Some "Lost" Doubles in the WDS

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Abstract

The present paper discusses six double stars that appear to be misidentified in the WDS. After obtaining the relevant data files, and consulting the publications underlying them, the author has employed Aladin Lite (along with superimposed Gaia DR3 data), together with (in some cases) his own observations, to argue for corrected identities. The doubles in question are the following: HO 638AE (= SMR 7); POP 137; OL 222; DJU 8 (= MLR 85); GCB 63 (= J 1224BC); and HU 2AB.

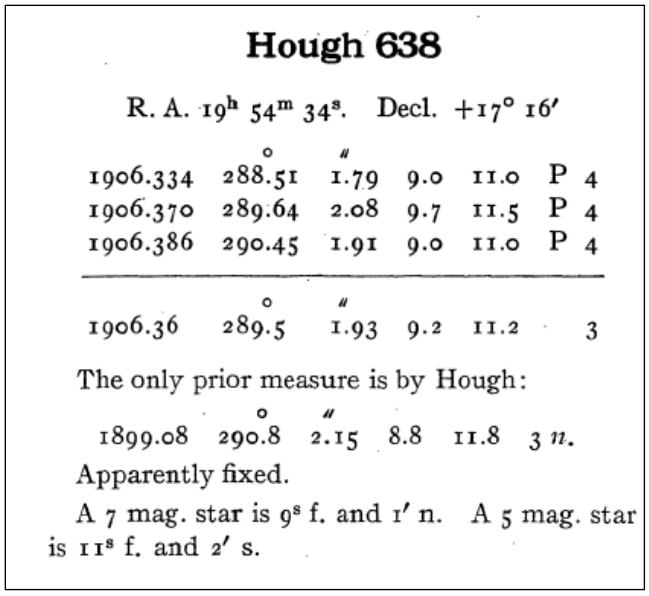
Introduction

The Washington Double Star Catalog (WDS) contains thousands of pairs of stars for which there is no measurement more recent than about 40 years ago. Why this is so varies from star to star. Some may be intrinsically difficult to observe because of a large differences in magnitude or faintness of both components, or simply because they lie in the southern hemisphere of the sky, while most double-star observers are still in the northern hemisphere. In still other cases, however, a confusion of identity has arisen, occasioned by mistakes in published papers, their limited accuracy in the determination of stellar coordinates, or from errors in progenitor catalogs that fed into the WDS. Six of these "lost" doubles are discussed in the present paper. Four have clear solutions. For the remaining two, possibilities are suggested.

HO 638

The first (and most complex) case concerns the 638th double in a list of discoveries made by George Washington Hough (1836-1909), Director of the Dearborn Observatory at Northwestern University. Located near 13 Sagittae, this double was first measured by Hough in 1899.08, according to the catalog of Hough's doubles published in 1907 by Eric Doolittle (1869-1920), Director of the Flower Observatory at the University of Pennsylvania:[1]

1. Doolittle (1907), 113. The WDS gives 1889.08 as the date of first measurement, apparently following a mistake in Aitken (1932), 2, 1157 (#13225). See Fig. 4 below.



Hough 638

R. A. 19h 54m 34s. Decl. +17° 16′

	°	″			
1906.334	288.51	1.79	9.0	11.0	P 4
1906.370	289.64	2.08	9.7	11.5	P 4
1906.386	290.45	1.91	9.0	11.0	P 4
1906.36	289.5	1.93	9.2	11.2	3

The only prior measure is by Hough:

	°	″			
1899.08	290.8	2.15	8.8	11.8	3 *n.*

Apparently fixed.

A 7 mag. star is 9s f. and 1′ n. A 5 mag. star is 11s f. and 2′ s.

Figure 1. Measures of Hough 638 as published by Doolittle

Further measures followed in 1906 (by Doolittle himself), 1912 (by R. Jonckhèere), and finally in 1928 (by P. Fox). Then nothing up to the present. In the meantime, a nearby, easily-seen double star (WDS 20000+1736 SMR 7) was apparently first found in 2009 by J.S. Schlimmer.[2] Although thought to be a new discovery, the present author contends that SMR 7 is, in fact, Hough's star 638, which in the interval between 1928 and 2009 had been misidentified as a different, brighter star, lying near HO 638.

First Case of Mistaken Identity

The coordinates of HO 638 as given by Doolittle (Fig. 1, for epoch 1880) are: RA 19h 54m 34s; DEC +17° 16′.[3] Precessed to J2000, these yield: 19h 59m 59s; +17° 36′.[4] The J2000 coordinates for SMR 7, as given on the WDS website (rounded identically to Doolittle's) are: 19h 59m 59s; +17° 36′ – in other words, the same. Meanwhile, the J2000 coordinates for the star listed in the WDS as "HO 638AE" are: 20h 00m 08s; +17d 37m. These differ from Doolittle's precessed coordinates by 9s of RA and 1′ of DEC.

At this point, an image of the field may be of assistance. Recently, the author took the following image, using the 30-cm refractor he described in an Oct. 2023 article, published in the *Journal of Double Star Observations (JDSO)*:[5]

2. Schlimmer (2010).
3. The epoch is stated in Doolittle (1907), 9.
4. All precessed coordinates in this paper were calculated using the online tool supplied by the Chandra X-Ray Center. *Cf.* https://cxc.harvard.edu/toolkit/precess.jsp.
5. Ceragioli (2023), 365.

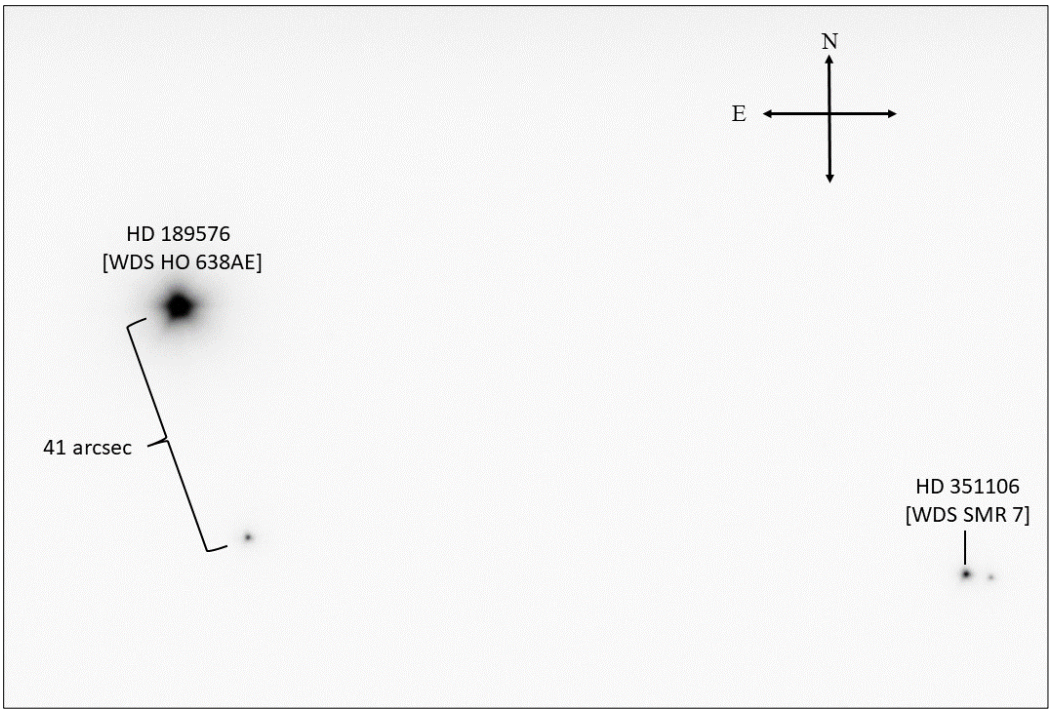
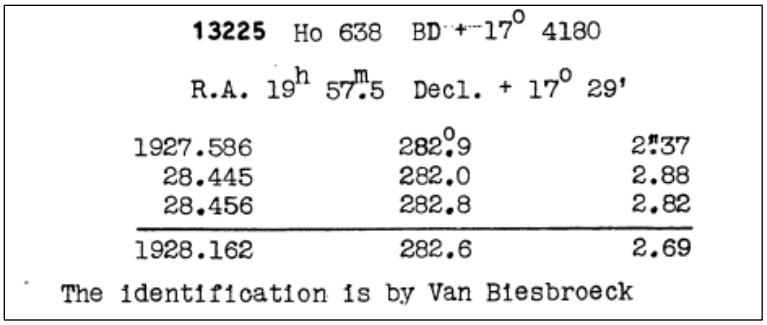


