and F stars, of giants and subgiants, is small in the solar neighborhood, altogether about three per cent, they will not affect the mean results significantly.

In the first line of Table 1 we see the different distances from the Sun; the next lines give the number n of stars with trigonometrically measured parallaxes and the relative star density which was already mentioned. Fourth line: the mean tangential velocities <TV>, 5th and 6th line the percentages of very small TV resp. of the TV exceeding 60 km/s. The last two columns give the data for all 1872 stars (and star systems) and for comparison the data for 345 McCormick red dwarf stars (Vyssotsky et al., 1943-1956) nearer than 25 pc.

What do we learn from these numbers ?

Table 1. Mean tangential velocities TV in different distances from the Sun

Distance pc	0 – 5	5 – 10	10 – 15	15 – 20	20 – 25	all stars 0 – 25	McC st. 0 – 25
Number	45	188	400	596	643	1872	345
$\mathrm{Density}_{rel}$	1.00	0.58	0.46	0.35	0.23	0.33	
<TV> km/s	44.0	41.6	40.6	41.7	41.6	41.5	35.4
TV $\leq$ 10; %	2	5	8	10	11	9	11
TV > 60; %	23	18	19	20	19	20	13

The mean TV in the 5 groups do not vary with distance from the Sun. The somewhat larger value of the nearest stars is still inside the limits of the observed dispersions. But we cannot exclude the possibility that among the objects nearest to the Sun, the percentage of stars below the mean main sequence is somewhat higher while only a smaller percentage has been detected in larger distances. We remember, the objects below the mean dwarf sequence show a larger velocity dispersion. However such explanations would be speculation only.

Among the stars between 20 and 25 pc we have 4 objects with still unmeasured proper motions.

The smaller mean TV of the McCormick stars - 35.4 km/s compared with 41.5 km/s - is not surprising. We do expect such differences as Vyssotsky did not select his sample members by the size of proper motion. Only 13 % of his stars show a TV exceeding 60 km/s compared with 20 % of all 1868 stars.

A typical distribution of transversal velocities of a sample of stars mainly selected by large proper motions show the 178 stars with trigonometric parallaxes published 1969-1978 (Gliese and Jahreiss, 1979). Their mean TV is 60 km/s; it increases from 44 km/s as TV of 25 GJ stars nearer than 10 pc to 69 km/s as mean value between 20 and 25 pc. That is what we expect, since large proper motions correspond to increasing TV with increasing distances.

Also before 1969 parallax programs often preferred stars with large proper motions but the sample of the 1872 parallax stars known in 1983 does not show a similar TV distribution. We understand that the percentage of small proper motions increases with distance but we do not believe in the given increase of objects with small TV (Table 1, 5th line). Are many stars moving together with our Sun ? More than seventy years ago Stroobant (1910) has compiled a list of such objects: "Le courant de Stroobant", but already for a long time we know that it does not exist - it is forgotten today ! We have a simple explanation for our finding: There is a remarkable number of stars with small proper motions whose parallax values were measured too large and their percentage increases approaching to the lower parallax limit.

As a spectacular example I quote two stars which were observed already half a century ago at Dearborn Observatory:

BD	π_t	s.e.	ann. p.m.	TV km/s	m_v	Sp	M_t
+11°2440	0."1931	± ."0345	0."10	2	5.85	A2m	7.3
+34°2839	0.1335	.0282	0.02	1	8.0	F0	8.6

Obviously, both parallax values are too large, the TV are too small. We remember, at Dearborn no rotating sector was used.

Schlesinger (1935) derived fairly large corrections for Dearborn parallaxes depending on apparent magnitudes from +0."004 at $11^m.0$ to -0."038 at $7^m.5$. The accidental errors are large. L.F. Jenkins (1952) did not incorporate these two observations into the GCTSP. But where should we set a limit for the inclusion of trigonometric observations ? In such cases re-observing seems to be the best procedure. But should we forget the old results ? May be this way is dangerous - we must ask again for limits ! Do we introduce by such procedure another bias ? We shall include each trigonometric parallax as given by van Altena but in very dubious cases we shall give a warning in the "Notes" for everyone who likes to use these distance determinations.

