



								23
271	+20°	1885	7	34.7	+20	27.3	8.2 ✓	E
272	+20°	1890	7	35.7	+20	33.1	7.5 ✓	
273	+20°	1889	7	35.7	+20	13.5	8.5 ✓	
274	+20°	1893	7	36.6	+20	39.3	6.5 ✓	
275	+19°	1794	7	31.9	+19	40.9	8.0 ✓	E
276	+19°	1777	7	28.5	+19	54.9	9.0 ✓	
277	+19°	1776	7	28.2	+19	17.9	9.0 ✓	
278	+19°	1772	7	27.7	+19	3.1	9.0 ✓	
279	+19°	1775	7	28.0	+19	33.1	8.8 ✓	
280	+20°	1846	7	26.9	+20	8.8	9.0 ✓	

## HISTORY

# Annie Jump Cannon and the Case of the Missing Columns

Katie Frey • Updated on August 24, 2022 • [Leave a Comment](#)

About a week ago we received two emails from volunteer transcribers who have been working on [Project PHaEDRA](#) at the [Smithsonian Transcription Center](#). They both wrote to ask about the number of columns found on the right hand pages of several Annie Jump Cannon volumes, and it kicked off an interesting investigation I thought I would share.

The first email referred to [AJC #42](#) (phaedra2125) and mentioned that when transcribing this volume, they weren't certain if they should follow the lines on the page when delineating the columns (5 columns) or if they should ignore those and count each column of numbers separately (8 columns).

271	+20°	1885	7	34.7	+20	27.3	8.2 ✓
272	+20°	1890	7	35.7	+20	33.1	7.5 ✓
273	+20°	1889	7	35.7	+20	13.5	8.5 ✓
274	+20°	1893	7	36.6	+20	39.3	6.5 ✓
275	+19°	1794	7	31.9	+19	40.9	8.0 ✓
276	+19°	1777	7	28.5	+19	54.9	9.0 ✓
277	+19°	1776	7	28.2	+19	17.9	9.0 ✓
278	+19°	1772	7	27.7	+19	3.1	9.0 ✓
279	+19°	1775	7	28.0	+19	33.1	8.8 ✓
280	+20°	1846	7	26.9	+20	8.8	9.0 ✓

A typical page from AJC #42 showing rows and columns of numbers in clear handwriting.

Looking through the pages of this volume, it was hard to glean any specific meaning from these columns of numbers other than that they were written in an orderly fashion. Some of the numbers starting with a plus sign looked like they could be interpreted as columns of Declination which, presumably, meant some of the other numbers represented Right Ascension. [\[Right Ascension and Declination\]](#) are coordinate numbers used to fix an object's location on the night sky. Declination usually begins with a plus or minus sign to indicate above or below the equator.]

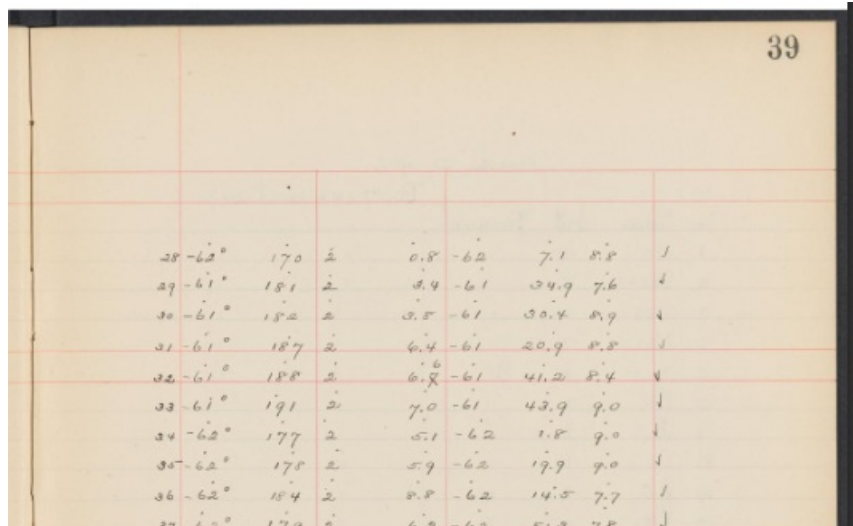
However, if that were the case why were there two columns that started with a + or – sign (typically found associated with Declination) and no clear set of three numbers (typically hours minutes and seconds) that could be clearly interpreted as Right Ascension? Since numbers written in a ruled column had large gaps between them, while those to either side of the ruled lines were frequently written very near to each other, it was difficult to tell with any certainty how the numbers were associated with each other.

Without being able to make sense of the content, the format question came down to asking if the columns follow the guidance of the ruled lines, thus creating 4 columns (or possibly 5 columns, depending on the status of the rightmost column which seemed to be treated separately)? Or should each column be written separately, creating 8 columns of numbers that could potentially be recombined later on if more information came to light?