Figure 2. Field of WDS HO 638AE and SMR 7

Four stars are visible in the image: 1) HD 189576, a star of Vmag = 6.98 (but variable) according to the SIMBAD database; 2) HD 351106, a star of Vmag = 10.04 also according to SIMBAD, together with a fainter companion at $\theta = 263.5°$, and $\rho = 4.29″$ according to the author's measurements made at J2023.70; and a star 41 arcsec SW of HD 189576 (listed in Gaia DR3 as source 1820488786830292096). Notice that in the image, there is no companion to HD 189576, the putative WDS HO 638A, but there is a companion of HD 351106. This latter happens to lie in the general direction that Hough and Doolittle assigned to the secondary star of HO 638, although at double their distance. After the lapse of a century, a change in position angle and separation would not be a surprise.

The next person to measure HO 638 was the famous French double-star observer, Robert Jonckhèere (1888-1974), in 1912. His numbers for position angle (PA) and separation (Sep.) showed no clear change from what preceded.[6] By 1928, however – nearly 30 years after Hough's original measurement – the situation was different. Philip Fox (1878-1944), successor to Hough at Dearborn, measured a change. His administrative duties at Northwestern, however, as well as at the Adler Planetarium (being its first director), and his extensive service in the US Army until the end of his life seem to have prevented him from publishing many of his later double star measurements. These were edited and printed in 1946 by George Van Biesbroeck (1880-1974), the famous Belgian-American double-star specialist at the Yerkes Observatory, in the *Annals of the Dearborn Observatory*:[7]

6. Jonckhèere (1912), 8. Special thanks to B. Mason for supplying a scan of this difficult-to-find article. Jonckhèere's means are reproduced in Aitken (1932), 2, 1157 (#13225). *Cf.* Fig. 4 below.
7. Van Biesbroeck (1946), 36. On Fox, see: Lee, O.J. (1944).



13225 Ho 638 BD +17° 4180

R.A. 19h 57m.5 Decl. + 17° 29'

1927.586	282°.9	2".37
28.445	282.0	2.88
28.456	282.8	2.82
1928.162	282.6	2.69

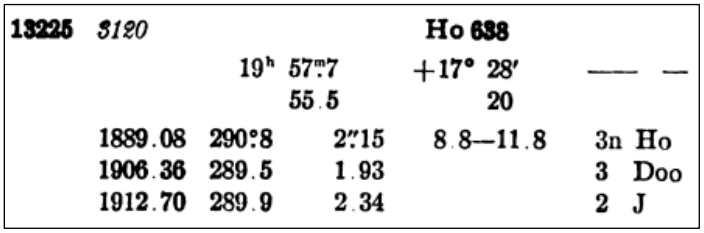
The identification is by Van Biesbroeck

Figure 3. Philip Fox's Measurements of HO 638 in 1927-8

Fox's mean position angle has decreased from earlier measures by about 7-8°, and his separation has increased by about 0.6-0.7″.

But one should notice the curious postscript: "The identification is by Van Biesbroeck." Perhaps Fox's observational notes left some doubt as to which star he had measured? No magnitude estimates are given, contrary to Hough, Doolittle, and Jonckhèere, who had estimated the components as being roughly of 9th and 11th mag (*cf.* Fig. 1 above). Van Biesbroeck gave the position as RA 19h 57.5m; DEC +17d 29m. The epoch here is 1950.[8] Precessed to J2000, we obtain: 19h 59m 45s; +17d 37m. This is clearly not HD 351106 (WDS SMR 7), nor is it HD 189576 (WDS HO 638AE), as a comparison with the coordinates given previously will show. Instead, the star closest to Van Biesbroeck's coordinates is HD 351109, a single star of Vmag = 9.02 according to SIMBAD, with B1950 RA of 19h 57.5m, and DEC of +17d 29m. This is clearly correct, since Van Biesbroeck explicitly names the star as BD +17° 4180, which is equivalent to HD 351109. It is not listed as a double in the WDS. And Gaia DR3 data show it to be a single star. Hence, Van Biesbroeck's identification of Fox's double is in error.

A further reference to HO 638 occurs in R.G. Aitken's 1932, *New General Catalogue of Double Stars Within 120° of the North Pole* (one of the feed catalogs for the WDS):



13225	5120			Ho 638		
		19h	57m.7	+17° 28′	——	—
			55.5	20		
	1889.08	290°.8	2".15	8.8—11.8	3n	Ho
	1906.36	289.5	1.93		3	Doo
	1912.70	289.9	2.34		2	J

Figure 4. Hough 638 in Aitken's New General Catalogue of Double Stars

Here we see, in the first place, the erroneous date of 1889.08 for Hough's original observation (later propagated into the WDS data), instead of 1899.08 (*cf.* Fig. 1). This is apparently a typo. Secondly, we find two positions given for the double, referenced to Epochs 1950.0 and 1900.0. These when precessed to J2000 both give the same result to within the implied uncertainties, namely RA 20h 00.0m; DEC +17d 36m. The J2000 coordinates of HD 351106 are: RA 20h 00.0m; DEC +17d 36m. Hence, Aitken's coordinates would seem to point to this star as HO 638, and not to HD 351109 or 189576.

8. Van Biesbroeck (1946), 7.

In other words, both Doolittle and Aitken appear to identify HO 638 with the acknowledged double HD 351106, now called SMR 7 in the WDS. Van Biesbroeck introduced some confusion by identifying HO 638 with HD 351109.

Notice further that in Doolittle's description (*cf.* Fig. 1), a 7th mag. star is said to lie 9s following (*i.e.*, east) and 1′ north of HO 638. This too is nearly correct for HD 189576 with respect to HD 351106, the coordinate differences being RA +09.5s; DEC +43″. Thus, Doolittle's HO 638 cannot have been HD 189576 (as currently indicated in the WDS), but must have been HD 351106 (currently called SMR7). The magnitudes, coordinates, and verbal description all point in this direction.

Doolittle also noted that a 5th mag. star lay a little to the southeast of HO 638. This must refer to 13 Sagittae itself, the only 5th mag. star in the vicinity. In J2000 coordinates, it lies 4s to the east and 5′ to the south, rather than the stated 11s and 2′. It is possible that Doolittle misread his own notes, or measured wrongly. Nevertheless, there is a 5th mag. star in the general direction he indicated.

Hence, the present author would propose retiring the current designations WDS 20001+1737 HO 638AE and WDS 20000+1736 SMR 7, combining all the measures and introducing a new designation: WDS 20000+1736 HO 638. The first measure was made in 1899.08 at $\theta = 290.8°$; $\rho = 2.15″$. The last currently published is 2020.725 at $\theta = 263.9°$; $\rho = 4.04″$. The author's more recent measure (not yet published) at 2023.70, is $\theta = 263.5°$; $\rho = 4.29″$.

