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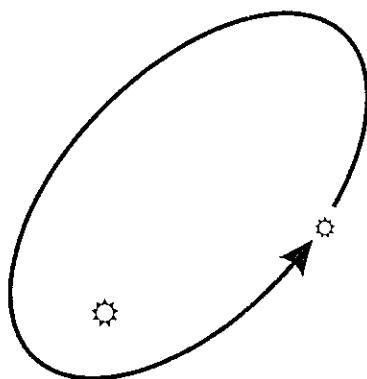


The Webb Deep-Sky Society

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Double Star Section

Circular No. 20



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This circular has been edited and arranged by R.W.Argyle, Director of the Webb Society Double Star Section.

E-mail: rwa@ast.cam.ac.uk.

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In case of difficulty, contact the Webb Society Webmaster, Tim Walker at: tim.s.walker@btinternet.com

For further information about the Webb Society contact:

In the USA and Canada: J. E. Isles, 10575 Darrel Drive, Hanover, Michigan 49241, U.S.A.

E-mail: jisles@frontier.com

In the UK: D. J. Miles, 10 Rosewood Gardens, Clanfield, Waterlooville, Hampshire, PO8 0LT, England.

E-mail: donjmiles@googlemail.com

In Australia and New Zealand: Jenni Kay, P.O. Box 74, Lobethal, South Australia 5241, Australia.

E-mail: jenni@esc.net.au

or see the Society web site <http://www.webbdeepsky.com>

LOST CHEVALIER PAIRS - A FOLLOWUP

W. I. Hartkopf, United States Naval Observatory, 3450 Massachusetts Ave., NW,
Washington, DC 20392-5420, USA

E-mail: wih@usno.navy.mil

Introduction

Ernö Berkó (2011) recently undertook the commendable effort of investigating a large number of doubles which had been discovered by Chevalier (1908) but never confirmed. While checking over Berkó's work in the course of entering his corrections into the WDS¹, some patterns began to emerge in these corrections; this prompted an analysis of Chevalier's paper. A number of errors were found in that early work, including one significant error which explained the reason for most of these 'lost' doubles. Other double star papers by Chevalier were then analyzed for similar errors.

Chevalier and the Shanghai Observatory

The Reverend Father Stanislaus Chevalier was born October 22, 1852, in Saint Laurent des Autels, Maine et Loire, France. He was sent to China in 1883 as a Jesuit missionary, and from 1888-1897 served as director of the Xu Jiahui (Zi-ka-wei) Magnetic and Meteorological Observatory, founded in 1872 by the French Mission Catholique near Shanghai. From 1897-1898 Chevalier surveyed the Upper Yang-tze river and published a major atlas of that region, for which he was awarded the Lorrain Gold Medal of the Paris Geographical Society (Rigge 1904).

In 1900 Chevalier and the Jesuits founded the Sheshan (Zo-Se) Astronomical Observatory, and installed a 40 cm double astrograph on top of Sheshan hill, located 40 km to the west of Shanghai (see Figure 1). This was the largest telescope in East Asia at that time². Chevalier became director of Sheshan in 1901, and served in that capacity until 1924. During that time he was involved in a wide variety of astronomical endeavors in addition to his double star work, including observations of sunspots, comets, asteroids, the Moon, Jupiter (including its moons and occultations of stars by the planet), as well as stellar photometry. He photographed Halley's Comet in 1909, and attempted diameter measurements of both the Sun and Moon. His most ambitious effort, however, was a catalogue of positions for over 14,000 stars (discussed below).

The Chevalier Doubles

The pairs investigated here were published in a series of Zo-Se observatory reports between 1908 and 1911. The first two publications (Chevalier 1908, 1909) were comprised of measures of new pairs discovered on photographic plates, while the latter two (Chevalier 1910, 1911) also included visual micrometry measures of new and known pairs. For each photographic plate, Chevalier noted the coordinates (epoch 1900) of the plate center, as well as the plate scale and other plate constants, then gave a table of results. For each pair measured on that plate he noted the rectilinear offset (x,y) from the plate center to the primary in arcminutes, the resulting angular coordinates of the primary (RA, Dec), the offset ($\Delta x, \Delta y$) from the primary to the secondary, the resulting relative astrometry (θ, ρ), the diameter of each stellar image in microns, and a resulting estimate of magnitude for each component. In these four papers Chevalier made a total of 578 measures (49 visual, the remainder photographic) and discovered 471 doubles and 35 triples (although some of these "discoveries" were later determined to be known pairs).

¹ *Washington Double Star Catalog*, <http://www.usno.navy.mil/USNO/astrometry/optical-IR-prod/wds/wds.html>

² Although this was the same type of instrument used in the Carte du Ciel project, Sheshan was not one of the Carte du Ciel observing sites.