With only the information (or lack thereof) in AJC #42 to go on, the 8 column approach seemed like the cleanest option. It would be easier later on to combine columns that were incorrectly split than to separate columns that were incorrectly joined.

The next email however, stated that they had noticed heading titles in some of the earlier AJC volumes that were dropped from the later volumes. I realized I had made a mistake by looking at AJC #42 in complete isolation from the rest of the series. With this reminder, I pulled open a few more volumes and brought Nico Carver in for a second opinion.

At first, the pages of various AJC volumes did not seem to yield any additional clues.

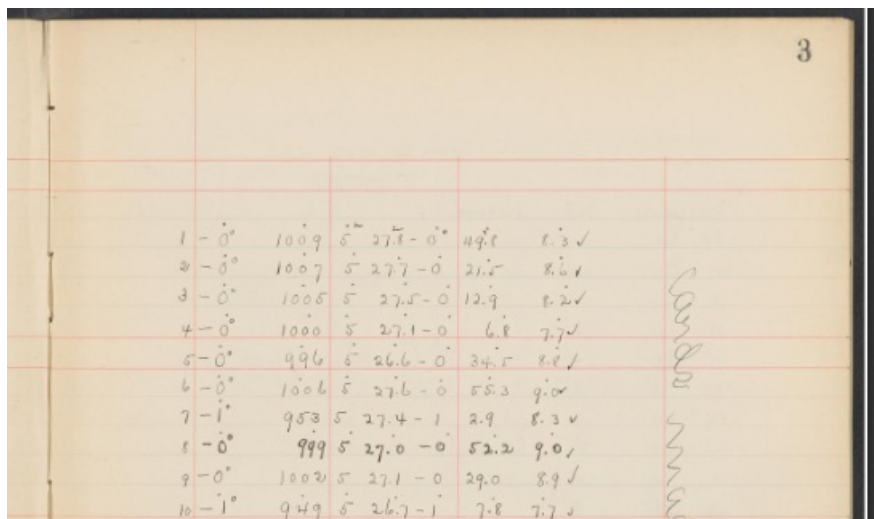


39

28-62°	170	2	0.8	-62	7.1	8.8	1
29-61°	181	2	3.4	-61	34.9	7.6	2
30-61°	182	2	3.5	-61	30.4	8.9	3
31-61°	187	2	6.4	-61	20.9	8.8	4
32-61°	188	2	6.8	-61	41.2	8.4	5
33-61°	191	2	7.0	-61	43.9	9.0	6
34-62°	177	2	5.1	-62	1.8	9.0	7
35-62°	178	2	5.9	-62	17.9	9.0	8
36-62°	184	2	8.8	-62	14.5	7.7	9
37-62°	179	2	6.9	-62	51.9	7.8	10

An image of [AJC #41](#) (phaedra2124), page 39, showing the clean rows of numbers in the same format as AJC #42.

Then the mystery deepened as the layout of the numbers with respect to the ruled lines seemed to change. In [AJC #40](#) (phaedra2123), the second column of numbers to start with a + or - sign was now found to the LEFT of the red ruled line, while in later volumes this column appeared to the right.



3

1-0°	1009	5	27.1-0°	49.8	8.3	✓
2-0°	1007	5	27.7-0°	21.5	8.6	✓
3-0°	1005	5	27.5-0°	12.9	8.2	✓
4-0°	1000	5	27.1-0°	6.8	7.7	✓
5-0°	996	5	26.6-0°	34.5	8.8	✓
6-0°	1006	5	27.6-0°	55.3	9.0	✓
7-1°	953	5	27.4-1	2.9	8.3	✓
8-0°	999	5	27.0-0°	52.2	9.0	✓
9-0°	1002	5	27.1-0°	29.0	8.9	✓
10-1°	949	5	26.7-1	7.8	7.7	✓

COPIES

An image of AJC #40, page 3, showing rows and columns of numbers

To make matters more confusing, on this page, if you look very closely, instead of the usual dots above each column there are a couple of squiggles which you might be able to convince yourself are a tiny "h" and a tiny "m," possibly denoting hours and minutes in Right Ascension, though the rest of the column format continues to obscure their exact meaning.

0°	1009	5 <sup>h</sup>	27.8 - 0°	49.8	8.3 ✓
0°	1007	5	27.7 - 0	21.5	8.6 ✓
0°	1005	5	27.5 - 0	12.9	8.2 ✓
0°	1000	5	27.1 - 0	6.8	7.7 ✓

A close up of AJC #40 page 3 where tiny squiggles appear over two of the "columns."

Finally, in [AJC #39](#) (phaedra2122), page 45, we came across an example of the column headers referenced in the second transcriber email. What was perhaps more interesting was that about halfway through the page the handwriting changed and the number of columns changed.