A table of numbers may help to elucidate this discussion:

Table 1. Stars and Coordinates

Observer/Cataloger	Star (Catalog)	Cited Coordinates (Epoch)	J2000 Coordinates
Hough/Doolittle	HO 638	19h 54m 34s +17d 16m (1880)	19h 59m 59s +17° 36′ (= 20h 00.0m +17° 36′)
Fox/Van Biesbroeck	HO 638	19h 57.5m +17d 29m (1950)	19h 59.8m +17° 37′
Aitken	HO 638 (ADS 13225)	19h 57.7m +17d 28m (1950)	20h 00.0m +17° 36′
Schlimmer, *et al.*	SMR 7 (WDS)	N/A	19h 59m 59s +17° 35′ 56″ (= 20h 00.0m +17° 36′)
N/A	HO 638AE (WDS)	N/A	20h 00m 08s +17° 36′ 39″ (= 20h 00.1m +17° 37′)

But if WDS HO 638AE is the same pair of stars as WDS SMR 7, then can they be connected using proper or orbital motion? Here we may avail ourselves of the most recent Gaia data release (DR3) for SMR 7. Doing so via the SIMBAD website and its application VizieR, we find that this is an optical double: the primary star has a parallax of 4.42 mas/yr, giving a distance of 226 pc, while the secondary has a parallax of 0.90 mas/yr, giving a distance of 1116 pc. Hence, these stars lie about 2900 light years apart from one another. Their proper motions are quite different as well. The "primary" shows a motion of Δ RA = +14.8 mas/yr, and Δ DEC = +18.6 mas/yr, while the "secondary" shows Δ RA = +0.3 mas/yr, and Δ DEC = +6.9 mas/yr. So, indeed, not only is the apparently brighter star much less intrinsically luminous than the apparently fainter star, it is drifting (to the northeast) much faster as well.

If we transform the PA and Sep. of the pair into a differential RA and DEC (using numbers given in the WDS data file for 2020), retroject backwards to 1900 (using the Gaia proper motions), and then convert back to PA and Sep., we obtain: 293.2° and 2.48″. This compares with Hough's and Doolittle's numbers of

about 290°, and 2″ (*cf.* Fig. 1). Although the retrojected numbers are not extremely close to the measured, they are not wildly different, and the uncertainties in the underlying data may account for the differences.

Another way to proceed is to graph the data in a plotting program, such as R. Harshaw's Excel-based spreadsheet, Plot Tool 3.19. First, however, we present a table of the combined data for HO 638AE and SMR 7, derived from WDS data files:

Table 2. Combined Data for HO 638AE and SMR7

HO 638	1899	1928	20	291	264	2.2	4.3								195958.80	+173555.6
	1899.08	290.8	.		2.15	.	8.8	.	11.8	.			0.5	3	Ho_1907	Ma 5
	1906.36	289.5	.		1.93	.	9.2	.	11.2	.			0.5	3	Doo1907	Ma 3
	1912.70	289.9	.		2.35	.	9.1	.	10.5	.			0.4	2	J__1912h	Ma 3
	1928.16	282.6	.		2.69	.	.	.	.	.			0.5	3	Fox1946	Ma N 0
	1997.66	266.7	.		3.56	.	9.098	0.041	9.601	0.024	1256	245	1.3	1	TMA2003	E2 7
	2001.563	266.6	0.1		3.904	0.033	9.98	0.02	11.37	0.07	609	70f	0.2	4	UC_2013b	Eu P 7
	2009.633	260.8	.		3.63	.	.	.	.	.			0.2	1	Smr2010	C 7
	2009.8021	265.1	.		4.00	.	.	.	.	.			0.7	2	WSI2013b	Su 7
	2010.474	265.0	.	:	4.06	.	.	.	.	.	550		0.7	2	WSI2011b	Cu P 7
	2010.672	262.4	.		3.86	.	.	.	.	.			0.2	1	Smr2011b	C 7
	2011.581	261.9	.		4.06	.	.	.	.	.			0.2	1	Smr2012	C 7
	2012.711	264.3	.		4.17	.	.	.	.	.			0.3	2	Smr2013	C 7
	2013.704	265.3	.		4.15	.	.	.	.	.			0.3	2	Smr2014b	C 7
	2014.751	264.9	.		4.1	.	.	.	.	.			0.3	1	Smr2015b	C 7
	2015.0	264.702	.		4.120	.	9.930	.	11.235	.	673	440	1.0	1	Kpp2018m	Hg 7
	2015.745	264.0	.		4.08	.	.	.	.	.			0.3	1	Smr2016	C 7
	2016.683	263.5	.		4.09	.	.	.	.	.			0.3	1	Smr2018	C 7
	2018.789	264.6	.		3.60	.	.	.	.	.			0.3	1	Smr2019	C 7
	2020.725	263.9	.		4.04	.	.	.	.	.			0.3	1	Smr2021c	C 7
	2023.700	263.5	.		4.29	.	.	.	.	.			0.3	1	Cgl2023	C 7

Note that the author has corrected the date of Hough's observation from the erroneous 1889.08 to 1899.08, and has appended his own unpublished 2023.70 measurement. If these data are graphed in Plot Tool 3.19, we obtain the following:

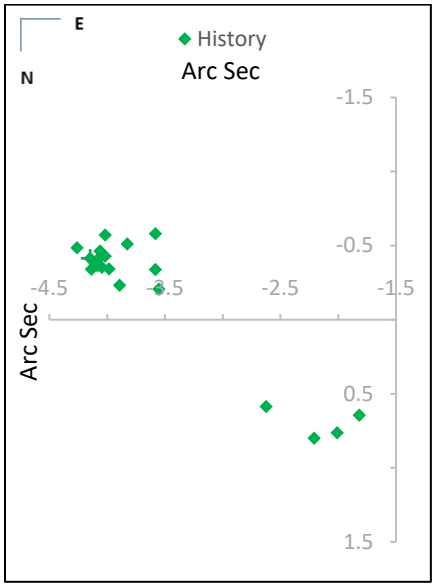


Figure 5. Plot of Combined Data

In this graph, we have the measured PAs and Seps transformed from polar to rectangular coordinates (*i.e.* relative RAs and DECs in arcsec), where the brighter star is located at (0, 0), outside the graph's limits.

Notice, also, that the cardinal directions on the sky are reversed N-S and E-W with respect to Fig. 2 above, now following standard double-star conventions with N at bottom and E to the right.

There are two clumps of data points, but no crystal-clear trend. This is because of a some outliers in the data (especially since 1997). If one examines the run of the Seps in Table 2 above, these can easily be spotted, namely the measurements at 1906.36, 2009.633, 2010.672, and 2018.789. In addition, the run of the PAs reveals an outlier at 2011.581. If one eliminates these data points and re-graphs, one obtains:

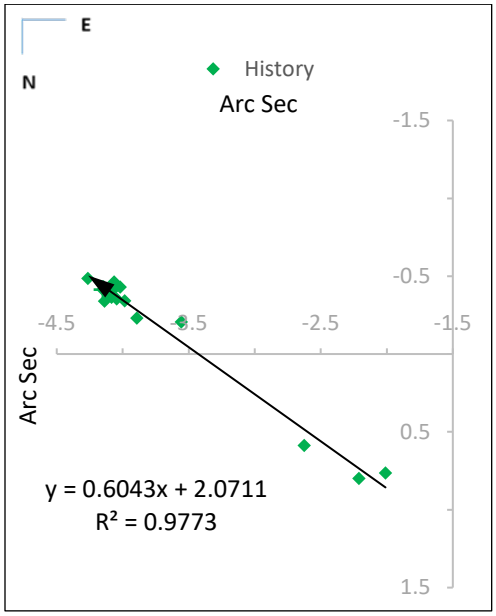


Figure 6. Data Re-graphed with Outliers Eliminated

Now a trend is clear. A trend line has been added, as well as its linear equation. The R^2 (goodness-of-fit) value is high (0.9773), indicating that the remaining data points conform well to the trend line. This suggests that, in fact, one and the same pair of stars has been measured from Hough down to the present day, as the documentary evidence already discussed indicates.