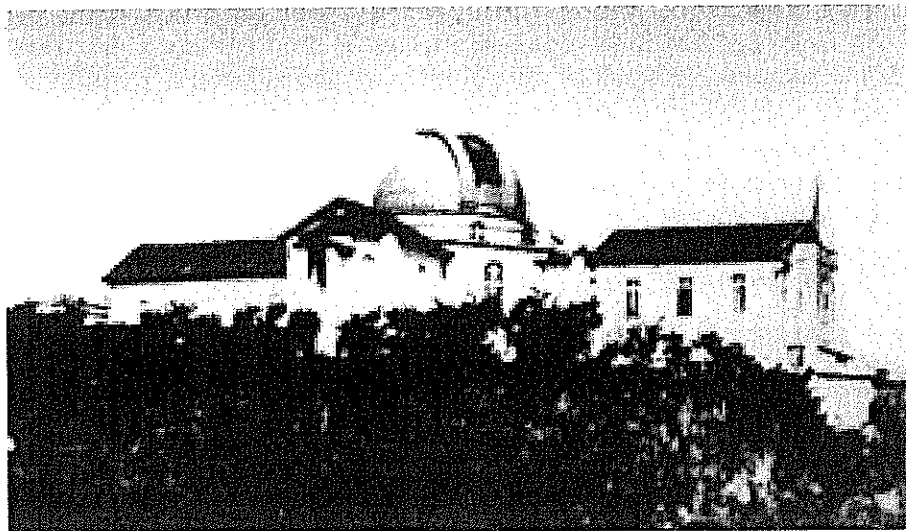


Figure 1: Old photograph of the Sheshan Observing Station (from Shanghai Observatory website: <http://www.shao.ac.cn/eng/au/hj/>).

In the current effort, any of Chevalier's systems for which there was uncertainty in coordinates, photometry, or relative astrometry was examined using Aladin (Bonnarel et al, 2000), then information was updated in the WDS database. Coordinate and proper motion information came primarily from UCAC3 (Zacharias et al. 2010); magnitudes came from GSC2.3 (Lasker et al. 2008) for most stars, Tycho (Hög et al. 2000) for the few stars brighter than 11th magnitude, or NOMAD (Zacharias et al. 2004) for stars lacking Tycho and/or GSC data. All pairs whose coordinates and/or relative astrometry in Chevalier's paper were substantially corrected are listed in Table 1; columns in this table include WDS designation, Discoverer Designation (and components if part of a multiple system), V magnitudes for both components, corrected precise (epoch-2000) coordinates, Chevalier's observation date and corrected values for his position angle θ (in degrees) and relative separation ρ (in arcseconds), a reference to the original measure, and a flag indicating the error type. Note that Chevalier's measures are included only if they have been corrected in some manner.

As a part of this check, new matches against 2MASS (Cutrie et al. 2003) were made to the components of nearly all of Chevalier's pairs not previously matched; the additional measures resulting from these coordinate matches are also listed in Table 1 and have been added to the WDS database.

The following sections look at each of these four papers in a little more detail.

Chevalier (1908)

Chevalier measured pairs from four plates in his first double star paper. Three of the four plates (78 systems in total) had only a few errors of any consequence, as noted below.

Pairs from plate #3 (the subject of Berkó's investigation) were rather problematic, however. Chevalier measured 36 doubles and 1 triple, and nearly all of them have remained either unconfirmed or "confirmed" by an earlier automated match against 2MASS which instead found random faint pairs which agreed within search parameters.

In checking Berkó's matches, it was noticed that several pairs seemed to be offset by a similar amount from Chevalier's coordinates. Fortunately, Chevalier had provided notes identifying three primaries as *Durchmusterung* stars. A comparison of Chevalier's coordinates with values from SIMBAD found very consistent offsets of $-18^s.1$ in RA, $-1'05''$ in Dec for these objects, leading to the conclusion that Chevalier had apparently made an error in determining his plate center. When this offset was applied to Chevalier's coordinates for the other pairs, nearly all were immediately apparent on Aladin images.

However, another error was also discovered, one which caused Berkó to reject many of these pairs. In virtually all cases, the separation of the pair at the updated coordinates was correct, but the true

position angle was 180° minus the Chevalier value. The initial conclusion was that Chevalier had made a trigonometry error in reducing $(\Delta x, \Delta y)$ to (θ, ρ) , as seen for CHE 4 on another plate. However, the fact that nearly all such errors were confined to this one plate and nearly all pairs on that plate were affected led to a simpler conclusion: namely, that Chevalier had inadvertently flipped over the photographic plate before measuring his new pairs. It is impossible to know if this was indeed the case, but it seems the most likely cause; it may also account for the incorrect coordinates for the plate center.

Notes to some individual systems are given below.

