The Southern Double Stars of Carl Rümker I: History, Identification, Accuracy

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Abstract: The second catalog of southern double stars was published by Carl Rümker 1832. We describe this catalog, obtain modern nomenclature and data and estimate the accuracy of his positions for the primary components. We have shown the equinox and epoch to be B1827.0. Of the 28 pairs, 27 could be identified. RMK 23 is RMK 22 and RMK 24 could not be identified. Five pairs observed by Rümker are credited to co-worker Dunlop (DUN) in the WDS. There are two typographical errors. We tentatively identify RMK 28 with COO 261. We have shown the positional data in the 1832 catalog to be accurate and we present a modern/revised version of Rümker's catalog.

Introduction

The finding, cataloging, and astrometric study of double stars dominated the astronomy of the 19th century. In the southern sky, the pioneering double stars work of Sir John Herschel (JH) in the 1830-40s is recognized for its accuracy and completeness.

However, some two decades prior to the work of JH, a small but well equipped privately owned observatory was established in the fledgling British Colony of New South Wales by Sir Thomas Makdougall Brisbane, the 6th Governor of the Colony. For about a decade, the Parramatta Observatory reigned supreme in the southern hemisphere, systematically exploring for the first time the deep southern skies.

The Parramatta Observatory was constructed by Sir Thomas Brisbane, and staffed by two astronomers, Carl Rümker (Figure 1) and James Dunlop. From Parramatta came dedicated catalogs of stars (Richardson, 1835), double stars (Dunlop, 1829) and non-stellar objects (Dunlop, 1828). This paper follows the work of one of the first of the double star catalogs, that of Rümker (Rümker, 1832).

Biography

Carl Rümker (Figure 1) was born 1788 May 18 in Burg Stargard, Germany, and graduated as a Master-

Figure 1: Carl Rümker, from Wikipedia (artist and date unknown)

Builder in 1807. In 1808 he was teaching mathematics in Hamburg and from 1809 to 1811 he was a midshipman for the British East India Company, entering the

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Merchant Navy in 1811. After being discharged in 1813 he was walking in London when he was suddenly pressganged into the Royal Navy. This unfortunate event turned out to have profound positive repercussions.

The captain of the vessel to which Rümker was assigned, discovered that Rümker was well-educated and a teacher of mathematics and so put him in charge of teaching navigation with an officer's rank. While serving with the Royal Navy, Rümker became firm friends with Baron Franz Xavier von Zach, a Hungarian astronomer and, at the time, editor of the important journal *Correspondance astronomique*. Zach recognized Rümker's astronomical talent and encouraged him to pursue the science.

Discharged from the Royal Navy in 1819 at the end of the Napoleonic Wars, Rümker returned to Hamburg where he became a teacher at the School of Navigation. However, in 1821, through a series of contacts, Rümker applied for the position of astronomer to Thomas Brisbane (Figure 2), hoping to make a name for himself by publishing data from the almost totally unknown far southern sky. Thomas Brisbane, a well-respected and keen amateur astronomer, had just been appointed Governor of the penal colony of New South Wales and was looking to personally fund a professional astronomer to take charge of an observatory he intended to build at the Governor's house at Parramatta, then a very small settlement about 20 miles west of Sydney, and now part of greater Sydney. Sir Thomas also employed James Dunlop (Figure 3), a young mechanically-minded Scot, 5 years Rümker's junior, to maintain the observatory's equipment. James Dunlop was later to learn the art of astrometry from Brisbane and in fact published the first catalogue of southern double stars in 1829, beating Rümker's publication by 3 years.

After arriving in Parramatta and overseeing the construction of the observatory which stood behind Government House, Rümker began work on 1822 May 2, not long before his 34th birthday. The Parramatta Observatory (Figure 4) was Brisbane's own personal observatory entirely funded by him. His main goal was to publish a catalogue of stars in the southern hemisphere that were south of declination -30°; a region beyond the reach of the main European observatories, especially Greenwich.

This work was to follow Lacaille's *Coelum australe stelliferum* which had been published in 1763 but contained many known errors and was incomplete. A complete reduction of Lacaille's stars was only published in 1847 (Lacaille, Henderson, Baily, & Herschel, 1847). The so-called "Brisbane Catalogue" was published in 1835 (Richardson, 1835).