Second Case of Mistaken Identity: POP 137

The double star WDS 21313+4455 POP 137 has not been measured since 1986. The precise coordinates given for this pair in the WDS, namely 21h 31m 20.20s +44° 54′ 23.5″, point to the star BD +44 3848 (Vmag = 10.29, according to SIMBAD) as POP 137. Yet according to Gaia DR3, that is a single source.

Consulting the original publications about POP 137, stemming from its discoverer, G.M. Popović, and his collaborator, D.J. Zulević, at Belgrade Observatory in what was then Yugoslavia, we find that their double was not BD +44 3848, but rather a fainter star 1 arcmin to the north:

POP 137	21275N4429	+44.3848(9.4)	86.709	106.9	1.90	11.5-11.5	1 1 2	
	21296N4442	0 s	86.862	104.0	2.10	0.3	1 1 2	
	21313N4455	+1 arc min.	86.786	105.4	2.00	0.2	2n	POP
			86.709	102.3	1.60	0.1	1 1 2	
			86.862	102.8	1.68	0.1	1 1 2	
			86.786	102.6	1.64	0.1	2n	ZUL

Figure 7. Popović and Zulević's identification of POP 137

They indicate their star by differentiation from BD +44 3848, saying its RA is the same, but its DEC is increased by 1 arcmin. It has a PA of about 104.0° and Sep. of about 1.8″. The magnitude of both stars (they say) is about 11.5, and not 10.5 as the WDS has it. Clearly, they are pointing to a fainter, close double lying to the north of BD +44 3848. And there is such a double.

The author recently took the following image:

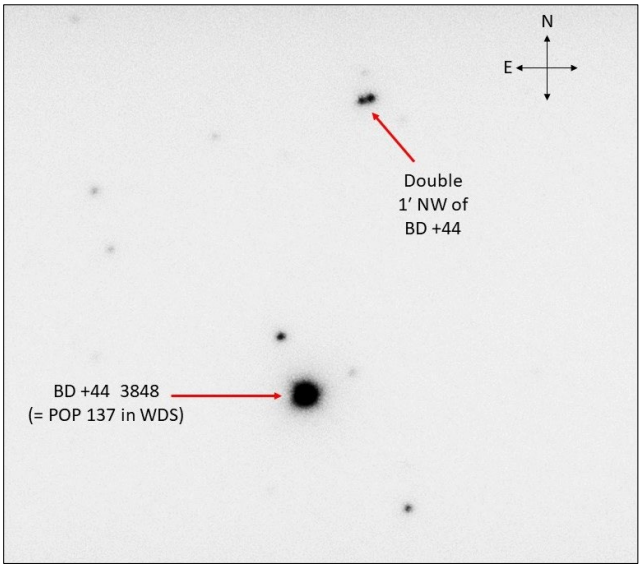


Figure 8. BD +44 3848 and Double Star to NW

Here we see, clearly marked, BD +44 3848 (below center), and above to the right at Δ RA = -1.5s; Δ DEC = +1′ 05″, an equal double as indicated by Popović and Zulević. Its PA and Sep. are 105.6° and 2.04″, as measured recently at J2023.90 by the author, closely matching their numbers. Thus, we have likely found the true POP 137.

The Gaia DR3 Gmags for this pair are 13.0 and 13.3, significantly fainter than BD +44 3848, and fainter than Popović and Zulević's visual estimate of 11.5. Both stars lie at nearly the same distance (450 pc), according to Gaia DR3 data, and have very similar proper motions to one another, pointing to their forming a true binary. Hence, the WDS should probably be changed to reflect all this.

Third Case of Mistaken Identity: OL 222

This double was measured twice by its discoverer, Charles P. Olivier, in the years 1939-1947 at the University of Pennsylvania. His position (in 1950 coordinates) is given as: RA = 22h 11m; DEC = +13° 31′.[9] Precessed to J2000, we have 22h 13.5m; +13° 46′:

01 194 9.6 10.1

$22^h\ 11^m$ +13° 31'

39.705	244.3	2.98
39.790	243.0	3.10
39.748	243.6	3.04
42.876	241.5	3.42
43.805	244.0	3.84
46.758	238.3	3.+
47.876	237.2	3.70
45.329	240.2	3.65

Figure 9. Olivier's Measures of OL 222

Olivier gives estimated magnitudes of 9.6 and 10.1. The mean PA and Sep. would be 241.9° and 3.35″ respectively for the mean date of 1942.5.

Consulting Aladin Lite for the precessed position, we find the following field (with Gaia DR3 sources superimposed as small blue squares):

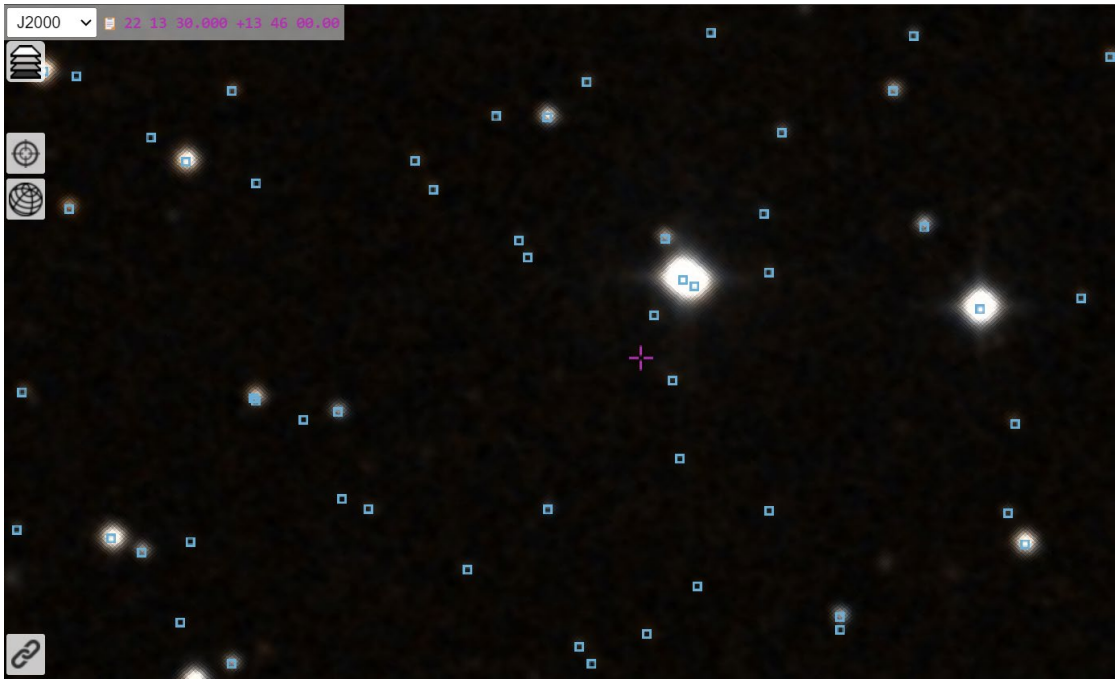


Figure 10. The Aladin Lite Field Centered on J2000 RA 22h 13.5m; DEC +13° 46′

9. *Cf.* Barton *et al.*, (1949), 43, where the double is termed "Ol 194."