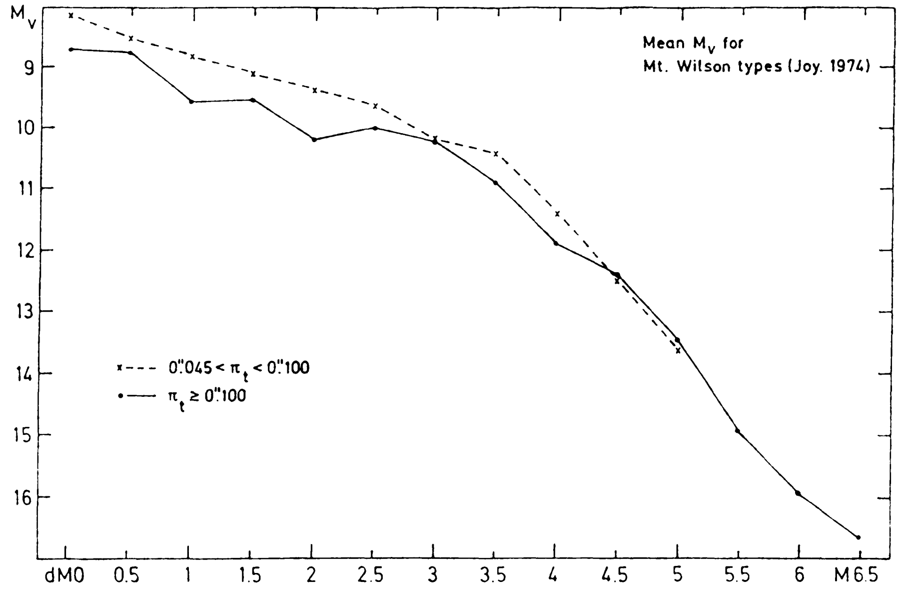

Figure 1. The (M_V,Mt.Wilson type) relation for M dwarf stars classified by Joy (Joy and Abt, 1974), subdivided into the nearest stars ($\pi_t \geq 0''.100$; full line) and into stars with parallaxes between 0".045 and 0".100 (dashed line).

4. EFFECTS OF THE MALMQUIST BIAS

To give you a strong impression of the effects of the Malmquist bias I have chosen the sample of M dwarf stars classified by Joy (Joy and Abt, 1974). I derived the mean absolute magnitudes M_V from reliable trigonometric parallaxes and photoelectrically measured V magnitudes for each spectral class dM0, dM0.5, ... The sample was subdived into the stars nearer than 10 pc and into those with parallaxes smaller than 0".100. There exists a remarkable difference between the two mean main sequences from dM0 to dM4. For the later types only four objects in the more distant group are available which is not sufficient for any conclusion.

In the diagram (Fig.1), a full line is drawn between the mean absolute magnitudes of the nearer stars whereas a dashed line shows the mostly somewhat brighter mean luminosity of the objects with smaller parallaxes.

The explanation: The observational material has a faint magnitude limit. In the Mount Wilson sample are included most of the northern M dwarfs brighter than V = 11 mag. and also some fainter ones. We assume that the more distant group is more incomplete; many of their members of lower luminosities were not observed. Therefore this group defines a main sequence brighter than that of the very nearby stars. The mean difference between both curves is ΔM (nearest stars minus 10/25 pc - stars) = $+0^m.45 \pm 0^m.09$.

5. DESIDERATA FOR PARALLAX PROGRAMS

We have seen that the above mentioned effects really disturb and falsify results derived from nearby stars when using their trigonometric parallaxes in statistical investigations. Which are desiderata for eliminating or, at least, diminishing these effects ?

