Measures of double stars

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MEASURES OF DOUBLE STARS

by A. D. FOKKER

During the years 1948, 1949 and 1950 the writer has made measures of double stars with the 10½-inch Clark-Repsold refractor of the Leiden Observatory, the results of which are contained in the present paper. Half of the measures were made in the first year, the telescope being used most of the time for photoelectric work during the next years. Most of the pairs measured have separations less than 4″ and are brighter than 9^m. The number of pairs measured amounts to 170; the total number of measures is 534.

Method of observation. As a rule a measure consisted of 4 settings for position angle and an equal number for distance. Settings for position angle were started from alternative directions. Position angles of sufficiently bright pairs were measured according to SALET and BOSLER's method, two settings without and two with prism being made. Half of the pairs were measured in this way. In case of narrow pairs the number of settings was reduced to two or three, further settings showing a tendency to become merely repetitions of the first. As a rule every night one setting was made with the threads parallel to the equator, the reading being obtained by uncoupling the driving work and letting a star trail along the thread. Means of a number of equator settings were used in determining the position angles. An eye-piece with power 450 was almost exclusively used.

The internal error of the measures. The mean error of one single observation has been determined from pairs that have been observed on three or more nights. These pairs have been grouped according to their separations and to the differences in magnitude of the components (as given in AITKEN's catalogue). The results are listed in Table 1. Between parentheses is given the number of stars used in each determination.

TABLE 1

Mean errors of single observations

Δm	0″–1″			1″–1″·5			1″·5–2″			2″–4″			4″		
< 1	°2·98	(29)	″·062	°1·48	(31)	″·138	°1·27	(15)	″·119	°1·24	(19)	″·124	°·85	(6)	″·192
> 1	3·31	(6)	·082	1·37	(10)	·087				1·59	(14)	·143	1·18	(6)	·201

The accuracy of position angle appears to increase with greater separations, whereas the accuracy of distances decreases for wider pairs (relative to the amount of separation however the errors in distance are smaller for wider pairs).

Comparison with other observers. Observations of slowly moving pairs have been compared with recent measures by other observers. These observers are: MULLER (*Journ.d.Obs.* **30**, p. 104), BAIZE (*Journ.d.Obs.* **31**, pp. 99, 138, 151), AREND (*Ann. de l'Obs. Roy. de Belg.* t. IV, fasc. 4), STEIN (*Ric. Astr. Vaticana* **1**, No 9), ARMELLINI (*Contr. Mt Mario* No 124), MÜNDLER (*Heidelberg Veröff.* **15**, No 9) and BARTON and OLIVIER (*Publ. Flower Obs.* **7**, part 1). Their observations have all been made after 1940. If necessary, corrections were applied to the positions given, reducing them to the epoch of observation. These corrections were based on the yearly motions of the pairs concerned. For very slow-moving pairs observations of earlier date were also used. If more observations of one pair were available they were combined into one value, comparison with this value being made. The differences (FOKKER minus other observers) are grouped according to position angle. Means for these groups, differences being weighted according to the number of observations used for the comparison, are as follows:

315°–45°	45°–135°	135°–225°	225°–315°
+°·51 ± °·56 (m.e.) (16)	+°·17 ± °·28 (m.e.) (15)	+°·15 ± °·59 (m.e.) (18)	+°·24 ± °·49 (m.e.) (20)

The number of differences used is given between parentheses. Because of the large mean errors of these values it does not seem legitimate to conclude that systematic errors of any importance are present.

TABLE 2

Means of the differences between observed distances and those given by other observers

d	F − others	n
$< 1''$	$-''\cdot07 \pm ''\cdot05$ (m.e.)	10
$1''-2''$	$-''\cdot17 \pm ''\cdot03$ (m.e.)	36
$2''-4''$	$-''\cdot06 \pm ''\cdot04$ (m.e.)	16
$> 4''$	$''\cdot00 \pm ''\cdot08$ (m.e.)	6

Table 2 gives means of the differences with other observers of the measured separations, arranged according to the width of the pairs. The measures of pairs with separations less than 4″ seem to yield values that are systematically too low. It seems therefore advisable to add an appropriate correction to the values given in the list of measures, before using them.

Comparison with orbits. Residuals from computed positions have been taken and grouped according to position angle. Means of the residuals for groups are as follows (the number of residuals being given between parentheses):

315°− 45°	45°− 135°	135°− 225°	225°− 315°
$+1^\circ\cdot5$ (3)	$-1^\circ\cdot1$ (8)	$-1^\circ\cdot9$ (4)	$+1^\circ\cdot0$ (6)

Means for the residuals in distance are given in Table 3. The negative mean residual $-''\cdot06$ for reliable orbits and separations below 2″ points into the same direction as the evidence drawn above from the comparison with other observers.

TABLE 3

Means of the residuals from computed positions

	0″−2″	>2″
reliable orbits	$-''\cdot06$ (7)	$''\cdot00$ (3)
preliminary orbits	$''\cdot04$ (8)	$-''\cdot07$ (3)

The reversing prism. In order to get an idea about the effectiveness of the reversing prism, the distribution of the values of one single night's settings, with and without prism, has been investigated. Usually two settings were made with prism and two without. Denoting the measures made with prism by crosses and those made without by circles, one may write down these symbolically in the order of increasing values of their corresponding readings. The measures with and without prism may then be distributed in different ways. In fact the following combinations exist:

a : × × ○ ○	b : × ○ × ○	c : × ○ ○ ×
a': ○ ○ × ×	b': ○ × ○ ×	c': ○ × × ○

For our present purpose a' is equivalent with a, b' with b and c' with c.

If there were no systematic errors or if the reversing prism had no influence, one out of three times the measures should show the distributions a or a'. If, however, the measures are affected by systematic errors and if the prism is effective in reducing them, there will be a tendency of the results to be grouped more according to the combinations a or a' than in other combinations. Actually, the measures yielded a ratio for the number of distributions a or a' to the total number of measures equal to 144/264= ·545, which is much greater than the 'predicted' ratio ·333. One must draw the conclusion that systematic errors certainly are present, and that the influence of the reversing prism is considerable.

Something of the same kind has been done with the night averages. This can be done by making use of those pairs for the measurement of which the reversing prism has been used only one night out of a total of three or four nights and those pairs that, conversely, have been measured only one night without prism, whereas the other two or three nights the prism has been actually used. If measures made without prism differ systematically from measures made with it, this will cause a measure that, as concerns the use of the prism, has been made in a way different from the other measures, to show a tendency of yielding a greater residual from the average than the other measures. Again one has the following combinations:
In case of a total number of four measures (I):

× ○ ○ ○ ○ × × × (a)	○ ○ ○ × × × × ○ (a')	○ × ○ ○ × ○ × × (b)	○ ○ × ○ × × ○ × (b')

in case of three measures (II):

× ○ ○ ○ × × (a)	○ ○ × × × ○ (a')	○ × ○ × ○ × (b)

Without any influence of the reversing prism one would expect, for case I, the combinations a, a' to be as frequent as b, b'. Actually however, the distributions a or a' were found in 16 cases out of 20. In case II one would expect 2 out of 3 times the combinations a or a'. These combinations were found 10 out of 13 times. Although less convincing, because of the small numbers concerned, than what follows from the readings made during a single night, these results still point into the same direction as the former.

The seeing. The seeing was qualified by the numbers 1 to 5, the last number denoting excellent seeing conditions. For different seeings the mean deviation of a single night's measure from the mean of all measures of a pair was determined for pairs with separations between 1″ and 2″ and with a difference of magnitude less than 1 magnitude. The results are as follows (numbers of residuals being given between parentheses):

seeing :	2		3		4	
mean deviation from mean value:	−″·022	(28)	″·000	(55)	+″·007	(44)

One may safely assume that the seeing conditions do not influence the measures in a systematic way.