Plate #1 (plate center 0017+26)

- 00199+2633 CHE 4 Chevalier's separation was correct, but his published $(\Delta x, \Delta y)$ predict a different value than published. This was apparently due to a typographic error in Δy , which was printed as $-0'0317$ rather than $-0'0617$. There is also an apparent trigonometric error in his value for position angle. Chevalier gives a value for θ of $154^\circ 62'$, but all later measures in the WDS give values of about $204^\circ 0'$. It appears his value should be $360 - 154.62 = 205^\circ 38'$ instead.
- 00210+2647 CHE 9 A similar typographical error as for CHE 4 above; Δx should be $+0'0708$. Also, Chevalier applied his declination offset from the plate center in the wrong direction, leading to an error of over $25'$ in the coordinates. The image for the pair at the corrected coordinates is elongated on the Aladin plate; due to an uncertain relative proper motion it's impossible to tell whether his ρ and θ values are correct.
- 00234+2624 CHE 17 AC pair of triple: A similar typographical error as for CHE 4 above; Δy should be $-0'2783$.
- 00250+2726 CHE 24 There was a $1'$ error in Chevalier's declination.

Plate #2 (plate center 0840+19)

- 08467+1914 CHE 507 Chevalier's separation is actually $11''58$ rather than $23''68$. This pair is identical with WDS 08462+1915 = STF1269, but the incorrect published value for ρ led to a match with a nearby pair which roughly agreed with the Chevalier measure. Measures in the WDS have been merged with those of the Struve pair.

Plate #3 (plate center 1947+22)

- 19493+2202 CHE 152 In addition to the plate center and trigonometry/plate errors, there was an additional $10'$ error in Chevalier's declination, due to an error in applying the y offset. Berkó was unable to find a match.
- 19501+2325 CHE 155 After correcting for the plate center and trigonometry/plate errors, this pair was found to match $19498+2324 = J 496AB$, as noted by Berkó. Measures have been merged in the WDS.
- 19501+2311 CHE 156 This pair was found to match $19498+2310 = POU4111$. Measures have been merged in the WDS. Berkó's match is actually a new pair.
- 19511+2306 CHE 162 Berkó's match is actually CHE 164.
- 19511+2228 CHE 163 Berkó's match is actually a new pair. However, his pair $19508+2227 = \text{Anon 13}$ is actually CHE 163.
- 19512+2306 CHE 164 Berkó's match is actually CHE 162. His pair Anon 18Ax is part of this system.
- 19513+2308 CHE 166 AC pair of triple: Berkó's match is actually CHE 165.
- 19513+2304 CHE 167 Berkó's match is actually a new pair. However, his pair $19500+2304 = \text{Anon 9}$ is actually CHE 167.
- 19515+2240 CHE 168 Berkó's match is actually CHE 174.
- 19516+2320 CHE 169 This pair was found to match $19513+2319 = POU4120$, as noted by Berkó. Measures have been merged in the WDS.
- 19518+2303 CHE 173 Berkó's match is actually CHE 175.
- 19527+2336 CHE 177 Berkó was unable to find a match to this pair.
- 19539+2317 CHE 181 Berkó's match is actually a new pair. However, his pair $19536+2316 = \text{Anon 52}$ is actually CHE 181.
- 19541+2238 CHE 184 This pair was found to match $19538+2237 = COU 825AC$. Measures have been merged in the WDS. Berkó's match is actually a new pair.

Plate #4 (plate center 2238+29)

- | | | |
|------------|---------|---|
| 22389+3010 | CHE 331 | Chevalier made an error in applying the RA offset. |
| 22424+3025 | CHE 380 | There was possibly an error in either transcription or precession in generating the initial WDS designation, as the pair was at the location predicted from Chevalier's coordinates. |
| 22458+3006 | CHE 421 | This pair was not found at the predicted location, nor was any likely pair seen at other locations resulting from transposing x and y offsets from the plate center, or possible sign errors in x and/or y. It remains the only one of Chevalier's doubles from this paper not recovered. |

Chevalier (1909)

This paper had far fewer problems than the previous one, with minor issues found on only one of the seven plates measured. As noted in Table 1, five pairs were published with the position angle off by 180° (i.e., measured from secondary to primary rather than vice versa). These θ values have been corrected.

Plate #6 (plate center 2139+00)

- | | | |
|------------|---------|--|
| 21437+0030 | CHE 315 | There was an error in the printed declination, but the published offset from the plate center gives coordinates of a pair which matches that of Chevalier. |
|------------|---------|--|

Chevalier (1910)

This paper included a short table of micrometry measures of new and known pairs, plus measures from six plates. Most of the problems involved the visual measures; the coordinates provided were often very poor (with errors as large as $30''$ in RA and $3'$ in Dec), so it was not possible to recover all of Chevalier's discoveries.