1) Preference of large proper motions ? In the region of the late K and early M dwarf stars the Vyssotsky stars (Vyssotsky et al., 1943-1956) are still the most impressive sample of unbiased objects. We appreciate that these stars were set successively on trigonometric parallax programs. Upgren et al.(1972) have supplemented this work by a search for dwarf K and M stars in the southern hemisphere. In the southern sky we have, moreover, the large list of dwarfs K7 and later by Smethells (1974) which includes a remarkable number of nearby objects. Meanwhile, for many of them good photometry was observed, photometric parallaxes were derived but again I have reasonable doubt whether such distance determinations are accurate enough in each case. I should prefer trigonometric measurements. Furthermore, there are some objective-prism surveys near the galactic poles (Sanduleak, 1976; Pesch and Sanduleak, 1978) providing unbiased lists of dwarf M stars of even later types. Here would be also a wide field for measuring trigonometric parallaxes of unbiased samples of red dwarfs, especially in the southern hemisphere.

Some months ago we hoped to meet in Venezuela - much trigonometric work is waiting for being done with the excellent Zeiss 65-cm refractor in that country - - Sorry !

But we should not condemn programs which prefer the objects with the largest proper motions. Most of the very nearby stars will be detected by such a procedure. A proper motion of 1"/yr corresponds to a tangential velocity of 24 km/s at a distance of five parsecs. Among the 45 stars with parallaxes $\pi \geq 0''.200$ only seven show proper motions smaller than 1"/yr; the lowest observed value is $0''.48$/yr. In the LHS, Luyten (1979) listed 528 stars with $\mu \geq 1''.00$/yr; for 124 (about 23 %) of them no trigonometric parallax is known today. All these objects are fainter than $m_{pg} = 12.0$ and 80 per cent of them are in southern declinations. If the parallaxes of all these 528 stars would be determined we should know probably 80 % of the stars nearer than 5 pc, except perhaps speculative objects like dark dwarfs. It is desirable to extend such proper-motion star samples to stars as faint as possible with the best astrometric instruments. I remember that Luyten has tried to estimate parallaxes of very faint objects even on 48-inch plates of the Palomar-Schmidt.

2) We have mentioned above the predominence of positive parallax

errors over negative errors, their effects on luminosity calibrations, and that these effects are reduced by applying the "Lutz-Kelker correction". For nearby stars the shifting of the mean absolute magnitudes is kept small by using parallax data with small observational errors only. For such purposes we recommend work with results from modern series of suitable accuracies and we appreciate observations and selections of a sufficient number of stars along the main sequence. In my opinion it is not necessary to say more about this point.

3) The Malmquist bias: Each observational program has a faint magnitude limit of its objects which is, however, very often no strong limit. In such cases the elimination of the disturbing effects becomes complicated. If this limit is beyond the mean $\langle M \rangle$, plus dispersion in M, plus maximal distance modul of the stars of a certain type or color, the Malmquist bias will not appear. It is unavoidable in the group of the lowest luminosities which is observed in a series.

In 1982 I have calibrated anew (Gliese, 1982) the mean (M_V,B-V) and (M_V,R-I) relations for main sequence stars from F5 to M types based on Eggen's photometry of stars with large proper motions (Eggen, 1979 and 1980). A comparison with the relations derived 1971 (Gliese, 1971) from all material available at that time showed a surprising difference: For $9 < M_V < 13.5$ the new curves were fainter by $0\overset{m}{.}3$ and obviously even more in the R-I relation. My first impression was to explain this deviation by the somewhat larger velocities of Eggen's objects, since there appears really a correlation between mean space velocity and mean luminosity. But today I assume that this effect is overlapped by the effects of a Malmquist bias. Since 1971 many newly determined trigonometric parallaxes just in that region became available, values measured with small accidental errors and these new series will be free of any Malmquist bias in the region where both curves deviate from each other significantly. If we look at the distribution of all known M_V in a color-luminosity diagram and we draw the two differing mean relations, this whole sample seems to define a line between the 1971- and the 1982-curve for which we estimate:

$$M_V(1971) + \frac{2}{3}\,\Delta(M_{82} - M_{71}) = M_V(1982) - \frac{1}{3}\,\Delta(M_{82} - M_{71}) = \langle M_V \rangle$$

Perhaps a very rough conclusion is: Two thirds of the occuring differences are due to a Malmquist bias and one third results from the velocity dependence.