The screw value. A redetermination of the screw value of the micrometer was made by measuring the difference in declination of two pairs of stars in the Pleiades. For this purpose the stars BD +23°507, BD +23°505 and BD+23°563, BD+23°569 were used. The value of one revolution was found to amount to 30″·853± ″·005 (m.e.), in reasonable agreement with previous determinations by VAN DEN BOS, DE VOS VAN STEENWIJK and VÔUTE.

The list of measures. In the following list of measures the first line gives the number of the star in AITKEN's *New General Catalogue*, and other indications. The next line gives the co-ordinates for 1950 and the magnitudes, taken from AITKEN's catalogue. In the following lines the respective columns give: the date (the century being omitted), the hour angle, the position angle, the distance and the seeing (5= excellent; 2= bad, 1= so bad that no measures could be made). Those measures that have been made with the aid of the reversing prism are indicated by an asterisk. Residuals resulting from comparison with orbits always are given in the sense observed minus computed.

The writer wants to express his thanks to Dr W.H. VAN DEN BOS for his encouragement and the interest he has shown for this work.

THE MEASURES [1])

32 Σ 3056

h m ° ′ 0 02·1 +33 59 7·4−7·4

	h	°	″	
49·697	·0	144·5*	·69	3
·723	−·5	149·5*	·75	3
·736	−·2	147·8*	·73	3
·830	·0	145·6*	·63	3
49·746		146·9	·70	

41

h m ° ′ 0 02·4 +45 24 7·9−8·9

	h	°	″	
49·813	+ ·7	336·7	3·75	3
50·863	+1·0	333·7	4·00	2
·945	+1·7	339·5	3·50	3
50·540		336·6	3·75	

48 OΣ 547

h m ° ′ 0 02·8 +45 32 8·3−8·3

	h	°	″	
49·679	+·2	158·2*	5·12	3
·739	−·2	158·7*	5·77	4
·813	+·9	159·6*	5·31	3
49·744		158·8	5·40	

61 Σ 3062

h m ° ′ 0 03·5 +58 09 6·9−8·0

	h	°	″	
49·687	+·8	205·0*	·90	3
·739	+·4	204·3*	·88	4
·830	+·2	195·3*	·90	4
49·752		201·5	·89	

Residuals BAIZE's orbit (*l'Astronomie* **57**, 44): ° ″ −1·8 ·00

207 Σ 13

h m ° ′ 0 13·4 +76 40 6·6−7·1

	h	°	″	
48·857	+·2	69·0*	·78	3
·912	+·5	67·3*	·85	4
49·679	+1·0	69·0*	·88	4
·739	+ ·3	67·7*	·78	4
·813	+1·5	67·4*	·85	3
·830	+ ·5	69·6*	·92	3
48·884		68·1	·82	
49·765		68·4	·86	

263

h m ° ′ 0 16·5 +59 26 8·5−9·0

	h	°	″	
48·857	+·2	185·9	2·00	3
·912	+·8	184·6	2·11	3
48·884		185·3	2·06	

285

h m ° ′ 0 18·3 +32 42 7·5−8·0

	h	°	″	
48·663	− ·3	285·5*	1·49	4
·693	− ·5	285·4*	1·45	4
·745	+1·3	286·9*	1·32	3
·750	+ ·7	286·6*	1·40	4
·843	·0	284·7*	1·54	2
48·739		285·8	1·44	

416

h m ° ′ 0 28·0 +47 15 8·2−8·4

	h	°	″	
48·663	+ ·6	286·0*	·97	4
·693	− ·5	283·9	1·02	4
·742	+1·3	289·7	1·38	2
·750	+ ·7	284·3*	1·10	4
48·712		286·0	1·12	

[1]) As to the measures of the separations, compare what has been remarked on page 366 with regard to their systematic errors.

THE MEASURES (*continued*)

434 OΣ 12 λ Cas

h m ° ′
0 29·0 +54 15 5·6—5·9

h	°	″	
49·676	− ·7	166·2	·65	3
·679	− ·3	172·0*	·68	4
·739	·0	172·8*	·68	4
·813	+1·0	173·4*	·71	3
49·727		171·1	·68	

497 Σ 42

h m ° ′
0 33·4 +29 44 7·9—8·7

h	°	″	
48·663	+ ·2	24·1*	5·77	4
·693	− ·3	26·0*	5·82	4
·742	+1·3	26·4*	5·65	3
·750	+ ·8	26·0	5·80	4
48·712		25·6	5·76	

671 Σ 60 η Cas

h m ° ′
0 46·1 +57 33 4·0—7·6

h	°	″	
49·676	−·7	287·1*	9·93	3
·679	−·5	288·1*	9·84	3
50·936	+·5	290·7*	10·03	3
50·097		288·6	9·93	

Residuals STRAND's orbit (*Leiden Ann.* **18**^{2}, p. 66): ° +·3 ″ −·29

Residuals BAIZE's orbit (*A. J.* **51**, 221): ° −·3 ″ +·13

709 Σ 67

h m ° ′
0 49·5 +10 20 8·3—9·0

h	°	″	
48·693	− ·3	354·6	1·98	3
·772	−1·2	356·6	1·91	3
·857	+ ·7	354·3	1·98	2
48·774		355·2	1·96	

755 Σ 73 36 And

h m ° ′
0 52·3 +23 22 6·2—6·8

h	°	″	
48·693	·0	154·5*	·68	4
·750	+·8	153·0*	·69	5
·775	+·3	145·3	·73	3
·778	+·3	147·1	·62	3
48·749		150·0	·68	

Residuals BAIZE's orbit (*A. J.* **51**, 221): ° −1·3 ″ +·04

955

h m ° ′
1 07·0 +23 32 7·1—7·3

h	°	″	
48·693	+·2	294·0*	·75	4
·750	+·7	298·0	·77	4
·775	+·3	291·6	·73	3
·778	−·2	285·9	·87	3
48·749		292·4	·78	

978

h m ° ′
1 08·9 +47 32 9·0—9·1

h	°	″	
48·742	+1·2	46·0	1·62	3
·775	+ ·7	50·2	1·62	3
48·758		48·1	1·62	

983 Σ 96

h m ° ′
1 09·4 +64 45 7·8—8·8

h	°	″	
48·750	+ ·8	270·2	·75(est)	3
·857	− ·5	285·8*	·90	3
·903	+1·3	276·8		2
48·837		277·6	·82	

1080

h m ° ′
1 17·2 +36 23 8·5—8·9

h	°	″	
48·742	+1·3	184·0	4·26	3
·912	+ ·5	183·9	4·06	3
50·936	+ ·7	185·7	4·29	4
50·197		184·5	4·20	

1081 Σ 113 42 Cet

h m ° ′
1 17·2 −0 46 6·2—7·2

h	°	″	
48·772	+·8	4·8	1·44	2
·778	−·8	4·6*	1·28	2
·857	+·3	4·7*	1·49	3
48·802		4·7	1·40	

1105 Σ 115

h m ° ′
1 20·1 +57 53 7·3—7·5

h	°	″	
48·778	+ ·5	145·3*	·95	3
·857	− ·2	144·0*	·93	4
·903	+1·0	149·3*	·85	3
·912	+ ·2	145·4*	·93	3
48·863		146·0	·92	

1254 Σ 138

h m ° ′
1 33·4 +7 23 7·3—7·3

h	°	″	
48·778	−1·0	52·0	1·39	3
·857	+ ·3	47·6*	1·28	4
·912	+ ·2	47·1*	1·49	4
48·849		48·9	1·39	