Here north is up and east is to the left as usual in this photographic star atlas. Just a little way from the purple cross, which marks the queried position, we see what is clearly an elongated star (Gaia DR3 source 2734841625686892416) with Gmag of 11.8. Accompanying it at a short distance is another star of Gmag 12.2, according to Gaia data. Working from the precise Gaia DR3 coordinates, we find a PA of 243.7°, and a Sep. of 3.66″, which are very similar to Olivier's numbers.

Consulting the WDS catalog, we find that precise coordinates for OL 222 are lacking altogether there. Instead, we have the approximate position, RA = 22h 10.0m; DEC = +13° 46′. This leads to a location 3.5 minutes of RA to the west, where there is no nearby double matching Olivier's description. The closest significant double is STT 463, whose separation is close to Olivier's number, but whose position angle is different by nearly 120°. Olivier had estimated a magnitude difference of about 0.5 for the components in his double. But the Δ Mag for STT 463 is 3.3. All this suggests that Gaia DR3 source 2734841625686892416 is probably Olivier's "lost" double.

The author recently imaged this star along with the star TYC 1149-1573-1, lying to the west:

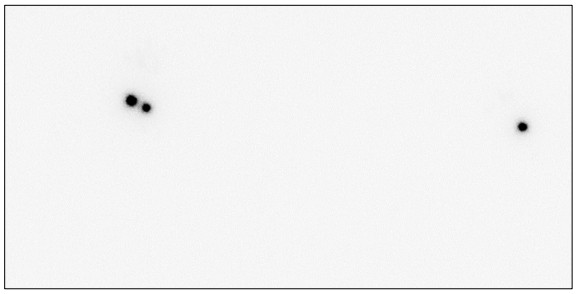


Figure 11. The Probable Double OL 222 (Left) and the Single Star TYC 1149-1573-1 (Right)

The image should be compared to the Aladin Lite view, shown above in Fig. 10. The author's J2023.90 measurement of the putative OL 222 gives PA = 242.6°; and Sep. = 3.60". Clearly, there has been almost no relative movement since Olivier's measurement 80 years ago. This makes sense, when we consult the Gaia DR3 data for the components. Their parallaxes and proper motions differ but little from one another, and their relative proper motions over 80 years would lead to a Δ RA of about 0.04° and Δ DEC of 0.03°, which would not be clearly measurable except by satellite or speckle techniques on large ground-based telescopes, neither of which existed in Olivier's day. Hence, the present author proposes Gaia DR3 source 2734841625686892416 as OL 222.

Fourth Case: DJU 8

Unfortunately, the next case does not lend itself to results as neat as the preceding. In 1956, P.M. Djurković and Lj.M. Dačić at the Belgrade Observatory, published a measurement of a new double.[10] This, they said, consisted of two 10th mag. stars having PA = 35.1°, and Sep. = 0.58″. The double's location on the sky (in

10. Djurković *et al.* (1956), 10.

1950.0 coordinates) was: RA = 22h 44.8m; DEC = +65° 56′. They designated the star Bd [presumably "Belgrade"] 9. In the WDS, it is called DJU 8:

MESURES MICROMÉTRIQUES D'ÉTOILES DOUBLES

Faites au réfracteur de 0.65 m d'ouverture

par *P. M. DJURKOVIĆ* (*Dj*) et *LJ. M. DAČIĆ* (*Dc*)

ADS № et désignation		Époque 1956 +	Θ °	ρ ″	Grandeurs	Dj	Dc
Bd	9[5]	800	35.1	0.58	10.5 —10.9	2	1

1950.0

[5] α = 22 44.8, δ = + 65 56

Figure 12. Djurković and Dačić's Mean Measures, Magnitudes, and 1950.0 Position for WDS DJU 8

If we precess the coordinates to J2000, we obtain: 22h 46.6m; +66° 12′. This is a position lying about 3 minutes of RA west of iota Cephei. On consulting Aladin Lite with superimposed Gaia DR3 data, we find no obvious nearby candidate star for DJU 8. The WDS gives no precise coordinates or observations more recent than those made in 1963-1967 by Charles E. Worley (1935-1997), the famous double-star observer at the United States Naval Observatory (the USNO, home of the WDS), indicating a known problem with DJU 8. Worley gave its coordinates as 22h 43.1m; +66° 12′, noting that the position can be "interpreted as the right ascension and declination of the pair for 1900."[11] This is (he indicated) the identifier used in the *Index Catalogue of Visual Double Stars* (IDS), the all-sky successor to Aitken's earlier catalog, and predecessor of the WDS.[12] Indeed, consulting the IDS shows exactly these numbers for epoch 1900.

As one can immediately see, however, while the declination matches Djurković and Dačić's when precessed to J2000, if we precess backwards to J1900, we obtain: 22h 43.0m; +65° 40′. Hence, it would appear that by mistake, the IDS's RA is for J1900, whereas its DEC is for J2000.[13] Meanwhile, the WDS identifier calls the star 22466+6644 DJU 8, suggesting a position of 22h 46.6m; +66° 44′. This would appear to be IDS's coordinates (assumed to be uniformly for J1900) precessed to J2000.

Laying aside these positional problems, if we consider Worley's measured PAs and Seps, we have the following:

DJU					22 43.1		+66 12	
63.690	38.4	0.58			1 5 0.0	2	0.4	26
65.721	37.8	0.91			1 5 -0.1	2	0.8	26
67.830	41.1	0.79			1 5 +0.1	2	0.3	26
65.747	39.1	0.76	3N	0.5			26-INCH	

Figure 13. Charles Worley's Measures of DJU 8

11. *Cf.* Worley (1971), 129. For the quotation, *cf.* p. 10.
12. *Cf.* Jeffers *et al.* (1963), 2, 768.
13. The discrepancy in RA (43.1m *versus* 43.0m) may be due to differences in rounding. Even the IDS's editors publicly lamented the great number of errors they themselves had found in their catalog, and appealed for observers to help in correcting these. *Cf.* Jeffers *et al.* (1963), 1, xiv.

Worley was a very experienced observer and professional astronomer, using a 66-cm refracting telescope and a filar micrometer. We can easily see that for this close pair, the PAs of his three individual observations (the last line in Worley's table gives his means) from 1963, '65, and '67 varied between 37.8° and 41.1°, while his Seps varied between 0.58″ and 0.91″. This is helpful in that it shows how much even an expert visual observer can vary when using a micrometer on a close double star. We have no equivalent information from Djurković and Dačić, but only their means. Still, it is enough to show us that we should not be too surprised if when using modern measurement techniques (direct CCD imaging or speckle interferometry), we find the numbers obtained to be somewhat different, although (hopefully) more consistent.