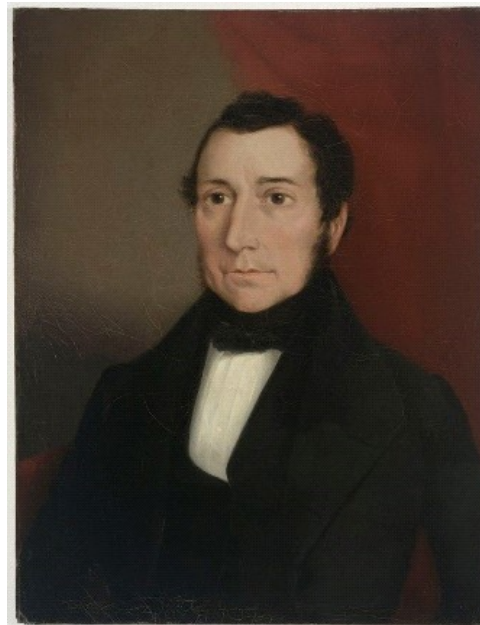*Figure 2: Thomas Brisbane, from Wikipedia (artist and date unknown)*

Figure 3: James Dunlop, from Wikipedia (by Joseph Blackler, c. 1843). Held by the Mitchell Library, State Library of New South Wales.

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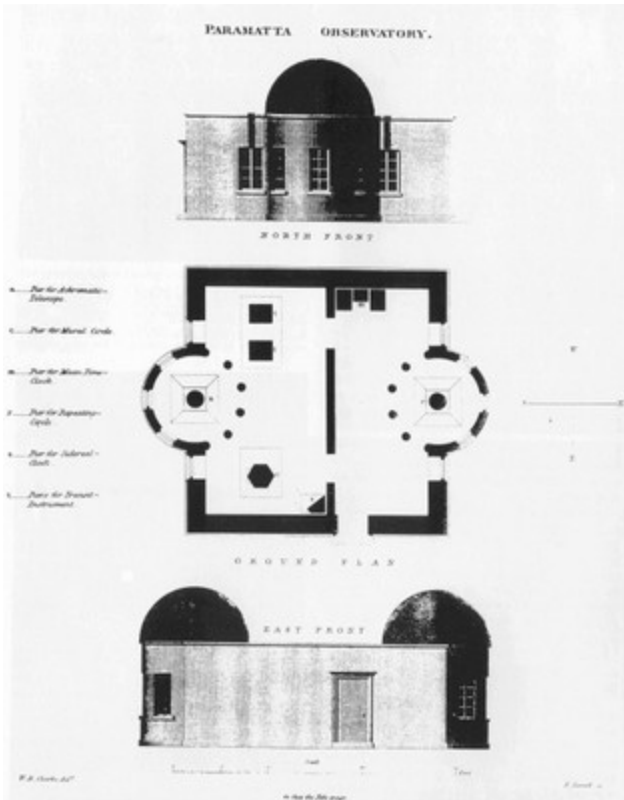

Figure 4: A drawing of the Parramatta Observatory by W. B. Clarke (1825). Published in Richardson (1835).

On the evening of 1822 June 2, Dunlop was the first in the world to sight the return of Encke's comet. Rümker had calculated its return position. Brisbane was justly proud of Rümker and as Governor granted him 1000 acres of land at Picton, south-west of Sydney.

However, for reasons which are not entirely clear, Rümker fell out with Brisbane and left Brisbane's employment a year later on 1823 June 16 and went to his farm. He continued some astronomical work there but was largely caught up in the demands of making a living.

Brisbane was re-called by the British Government and vacated his Governorship on 1825 Dec 1, to be replaced by Ralph Darling. Dunlop returned to England a few months later. The Parramatta Observatory moved into Government hands and Rümker returned to work at the observatory and on 1827 Dec 21 was appointed Government Astronomer.

Rümker was immensely proud and happy in this position and intended to stay. To that end he acquired another 3000 acres, tripling the size of his farm. He certainly had plenty of astronomy to do as well. At the time, there was no other southern observatory. In 1820

the English Board of Longitude had successfully petitioned for a permanent observatory in South Africa, but this did not begin observations until 1829 (Moore & Collins, 1977).

In 1828 Rümker made a requisition for more instruments and thought it best to go to England to supervise their procurement. While in England, he quarrelled with Sir James South, President of the Royal Astronomical Society, Fellow of the Royal Society and the King's own Astronomer; the upshot of which was his dismissal from the British Service on 1830 June 18.

His reputation was not entirely in tatters. At the beginning of 1831 he was appointed Director of the School of Navigation in Hamburg. On 1833 Oct 31 Rümker was appointed Director of Hamburg Observatory. He was awarded the Gold Medal for Arts and Science by the King of Hanover in 1850 and the Gold Medal of the (British) Royal Astronomical Society in 1854.

Rümker eventually married the Englishwoman Miss Mary Ann Crockford on 1848 Nov 24. He was 60 and she was 39 and the discoverer of Comet VI of 1847. Suffering from asthma and a disabling leg which he injured in a fall, he and his wife retired to Lisbon, Portugal. He died there on 1862 Dec 21 at the age of 74. His body is buried in the churchyard of the Anglican Church at Estrella, near Lisbon.

The Catalogue of Scientific Papers listed 231 papers published by Rümker (White, McLeod, & Morley, 1872; White & Morley, 1871). The standard biography on Rümker is still that of Bergman (1960) from which most of the above was adapted.