1457 Σ 174 1 Ari

h m ° ′
1 47·4 +22 02 6·2—7·4

h	°	″	
48·824	− ·5	165·3*	2·66	2
·912	+ ·3	165·8*	2·77	4
·991	−1·3	165·5*	2·82	3
48·909		165·5	2·75	

1538 Σ 186

h m ° ′
1 53·3 +1 36 7·2—7·2

h	°	″	
48·857	+ ·3	47·7*	1·34	3
·906	+1·3	48·0*	1·48	4
·909	+ ·3	46·6*	1·46	4
·912	−1·0	46·7*	1·21	2
48·896		47·3	1·37	

1615 Σ 202 α Psc

h m ° ′
1 59·4 +2 31 4·0—5·0

h	°	″	
47·891	−2·0	300·4	2·56	3
48·038	+ ·5	302·6	2·53	3
·049	+2·0	299·4	2·40	4
47·993		300·8	2·50	

1709 Σ 228

h m ° ′
2 10·8 +47 15 6·7—7·6

h	°	″	
48·857	+·8	221·7*	·65	4
·912	+·3	224·0*	·75	4
48·884		222·9	·70	

Residuals KUIPER's orbit (*B.A.N.* **5**, 231): ° −5·9 ″ −·14

Additional measure:
50·936 −·5 229·2 ·65

1786 Σ 248

h m ° ′
2 17·9 +42 23 8·9—8·9

h	°	″	
48·857	+1·0	125·1*	1·02	3

THE MEASURES (*continued*)

1801

h m ° ′
2 18·7 +8 39 8·3—9·2

	h	°	″	
48·857	+1·2	216·5	1·04	3
·903	+1·5	214·0	1·16	3
·906	+1·2	217·3	1·07	3
48·889		215·9	1·09	

2004 Σ 285

h m ° ′
2 35·9 +33 12 7·0—7·7

	h	°	″	
49·830	−2·0	166·9*	1·65	3
·835	+ ·5	167·7*	1·82	4
50·025	+ ·8	167·5*	1·57	3
49·897		167·4	1·68	

2034 OΣ 43

h m ° ′
2 37·8 +26 25 7·2—8·8

	h	°	″	
48·857	+1·2	24·2	1·07	3
·903	+1·5	24·2*	1·09	3
·906	+1·0	23·9	·95	3
49·830	−1·7	22·9	·91	3
·838	+ ·3	20·9*	·96	4
50·025	+1·0	24·3	·79	3
48·889		24·1	1·04	
49·898		22·7	·89	

2117

h m ° ′
2 44·0 +35 21 6·3—8·4

	h	°	″	
48·903	+1·7	178·7*	1·38	3
·906	+1·2	183·7*	1·34	3
·912	+ ·2	181·0	1·23	4
48·907		181·1	1·32	

2204 Σ 312

h m ° ′
2 51·0 +72 04 7·1—8·0

	h	°	″	
49·819	−1·2	28·2*	2·58	4
·827	+1·3	30·0*	2·24	3
50·936	− ·3	28·9*	2·67	4
50·194		29·0	2·50	

2257 Σ 333 ε Ari

h m ° ′
2 56·4 +21 08 5·7—6·0

	h	°	″	
48·988	−1·7	205·0*	1·32	3
50·849	+ ·2	205·7*	1·38	2
·863	−1·2	204·4*	1·48	2
50·233		205·0	1·39	

2377 OΣ 50

h m ° ′
3 07·6 +71 22 7·5—7·5

	h	°	″	
50·819	·0	182·0*	1·15	3
·936	−·5	182·5*	1·23	4
50·877		182·3	1·19	

2504 Σ 381

h m ° ′
3 20·4 +20 48 7·0—8·7

	h	°	″	
48·857	+1·0	101·2	·97	3
49·860	−1·0	95·5	·80	2
50·936	·0	102·3	·77	4
49·884		99·7	·85	

2628

h m ° ′
3 32·5 +31 31 7·0—7·0

	h	°	″	
48·988	+ ·3	45·3*	·90	4
50·849	− ·2	45·1	·95	2
·863	−1·5	44·1	·90	2
50·233		44·8	·92	

2668 Σ 425

h m ° ′
3 37·0 +33 57 7·3—7·3

	h	°	″	
48·824	−1·1	81·6*	1·92	2
·857	+1·0	80·9*	1·82	4
·903	+1·0	81·3*	1·89	3
·906	+ ·5	81·2*	1·85	4
48·873		81·3	1·87	

2729

h m ° ′
3 41·4 +35 42 7·8—8·0

	h	°	″	
49·077	+·7	194·1	1·12	3
·988	+·4	190·4	1·07	2
50·936	−·5	190·8*	·97	4
50·000		191·8	1·05	

2787

h m ° ′
3 46·2 +14 49 8·1—8·3

	h	°	″	
49·074	+ ·3	335·4	·85	2
50·936	·0	333·1	·74	3
·988	+1·0	337·4	·77	2
50·333		335·3	·79	

2873

h m ° ′
3 53·3 +33 02 8·2—8·5

	h	°	″	
49·827	−1·2	85·8	·62	3
·838	− ·2	88·9*	·72	4
50·025	·0	91·3	·75	4
49·897		88·7	·70	

2959 Σ 483

h m ° ′
4 00·7 +39 23 8·0—9·5

	h	°	″	
49·827	−1·2	109·4	·79	3
·838	·0	121·9	·69	3
50·025	+ ·2	135·6	·75 (est.)	3
49·897		122·3	·74	

Residuals VARCHON's orbit (*J. d. O.* **21**, 12): ° −6·7 ″ +·01

2963 Σ 460 49 H Cep

h m ° ′
4 01·4 +80 34 5·2—6·1

	h	°	″	
48·857	+1·0	84·1*	·95	3
·903	− ·8	87·7*	·88	3
·906	+1·3	85·5*	·79	3
49·063	+5·3	86·7*	1·04	4
·066	+5·0	85·4*	·81	3
48·959		85·9	·89	

Additional measure:

49·827		86·8	·93	

2990 OΣ 71

h m ° ′
4 03·8 +33 19 7·0—9·0

	h	°	″	
48·772	−4·0	206·1	·71	3
50·936	+ ·5	224·4*	·56	4
49·854		215·3	·64	

3163 Σ 536

h m ° ′
4 19·7 −4 48 8·1—8·7

	h	°	″	
49·074	+·5	169·3	1·40	2
50·988	+·8	177·4	1·19	2
50·031		173·4	1·30	

3390 Σ 577

h m ° ′
4 38·8 +37 25 7·7—7·7

	h	°	″	
48·988	− ·5	43·2*	1·12	4
49·060	+1·3	43·8*	1·25	3
·077	+ ·2	43·7*	1·24	4
49·042		43·6	1·20	

THE MEASURES (*continued*)

3643

h m ° ′
5 00·8 +35 42 9·0—9·2

	h	°	″	
49·077	+·3	18·5	2·16	2
50·936	−·3	15·4	2·53	4
·988	+·3	15·3	2·62	3
50·334		16·4	2·44	

3711 OΣ 98 14 Ori

h m ° ′
5 05·2 +8 26 6·0—6·8

	h	°	″	
48·988	−·5	93·2*	·88	3
49·060	+1·3	92·0*	·97	3
·077	+·5	92·8*	·96	4
49·042		92·7	·94	

Residuals v. D. Bos' orbit (*U.O.C.* No. 90, p. 383): ° −·4 ″ −·14

3956 Σ 677

h m ° ′
5 20·0 +63 21 7·7—8·0

	h	°	″	
49·063	+4·3	193·7	·82	3
·066	+4·0	195·2	·91	2
50·936	−·5	199·1*	·86	4
49·688		196·0	·86	