For reasons that are probably self-evident, no one has measured DJU 8 since Worley's time. One cannot, in fact, be sure which star these men had been looking at. Still, if we attend once again to Aladin Lite, superimposing the Gaia DR3 data sources on it, a possibility emerges. Closer to iota Cephei there is a known 10th mag. double (matching Djurković and Dačić's estimates), namely MLR 85, discovered by Paul Muller (1910-2000), the famous French double-star observer. According to the WDS's data sheet, Muller first observed his star in 1970. Perhaps in reality it was this star that Djurković, Dačić, and Worley had earlier observed and measured, prior to Muller's "discovery?" The J2000 coordinates of MLR 85 are: RA = 22h 47.8m; DEC = +66° 14′. This is relatively close to the J2000 precessed coordinates of Djurković and Dačić, namely: 22h 46.6m; +66° 12′. Principally, we have an error in RA of a little over 1 minute:

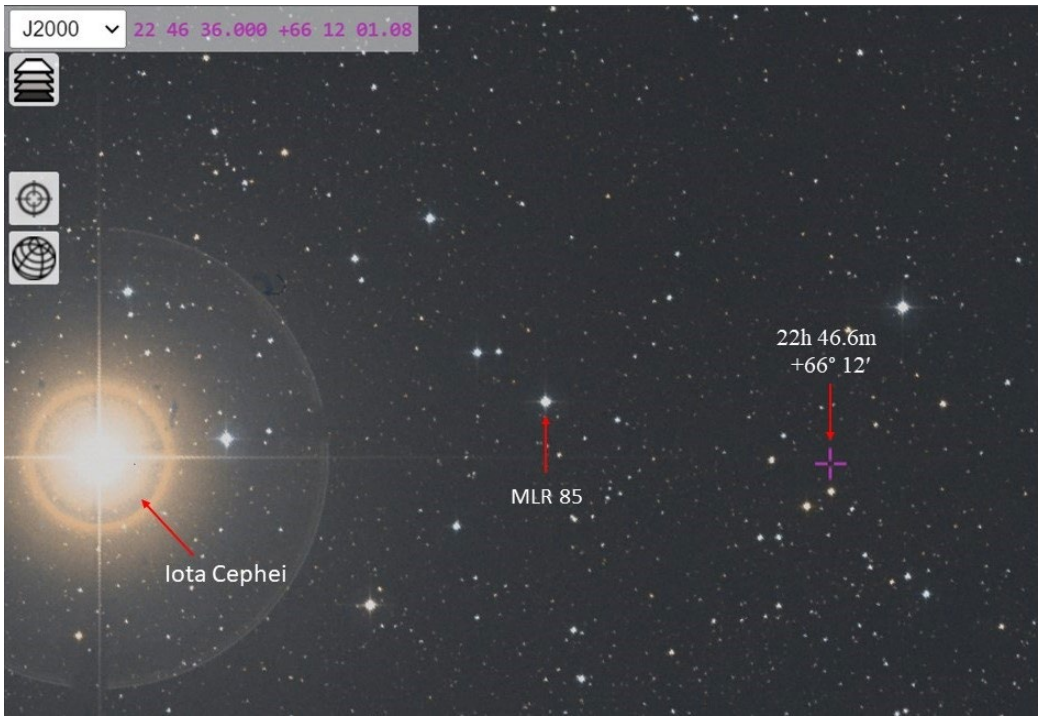


Figure 14. Aladin Lite Image of the Sky Between Iota Cep and Djurković/Dačić's Stated Position of Their Double (Precessed to J2000), Containing MLR 85

Although several other 10th-mag doubles lie in the vicinity (for example, HU 984 and MLB 274), none has a PA and Sep. close to that recorded for DJU 8. Only MLR 85 is close, and indeed very close:

```
MLR  85   |   1970 2017   12  35  37   1.0    1.0 10.72 10.86 G5        +056+000 +056+000 +65 1807 N    224748.28+661333.8
     1970.59      35.       .       1.0       .       10.1     .     10.3      .                  0.7   1 Mlr1973a Ma   2
     1973.58      38.9      .       0.80      .        .       .       .       .                  0.5   2 Mlr1978b Ma   2
     1981.64      35.4      .       0.73      .        .       .       .       .                  0.5   3 Mlr1984  Ma   4
     1981.65      33.2      .       0.81      .        .       .       .       .                  0.6   2 Hei1983a Ma   2
     1989.60      37.5      .       0.79      .        .       .       .       .                  0.5   3 Mlr1990  Ma   4
     1991.71      30.5      .       0.839     .       10.721 0.050  10.858 0.057  530 100         0.3   1 TYC2000a Ht   5
     1991.71       .        .        .        .       11.644 0.067  11.657 0.068  430  90         0.3   1 TYC2000a Ht   7
     2001.9279    35.1      .    :  0.84      .        .       .       .       .  560  45         0.7   1 WSI2002  Su P 6
     2004.715     35.7      .       0.91      .        .       .      0.2      .                  0.5   2 Drd2009  C    7
     2008.655     34.6      .       0.941     .        .       .       .       .  530 340         0.7   1 Gii2012  S    7
     2015.0       37.005    .       0.947     .       10.158   .    10.498     .  673 440         1.0   1 Kpp2018m Hg   7
     2016.0       36.45   0.00      0.98923  0.00003  10.375   .    10.686     .  584 436         1.0   1 ElB2021  Hg   7
     2016.0        .        .        .        .       10.231   .    10.185     .  502 228         1.0   1 ElB2021  Hg   7
     2016.0        .        .        .        .        9.274   .     9.286     .  759 294         1.0   1 ElB2021  Hg   7
     2017.7719    37.34   2.62      0.952    0.052     .       .       .       .                  0.3   1 Bvd2018a Cl   7
```

Figure 15. WDS Data for MLR 85

We see for the micrometric measurements made in the 1970s and ’80s by Muller and Wulff Dieter Heintz (1930-2006), the famous German double-star observer, PAs and Seps identical in range to Worley’s from the 1960s. Only with the advent of CCD arrays and the Gaia satellite has the Sep. stabilized at about 1 arcsec. The author’s own recent measurement at J2023.90 is PA = 34.2°; Sep. = 0.97″. Djurković and Dačić had given estimated magnitudes of 10.5 and 10.9 for their components, close to the Gaia DR3 Gmags of 10.4 and 10.7 for MLR 85. Thus, the balance of evidence would seem to favor the notion that DJU 8 must in fact be MLR 85. This is why no one has found or measured the former since 1967 – because it is the latter, whose position has been clearly known since 1970. Many measurements have been made since then.

Fifth Case: GCB 63

The 63rd star in a list of measures published in 1932 by the French comet hunter and double-star observer, Michel Giacobini (1873-1938), who worked for decades at the Paris Observatory, also presents grave difficulties of identification. GCB 63 has not been measured since 1970, and with good reason. If we take Giacobini’s coordinates (for epoch 1930.0) – namely, RA = 22h 00m 50s; DEC = +23° 48′ – and precess them to J2000, we obtain: 22h 04.1m; +24° 08′.[14] Aladin Lite, when queried for this position, shows nothing and, moreover, no plausible double star close by. Giacobini had estimated his pair as of mag. 10.5 and 11, with PA = 358.8° and Sep. = 1.43″ for the mean date of 1930.5. This should easily be seen in the Gaia DR3 data. But there is nothing near the stated position.

Forty years later, Richard L. Walker (1938-2005), an astronomer of the USNO, used the observatory’s 1-meter reflector stationed near Flagstaff, Arizona to observe GCB 63.[15] Walker’s measurement in 1970 gave a result close to Giacobini’s, namely PA = 1.9°; Sep. = 1.57″, suggesting that he had observed the same star. Walker’s stated position (likely taken from the IDS), when precessed to J2000, is RA = 22h 04.0m; DEC = +24° 09′.[16] He does not give estimated magnitudes for the pair, but a Δ Mag of 0.3, not dissimilar to Giacobini’s 0.5:

14. Giacobini (1932), 31.
15. Walker (1972), 58.
16. Walker’s stated coordinates are identical to IDS’s coordinaters for Epoch 1900. *Cf.* Jeffers *et al.* (1963), 2, 742.