An Examination of Rümker's 1832 Catalogue of Double Stars

Accuracy of determination of stellar positions has steadily improved over the last few centuries and, in particular, since the advent of satellite-based astrometry (Høg, 2008, 2009, 2011).

Recent studies have retrospectively looked in detail at the accuracy of old star catalogs using HIPPARCOS astrometry (Ahn, 2012; Lequeux, 2014; Verbunt, 2004; Verbunt & van Gent, 2010a, 2010b, 2011, 2012). We acknowledge the work of Schlimmer's (2007) *Christian Mayer's Double Star Catalog of 1779* in looking at an old double star catalogue. Our intention here is to similarly look at the 1832 southern double star catalog of Carl Rümker.

Rümker's Southern Double Star Catalogue

The work we refer to here is the Catalogue of double stars found by Rümker at Parramatta as presented in the introduction to the 1832 *Preliminary Catalogue of Fixed Stars (Preliminary Catalogue of Fixed Stars:*

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Intended for a Prospectus of a Catalogue of the Stars of the Southern Hemisphere Included Within the Tropic of Capricorn: Now Reducing from the Observations Made in the Observatory at Parramatta). This *Preliminary Catalogue of Fixed* Stars is one of Rümker's major works but curiously, it is not listed in *The Catalogue of Scientific Papers*.

Nor were double stars high on his list of priorities. The double star catalogue and its introduction covered just two (15 and 16) out of the 47 pages of the *Preliminary Catalogue of Fixed Stars*. As he stated: "I join here a list of double Star's (sic) extracted from my observations, which probably contain more of them." He did not attempt a systematic search for southern double stars, but merely noted them with the occasional measure whenever he came across one.

Rümker's double star catalogue is reproduced in Table 1, except for the first column (RMK) which has

Table 1: Rümker's 1832 Double Star Catalogue

RMK	Stellae Nomen	AR.	DEC	Diff AR. in arc.	Comes.	Diff. Declinat.	Comes ad
1		11° 27′	70° 27′				
2	ζ Phoenicis	15 16	56 10		praecedit		Austrum
3		63 56	63 41				
4		65 13	57 28	5.25″			
5		106 43	55 19				
6		109 03	52 00				
7	ε Piscis volant.	121 50	68 07		sequitur		Boream
8		123 09	62 13		sequitur		Boream
9	799 C. A.	130 15	58 06	13.5	sequitur		
10		138 56	69 04		sequitur		Boream
11	α Argus	145 42	64 16	12.0	sequitur		Austrum
12		147 53	68 24				
13	τ Argus	153 37	55 10		sequitur		Austrum
14	D Centauri	181 15	44 46		praeccedit		Austrum
15	α Crucis	184 16	62 08	12.3	sequitur	4.45″	Austrum
16	Θ Muscae	194 17	64 24				Austrum
17		200 08	62 10				
18		205 15	51 57	25.5	praecedit	5.0	Boream
19	Y Centauri	212 35	57 40	8.8	sequitur	10.0	Austrum
20		233 05	64 54		sequitur		Austrum
21	η Lupi	237 10	37 53	7.87	sequitur		Austrum
22		265 41	55 20				
23		265 44	60 20		sequitur		
24		285 16	57 29	0.0	praecedit		
25		300 15	57 30	10.5	praecedit	5.0	Boream
26		309 17	63 04	15.0	sequitur		
27	Θ Phoenicis	352 34	47 36				
28		354 32	61 30				

Explanation of Table 1: Rümker's 1832 Double Star Catalogue

Column 2: **Stellae Nomen**, name of star.
Column 3: **AR.**, right ascension in degrees (°) and min arc (').
Column 4: **DEC**, declination in degrees and min arc from the equator.
Column 5: **Diff AR**., difference in right ascension between the primary and secondary, in sec arc (").
Column 6: **Comes**., whether the secondary precedes (praecedit, praeccedit [sic]) or follows (sequitur) the primary.
Column 7: **Diff. Declinat**., difference in declination between the primary and secondary, in sec arc.
Column 8: **Comes ad**, whether the secondary is north (Boream) or south (Austrum) of the primary.

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been added to aid discussion and comparison.

In a modern context, this catalogue is deficient and/or different in many ways. These include the fact the RA positions are given in degrees (rather than hours, minutes and seconds of time) and both the RA and the Declination positions are rounded off to a precision of min arc only. In addition, there is no stated Equinox or Epoch of the observations, and no computed separation (ρ) and Position angle (PA). There are no estimates of magnitude (on any color scale) given for any star.

Modern Assessment of the Rümker Catalogue

Of the 28 pairs listed in Rümker's double star catalogue, numbers 2 - 14, 16, 18, 20, 22, 25, and 26 have RMK as the discoverer code in the WDS.