4068 Σ 716 118 Tau

h m ° ′
5 26·2 +25 07 5·8—6·6

	h	°	″	
47·966	·0	204·4	5·20	3
48·036	−1·0	204·7	4·91	3
·052	−·7	205·1	4·94	2
·118	+·5	203·0	5·00	3
·131	+·2	204·4*	4·95	4
48·061		204·3	5·00	

4349 Σ 787

h m ° ′
5 43·0 +21 18 8·1—8·5

	h	°	″	
48·903	+·2	67·3*	1·04	3
·906	−1·2	68·2*	·96	4
49·063	+1·2	65·3*	1·07	3
·077	+·3	67·5*	1·03	4
48·987		67·1	1·03	

4390 Σ 795 52 Ori

h m ° ′
5 45·3 +6 26 6·2—6·2

	h	°	″	
48·903	·0	210·0*	1·42	3
·906	−1·0	211·5*	1·48	4
50·936	−·5	210·0*	1·22	4
49·582		210·5	1·37	

4452 Σ 799

h m ° ′
5 48·8 +38 33 7·2—8·3

	h	°	″	
48·903	+·3	175·2*	·91	4
·906	−3·0	175·3*	·79	3
49·063	−·3	172·7*	·96	4
48·957		174·4	·89	

4490 Σ 813

h m ° ′
5 51·4 +18 53 8·0—8·0

	h	°	″	
48·988	−3·2	147·7	2·73	2
49·063	+1·2	149·4*	3·27	4
·077	+·4	149·1*	2·75	4
49·042		148·7	2·92	

4577 OΣ 125

h m ° ′
5 56·7 +22 28 7·0—8·5

	h	°	″	
49·077	·0	·2*	1·28	4
50·936	−·5	1·5*	1·13	4
·988	·0	359·1*	1·14	2
50·333		·3	1·18	

5197 Σ 932

h m ° ′
6 31·5 +14 48 8·2—8·3

	h	°	″	
49·077	·0	320·4*	1·67	4
·090	+1·5	320·1*	1·77	3
·129	+1·3	320·2*	1·68	3
50·025	−1·2	317·4	1·49	3
·028	+2·2	317·5	1·48	2
49·099		320·2	1·71	
50·027		317·5	1·49	

5296 Σ 945

h m ° ′
6 36·8 +41 01 7·1—8·0

	h	°	″	
49·063	+1·0	292·2	·75	4
·066	+1·5	282·2	·77	2
·077	+·5	279·0	·69	3
49·069		284·4	·74	

5368 Σ 946

h m ° ′
6 40·4 +59 30 7·2—9·0

	h	°	″	
49·063	+3·0	134·5*	3·57	4
50·936	−·5	131·5*	3·86	4
·988	−·5	131·3*	3·83	4
50·329		132·4	3·75	

5400 Σ 948 12 Lyn

h m ° ′
6 41·8 +59 30 5·2—6·1

AB

	h	°	″	
49·063	+3·2	93·6*	1·50	4
·066	+3·2	95·5*	1·53	3
50·936	−·3	93·4*	1·39	4
49·688		94·2	1·47	

$\frac{AB}{2} - C$

	h	°	″	
49·063	+3·3	305·5*	8·42	4
·066	+3·3	304·9*	9·01	3
50·936	−·2	313·9	9·06	4
49·688		308·1	8·83	

5436 Σ 958

h m ° ′
6 51·8 +13 15 5·4—7·7

	h	°	″	
47·956	+2·0	258·8	5·25	3
48·049	+1·0	261·0		2
·085	+·5	257·7	4·87	3
·115	+·1	258·4	4·58	3
·129	−·3	257·2*	4·49	4
48·067		258·6	4·80	

5447 OΣ 156

h m ° ′
6 44·5 +18 15 6·5—7·0

	h	°	″	
50·025	−1·7	269·6	·68	3
·936	−·8	265·9*	·68	4
·988	−1·3	264·2	·63	3
50·650		266·6	·66	

5471

h m ° ′
6 46·1 −4 01 7·6—8·3

	h	°	″	
49·063	+1·4	153·9*	4·43	3
·077	+·5	154·4*	4·01	3
50·988	−·1	155·8	4·51	2
49·709		154·7	4·32	

THE MEASURES (*continued*)

5559 Σ 982 38 Gem

h m ° ′
6 51·8 +13 15 5·4—7·7

	h	°	″	
47·956	+1·2	152·5	6·97	3
48·068	·0	150·5	7·33	3
·115	+ ·8	150·3	6·99	4
·129	+ ·2	151·4*	6·93	4
49·063	+1·5	153·0*	6·70	3
·090	+1·4	152·8*	6·79	3
48·067		151·2	7·06	
49·076		152·9	6·75	

6569 Σ 1177

h m ° ′
8 02·6 +27 40 6·5—7·4

	h	°	″	
48·192	−1·0	350·3*	3·75	3
·230	+ ·7	350·8*	3·65	3
50·988	−1·7	350·7*	3·41	3
49·137		350·6	3·60	

6623 Σ 1187

h m ° ′
8 06·4 +32 22 7·1—8·0

	h	°	″	
48·137	+ ·1	30·4	2·92	3
·153	+1·9	31·8	2·93	3
·156	+1·0	32·1	2·70	4
·186	+1·0	32·8	2·81	2
·189	+ ·2	31·8*	2·69	3
48·164		31·8	2·81	

6650 Σ 1196 ζ Cnc

h m ° ′
8 09·3 +17 48 5·0—5·7

AB

	h	°	″	
48·068	+ ·6	42·5	1·17	3
·071	+ ·3	43·1	1·05	4
·115	+ ·2	42·6	1·17	3
·129	+1·0	44·0*	1·23	3
49·063	+ ·7	43·0*	1·02	3
·090	+ ·5	43·0*	1·02	4
·126	+ ·1	43·1*	1·00	3
·129	+ ·2	41·1*	1·11	3
48·096		43·0	1·16	
49·102		42·5	1·04	

Residuals MAKEMSON's orbit (*A. J.* **42**, 153): ° ″
+ ·9 + ·10
+4·3 − ·05

6650 Σ 1196 ζ Cnc (*continued*)

$\frac{AB}{2} - C$

	h	°	″	
48·068	+ ·7	97·3		3
·071	+ ·4	97·4	5·77	4
·115	+ ·3	97·3	5·32	3
·129	+1·1	98·1*	5·39	3
49·063	+ ·8	97·0	5·34	3
·090	+ ·6	93·6	5·20	4
·126	+ ·8	98·3	5·09	3
·129	+ ·3	95·6	5·19	3
48·096		97·5	5·49	
49·102		96·1	5·21	

6762 Σ 1216

h m ° ′
8 18·8 −1 26 7·5—8·2

	h	°	″	
49·090	+ ·5	239·0	·63	4
·131	+ ·5	251·4	·68(est.)	3
50·988	− ·3	252·9	·63(est.)	3
49·736		247·8	·65	

Residuals EKENBERG's orbit (*Lund Medd.* ser. II, No 116): ° ″
−3·7 + ·14

7044

h m ° ′
8 48·0 +8 03 8·6—8·7

	h	°	″	
49·090	+ ·3	110·6	2·04	3

7067 Σ 1280

h m ° ′
8 51·0 +71 00 7·5—7·6

	h	°	″	
49·066	·0	62·0	2·37	3
50·988	−1·0	63·5	2·58	4
50·027		62·7	2·47	

7071 Σ 1291 57 Cnc

h m ° ′
8 51·2 +30 46 5·9—6·4

	h	°	″	
48·192	−1·3	317·0	1·43	3
·230	+ ·2	319·1	1·48	3
49·063	+1·3	319·8*	1·22	4
·066	+ ·5	318·9*	1·38	4
·077	+ ·3	318·2*	1·45	3
·090	−1·2	319·6*	1·34	3
·112	·0	319·2*	1·46	4
48·211		318·0	1·46	
49·082		319·1	1·37	