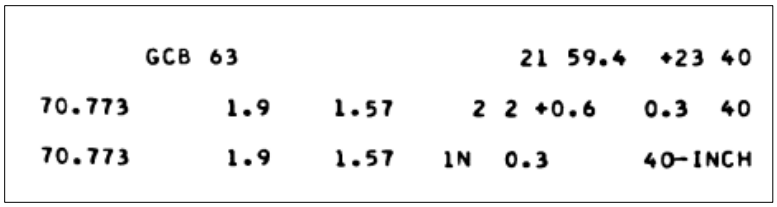


Figure 16. R.L. Walker's Measurement of GCB 63 in 1970

After Walker, there is no further observation up to the present, since the exact location of this double star is uncertain. The current WDS position is simply Walker's, precessed to J2000. Casting further afield, we find WDS J 1224BC lies 10′ south and somewhat east of Giacobini's nominal location, at J2000 RA = 22h 04.3m; DEC = +23° 58′. This star has been observed a number of times, having seven recorded PAs and Seps in its WDS data sheet, since R. Jonckhèere first recorded it in 1916:

J	1224BC	1916	2016	7	357	0	0.5	1.6	12.39	13.2	+004-007			220419.24+235805.8	
	1916.83	356.6	.	0.48	.	11.0	.	11.0	.		0.7	1	J__1917a	Ma	3
	1946.33	1.2	.	1.73	.	.	.	.	.		2.1	3	VBs1954	Mb	0
	1949.62	355.7	.	1.22	.	10.6	.	11.8	.		0.4	2	J__1949b	Ma	0
	1953.85	5.2	.	1.23	.	10.6	.	11.3	.		0.4	3	Cou1953e	Mc	0
	2009.830	28.30	.	1.48	.	.	.	.	.		0.4	1	Bko2010b	C	7
	2013.818	0.2	0.4	1.556	0.012	.	.	.	.		0.8	1	Gii2022	S	7
	2016.0	359.75	0.00	1.57259	0.00002	12.797	.	13.193	.	584 436	1.0	1	ElB2021	Hg	7

Figure 17. WDS Data for J 1224BC

Examining these data, we see that Jonckhèere's first measurement contains an anomalous separation for 1916.83, which is a whole second of arc smaller than what follows. Perhaps a typo is involved in the original printing.[17] Gaia DR3 data for this pair do not support the notion of a large relative proper motion. Nor do the succeeding measurements down to 2016.0 suggest a large orbital motion. Any actual motion over 100 years would be impossible to verify with ground-based equipment. The rest of the measured Seps from 1946 onward cluster in the range of 1.2-1.7″ with a mean of 1.46″. The Gaia datum from 2016.0 is 1.57″, which happens to be the same number as Walker's mean from 1970 for GCB 63.

The PAs for J 1224BC likewise fluctuate, and except for Berkó's anomalous measurement of 2009.83, the rest of the measures cluster in the range of 355.7° to 5.2°, the mean being 359.78° which is virtually the same as the Gaia 2016.0 datum of 359.75°. Walker's and Giacobini's PAs for GCB 63 are insignificantly different, falling within the same range. And finally, let us note that Jonckhèere and Couteau's visual magnitude estimates for J 1224 BC average to 10.7 and 11.4, which are close to Giacobini's original 1932 estimate for GCB 63 of 10.5 and 11.

Thus, it seems reasonably certain that GCB 63 must, in fact, be the same as J 1224BC. If so, Giacobini's 1930.0 coordinates, instead of saying: RA = 22h 00m 50s; DEC = +23° 48′, ought to have read: RA = 22h 01m 04s; DEC = +23° 38′. If we take the J2000 coordinates for many of his pairs and precess them to J1930, then comparing the latter to the numbers in his 1932 article, we find that errors of up to 30 or 40s in RA are frequent. Hence an error of 14s with GCB 63 would not be unusual. Errors of greater than 1′ or 2′ in declination, on the other hand, are not easily found in his list.

17. *Cf.* Jonckhèere (1917), 163.

Hence it may be that we are dealing with a typo in Giacobini's list. But even an error of 10 arcmin is only about 1/3 the apparent diameter of the Moon. If on pointing a telescope at the nominal sky location and examining the field visually, an observer did not find GCB 63 at image center, a scan around the field would likely reveal it. In this way, R.L. Walker might have found J 1224BC while looking for GCB 63, and not have recognized that he had found a "different" double.

Finally, it should be noted that E. Berkó already suggested the possible equivalence of GCB 63 with J 1224BC in 2010.[18]

Sixth Case: HU 6AB

The last case of mistaken identity has a more definitive conclusion. WDS 01220-0927 HU 6AB has not been measured since 1953. Its precise J2000 coordinates, as given in the WDS are RA 01h 21m 59.14s; DEC -09 27′ 27.8″.

Querying Aladin Lite for this position produces the following result:

Figure 18. Aladin Lite Field Centered on WDS 01220-0927 HU 6

The bright star (centered under purple cross) is the supposed double. Yet the superimposed Gaia DR3 sources show only a single small blue box, meaning that to the limit of Gaia's resolution (approximately 0.4 arcsec) there is no companion. Earlier measures from 1899 (by W.J. Hussey) and 1953 (by P. Couteau) indicated Seps of between 0.52 and 0.72 arcsec, which ought to be resolved in Gaia DR3, especially since the Δ Mag between the components is only 0.2 according to the WDS data.

18. Berkó (2010), 39, note 350.

But note the slightly less bright star to the southwest. This is the "C" star of the system. As currently catalogued, the two bright stars in Fig. 18 (with PA and Sep. of about 245° and 51.7″) form the double HJ 2039AB,C – an object first catalogued by John Herschel in 1830. Hussey in 1899 found the much closer star, currently catalogued in the WDS as HU 6B, a companion of A. In other words, the brighter star ought to be double. Yet Gaia DR3 finds it single. Rather, it is the "C" star that has a tiny pair of blue boxes, which are more easily seen in the next illustration, giving an expanded view:

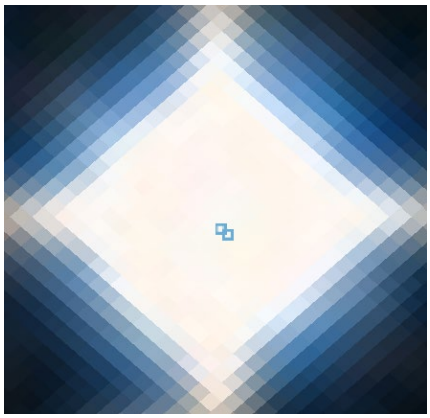


Figure 19. Expanded View of the "C" Star in Aldin Lite

Of this double, the brighter component has a Gmag of 10.9, and the fainter a Gmag of 11.1, according to Gaia. The PA and Sep., derived from DR3 precision coordinates, are 234.0° and 0.52″. These values are not far from the data given in the WDS data file for "HU 6AB":

```
HU    6AB    1899 1953    6 240 240   0.6   0.7  9.8  10.0  F0        +024-023          -10  295      012159.14-092727.8
      1899.87     240.3     .       0.61     .       9.1    .      9.3    .                0.9   3 Hu_1900a Ma   3
      1920.897    227.0     .       0.63     .       10.5   .      10.8   .                1.0   3 VBs1927a Ma   3
      1929.60     238.4     .       0.66     .       10.5   .      10.8   .                0.6   3 Vou1932  Ma   0
      1942.62     232.0     .       0.52     .         .    .       .     .                0.4   3 Vou1955  Ma   0
      1948.95     233.7     .       0.68     .         .    .       .     .                2.1   3 VBs1954  Mb   0
      1953.89     240.3     .       0.72     .       10.1   .      10.1   .                0.4   2 Cou1953e Mc   0
```