The method of identification of the stars in modern catalogs is as follows.
1. Rümker's Equinox was first assumed to be B1825.0. This is assumed because Rümker worked at the Parramatta Observatory between 1822 and 1829, and because the Brisbane Catalogue is clearly identified as Equinox B1825.0.
2. The B1825.0 coordinates were precessed to J2000.0 using an EXCEL custom function written for the purpose adopting the IAU 1976 equations (Lieske, Lederle, Fricke, & Morando, 1977), but without taking into account the, as yet, unknown proper motions. The IAU 1976 equations give smaller than 1" uncertainty over the time period.
3. Using ALADIN (Bonnarel et al., 2000), each J2000.0 position was examined using the DSS (Digitized Sky Survey from CDS) image.
4. The DSS image was overlaid with WDS, ASCC 2.5, UCAC4 and Gaia data. We preferred the use of the homogenized All-sky Compiled Catalogue of 2.5 million stars (Kharchenko, 2001). Four of Rümker's secondaries do not have UCAC4 numbers and there are still numerous lacunae in the current GaiaSource data and uncertain identifications (Collaboration, 2016). Cross-referencing of the ASCC 2.5, UCAC4 and Gaia data is given in Table 2.
5. The nearest double star was taken to be the A component intended by Rümker (except for RMK 23 and 24, see below).

The modern identification of Rümker's doubles are presented in Table 2.

In the WDS the discovery of RMK 1, 15, 17, 19, and 27 are attributed to co-worker James Dunlop, however as Dunlop also did not record the epoch of observation (nor Equinox) it is uncertain as to who made the initial discovery.

RMK 23 could not be identified by the above meth-

od. However, the *Southern Double Star Catalogue* (Innes, Dawson, & van den Bos, 1927) for RMK 22 (17^h 48.9^m at B1900.0) has the remark that RMK 23 is the same as RMK 22 "with error 5°" in declination. That is, Rümker's original declination should have been 55° 20'' and not 60° 20''. The small difference in RA of 3 min arc in the Rümker list can be accounted for by the real possibility that Rümker recorded the double stars on different days. Other typographical errors in Rümker's original catalogue were found during preparation of this paper (see below).

RMK 24 could not be identified at all. The J2000 position (precessed from B1825) is 19^h 15^m 50.6^s -57° 11' 47.4". The nearest WDS entry is 19116-5642 (HRG 130) at a distance of 46 min arc which we considered too far to be equated.

Rümker's original coordinates for RMK 28 precessed from, for example, B1827 forward to J2000 (without proper motion) yields a position of 23^h 47^m 30.96^s -60° 32' 21.3". At 75 sec arc the nearest WDS double is COO 361. If we precess COO 361 from J2000 back to B1827 using proper motion the coordinates are 23° 38^m 10.18^s -61° 28' 48.3" (from Table 3) or a separation of 1.2 min arc. From Figure 7 (the Histogram) we note that this is at the high end of separations, but less than some others (RMK 16 and 17) whose identity are accepted (see Table 3).

Estimation of the Equinox of Observations

Rümker did not record the Equinox for the Catalogue nor the epoch of each observation. However, we recovered the most likely Equinox via the following method.

With J2000.0 coordinates, and modern proper motion data, of the primaries as listed in ASCC 2.5 positions were found for a range of Equinoxes from B1821.0 to B1830.0.

The separation (in sec arc) at each Equinox between the Rümker coordinate and the precessed coordinate was calculated.

By taking the average of each set of separations per Equinox, Figure 5 was obtained.

It is clear from Figure 5 that the Equinox with the lowest total separation is B1827.0. We therefore accept this to be the Equinox of the Rümker catalogue. This determination is supported - if not confirmed - by the fact that his Star Catalogue, also published in the *Preliminary Catalogue*, has a stated Equinox of "pro initio Anni 1827".

While undertaking the calculations for estimating the Equinox, we detected what we have taken to be two typographical errors in declination. The original

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Table 2: Modern Identifications of Rümker's Southern Doubles