7284 Σ 3121

h m ° ′
9 14·9 +28 47 7·5—7·5

	h	°	″	
50·025	+1·0	206·8	·62(est.)	2
·123	+ ·8	215·2	·63(est.)	3
50·074		211·0	·63	

7286 Σ 1333

h m ° ′
9 15·4 +35 25 6·6—6·9

	h	°	h	
48·071	·0	44·7	2·22	3
·118	·0	45·9	1·82	3
·131	− ·5	46·2	1·73	4
·137	−1·6	48·1*	1·91	3
48·114		46·2	1·92	

7307 Σ 1338

h m ° ′
9 17·9 +38 24 7·0—7·2

	h	°	″	
48·140	+ ·3	207·5	1·34	3
·153	−1·2	209·4	1·34	3
·159	+ ·2	209·8	1·35	5
·189	+ ·5	209·1	1·43	3
·192	− ·2	213·7	1·28	3
48·167		209·9	1·35	

7352 Σ 1348

h m ° ′
9 21·8 +6 34 7·5—7·6

	h	°	″	
48·156	+ ·7	319·4	1·96	5
·189	+ ·5	317·0		2
·230	·0	317·9	2·10	3
48·192		318·1	2·03	

7398

h m ° ′
9 26·8 +42 29 8·0—8·0

	h	°	″	
49·112	+ ·8	28·9*	1·12	4
·129	·0	26·1*	1·10	3
·131	− ·2	28·8	·93	3
·175	+ ·3	27·0	·90	2
50·025	− ·5	27·0*	·91	3
·028	− ·3	29·7	·99	2
·123	·0	29·6*	1·03	4
49·137		27·7	1·01	
50·059		28·8	·98	

THE MEASURES (*continued*)

7477 Σ 1374

h m ° ′
9 38·3 +39 11 7·0–8·3

h	°	″	
48·071	+1·0	298·5	3·18	3
·093	+ ·5	295·9	2·99	4
·131	+ ·7	295·8	3·10	4
·137	− ·3	293·5	3·22	3
48·108		295·9	3·12	

7551 Σ 1389

h m ° ′
9 49·6 +27 13 8·0–9·0

h	°	″	
49·175	+ ·4	299·7	1·89	3
·211	+ ·3	299·2	2·11	3
·230	+1·0	300·9	1·83	2
49·205		299·9	1·94	

7632 Σ 1406

h m ° ′
10 02·8 +31 20 8·0–8·7

h	°	″	
49·131	− ·3	228·7	·74	2
·219	+1·0	227·7	·90	3
49·175		228·2	·82	

7692

h m ° ′
10 11·8 +18 09 8·0–8·5

h	°	″	
49·151	+1·0	9·2	1·14	4
·175	+ ·4	10·4*	1·11	3
·183	+ ·8	8·8*	1·08	2
·211	+ ·7	9·1	1·04	3
49·180		9·4	1·09	

7704 OΣ 215

h m ° ′
10 13·6 +17 59 7·0–7·2

h	°	″	
48·192	− ·7	188·0	1·31	3
·227	+1·5	188·6	1·16	3
·230	− ·5	190·8	1·44	3
·320	+1·7	188·6	1·05	3
48·242		189·0	1·24	

7721 Σ 1423

h m ° ′
10 16·5 +20 49 8·6–9·3

h	°	″	
50·123	·0	41·7	1·23	3

7724 Σ 1424 γ Leo

h m ° ′
10 17·2 +20 06 2·0–3·5

h	°	″	
48·071	+·7	120·8	4·32	3
·093	+·5	120·5	4·32	4
·118	·0	119·4	4·33	3
·131	+·5	121·1*	4·11	3
48·103		120·4	4·27	

7730 Σ 1426

h m ° ′
10 17·9 +6 41 7·8–8·3

h	°	″	
49·093	+1·0	294·4*	·95	3
·112	+ ·3	298·9*	·85	4
·129	− ·5	297·3*	·95	3
·151	·0	294·5*	·81	2
49·121		296·3	·89	

7802 Σ 1439

h m ° ′
10 27·4 +21 04 8·0–8·5

h	°	″	
49·093	+·3	97·7*	1·44	4
·112	+·4	100·2*	1·22	4
·151	−·3	98·8*	1·42	3
·175	+·3	100·6	1·19	3
49·133		99·3	1·32	

7864 Σ 1457

h m ° ′
10 36·1 +6 00 7·4–8·4

h	°	″	
49·093	+·5	326·8*	1·61	4
·112	+·7	326·6*	1·55	4
·129	−·7	325·6	1·49	3
·151	+·2	325·4*	1·34	2
49·121		326·1	1·50	

7929 OΣ 229

h m ° ′
10 45·2 +41 22 6·7–7·1

h	°	″	
49·093	+·5	296·4*	1·02	4
·112	+·4	294·8*	·83	4
·131	−·7	295·1	·83	2
·151	+·2	296·0*	·82	3
49·122		295·6	·88	

8043 Σ 1504

h m ° ′
11 01·4 +3 55 7·5–7·6

h	°	″	
50·123	+·3	293·3	1·22	2

8047

h m ° ′
11 02·2 +38 41 8·0–8·2

h	°	″	
50·123	−·5	239·4	·75	3

8105 Σ 1521

h m ° ′
11 12·7 +27 51 7·2–7·5

h	°	″	
48·093	+ ·2	96·6	3·40	3
·118	−1·0	96·1	3·47	3
·134	−2·2	96·6*	3·77	4
·140	−2·0	94·5	3·66	3
48·121		95·9	3·58	

8128 Σ 1527

h m ° ′
11 16·4 +14 33 6·9–8·1

h	°	″	
48·159	− ·8	22·2*	2·93	5
·227	+ ·7	21·8*	2·53	3
·230	−1·2	25·4	2·40	4
·320	+1·0	21·8*	2·45	3
49·151	·0	22·0*	2·33	4
·175	−·2	22·0*	2·42	3
·183	·0	23·1*	2·50	3
·211	−·8	24·1*	2·27	3
48·234		22·8	2·44	
49·180		22·8	2·38	

8197 OΣ 235

h m ° ′
11 29·5 +61 22 6·0–7·3

h	°	″	
49·151	+·8	53·0	·79	3
·211	·0	51·5	·90	3
49·181		52·3	·85	

Residuals AITKEN's orbit (*Lick Publ.* **12**, 72): ° ″
+·7 −·14

8220 Σ 1552 90 Leo

h m ° ′
11 32·1 +17 04 6·0–7·3

h	°	″	
48·301	− ·2	209·3*	3·69	3
·320	+1·0	209·5*	3·41	4
·339	+1·0	208·0*	3·60	3
·347	+1·3	207·0*	3·45	3
48·328		208·5	3·54	

THE MEASURES (*continued*)

8406 Σ 1596 2 Com

h m ° ′
12 01·7 21 44 6·0—7·5

h	°	″	
48·118	+3·2	235·7	3·69	3
·131	+ ·7	237·2	3·83	4
·137	— ·8	237·6*	3·70	4
·140	—1·5	238·1	3·69	3
48·132		237·1	3·73	

8446 Σ 1606

h m ° ′
12 08·3 +40 10 6·3—7·0

h	°	″	
48·131	— ·4	312·5*	1·05	4
·137	— ·5	309·5	·97	4
·153	—1·0	306·3	·86	3
·159	— ·3	304·5	·86	4
48·145		308·2	·94	