Figure 20. WDS Data File for "HU 6AB," Last Measured in 1953

William J. Hussey (1862-1926) was a well-known American double-star astronomer, who worked at the Lick Observatory and the University of Michigan. In 1900, he published a paper listing 100 new doubles he had found at Lick. It is the sixth star in his list that is of interest to us:

6. DM. −10°294.

$\alpha = 1^h\ 16^m\ 57^s$; $\delta = -9°\ 59'.2$

1899.756	239.6	0.59	9.2	9.2
.917	240.8	0.60	9.2	9.2
.933	241.2	0.64	9.0	9.5
1899.87	240.3	0.61	9.1	9.3

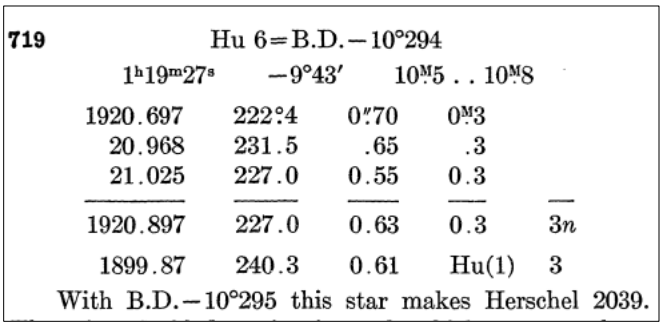
This is the companion of *h* 2039.

Figure 21. Hussey's Measures from 1899

Hussey identifies his star as "DM. -10°294." This is equivalent to the modern designation "BD -10 294," which is the "C" star, shown above in Figs 18 and 19, and not the "A" star. The latter is BD -10 295. As

we shall soon see, later catalogs confused these designations. Notice also that Hussey explicitly says: "This is the companion of *h* 2039," meaning the secondary star ("companion") in John Herschel's pair, called HJ 2039 in the WDS. So Hussey explicitly notes that it is the fainter star of HJ 2039, namely BD -10 294, that is his double.

George Van Biesbroeck also understood the matter this way in 1927, when he published a list of double-star measurements made at the Yerkes Observatory:



719 Hu 6 = B.D. − 10°294

$1^h19^m27^s$ −9°43′ 10^M5 . . 10^M8

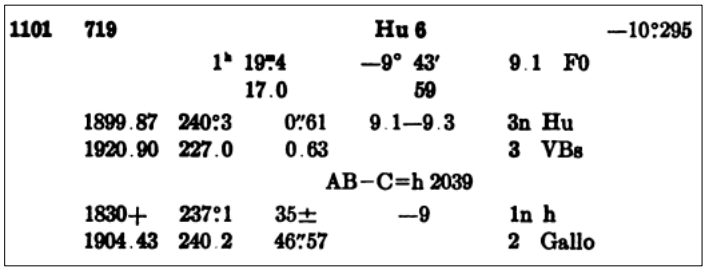
1920.697	222°.4	0″.70	0^M3	
20.968	231.5	.65	.3	
21.025	227.0	0.55	0.3	
1920.897	227.0	0.63	0.3	3*n*
1899.87	240.3	0.61	Hu(1)	3

With B.D. − 10°295 this star makes Herschel 2039.

Figure 22. Van Biesbroeck's Measures of HU 6 from 1920.

Here we could ask for nothing clearer. Van Biesbroeck explicitly equates HU 6 with BD -10 294, and says that in conjunction with BD -10 295, the pair make the double HJ 2039.

Unfortunately, the matter became confused in Aitken's 1932 compilation, *New General Catalog of Double Stars*, known as the ADS. Here, the brighter star (BD -10 295) is named HU 6. This is probably the origin of the error we presently find in the WDS:



1101 719 Hu 6 −10°295

	1^h 19.4		−9° 43′	9.1	F0
	17.0		59		
1899.87	240°.3	0″.61	9.1—9.3	3n	Hu
1920.90	227.0	0.63		3	VBs
		AB−C=h 2039			
1830+	237°.1	35±	−9	1n	h
1904.43	240.2	46″.57		2	Gallo

Figure 23. Aitken's Catalog Listing for HU 6 in 1932.

HU 6AB is here equated with BD -10 295, leaving BD -10 294 implicitly as HU 6C. The pairing HU 6AB,C is identified as HJ 2039. All this is just as in the modern WDS catalog.

By now, however, it should be clear that this identification is erroneous. Both Hussey and Van Biesbroeck identified HU 6 as the fainter component of HJ 2039, namely the star BD -10 294, which is what Gaia DR3 shows to be double. Hence, the confusion in the WDS ought to be cleared away. The author recently measured this double, and found its J2023.94 PA and Sep. to be 237.2°, and 0.43″. The PA is not significantly changed from earlier measures; the Sep. may be a little smaller. An image of the pair (as part of HJ 2039) is shown below:

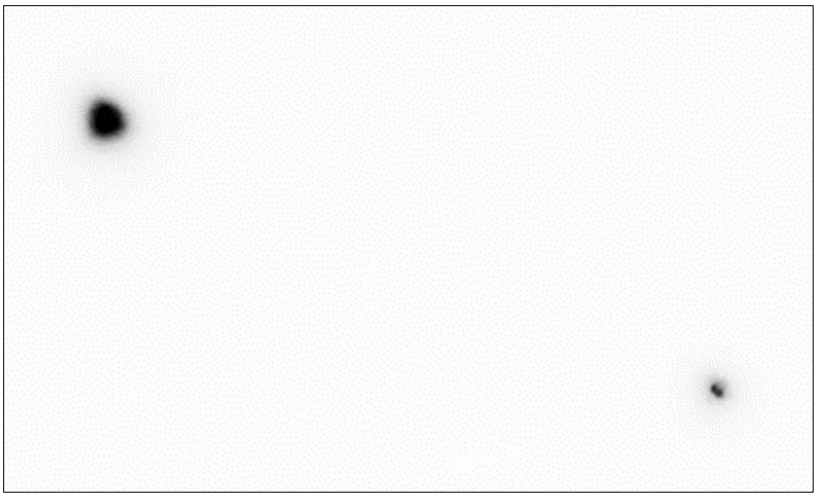


Figure 24. Author's Recent Image of HJ 2039,
Where HU 6 is the Fainter Component (Lower Left)

Conclusions

From the six cases just discussed, it is clear that by delving into original publications, as well as making judicious use of the SIMBAD database (along with Gaia DR3 data) and selected new observations, we can in many cases clear away old errors and improve the WDS. The total number of additional misidentifications is not known or easily ascertained, since not all doubles lacking a recent measurement are subject to such errors. There are many Rossiter and van den Bos pairs, for example, which because of their southerly location and small Seps have not been observed for decades. Nevertheless, they are real pairs. Many can be found in Aladin with superimposed Gaia DR3 sources. The present author continues to image those pairs that lie north of -30° declination (with Seps > 0.4″), using lucky imaging and stacking *via* the *REDUC* software of Florent Losse. It is as part of this measurement program that the author became aware of WDS "lost" doubles. More are yet to be found and researched, and the author plans to continue doing so in future.

Acknowledgments

This research has made use of the Washington Double Star Catalog maintained at the U.S. Naval Observatory. The author wishes to thank the USNO, and Dr. Brian Mason for his prompt, kind, and extensive assistance. Also, F. Losse for the use of *REDUC*; T. Edelmann for *FireCapture*; and G. Sordiglioni for *Stelle Doppie*. The author also acknowledges and thanks *Stellarium*, and the CDS for the SIMBAD database, Richard Harshaw for the development and use of Plot Tool 3.19. Harshaw, Mason, and Mark Copper kindly read and commented on earlier versions of this paper. The author profited greatly thereby and renders his sincere thanks.

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