Visual measures

- | | | |
|------------|---------|---|
| 05203+2510 | STF 683 | The identification of this pair was incorrectly labeled as STF 694, so the measure was never added to the WDS; the correct ID was determined based on his coordinates. |
| 00240-0329 | BU 488 | Due to poor coordinates, this pair was originally added to the WDS as a new discovery: 00245-0327 CHE 23. The measure has been merged with the Burnham pair. |
| 00094+1415 | CHE 1 | Due to poor coordinates, identification with the coordinates in Table 1 is uncertain. Chevalier's measure does not agree well with others for this pair. |
| 00304-0947 | CHE 27 | This pair has opened considerably since its discovery (from $9''.6$ to $19''$), due to the considerable proper motion of the primary. AC2000 coordinates of both components from ~ 1901 are in good agreement with Chevalier's measure, however, so identification with this pair appears probable. |
| 03109-0104 | CHE 75 | There is nothing that matches Chevalier's measure near the coordinates specified by him. |
| 23505+0807 | CHE 505 | Chevalier gave an incorrect Durchmusterung number for this pair, leading to incorrect coordinates being added to the WDS. |
| 23516+0841 | CHE 506 | Chevalier gave an incorrect Durchmusterung number for this pair, leading to incorrect coordinates being added to the WDS. |
| 19594+2450 | CHE 186 | There is nothing that matches Chevalier's measure near the coordinates specified by him. |
| 21014-0539 | CHE 304 | There is nothing that matches Chevalier's measure near the coordinates specified by him. |

Plate #2 (plate center 0200+13)

- 02058+1241 CHE 42 There are no obvious errors in applying the offset from the plate center, but there are no appropriate pairs near Chevalier's coordinates, nor at coordinates found by reversing the sign of either or both offsets. The pair is likely lost.

Chevalier (1911)

This paper also included micrometry data as well as measures from four photographic plates. Poor coordinates for the visual discoveries were again a major source of error.

Visual measures

- 02020+0246 STF 202 Chevalier identified this star as α Psc, but gave an incorrect declination, leading to its initial designation as 02020+0320 CHE 32.
- 07075-0112 CHE 83 There is nothing that matches Chevalier's measure near the coordinates specified by him.
- 09285+0903 STF1356 Chevalier identified this star as ω Leo, but gave incorrect coordinates, leading to its initial designation as 09283+0903 CHE 137.

Plate #2 (plate center 2239+32)

- 22459+3252 CHE 425 Chevalier noted a large magnitude difference for this pair (5 mags). The bright primary has a large proper motion along approximately the same direction as the position angle. The elongated image seen in Aladin suggests that the pair has closed in separation and the secondary is currently lost in the primary's glare.
- 22467+3226 CHE 430 The double measured by Berkó (2010) is about 3' from Chevalier's coordinates, but appears to be the correct pair.

Plate #3 (plate center 2321+42)

- 23246+4139 CHE 452 There are no obvious errors in applying the offset from the plate center, but there are no pairs at Chevalier's coordinates, nor at coordinates found by reversing the sign of either or both offsets.

Plate #4 (plate center 0846+12)

- 08506+1211 CHE 115 Based on a check of coordinates for other objects flagged as Durchmusterung stars, Chevalier's coordinates are very accurate for this plate. There are no obvious errors in applying the offset from the plate center, but there are no pairs at Chevalier's coordinates, nor at coordinates found by reversing the sign of either or both offsets. The pair is likely lost.
- 08546+1219 CHE 134 A star of appropriate magnitude is seen at Chevalier's coordinates, but with no companion. Reversing the sign of either or both offsets from the plate center yields no likely pairs, either. Perhaps the secondary measured by Chevalier was instead a plate flaw or other spot on the emulsion?

Chevalier's later years

Chevalier apparently did not publish any other double star data for some 14 years, probably due to the observatory's efforts in producing an astrometric catalog; this catalog eventually included positions for over 14,000 stars in the equatorial region (Chevalier 1928). However, at the end of his term as observatory director he did publish one small list of measures of known pairs, extracted from various photographic plates taken between 1912 and 1921 (Chevalier 1925). Figure 2 is a photograph of him from about this period.

Father Chevalier served again as director of Zi-ka-wei from 1926-1929, and died in Shanghai October 27, 1930. The Zi-ka-wei and Zo-Se Observatories merged in 1962 to form the current Shanghai Astronomical Observatory.