RMK	WDS	Disc. Code	ASCC 2.5	UCAC4	Gaia
1	00524-6930	DUN 2	2373287	103-000763	4691995687749952384
			2373289	103-000765	4691995996987597568
2	01084-5515	RMK 2 AB,C	2198437	174-001101	
			2198436	174-001098	4913847584861259392
3	04177-6315	RMK 3	2296521	134-003905	4676067715633387776
			2296522	134-003906	4676067715634544512
4	04242-5704	RMK 4	2202770	165-004328	4775347911905128064
			2202769	165-004326	4775347911905128192
5	07104-5536	RMK 5	2208862	173-010758	5490328643768957952
			2208857	173-010752	5490328643768958080
6	07204-5219	RMK 6	2114933	189-011558	5492026736399938560
			2114936	189-011559	5492026736399861888
7	08079-6837	RMK 7	2383172	107-017738	
			2383174	107-017740	5270986003994879744
8	08153-6255	RMK 8	2304832	136-013964	5277370356913491840
			2304833	136-013965	5277370352621451648
9	08451-5843	RMK 9 AB	2214637	157-017868	
			2214633	157-017864	
10	09179-6948	RMK 10	2386328	101-025487	5222647212228907136
			2386329	101-025489	5222650167166406656
11	09471-6504	RMK 11	2387890	125-024040	5249119019819706624
			2387893	125-024041	5249119019819706752
12	09551-6911	RMK 12	2388374	105-028729	5243135168304173440
			2388372	105-028727	5243135168305893504
13	10209-5603	RMK 13 AB	2227934	170-044959	
			2227939	170-044967	5354994808388487680
14	12140-4543	RMK 14	2048721	222-062225	6143569839228193536
			2048720		
15	12266-6306	DUN 252 AB	2333718	135-077813	
			2333721	135-077814	
16	13081-6518	RMK 16 AB	2401908	124-083590	
			2401910	124-083587	5858915762084797312
17	13321-6303	DUN 137	2340319	135-096113	5865249808055799936
			2340318	135-096111	5865249808055799168
18	13521-5249	RMK 18	2155481	186-097617	
			2155477	186-097609	6065984175603789440
19	14226-5828	DUN 159 AB	2260099	158-132657	
			2260102	158-132658	5891112108248454784
20	15479-6527	RMK 20 AB	2412907	123-149637	5825553383847202176
			2412908		5825553388138641024
21	16001-3824	RMK 21 AB	1873533	259-087966	
			1873535	259-087970	5998066826966118656
22 & 23	17572-5523	RMK 22	2279415	174-191989	
			2279416		
25	20149-5659	RMK 25	2285617	166-210020	6468703708258513152
			2285618	166-210021	6468703708258513024
26	20516-6226	RMK 26	2368303	138-190599	
			2368304		
27	23395-4638	DUN 251	2100751	217-192156	6525488226793694720
			2100750	217-192155	6525488226794240256
28	23476-6031	COO 261	2372217	148-236277	6488336862761979392
			2372219	148-236276	6488336862762255232

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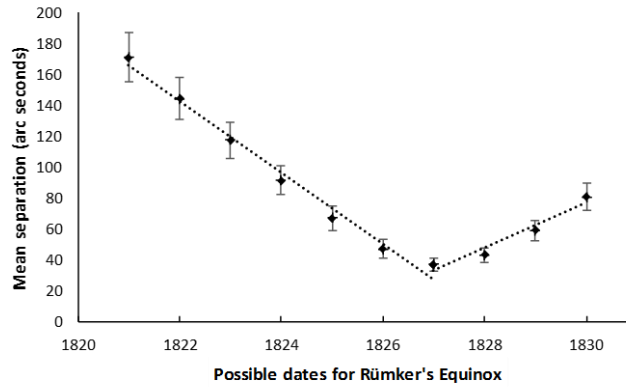

Figure 5: Finding Rümker's Equinox.

Table 3: Accuracy of Primary Star Location. All coordinates are Equinox and Epoch B1827.0.

RMK	RMK RA (h:m:s)	RMK DE (d:m)	ASCC 2.5 RA (h:m:s)	ASCC 2.5 DE (d:m:s)	ΔRA RMK-ASCC (min arc)	ΔDE RMK-ASCC (min arc)	Offset (min arc)
1	00 45 48	-70 27	00 45 47.56	-70 26 30.7	0.0	-0.5	0.5
2	01 01 04	-56 10	01 01 05.45	-56 10 20.8	0.2	0.3	0.4
3	04 15 44	-63 41	04 15 45.33	-63 40 36.0	0.1	-0.4	0.4
4	04 20 52	-57 28	04 20 50.42	-57 27 55.2	-0.2	-0.1	0.2
5	07 06 52	-55 19	07 06 53.63	-55 18 10.6	0.2	-0.8	0.9
6	07 16 12	-52 00	07 16 11.01	-51 59 43.3	-0.2	-0.3	0.3
7	08 07 20	-68 07	08 07 19.90	-68 06 33.0	0.0	-0.4	0.5
8	08 12 36	-62 23	08 12 37.75	-62 23 00.5	0.2	0.0	0.2
9	08 41 00	-58 06	08 40 58.78	-58 05 43.0	-0.2	-0.3	0.3
10	09 15 44	-69 04	09 15 46.35	-69 04 31.6	0.2	0.5	0.6
11	09 42 48	-64 16	09 42 46.28	-64 16 16.5	-0.2	0.3	0.3
12	09 51 32	-68 23	09 51 28.82	-68 22 13.5	-0.3	-0.8	0.8
13	10 14 28	-55 10	10 14 29.32	-55 10 27.1	0.2	0.5	0.5
14	12 05 00	-44 46	12 05 01.86	-44 45 41.5	0.3	-0.3	0.5
15	12 17 04	-62 08	12 17 02.65	-62 08 21.6	-0.2	0.4	0.4
16	12 57 08	-64 24	12 57 02.80	-64 22 42.1	-0.6	-1.3	1.4
17	13 20 32	-62 10	13 20 28.37	-62 08 44.8	-0.4	-1.3	1.3
18	13 41 00	-51 57	13 40 59.40	-51 56 56.2	-0.1	-0.1	0.1
19	14 10 20	-57 40	14 10 18.34	-57 39 46.5	-0.2	-0.2	0.3
20	15 32 20	-64 54	15 32 12.75	-64 53 17.8	-0.8	-0.7	1.0
21	15 48 40	-37 53	15 48 40.87	-37 53 36.5	0.2	0.6	0.6
22 & 23	17 42 44	-55 20	17 42 47.31	-55 20 16.5	0.5	0.3	0.5
25	20 00 60	-57 30	20 00 59.03	-57 28 57.2	-0.1	-1.0	1.1
26	20 37 08	-63 04	20 37 06.45	-63 03 36.9	-0.2	-0.4	0.4
27	23 30 16	-47 36	23 30 08.50	-47 35 50.5	-1.3	-0.2	1.3
28	23 38 08	-61 30	23 38 10.18	-61 28 48.3	0.3	-1.2	1.2