Whatever the reasons are - new accurate parallax observations are desirable from unbiased samples as well as for the total number of stars with proper motions exceeding a certain limit like $\mu = 1''$/yr. And do not forget the southern hemisphere!

6. POSITIONS

Astrometric desiderata for nearby stars - this topic does not only concern trigonometric parallax programs. A catalogue gives also the positions of its members and it is desirable to list right ascensions and declinations with an accuracy which allows an unequivocal identification and location also of each faint star. Already in the first edition, 1957, we required an accuracy of one second of time in RA and of one tenth of an arc minute in declination - whenever possible. Unfortunately, the positions given by parallax observers (especially in the past) very often did not fulfil these conditions. As an example I mention two faint stars with duplicate entries in the General Catalogue of Trigonometric Stellar Parallaxes (Jenkins, 1952 and 1963):

Nos. 1810.1 = 1813	difference in RA =	$0^{m}.2$,	$\Delta\delta = 0'$
4720 = 4728		0.7	0'

For the compilation of the nearby star catalogues at Heidelberg many different sources are used; we did not measure any data and quantities ourselves. The positions in the 1969-edition are from

fundamental catalogues and meridian astrometry (mostly GC, SAO)	63 %
photographic catalogues (AGK2, CFS ....)	5
various photographic positions .... (many private communications)	14
old Astrographic Catalogues	16
No accurate position .... more than	1 %

Of course, the positions were not reduced to a common system which is one reason more for restricting the accuracy to 1^{s} and $0'.1$. However, for the observations by HIPPARCOS, higher accuracy will be necessary which means that a large number of faint objects must be measured anew.

Today we know identification charts for many of the faint objects, especially for the proper motion stars listed by Giclas and Luyten who give their positions also to 1^{s} and $0'.1$. For 201 (or 68 %) of the 294 nearby stars catalogued additionally 1979 (Gliese and Jahreiss), Giclas or Luyten positions are given; only 29 (10%) of them were found in meridian catalogues, for 56 (19%) photographically determined RA and Dec were available whereas for 8 objects no precise position has been found. In nearly all cases the agreement between the data from Lowell plates and those from 48-inch plates was good. Difficulties however arise south of -45°.

Meanwhile several samples of faint red stars have been published; the stars were classified on objective prism plates - many of them seem to be nearby dwarfs but only part of them are found in catalogues which give precise positions and proper motions. Therefore programs are welcome which determine such lacking data.

Let me very briefly make a few remarks on experiences gained by work with various sources of positions of faint stars. For our purposes computation of positions from the Astrographic Catalogues is justified even when we use the old plate constants. Comparisons between the two positions reduced to the same epoch show differences in each coordinate

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mostly smaller than 1", and as maximum differences I found values between 2" and 3". Differences between Luyten's data and the AC are normally near zero - in spite of the large epoch-differences - but in some cases deviations up to 4^s and 0!5 have been found. Also Woolley's positions deviate from catalogues with reliable data in a few cases by several seconds in RA (up to 4^s) and up to 0!6 in Declination.

In the Introduction to the LHS Catalogue (Luyten 1976), Luyten himself confessed that in the worst possible cases errors in position may amount to 10^s in R.A. for stars of high declinations and to 2' in declination. Therefore I assume that our positions occasionally may have similar errors.