8539 Σ 1639

h m ° ′
12 21·9 +25 52 6·7—7·9

h	°	″	
49·151	— ·3	334·0*	1·05	4
·175	—1·0	331·2*	·99	3
·183	—1·0	332·2*	1·02	3
·211	—1·2	332·2*	·97	3
49·180		332·6	1·01	

8553 Σ 1643

h m ° ′
12 24·7 +27 19 8·4—8·7

h	°	″	
48·307	—·5	23·7	2·24	3
·320	+·5	18·4	2·36	3
·339	+·3	20·5	2·44	3
·347	+·8	23·6	2·35	3
48·328		21·5	2·35	

8575 Σ 1647

h m ° ′
12 28·0 +10 00 7·5—7·8

h	°	″	
49·230	—1·2	234·4*	1·14	2
·309	·0	233·2*	1·28	3
·345	— ·3	235·4*	1·28	2
·364	— ·5	236·5	1·32	2
49·312		234·9	1·26	

8606 Σ 1661

h m ° ′
12 33·5 +11 41 8·5—8·5

8606 Σ 1161 (*continued*)

h	°	″	
49·151	— ·3	246·6	2·12	2
·175	—1·0	244·8	1·87	3
·183	—1·0	245·3	1·98	2
·211	—1·2	246·4	1·87	3
49·180		245·8	1·96	

8630 Σ 1670 γ Vir

h m ° ′
12 39·1 —1 11 3·0—3·0

h	°	″	
48·137	— ·3	312·9*	5·76	3
·153	—1·2	313·6*	5·68	3
·159	— ·8	313·5	5·37	4
48·150		313·3	5·60	

Residuals STRAND's orbit (*Leiden Ann.* **18**², p. 77): ° +·2 ″ +·08

8695 Σ 1687 35 Com

h m ° ′
12 50·8 +21 31 5·0—7·8

h	°	″	
49·307	—·2	132·7	·96	3
·345	—·3	128·4	·99	2
·364	+·5	129·8		2
49·339		130·3	·98	

8708 OΣ 256

h m ° ′
12 53·9 —0 41 7·2—7·6

h	°	″	
49·175	—·7	85·7*	·79	3
·309	·0	85·1*	·81	4
·345	—·2	85·1*	·88	3
49·276		85·3	·83	

8710 Σ 1695

h m ° ′
12 54·1 +54 22 6·3—8·2

h	°	″	
48·307	—·8	282·5*	3·67	3
·320	+·5	282·8*	3·47	3
·339	+·3	282·7*	3·42	3
·348	+·7	282·3*	3·30	4
48·328		282·6	3·47	

8721 Σ 1699

h m ° ′
12 56·3 +27 45 7·8—7·8

h	°	″	
48·290	—·7	10·7	1·62	3
·339	+·8	4·8	1·45	3
48·314		7·8	1·54	

8759 48 Vir

h m ° ′
13 01·3 —3 24 6·2—6·5

h	°	″	
49·309	·0	206·9	·82	4
·345	—·2	212·8	·88(est.)	2
49·327		209·8	·85	

8814 OΣ 261

h m ° ′
13 09·7 +32 21 6·9—7·4

h	°	″	
48·307	+ ·2	342·5*	2·01	3
·320	+1·0	341·9	2·12	4
·339	·0	340·4	2·11	4
·383	+2·3	341·6*	2·00	2
48·337		341·6	2·06	

8887

h m ° ′
13 21·3 +29 29 8·3—8·5

h	°	″	
49·175	—·7	38·9	·67	3
·309	·0	44·0	·73(est.)	4
49·242		41·4	·70	

8914 OΣ 266

h m ° ′
13 26·0 +15 58 7·3—7·8

h	°	″	
49·175	— ·6	347·7	1·76	3
·183	—1·2	348·7*	1·50	2
·230	—1·7	349·0	1·59	2
·309	+ ·2	347·0*	1·74	4
49·224		348·1	1·65	

8949 Σ 1757

h m ° ′
13 31·7 —0 04 7·8—8·9

h	°	″	
48·227	·0	98·9	2·61	3
·320	+1·0	98·4*	2·67	4
·339	+1·0	98·2*	2·60	4
·348	+ ·5	97·7	2·45	2
48·309		98·3	2·58	

Residuals LUPLAU JANSSEN's orbit (*A. N.* **241**, 61): ° —1·6 ″ +1·5

8974 Σ 1768 25 C Vn

h m ° ′
13 35·2 +36 33 5·7—7·6

h	°	″	
49·230	—1·7	116·0	1·28	2
·309	+ ·2	111·7*	1·48	4
·345	— ·5	114·4*	1·36	2
·364	·0	112·8	1·27	2
49·312		113·7	1·35	

THE MEASURES (*continued*)

9019 Σ 1781

h m 13 43·6 + 5 22 7·8—8·2

49·309	+·3	324·0	·83(est.) 3
·345	−·3	317·3	·83(est.) 2
49·327		320·7	·83

9031 Σ 1785

h m 13 46·8 +27 14 7·2—7·5

h		°	″	
48·227	+ ·3	125·4	2·25	3
·230	−1·5	126·2	2·36	3
·320	−1·0	124·9	2·41	4
·339	+1·2	129·3	2·16	3
48·279		126·5	2·30	

Residuals RABE's orbit (*A. N.* **231**, 121): ° −4·1 ″ −·07

9060 OΣ 273

h m 13 53·8 +5 32 8·0—8·5

h		°	″	
49·309	+·4	109·7	·95	4
·345	−·3	107·3	·96	3
49·327		108·5	·95	

9167 Σ 1820

h m 14 11·4 +55 33 8·2—8·5

h	°	″	
49·345	+·2	96·6	1·80	3

9174 Σ 1816

h m 14 11·7 +29 20 7·0—7·1

h		°	″	
48·307	+1·0	82·7	1·02	4
·320	+1·0	86·4	·96	3
·339	+1·0	85·9	1·00	3
·397	+1·3	86·4	1·11	3
48·341		85·4	1·02	

9182 Σ 1819

h m 14 12·8 +3 22 7·9—8·0

h		°	″	
49·309	+·7	304·4*	·87	4
·345	−·5	301·5*	1·01	3
·364	·0	300·5	·96	2
49·339		302·1	·95	

Residuals v. BEZOLD's orbit (*A. N.* **267**, 233): ° +·9 ″ −·07

9229 Σ 1834

h m 14 18·5 +48 44 7·1—7·2

h		°	″	
49·309	+1·5	100·5*	·88	4
·345	− ·2	100·9*	·97	3
·364	·0	96·6	·87	3
·375	+ ·7	98·3	·85	4
49·348		99·1	·89	

Residuals v. D. BOS' orbit (*U.O.C.* No. 99, p. 458): ° −2·2 ″ +·01

9340 Σ 1867

h m 14 38·6 +31 30 7·7—8·2

h		°	″	
48·307	+1·0	12·0	1·02	3
·320	+1·0	5·8	·90	4
48·314		8·9	·96	

9343 Σ 1865 ζ Boo

h m 14 38·8 +13 57 3·5—3·9

h		°	″	
48·137	−2·5	310·0	1·30	2
·159	−2·5	310·0	1·27	3
·227	−1·8	310·7	1·20	3
·230	−2·0	311·2	1·30	3
48·188		310·5	1·27	

Residuals v. D. BOS' orbit (*U.O.C.* No. 98, p. 349): ° −·7 ″ +·12

9350 Σ 1871

h m 14 39·8 +51 37 7·0—7·0

h		°	″	
48·340	+1·2	303·1	1·62	3
·383	+1·3	300·7*	1·61	2
·405	+1·3	302·1*	1·95	4
·443	+ ·5	299·4*	1·77	2
48·393		301·3	1·74	