1. https://ma.as/258792.
2. https://ma.as/258735.

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Figure 6: Histogram of Offset (column 6 of Table 3)

Figure 7: Target Diagram (Columns 6 & 7 of Table 3). ASCC 2.5 positions are at (0,0), and the relative respective Rümker positions are indicated by a '+'.
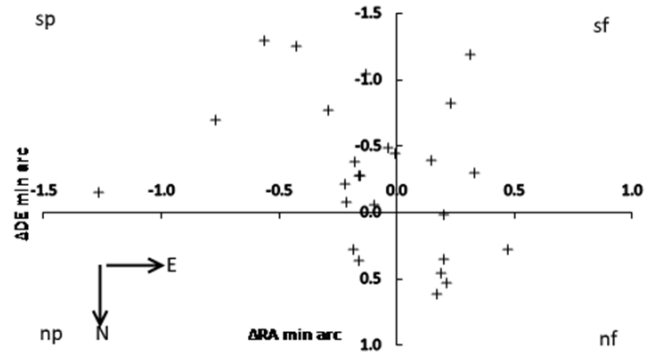
Rümker declinations for RMK 8 and 12 were 62° 13' and 68° 24' respectively. These yielded a ΔDE of +10.0 and -1.8 min arc respectively. Since these represent a significant departure from other ΔDE, we suggest that RMK 8 was 10' too far north and RMK 12 was 1' too far south in the original publication.

The Revised Rümker Double Star Catalogue

Armed with the assumption that Rümker's epochs were also B1827.0, we present here a revised Rümker Double Star Catalogue, based on modern astrometric data, with offset estimations for each double (Table 3).

Accuracy of Rümker's Original observations

We now look with retrospective vision at the accuracy of the Rümker catalogue of double stars using the results in Table 3; our intention being to ascertain the observational precision of this work.

Unfortunately, Rümker did not record the instrument he used. However, the instruments listed as being available at Parramatta were a 3.75-inch transit refractor made by Edward Troughton of London[1], and a 46-inch focal length, 3.25-inch aperture equatorial mounted refractor telescope made by Banks of London, fitted with a wire micrometer[2].

Within reason, it is possible to assume that the discovery of the pairs was by Rümker whilst he was using the transit instrument for the compilation of the star catalogue (the *Preliminary Catalogue of Fixed Stars)* where he noted the pairs for later observation, perhaps with the equatorial.

We note that both telescopes are very small with respect even to modern day amateur telescopes, and the quality of the results must be considered in that context.

Figures 6 and 7 are the distribution of the measured positions (by Rümker) relative to modern positions as precessed to B1827 and given in Table 3. There is a clear concentration of data points within ~0.5 min arc, with 3 outliers in the south preceding quadrant. The rounded-off precision of Rümker's positions to the nearest min arc accounts for most, if not all, of the spread in the positional accuracy.

We apply two measures to this data. In RA, we compute the standard deviation of the spread of these positional differences as 0.37 min arc, and the bias in the two data sets as -0.09 ± 0.07 min arc (being the SEM of the data set) and the sense being Rümker minus precessed modern data. Similarly, in declination, we have found that the standard deviation of the differences is 0.56 min arc, and the bias to be -0.28 ± 0.11 min arc. Rümker being to the north. These measures are well within the accuracy inferred in the Dunlop catalogue, as what we would expect from an observation set of this period using the instruments they had.