The positions of nearby stars fainter than 13th or 14th magnitude could be measured with sufficient accuracy, I think, on Schmidt Palomar plates and now also in the southern hemisphere on the ESO Atlas. However, as our objects are distributed over the whole sky, the data could be measured only at the expense of much work - whoever would be able and whoever would like to do that? In my opinion, in some cases we have to restrict to $0^m.1$ in R.A. and to 1' in declination, especially if identification charts are available.

Our desiderata are: Observers of nearby-star parallaxes should give or, at least, refer to positions of our precision or to identification charts.

7. PROPER MOTIONS

In the next paragraph we consider desiderata for proper motions of nearby stars. They are necessary for reducing positions from one epoch to another; they are also basic data for computing tangential velocities and space velocities. An error of 0".01/yr produces even in the worst case an error in tangential velocity which remains smaller than 1.2 km/s. We do not need the precision of the proper motions in fundamental catalogues. Luyten in LHS (1976) applied correction (not exceeding 0".012/yr) to all relative motions to transform them into absolute values.

An error of 1 km/s is a small amount compared with the accuracy of radial velocities of faint stars and compared with the uncertainty introduced in the space velocities by the parallaxes. But actually the systematic differences between the data in some of lists of large proper motions exceed 0".01/yr remarkably. Giclas (1959) has discussed this problem when he had determined his first series and Luyten (1974) finds mean differences between his machine-processed data and those in the Lowell Proper Motion Survey up to 0".07/yr (from 341 stars in common with Lowell motions from 0".50 to 0".59/yr). For some objects, deviations of 0".1/yr occur which makes 5" in position after half a century - the epoch difference between AC-positions and 1950.

We did not reduce the proper motion data in the CNS to a common system. We appreciate that observers of trigonometric parallaxes today also measure and publish the proper motions of their objects, and we emphasize the importance of such data for our compilation. A comparison of Luyten's values and those of the USNO parallax program shows agreement - 98 stars in common gave $<\Delta\mu> = +0\overset{''}{.}001 \pm 0\overset{''}{.}0027$/yr (Gliese, 1979 at Montréal).

In four volumes of the NLTT Catalogue (1979-1980), Luyten has listed nearly 60 000 stars with $\mu \geq 0\overset{''}{.}18$/yr. 85% of the 1872 parallax stars nearer than 25 pc are in the NLTT; among the 15% with smaller motions there are objects unjustly included in the 25-pc sample by errors in the parallaxes. For the nearby McCormick stars the percentages are 81 and 19; the difference 85 - 81 demonstrates again the preference of proper motion stars in trigonometric parallax programs. For our goal to collect as many reliable data for nearby stars as possible Luyten's catalogues as sources for proper motions are of exceptional value even although this compilation is not yet complete, especially in low galactic latitudes and in high southern declinations.

Only for 4 of the 1872 stars with trigonometric parallaxes we did not find any proper motion determination. However, for those stars which are classified on objective prism plates as possible nearby-stars, our knowledge is more incomplete. Such objects are mainly in southern declinations, in the magnitude range of about 11 to 13 or 14, and probably they have small proper motions. Therefore neglect of them would introduce a bias. On the northern hemisphere and in the equatorial region there exist computer lists of Luyten's LP stars with proper motions $\mu < 0\overset{''}{.}18$/yr - but what to do in higher southern declinations?

Astrometric desiderata for nearby stars - for completeness let me mention: Occasionally a wrong proper motion was published in an old list, maybe half a century ago and such an erroneous value was cited again in modern literature. An example is star CoD -30°13458 for which Porter et al. (1930; star Ci 20.1008) gave the remarkable proper motion $0\overset{''}{.}44$/yr, 342°. This value was repeated by Jenkins (1952; star No.3809) and by Woolley et al. (1970; star No.9577) but already in the LTT catalogue (Luyten, 1957) this star was no more listed; meanwhile its proper motion had proved to be smaller than $0\overset{''}{.}2$/yr. The best value known today is $0\overset{''}{.}19$/yr, 218° (Luyten, 1984).