08467+1914	CHE 507	084640.61+191401.1	10.6	11.3	1906.86	307.12	11.58	Che1908	1,2	
09261+0842	CHE 135	092609.65+084157.6	12.4	13.2						195
09312+0845	CHE 140	093115.16+084425.7	12.4	11.8	2000.15	203.6	25.03	2MASS		
09585+2119	CHE 144	095826.50+211956.5	11.7	12.8	1998.07	265.5	27.22	2MASS	7	195
10002+2058	CHE 146	100012.86+205756.8	12.2	13.8	1998.07	35.2	29.81	2MASS	7	
19485+2309	CHE 149	194812.52+230822.7	12.4	13.1	1907.69	261.10	15.64	Che1908	3,4,5	195
					2000.29	262.6	16.32	2MASS		195
19490+2227	CHE 150	194839.98+222605.9	10.9	11.5	1907.69	88.50	24.89	Che1908	4,5	
					2000.29	88.5	30.13	2MASS		195
19491+2259	CHE 151	194847.36+225758.7	12.0	13.7	1907.69	282.15	21.47	Che1908	3,4,5	
					2000.29	279.9	20.89	2MASS		195
19493+2202	CHE 152	194904.82+221127.7	11.1	11.7	1907.69	253.56	26.78	Che1908	1,3,4	195
					2000.29	253.6	27.41	2MASS		
19495+2234	CHE 153	194910.66+223302.2	9.5	12.4	1907.69	111.26	22.96	Che1908	3,4,5	201
					2000.29	113.3	21.67	2MASS		201
19495+2230	CHE 154	194915.09+222859.6	12.1	12.1	1907.69	114.78	19.55	Che1908	1,3,4	201
					2000.29	114.2	20.22	2MASS		201
19501+2325	CHE 155	194945.39+232432.5	10.8	12.7	1907.69	264.79	5.14	Che1908	3,4,5	201
19501+2311	CHE 156	194947.85+231007.7	11.8	13.2	1907.69	251.93	11.92	Che1908	1,3,4	201
19508+2310	CHE 158	195027.93+230907.5	11.7	13.8	1907.69	146.44	8.80	Che1908	3,4,6	201
					2000.29	147.8	8.91	2MASS		201
19508+2234	CHE 159	195031.00+223329.3	12.1	13.7	1907.69	224.69	22.06	Che1908	3,4,6	201
					2000.29	224.0	22.16	2MASS		201
19509+2235	CHE 160	195034.48+223344.3	12.1	12.4	1907.69	150.98	28.55	Che1908	3,4,6	201
					2000.29	150.5	28.49	2MASS		201
19511+2323	CHE 161	195047.62+232225.8	11.9	12.8	1907.69	111.24	12.11	Che1908	3,4,5	201
					2000.29	110.3	11.92	2MASS		201
19511+2306	CHE 162	195048.77+230447.1	11.8	12.1	1907.69	75.31	22.93	Che1908	1,3,4	201
					2000.29	74.8	23.15	2MASS		201
19511+2228	CHE 163	195049.13+222716.5	12.3	12.6	1907.69	154.19	7.99	Che1908	1,3,4	201
					2000.29	151.7	7.63	2MASS		201
19512+2306	CHE 164	195055.44+230520.9	12.1	13.0	1907.69	107.00	24.85	Che1908	1,3,4	201
					2000.29	107.8	24.44	2MASS		201
19513+2308	CHE 166AB	195057.10+230733.5	11.5	12.3	1907.69	256.54	11.63	Che1908	4,5	201
					2000.29	256.5	11.75	2MASS		201
	CHE 166AC			12.7	1907.69	16.03	19.60	Che1908	1,3,4	201
					2000.29	15.1	19.42	2MASS		201
19513+2309	CHE 165	195059.19+230808.4	12.3	13.8	1907.69	155.29	12.08	Che1908	3,4,6	201
					2000.29	155.2	12.05	2MASS		201
19513+2304	CHE 167	195101.89+230332.1	11.8	13.7	1907.69	210.02	10.93	Che1908	1,3,4	201
					2000.32	208.7	10.12	2MASS		201
19515+2240	CHE 168	195109.35+223933.1	12.6	13.6	1907.69	131.18	15.49	Che1908	1,3,4	201
					2000.32	136.5	14.90	2MASS		201
19516+2320	CHE 169	195117.09+231848.2	11.4	13.7	1907.69	227.64	11.62	Che1908	1,3,4	201
19517+2257	CHE 170	195121.88+225644.4	11.6	13.3	1907.69	67.44	13.30	Che1908	4,5	201
					2000.32	62.7	14.61	2MASS		201
19517+2223	CHE 171	195122.02+222202.7	12.5	13.1	1907.69	26.57	21.73	Che1908	3,4,6	201
					2000.32	24.2	21.16	2MASS		201
19518+2344	CHE 172	195125.79+234255.8	11.6	12.6	1907.69	42.80	22.22	Che1908	3,4	201
					2000.32	45.3	22.63	2MASS		201
19518+2303	CHE 173	195127.39+230219.4	12.2	12.8	1907.69	127.53	24.84	Che1908	1,3,4	201
					2000.32	127.7	24.97	2MASS		201
19518+2240	CHE 174	195130.79+223903.0	11.8	12.9	1907.69	63.56	18.87	Che1908	3,4,6	201
					2000.32	58.8	21.69	2MASS		201
19523+2249	CHE 176	195155.58+224803.3	10.9	12.6	1907.69	126.44	27.65	Che1908	3,4,6	21
					2000.32	125.9	27.60	2MASS		
19523+2307	CHE 175	195217.57+230713.9	11.7	12.9	1907.69	40.77	17.71	Che1908	3,4,6	21
					2000.32	43.6	16.79	2MASS		21
19527+2336	CHE 177	195222.14+233514.3	11.2	12.3	1907.69	228.82	13.54	Che1908	1,3,4	
					2000.32	226.0	11.76	2MASS		21
19528+2246	CHE 178	195228.95+224432.4	13.3	14.1	1907.69	277.87	4.06	Che1908	3,4,5	