9406 Σ 1890 39 Boo

h m 14 48·0 +48 55 5·8—6·5

h		°	″	
48·340	+1·7	43·4*	3·10	4
·383	+1·5	44·3*	3·20	3
·397	+1·3	45·6*	3·09	3
·443	+2·2	45·0*	3·10	3
48·391		44·6	3·12	

9413 Σ 1888 ξ Boo

h m 14 49·1 +19 19 4·7—6·6

h		°	″	
48·137	+ ·8	358·2*	6·17	3
·159	−2·3	357·4	5·99	4
·227	−1·8	357·9	5·83	4
·230	−1·8	357·6*	6·00	4
48·188		357·8	6·00	

Residuals STRAND's orbit (*Leiden Ann.* **18²**, p. 90): ° −·8 ″ ·00

9418 OΣ 287

h m 14 49·6 +45 08 7·5—7·6

h		°	″	
48·348	−·5	159·3	1·16	3
·443	+·7	161·1	1·11	2
48·395		160·2	1·14	

9425 OΣ 288

h m 14 51·0 +15 54 6·4—7·1

h		°	″	
48·348	+ ·3	179·5	1·54	2
·383	+1·8	177·6	1·63	2
·405	+1·7	180·1	1·71	2
·443	+ ·5	181·0	1·52	3
48·395		179·5	1·60	

9494 Σ 1909 44 i Boo

h m 15 02·2 +47 51 5·2—6·1

h		°	″	
48·307	+1·0	251·5*	1·90	3
·320	+1·0	251·8*	1·89	4
·340	+1·2	252·8*	1·89	4
·383	+2·0	252·7*	1·95	2
48·337		252·2	1·91	

Residuals STRAND's orbit (*Leiden Ann.* **18²**, p. 98): ° −1·7 ″ +·16

Residuals GENNARO's orbit (*Padova Publ.* No. 66): ° −1·2 ″ +·11

9530

h m 15 09·2 +10 19 8·1—8·1

h		°	″	
49·309	·0	35·3	·68	4
·364	−·7	51·6	·79	3
49·337		43·4	·74	

THE MEASURES (*continued*)

9626 Σ 1938 μ Boo

h m ° ′
15 22·6 +37 31 6·7—7·3

B − *C*

h	°	″	
49·364	·0	28·9*	1·61	3
·375	+·3	28·2*	1·78	3
·416	+·2	27·3*	1·87	3
49·385		28·1	1·75	

9639 OΣ 296

h m ° ′
15 24·7 +44 11 7·0—8·6

h	°	″	
49·309	·0	291·9*	1·71	4
·345	−·5	286·0	1·38	3
·364	·0	285·4	1·54	3
·375	+·2	287·6	1·59	3
·419	−·2	289·2*	1·46	2
49·362		288·0	1·54	

9758

h m ° ′
15 40·8 +13 50 6·5—7·0

h	°	″	
48·443	+·7	1·5	·52	3

9880 OΣ 303

h m ° ′
15 38·6 +13 25 7·4—7·9

h	°	″	
49·345	−·8	162·5	·99	3
·364	−·5	162·6*	·95	3
·375	·0	159·6	1·04	2
·419	·0	157·2	1·07	3
49·376		160·5	1·01	

10038 Σ 2047

h m ° ′
16 21·7 +47 45 7·5—8·0

h	°	″	
48·307	·0	324·1	2·01	3
·320	·0	327·7	2·15	4
·340	+·5	324·3	1·82	4
48·322		325·4	1·99	

10070 Σ 2049

h m ° ′
16 25·8 +26 06 6·5—7·5

h	°	″	
49·345	−1·0	201·2*	1·12	3
·364	−·5	205·7	1·04	3
·375	·0	205·7	1·25	2
·419	·0	200·1*	1·14	3
49·376		203·2	1·14	

10087 Σ 2055 λ Oph

h m ° ′
16 28·4 +2 06 4·0—6·1

h	°	″	
48·443	+·5	310·6	·59	3

Residuals BAIZE's orbit (*J. d. O.* **24**, 123): +8°·6 +″·05

Residuals DURHAM's orbit (*A. J.* **50**, 165): +8°·2 +″·03

10157 Σ 2084 ζ Her

h m ° ′
16 39·4 +31 41 3·0—6·5

h	°	″	
48·443	+1·6	130·6	1·09	3
·482	−·3	123·5	1·11	3
48·463		127·0	1·10	

Residuals SILBERNAGEL's orbit (*A. N.* **233**, 145): +6°·6 −″·29

10169 Σ 2091

h m ° ′
16 40·5 +41 17 7·5—8·0

h	°	″	
48·481	+·7	303·5*	1·11	2

10188

h m ° ′
16 42·4 +43 34 7·7—7·7

h	°	″	
49·419	0·0	165·8*	1·02	3

Residuals VAN BIESBROECK's orbit (*Publ. Yerkes Obs.* **5**, 1): +1°·2 −″·05

10312 Σ 2114

h m ° ′
16 59·6 +8 31 6·2—7·4

h	°	″	
49·419	+·2	176·9*	1·21	2
·465	+·5	173·1	1·11	3
·504	+·3	173·9	1·16	2
49·463		174·7	1·16	

10345 Σ 2130 μ Dra

h m ° ′
17 04·3 +54 32 5·0—5·1

10345 Σ 2130 μ Dra (*continued*)

h	°	″	
48·405	+·2	89·5*	2·14	3
·443	+·3	88·0*	2·16	4
·446	+·3	90·0*	2·02	3
·482	+·5	91·6*	2·13	3
48·444		89·8	2·11	

Residuals KOMENDANTOFF's orbit (*Pulkovo Obs. Circ.* No. 16, p. 13): −1°·4 −″·28

10558 Σ 2168

h m ° ′
17 24·9 +35 48 7·5—8·2

h	°	″	
48·482	+1·5	190·2*	2·17	4
·520	+1·0	189·2		3
48·501		189·7	2·17	

10699 Σ 2199

h m ° ′
17 37·9 +55 47 7·2—7·8

h	°	″	
48·405	·0	70·2	1·71	3
·443	+·2	73·9*	1·90	4
·446	+·8	75·1*	1·68	2
·482	+·3	74·3*	1·77	4
48·444		73·4	1·77	

10722 Σ 2203

h m ° ′
17 39·7 +41 41 7·5—7·8

h	°	″	
48·482	+·5	305·8	·82	4
49·051	+·5	301·6	·74	2
48·992		303·7	·78	

10795 Σ 2215

h m ° ′
17 44·9 +17 43 5·9—7·9

h	°	″	
48·482	+·7	274·4	·68	4
49·465	+·3	273·6	·81	2
48·974		274·0	·75	

10850 OΣ 338

h m ° ′
17 49·7 +15 20 6·6—6·9

h	°	″	
49·465	+·5	2·7*	·87	4
·501	+1·0	1·0*	·79	3
·504	·0	359·9	·79	2
49·490		1·2	·82	

THE MEASURES (*continued*)

10905 Σ 2245

h m ° ′
17 54·2 +18 20 7·0—7·0

h	°	″	
48·405	+ ·3	291·7	2·53	2
·443	+ ·2	293·9*	2·59	4
·446	−2·0	294·0*	2·51	2
48·431		293·2	2·54	