8. CALIBRATION OF STELLAR LUMINOSITIES FROM TRIGONOMETRIC PARALLAXES

Astrometric desiderata for the calibration of spectral type-luminosity relations and color-luminosity relations which can be used for distance determinations of nearby stars? This concerns preferentially main-sequence stars from F to M. Such calibrations were carried out already fairly often. In order to exclude disturbing effects of the accidental-error distribution in the trigonometric parallaxes it is recommendable to use only precise data of objects well distributed over the range from dF to dM stars. More reliable measurements for such purpose are appreciated.

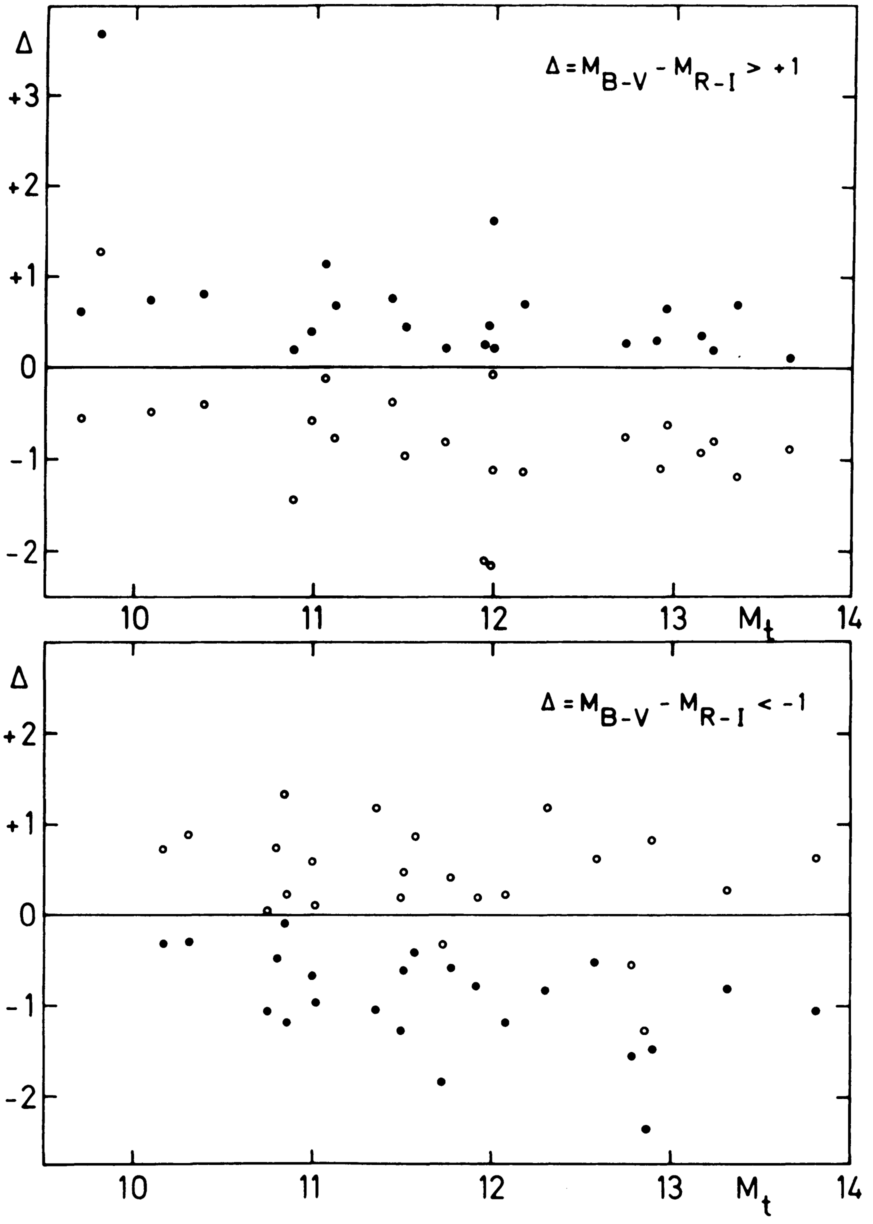

Figure 2. Differences between the absolute magnitudes M_V read from colors B-V (full circles) and from R-I (open circles) and the trigonometrically determined absolute magnitudes M_t, versus M_t. The upper diagram shows red dwarf stars with differences M(B-V) - M(R-I) > +1, the lower diagram shows stars with M(B-V) - M(R-I) < -1.

I should draw your attention to the following phenomenon: We know that the dispersion in M_V along the main sequence is unquestionably smaller in an M_V - (R-I) diagram than in an M_V - (B-V) diagram.

In many cases both colors of a star are known; does it mean we should forget the (B-V) dependent luminosities? There is a certain percentage of stars with significant differences $\Delta M = M(B-V) - M(R-I)$. I did examine the NSC of 1969 and its Supplement (Gliese and Jahreiss, 1979) and I picked out all the stars with $|\Delta M| > 1$ and with precisely measured trigonometric parallaxes (M_{trig} with errors not exceeding $\pm 0\overset{m}{.}30$ s.e.). A diagram (Fig.2) shows an amazing distribution among the M dwarf stars in the luminosity range M_V between 9 or 10 and 14. The zero-line defines the trigonometrically determined M_V, the filled circles the M_{B-V}, and the open circles the M_{R-I}. The upper part gives stars with $m_{B-V} - M_{R-I} > +1^m$, the lower diagram contains dM stars with $M_{B-V} - M_{R-I} < -1^m$. In all the firstly mentioned cases (except one) the trigonometric parallaxes give M_t between both photometric values; if the M_{R-I} are of lower luminosity the same tendency is observed but with a few exceptions.