						2000.32	281.4	3.92	2MASS	
19532+2223	CHE 179	195257.39+222117.2	12.4	12.9		1907.69	230.61	25.03	Che1908	3,4,6
						2000.32	230.6	34.76	2MASS	
19534+2246	CHE 180	195308.80+223404.4	12.3	13.5		1907.69	227.00	10.53	Che1908	3,4,6
						2000.32	232.4	9.74	2MASS	
19539+2317	CHE 181	195335.46+231535.7	10.7	13.0		1907.69	152.89	3.74	Che1908	1,3,4
19540+2309	CHE 183	195339.16+230711.3	11.9	13.8		1907.69	184.15	8.67	Che1908	3,4,5
						2000.32	188.0	6.86	2MASS	
19540+2333	CHE 182	195342.59+233119.1	10.7	12.0		1907.69	68.22	8.66	Che1908	3,4,6
						2000.32	71.4	8.25	2MASS	
19541+2238	CHE 184	195345.99+223634.0	9.6	14.3		1907.69	76.53	14.86	Che1908	1,3,4
19551+2317	CHE 185	195447.18+231548.1	12.3	12.5		1907.69	87.99	18.97	Che1908	2,4,5
						2000.30	93.8	19.55	2MASS	
20122+1512	CHE 188AB	201211.68+151159.1	12.4	12.4						
20122+1512	CHE 188AC	201211.68+151159.1	12.3	14.2		1998.73	75.4	33.62	2MASS	
20123+1607	CHE 189	201216.07+160629.8	12.8	12.6		1998.73	84.1	18.05	2MASS	
20123+1501	CHE 192	201222.25+150122.1	12.2	12.5		1998.73	5.5	25.00	2MASS	
20127+1508	CHE 196	201240.56+150742.3	11.1	12.4		1998.73	51.9	11.50	2MASS	
20128+1504	CHE 200	201250.30+150411.9	12.5	12.6		1998.73	147.1	16.39	2MASS	7
20129+1548	CHE 201AB	201251.31+154750.7	11.1	12.8		1998.73	321.8	27.87	2MASS	
20129+1548	CHE 201AE	201251.31+154750.7	11.1	12.0						
20130+1533	CHE 205	201259.94+153314.0	13.0	13.8		1998.73	338.2	23.45	2MASS	
20132+1503	CHE 208	201311.46+150244.4	12.8	13.5		1998.73	120.1	25.77	2MASS	
20134+1611	CHE 211	201325.93+161100.2	12.8	12.9		1998.73	339.6	21.69	2MASS	
20136+1537	CHE 215AB	201335.15+153642.7	11.8	12.6		1998.73	95.2	32.62	2MASS	
20139+1529	CHE 220	201355.47+152857.1	13.3	13.6						7
20143+1451	CHE 226	201420.17+145140.5	12.9	13.7		1998.73	285.3	12.89	2MASS	
20144+1608	CHE 228AB	201424.25+160818.9	11.2	13.4		1998.73	309.4	38.64	2MASS	
20144+1608	CHE 228AC	201424.25+160818.9	11.2	14.0						
20144+1533	CHE 229	201425.04+153251.8	11.7	13.1		1998.73	261.0	17.72	2MASS	
20146+1452	CHE 235	201436.19+145235.1	12.3	13.6		1998.73	28.5	13.92	2MASS	