11110 Σ 2283

h m ° ′
18 07·1 +6 08 7·2—7·7

h	°	″	
48·482	+·7	84·8	·89	3

11123 Σ 2289

h m ° ′
18 07·9 +16 28 6·0—7·1

h	°	″	
48·482	+1·8	226·3	1·13	4

11811

h m ° ′
18 52·2 +37 19 8·2—8·7

h	°	″	
49·465	·0	143·5	1·38	4
·501	− ·2	147·0*	1·28	4
·504	− ·7	144·5	1·15	3
50·463	−1·3	147·4	1·12	2
·482	− ·4	144·6	1·12	3
49·490		145·0	1·27	
50·473		146·0	1·12	

11869 Σ 2422

h m ° ′
18 55·1 +26 02 7·6—7·7

h	°	″	
49·465	+·8	84·1*	·83	4
·501	−·3	83·1	·79	3
49·483		83·6	·81	

11897 Σ 2438

h m ° ′
18 56·6 +58 09 7·0—7·6

h	°	″	
50·463	−·3	359·8*	·67	4
·482	−·2	1·4*	·67	3
50·473		·6	·67	

11956 Σ 2437

h m ° ′
18 59·7 +19 06 7·8—8·0

11956 Σ 2437 (*continued*)

h	°	″	
50·463	−1·0	46·6	·68	3
·482	−1·0	45·6	·69	3
·523	+ ·7	41·6	·77	2
50·489		44·6	·71	

12050 Σ 2455

h m ° ′
19 04·8 +22 06 7·2—8·3

h	°	″	
50·463	−1·2	45·0	5·02	2
·482	+ ·2	44·2*	5·25	3
·523	+1·2	45·0*	5·14	3
50·489		44·7	5·14	

12447 Σ 2525

h m ° ′
19 24·5 +27 13 7·4—7·6

h	°	″	
50·438	·0	297·1*	1·10	2
·463	+1·0	298·3*	1·22	4
·482	+1·3	296·0*	1·17	4
50·461		297·1	1·16	

13055

h m ° ′
19 50·4 +22 19 8·0—8·1

h	°	″	
50·482	+·5	273·8	·60	3

13082 Σ 2596

h m ° ′
19 51·7 +15 10 7·2—8·6

h	°	″	
48·482	·0	319·2*	2·00	3

13196 Σ 2606

h m ° ′
19 56·6 +33 08 7·5—8·2

h	°	″	
48·482	−·3	141·2*	1·05	3

14206 Σ 2720

h m ° ′
20 41·2 +16 46 8·5—8·7

h	°	″	
48·663	+ ·2	180·6	3·81	4
·692	−1·2	178·8		2
48·678		179·7	3·81	

14227 Σ 2724

h m ° ′
20 42·3 +23 45 8·2—8·3

h	°	″	
48·693	−1·0	329·0	2·33	2

14233 Σ 2723

h m ° ′
20 42·5 +12 08 6·4—8·2

h	°	″	
48·662	+·3	114·7	1·09	3

14822

h m ° ′
21 15·1 +35 33 8·0—8·5

h	°	″	
49·638	+ ·7	251·0	·99	2
·665	+1·8	247·5	1·12	3
49·652		249·3	1·06	

14889 OΣ 437

h m ° ′
21 18·7 +32 14 6·5—7·2

h	°	″	
48·662	·0	29·7*	2·06	4
·693	− ·8	27·8*	1·93	3
·786	− ·8	30·2*	1·90	3
·857	+1·3	29·3*	1·82	2
48·750		29·3	1·93	

14977 Σ 2797

h m ° ′
21 24·3 +13 28 6·7—8·2

h	°	″	
48·663	+·3	216·6	3·15	3
·693	−·8	216·9	3·09	3
48·678		216·7	3·12	

15007 Σ 2799

h m ° ′
21 26·4 +10 52 7·0—7·0

h	°	″	
49·638	+1·8	280·2*	1·36	3
·665	+ ·7	279·8*	1·21	3
·723	+ ·8	278·8*	1·29	3
49·675		279·6	1·29	

15076 Σ 2804

h m ° ′
21 30·6 +20 29 7·3—8·0

h	°	″	
49·638	+2·0	345·4*	2·97	3
·665	+ ·8	347·7*	2·87	3
·676	+1·7	343·0*	2·99	3
·698	+ ·8	344·5*	3·03	2
49·669		345·1	2·97	

THE MEASURES (*continued*)

15712 Σ 2879

h m 22 09·4 | ° ′ +63 09 | 8·0—8·0

	h	°	″	
48·693	— ·5	232·0	·82	3
·857	+1·7	236·9	·91	3
·912	+2·3	231·0	·83	4
48·821		233·3	·85	

15756

h m 22 11·7 | ° ′ +52 19 | 8·0—8·0

	h	°	″	
49·723	+1·7	133·1	·69	3

15769 Σ 2881

h m 22 12·3 | ° ′ +29 20 | 7·7—8·2

	h	°	″	
48·663	·0	89·6*	1·38	4
·692	—1·0	88·8*	1·50	3
·766	—1·6	87·2*	1·28	3
·772	—1·0	88·3*	1·34	3
49·665	+1·0	89·1*	1·11	3
48·912		88·6	1·32	

16266

h m 22 44·8 | ° ′ +44 31 | 8·4—8·5

	h	°	″	
49·665	+1·0	202·6	·75	3
·676	+ ·2	204·7	·87	3
·698	+ ·2	202·4*	·79	3
·723	·0	208·8	·69	2
49·691		204·6	·78	

16270 Σ 2944

h m 22 45·3 | ° ′ −4 29 | 7·0—7·5

	h	°	″	
49·665	·0	270·8*	2·31	2
·676	·0	271·4*	2·28	2
·679	+·2	271·0*	2·35	2
·698	·0	272·5*	2·33	2
49·680		271·4	2·32	

16298 Σ 2948

h m 22 47·8 | ° ′ +66 17 | 7·0—8·7

	h	°	″	
48·693	— ·8	·4	2·71	3
·745	+1·3	6·0*	2·62	2
·767	+ ·2	3·6*	2·31	3
·857	+ ·3	4·0	2·28	2
48·766		3·5	2·48	

16394 Σ 2961

h m 22 54·6 | ° ′ +62 36 | 8·0—8·0

	h	°	″	
48·693	— ·7	342·7*	2·19	3
·745	+1·3	349·0*	2·01	3
48·719		345·9	2·10	

16664 Σ 3000

h m 23 16·3 | ° ′ +24 55 | 8·7—8·8

	h	°	″	
48·663	— ·7	52·8	2·72	3
·745	+1·3	51·9	2·96	3
·772	— ·2	52·8	2·82	3
48·727		52·5	2·83	

16807 OΣ 497

h m 23 28·4 | ° ′ +9 12 | 7·9—8·6

	h	°	″	
48·663	—·2	214·0	1·42	3

17009 Σ 3041

h m 23 45·3 | ° ′ +16 47 | 7·5—8·2

	h	°	″	
48·663	— ·3	356·8	3·29	4
·693	— ·7	1·8	3·31	3
·742	+1·2	356·9*	3·27	2
·745	+1·3	355·1	3·35	3
·750	+ ·8	355·8	3·02	3
48·719		357·3	3·25	

17149 Σ 3050

h m 23 56·9 | ° ′ +33 27 | 6·5—6·5

	h	°	″	
48·663	— ·2	260·9*	1·46	4
·693	— ·7	259·1*	1·50	4
·742	+1·2	256·7*	1·46	3
·745	+1·3	260·6*	1·46	3
·750	+ ·8	256·3*	1·34	4
49·665	+1·0	262·1*	1·32	3
·676	·0	260·6*	1·25	3
·679	— ·5	261·8*	1·36	2
·723	— ·7	262·0*	1·23	3
48·619		258·7	1·44	
49·686		261·6	1·29	

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