Consequently we cannot recommend preference of one of the two color-luminosity relations; we rather suggest to work with a mean value for the absolute magnitude of such a star. However, our result is based on a fairly small number of objects with reliable astrometric parallax measurements. Already the inclusion of stars with inaccurate M_t obscures this picture and, as we know moreover such objects for which no parallaxes have been determined, further precise trigonometric measurements are desirable for deciding whether or not the true absolute magnitude is between M_{B-V} and M_{R-I} in these dubious cases.

9. DOUBLE STARS - MULTIPLE SYSTEMS

Astrometric desiderata for nearby stars include continuation and improvement of the observations of nearby double and multiple systems, in recent years supplemented by speckle interferometry. To do justice to the importance of this topic a special paper should be read. In my opinion one of the most interesting goals would be the elucidation of the controversy of the existence of planetary companions of Barnard's star. Many people, not only astronomers, are anxious to know of planets outside our solar system.

Finally, in brief, I should mention the class of the White Dwarfs for which additional astrometric measurements are most desirable, parallaxes and proper motions. But also for a discussion of these problems we need the time for a special paper.

At Heidelberg my colleague Hartmut Jahreiss and I myself, we are now compiling the 3rd edition of the catalogue of nearby stars.

Realization of our desiderata will be too late for the actual work. But a fourth edition will follow probably in the early ninetieths when new results are available from the Space Telescope, from HIPPARCOS, from new precise ground-based observations and, as we hope, from new programs on the southern hemisphere. The editors of a new CNS will then again express their thanks to all the observers so as I do here knowing that without their contributions we could not do our work!

I wish to thank Hartmut Jahreiss for helpful informations and discussions on data not yet fulfilling our requirements.

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Discussion:

STRAND: I believe the Dearborn parallaxes by Fox should not be used for the reason that no magnitude compensation was made for the target star. Fox believed the high quality of the images taken with the 18.5 inch refractor made such a correction unnecessary.

GLIESE: I intend to include these with an appropriate warning in the notes.