A Modern and Revised Rümker Catalog

Table 4 presents Rümker's southern double stars with associated modern data, which has been adopted from the Simbad data set utilizing the Aladin web interface. All positions are from the ASCC 2.5 catalog. Columns 6 and 7 were calculated from ASCC 2.5 data. The format is that of the WDS. Notes on individual pairs are

1. https://ma.as/258792
2. https://ma.as/258735

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Table 4: Rümker's Southern Double Stars with Modern Data. All at Equinox J2000.0 and Epoch J2000.0

RMK	RA h:m:s	DE d:m:s	WDS	Disc	PA (deg)	Sep (as)	Vmag1	Vmag2	SpType1	SpType2	pmRA1 mas/yr	pmDE1 mas/yr	pmRA2 mas/yr	pmDE2 mas/yr
1	00 52 24.520	-69 30 13.56	00524-6930	DUN 2	81.4	20.44	6.646	7.317	F7IV/V	G1V	3.78	-69.94	1.97	-74.58
2	01 08 23.083	-55 14 44.75	01084-5515	RMK 2AB,C	241.4	6.61	3.977	8.668	B6V + B0V	F3:V	22.46	28.56	21.09	29.71
3	04 17 40.272	-63 15 19.49	04177-6315	RMK 3	3.2	4.26	6.012	7.651	B9 III/IV	B 9 V	5.46	31.62	8.02	46.2
4	04 24 12.208	-57 04 16.81	04242-5704	RMK 4	246.5	5.49	6.638	7.171	G4V+...	G6 V	-104.04	-73.19	-96.38	-60.77
5	07 10 24.466	-55 35 15.77	07104-5536	RMK 5	225.8	6.95	7.59	7.725	G8/K0III+G/K		-1.83	-9.14	-0.4	-9.48
6	07 20 21.416	-52 18 41.59	07204-5219	RMK 6	26.1	9.22	5.965	6.534	F0-2 IV-V	F9Ve+K3V+	-43.88	135.71	-29.69	135.69
7	08 07 55.795	-68 37 01.42	08079-6837	RMK 7	24.2	6.04	4.39	7.296	B6IV		-28.6	30.52	-29.78	30.51
8	08 15 15.920	-62 54 56.31	08153-6255	RMK 8	68.6	4.02	5.222	7.563	A2 V		-26.75	-10.64	-26.86	-10.93
9	08 45 05.545	-58 43 27.55	08451-5843	RMK 9AB	292.2	4.15	6.722	6.94	B7III		-4.73	0.67	-5.23	0.66
10	09 17 54.988	-69 48 16.82	09179-6948	RMK 10	18.5	10.40	8.142	8.515	A0V:	A0	-8.8	6.78	-11.85	7.55
11	09 47 06.122	-65 04 19.22	09471-6504	RMK 11	127.9	5.03	2.993	5.98	A8 Ib	F0	-11.31	5.05	-11.51	4.96
12	09 55 05.606	-69 11 20.31	09551-6911	RMK 12	213.0	9.21	6.844	8.819	B9V		-67.12	30.51	-67.51	31.28
13	10 20 54.796	-56 02 35.59	10209-5603	RMK 13AB	101.8	7.19	4.506	7.21	B3III		-18.65	1.42	-18.12	1.47
14	12 14 02.698	-45 43 26.11	12140-4543	RMK 14	243.1	2.85	5.565	6.782	K3III		-34.2	4.82	-42.08	3.97
15	12 26 35.896	-63 05 56.72	12266-6306	DUN 252AB	112.8	4.02	1.039	1.57	B0.5IV	B1 V	-35.56	-13.9	-42.52	-7.67
16	13 08 07.153	-65 18 21.64	13081-6518	RMK 16AB	187.0	5.38	5.649	7.552	WC6 + O9.5I	O9.5 II	-4.42	2.53	-5.34	-2.25
17	13 32 03.910	-63 02 30.82	13321-6303	DUN 137	357.7	15.98	7.478	8.484	B0.5III:		-3.8	-1.87	-3.16	-4.11
18	13 52 04.862	-52 48 41.52	13521-5249	RMK 18	288.7	18.17	5.25	7.469	B9Vn	B8V	-39.13	-28.37	-46	-26.69
19	14 22 37.070	-58 27 32.70	14226-5828	DUN 159AB	157.8	9.42	4.914	7.151	G8/K1 + F/G		-46.45	31.37	-32.04	-3.66
20	15 47 53.058	-65 26 32.15	15479-6527	RMK 20AB	146.9	1.84	5.861	6.395	A5 III-IV	F1IV	-26.65	-30.53	-26.42	-31.37
21	16 00 07.328	-38 23 48.14	16001-3824	RMK 21AB	19.3	14.84	3.414	7.467	B2.5IV	A3 Vn	-16.44	-26.18	-26.2	-29.52
22, 23	17 57 13.209	-55 22 52.52	17572-5523	RMK 22	94.4	2.46	6.755	7.894	K0III+...		-8.38	-27.75	-6.69	-25.86
25	20 14 56.171	-56 58 35.28	20149-5659	RMK 25	28.7	7.16	7.894	7.971	F6/8 + F		37.31	-90.2	35.41	-97.76
26	20 51 38.507	-62 25 45.61	20516-6226	RMK 26	82.3	2.45	6.173	6.518	A2 Vn	A2 Vn	82.51	-49.27	82.55	-44.88
27	23 39 27.947	-46 38 16.08	23395-4638	DUN 251	276.3	3.92	6.291	7.236	A8V+...		25.45	39.95	23.76	37.63
28	23 47 34.208	-60 31 09.89	23476-6031	COO 261	279.9	5.88	9.142	8.812	K0	K1/2 III	30.98	-1.17	16.2	3.79