20148+1616	CHE 237	201449.53+161630.4	12.8	13.9		1998.73	218.9	21.97	2MASS	
20151+1555	CHE 241	201506.45+155538.0	12.6	13.5		1998.73	48.9	21.39	2MASS	
20154+1538	CHE 243AB	201523.34+153815.3	10.9	13.6		1998.73	221.6	24.00	2MASS	
20154+1538	CHE 243AC	201523.34+153815.3	10.9	13.5						
20161+1537	CHE 255	201604.87+153712.4	13.5	13.5		1998.73	217.0	23.61	2MASS	
20161+1553	CHE 254AB	201608.72+155248.5	13.7	14.5		1998.73	133.7	26.67	2MASS	
20163+1615	CHE 260	201614.61+161549.7	13.3	14.0		1998.73	200.4	27.05	2MASS	
20163+1538	CHE 261AB	201616.59+153814.8	12.5	12.6		1998.73	41.0	18.47	2MASS	
20163+1538	CHE 261AC	201616.59+153814.8	12.5	13.6		1998.73	110.1	23.75	2MASS	
20166+1606	CHE 263	201634.36+160607.6	11.4	13.0						
20171+1536	CHE 272	201704.03+153504.4	12.7	13.3		1998.73	105.4	17.76	2MASS	
20173+1443	CHE 275	201720.85+144206.2	11.7	12.9		2000.51	330.2	31.51	2MASS	
20177+1503	CHE 279	201742.98+150225.0	12.7	14.2		2000.51	181.1	6.76	2MASS	
20178+1440	CHE 282	201748.59+144002.2	11.0	13.1		1999.62	133.8	14.98	2MASS	
20180+1501	CHE 287	201800.58+150033.6	13.2	14.3		1998.74	135.5	27.19	2MASS	
20183+1539	CHE 293	201820.05+153843.2	11.6	12.5		1998.74	353.9	24.88	2MASS	7
20186+1548	CHE 295	201836.96+154745.5	13.0	13.3		1998.74	261.0	13.74	2MASS	
20186+1444	CHE 296	201838.20+144520.8	12.8	13.1		1998.74	23.6	29.46	2MASS	
20187+1551	CHE 297AB	201844.52+155010.4	11.3	11.5		1998.74	0.5	35.93	2MASS	
20187+1551	CHE 298AC	201844.52+155010.4	11.3	12.3		1998.74	317.3	16.87	2MASS	
20187+1551	CHE 298BC	201844.56+155046.3	11.5	12.3		1998.74	206.6	26.31	2MASS	
20188+1530	CHE 299AC	201849.47+152955.3	12.5	13.4		1998.74	328.9	37.23	2MASS	
20189+1546	CHE 301	201854.48+154542.1	11.9	12.7		1998.74	295.7	27.67	2MASS	
21421+0104	CHE 309	214204.51+010437.6	10.1	13.3		1907.74	346.87	27.45	Che1909	7
						2000.59	337.6	27.49	2MASS	
21421+0059	CHE 310	214210.82+005915.0	13.8	13.8						
21428+0028	CHE 313	214250.67+002812.5	12.3	13.5		1907.74	137.24	9.67	Che1909	7
						2000.59	173.5	7.13	2MASS	
21435+0003	CHE 314	214328.82+000305.0	9.2	13.8		1907.74	226.23	40.53	Che1909	7
						1998.70	228.3	38.27	2MASS	

21437+0030	CHE 315	214344.26+003621.4	12.0	14.2	1907.74	330.82	10.37	Che1909	7	comp
					2000.63	333.3	9.67	2MASS		4. Er
21447-0003	CHE 317	214444.43-000422.8	11.4	14.0	1907.74	223.54	28.64	Che1909	7	5. Be
					1998.70	223.2	29.15	2MASS		6. Be
21453+0007	CHE 318	214521.19+000644.3	11.0	12.5	1907.74	120.33	26.27	Che1909	7	7. Cl
					1999.67	120.8	26.34	2MASS		
21457+0031	CHE 319	214545.35+003050.8	13.3	13.6	1907.74	100.22	30.07	Che1909	7	
					2000.59	100.6	29.46	2MASS		Ack
21459+0015	CHE 320	214558.72+001443.1	13.0	13.0	2000.59	272.8	13.17	2MASS		
21467+0007	CHE 323	214644.69+000604.5	13.1	13.6	2000.59	315.7	28.54	2MASS		Thar
21467+0110	CHE 322	214644.92+011010.1	11.3	12.8	2000.59	129.7	9.56	2MASS	7	little
22389+3010	CHE 331	223922.87+300948.8	13.8	14.0	1906.86	13.17	12.45	Che1908	1	trove
					1998.43	14.9	12.50	2MASS		Bria
22396+3040	CHE 332	223931.78+304037.4	12.9	13.0	1998.43	262.9	27.84	2MASS		resea
22401+3258	CHE 336AB	223948.42+325903.6	12.1	12.3	1998.43	61.0	14.52	2MASS		also
22405+2939	CHE 343	224027.76+293911.6	10.9	14.5	1997.87	42.3	6.45	2MASS		
22406+2933	CHE 345	224038.02+293323.9	12.3	12.4	1997.87	326.4	21.97	2MASS		
22407+2959	STF3134	224043.16+295932.5	9.6	10.1	1906.86	76.62	6.33	Che1908	2	
22412+3223	CHE 355	224116.54+322319.4	14.0	14.3	1998.47	24.4	32.67	2MASS		Ref
22413+2925	CHE 359	224117.34+292515.2	12.7	14.1	1997.87	259.4	14.16	2MASS		
22417+3059	CHE 368	224141.88+305850.9	11.1	12.1	1906.86	323.06	8.47	Che1908	3	Berk
22418+3041	CHE 370AB	224149.05+304017.2	12.8	13.1	1998.47	205.6	10.80	2MASS		Berk
	CHE 370AC	224149.05+304017.2	12.8	14.0	1906.86	150.19	27.76	Che1908	2	Bom
					1998.47	156.0	28.74	2MASS		Che
22424+3025	CHE 380	224221.32+295512.7	12.5	13.0	1906.86	218.76	25.62	Che1908	1	Che
					1998.47	218.9	27.51	2MASS		Che
22426+3232	CHE 383	224236.93+323243.8	10.7	12.8	1998.47	183.2	33.07	2MASS		Che
22430+2944	CHE 393	224239.26+294420.8	13.3	13.6	1906.86	113.47	13.82	Che1908		Che
					1998.75	122.9	13.76	2MASS		Che
22427+3254	CHE 385AC	224243.03+325335.4	9.4	11.8	1998.47	221.4	12.95	2MASS		Che
22430+3004	CHE 392	224258.15+300442.4	12.1	14.2	1998.47	246.0	27.00	2MASS		Che
22432+2941	CHE 395	224314.48+294150.1	13.6	14.0	1998.75	283.8	18.23	2MASS		Tou
22443+2957	CHE 407	224407.90+295532.6	12.8	13.0	1906.86	216.65	24.04	Che1908		Cut
					1998.47	218.3	24.54	2MASS		and
22456+3027	CHE 418	224534.46+302633.2	6.5	13.3	1998.76	25.9	45.19	2MASS		Hoo
22458+3006	CHE 421				1906.86	338.39	19.26	Che1908	1	Lasl
22458+2940	CHE 423	224550.30+293853.5	12.7	13.8	1906.86	248.00	5.89	Che1908	2	
22459+3252	CHE 425	224554.08+325132.1	8.8	14.					1	Rigl
22463+3319	CHE 428AB	224618.78+331914.0	10.4	13.4	1998.76	160.9	31.33	2MASS		Zac
22467+3226	CHE 430	224656.79+322512.9	14.2	15.0	1910.83	285.16	14.76	Che1911	1	Zac
23226+4150	CHE 440	232234.76+415000.6	11.2	14.3	1999.85	125.4	27.27	2MASS		
23227+4142	CHE 443	232242.14+414140.5	11.2	12.0	1999.85	23.8	4.98	2MASS	7	
23234+4248	CHE 445	232321.59+424733.9	10.5	13.5	2000.76	253.7	31.42	2MASS		
23245+4223	CHE 450AB	232430.85+422251.0	13.5	13.9	1998.80	334.2	12.09	2MASS		
23245+4223	CHE 450AC	232430.85+422251.0	13.5	14.0						
23260+4201	CHE 458AB	232600.06+420049.5	13.5	14.2	1998.80	262.0	30.06	2MASS		
23271+4201	CHE 468	232703.83+420052.4	8.5	14.4	1998.80	84.5	16.51	2MASS		
23278+4218	CHE 477	232752.22+421829.9	13.4	13.9	1998.80	230.2	39.42	2MASS		
23280+4301	CHE 481	232802.84+430040.8	10.4	13.1	1998.80	281.9	15.18	2MASS		
23288+4144	CHE 492AB	232848.85+414430.1	10.5	12.7	1999.76	66.2	18.86	2MASS		
23293+4152	CHE 497	232919.38+415217.7	12.5	13.7	1999.76	50.1	7.01	2MASS		
23338+1159	CHE 504	233348.63+115859.4	10.5	10.7						
23505+0807	CHE 505	234939.55+083736.0	10.5	11.9	2000.74	215.9	16.94	2MASS	1	
23516+0841	CHE 506	235136.67+083741.9	11.4	12.3	1910.95	82.6	8.9	Che1910	1	
					2000.72	79.5	8.97	2MASS		

1. See comments in text.

2. Reduction error in converting from $(\Delta x, \Delta y)$ to (ρ, θ) .

3. Error in deriving θ ; correct value is $180^\circ - \theta$ (or $360^\circ - \theta$ if the secondary was found to be the brighter

component).

4. Error in original coordinates due to incorrect coordinates of plate center.
5. Berko's (2011) match to this pair is correct.
6. Berko's (2011) match to this pair is actually a new pair.
7. Chevalier's θ was flipped by 180° to make the primary the brighter component.

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