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Table 4 Notes:

RMK 1	λ^1 Tuc.	λ^1 Tuc is the double (Vmag (m_v) ~ 6.7 + 7.3). λ Tuc a brighter single star separated from λ^1 by ~13.6'. Norton & Ridpath note for λ^1: "Optical; little change".
RMK 2	ζ Phe.	Components A and B are a detached Algol-type eclipsing binary. WDS gives PA = 120° and ρ = 0.6". Rümker pair is AB-C. Component C is a high proper-motion star.
RMK 3	θ Ret.	
RMK 4	HD 28255.	X-ray source ~20" from component A.
RMK 5	HD 55598.	X-ray source ~11" from component A.
RMK 6	HD 57852.	Component A. Spectroscopic binary.
RMK 7	ε Vol.	Component A is spectroscopic binary. Norton & Ridpath note "Fixed".
RMK 8	HD 69863.	X-ray source 18" from component A.
RMK 9	HD 75086.	Two 10th magnitude companion stars at ~1' make pretty field. WDS give stars A–D.
RMK 10	HD 80807.	X-ray source 16" from component A.
RMK 11	υ Car.	Excellent infrared source position coincident. Norton & Ridpath note as "Fixed".
RMK 12	HD 86388.	
RMK 13	J Vel.	Be star. Norton & Ridpath note "Little change".
RMK 14	D Cen.	Norton & Ridpath note "Fixed".
RMK 15	α Cru.	Norton & Ridpath note "little change. Very easy".
RMK 16	θ Mus.	Component A is a Wolf-Rayet star. Spectroscopic binary. Norton & Ridpath note as "Fixed".
RMK 17	HD 117460.	
RMK 18	HD 120642.	Component B is HD 120641.
RMK 19	HR 5371.	X-ray source ~15" from component A. Infrared source close to component A.
RMK 20	HD 140483.	Component B is HD 140484.
RMK 21	η Lup.	Norton & Ridpath note as "Fixed".
RMK 22 & 23	HD 163028.	Also RMK 23 (see text).
RMK 25	HD 191869.	Component A is a spectroscopic binary. X-ray source at 5.2" from component Aa.
RMK 26	HD 198160.	Component B is HD 198161. High proper-motion pair.
RMK 27	θ Phe.	Norton & Ridpath note as "Slow binary, little change"
RMK 28	HD 223186.	Listed in the WDS as C00 261.

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given below.

Because the Rümker catalogue was only the second list of southern hemisphere doubles, it includes many of the brighter and more interesting southern doubles. The combined visual magnitudes range from (Vmag) 0.5 to 8.2, and the faintest *Comes* is about 9.1 (RMK 28). The separations range from ~1.8 sec arc to ~20.4 sec arc (assuming little movement since discovery). These values are impressive considering the instruments available to Rümker at Parramatta.

Of the 285 "Interesting Objects - Double stars" in total in *Norton's Star Atlas and Reference Handbook* (Norton & Ridpath, 1998), 10 of Rümker's 27 are to be found. Six out of 28 (21%) are noted for the southern polar map (Maps 15 and 16) alone.

Notes on Individual Pairs in Table 4

There are 26 binary pairs in Table 4. Of these, 6 are associated with X-ray sources and 2 are associated with infrared sources. There are 3 spectroscopic binaries, one Algol-type eclipsing variable and another non-specific variable. θ Muscae (RMK 16) is a complicated system containing a spectroscopic binary, one component of which is a most spectacular Wolf-Rayet star, and J Velorum (RMK 13) is a Be type star. The high X-ray content (23%) is in keeping with the recognized association between visual binaries and X-ray sources (see, for example, Makarov & Eggleton, 2009; Makarov, 2002, 2003).

Conclusion

Of the 28 pairs in Rümker's original catalogue of double stars of 1832, 27 could be identified. RMK 23 is the same as RMK 22 and only RMK 24 could not be identified. We identify 5 pairs observed by Rümker that have the discoverer code DUN (for James Dunlop) in the WDS, and two with typographical errors in the minutes' column of Rümker's declination. We tentatively identify RMK 28 with COO 261.

Rümker did not specify an equinox or epoch of observation, however, we have shown that B1827.0 is appropriate.

We have shown the positional data in the original catalogue to be accurate to within the precision allowed in the original observations, and we present tables of modern identifications of pairs and a modern/revised version of Rümker's Double star catalogue.

Acknowledgements

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