45

No	DM	RA	Dec	mg	
109	+18 549	3 43 57.1	+18 27.6	7.9 ✓	C C C C
110	+19 606	3 44 13.0	+19 10.8	8.0 ✓	
111	+18 546	3 42 2.2	+18 48.5	8.1 ✓	
112	+19 600	3 41 32.2	+19 7.7	8.2 ✓	
113	+19 586	3 36 30.7	+19 22.6	8.3 ✓	C C C
114	+19 625	3 48 27.8	+19 38.9	8.0 ✓	
115	+20 664	3 47 37.2	+20 21.8	8.2 ✓	
116	+20 638	3 40 34.1	+20 52.6	8.0 ✓	C C C
117	+20 607	3 37 43.7	+20 54.5	8.2 ✓	
118	+20 624	3 37 5.2	+20 47.3	8.0 ✓	

Identified by O.R.A. Mar. 7, 1912

Checked by A.M.C. Mar. 15, 1912

✓ 117	+17 601	3 31.2	+17 8.3	13 m	✓ 37373
✓ 120	+18 507	3 27.0	+18 26	7.0	7 " "
✓ 121	+19 647	3 53.5	+19 31	8.5	30 m ✓ 37417
✓ 122	+19 652	3 55.7	+19 35	8.5	31 " "

An image of AJC #39, pg 45, showing columns for No, DM, RA, Dec, mg; then, halfway down the page, the handwriting and columns change.



Looking down the page, it seemed like the numbers lined up well enough, other than the dropped column under RA. This lent strongly to the idea that the later volume should be transcribed with only 5 columns, but we still wanted to understand what was happening.

In the top half of the page, the RA column would presumably contain whole number hours, whole number minutes, and decimal seconds. In the second half of the page, it looks like the middle number of the RA column, presumably the whole number minutes, was dropped. If indeed this was the case, it would make this coordinate information useless, so that didn't seem like a logical explanation. The other possibility was that the minutes information was now converted to decimal form, eliminating the need for a seconds column. That still didn't fully explain why there was such a large gap left between the two numbers, giving the strong visual impression of missing a column of data.

Continuing to look through AJC #39, we noticed that, a few pages later, the format switched back to 5 clearly labeled columns where RA consisted of a set of three numbers. Then, on page 63, the middle RA number was dropped halfway through the page once more.

63

No	DM	RA	Dec.	Mag
28	+68 257	3 19 51	+68 16.0	8.5 ✓ C
29	+68 242	3 12 5	+68 38.4	8.0 ✓ C
30	+67 256	3 7 25	+67 55.7	7.5 ✓ C
31	+68 250	3 15 25	+68 57.4	7.3 ✓ C
32	+68 247	3 14 57	+68 40.6	7.0 ✓
33	+69 205	3 6 16	+69 11.7	6.5 ✓
34	+68 230	3 3 51	+68 54.4	8.0 ✓
35	+69 203	3 2 47	+69 26.2	7.7 ✓
36	+68 280	3 34 49	+68 44.6	8.0 ✓
37	+68 273	3 30 41	+68 31.4	8.3 ✓
38	+62 604	3 33 24	+62 53.1	5.3 ✓
Identified by C.R.A. April 1, 1912. checked by J.C.M. April 5, 1912				
39	+63 391	2 55.6	+63 53.1	9.0 ✓
40	+65 402	3 1.2	+63 2.4	8.8 ✓ +62 535 super. mag. 9.1
41	+62 533	3 0.9	+62 38.8	9.0 ✓
42	+64 381	3 5.0	+64 9.7	9.3 ✓
43	+64 385	3 9.3	+64 35.4	8.5 ✓

An image of AJC#39, page 63, showing again the neat columns of numbers, and that the RA column drops the middle number halfway through the page.

It was time to look for some more information. Recognizing that the DM column probably referred to a Durchmusterung catalog identifier number for a star, we decided to see what the catalog coordinates were for a few of these stars.

This turned out to be a bit complicated as, due to [perturbations](#), the coordinate location of stellar objects change over time. Astronomers update their catalogs roughly every 50 years, called [epochs](#), to account for these changes. Since these volumes were written around the early 1900s, it is unlikely that our modern coordinate information for these stars would match with those used by Ms. Cannon and her colleagues.

Not knowing exactly which epoch was going to be valid, we decided to search through the astronomical catalogs using [VizieR](#) to see what would come up. The DM catalog is now known as the BD catalog (for Bonner Durchmusterung) so we tried searching for one of the identifiers on the page: BD +63 391.

## VizieR

[Simple Target](#) [List Of Targets](#)

Target Name (resolved by [Sesame](#)) or Position:

Target dimension:

Clear

BD +63 391

B1855

2

arcmin

Submit

☒ Radius ☐ Box size

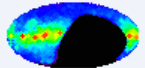
The 5 columns in *color* are computed by VizieR, and are *not part of the original data*. The precision of the *computed positions* has been increased compared to the original positions.

[I/122/bd](#)  
[Post annotation](#)

[Bonner Durchmusterung \(Argelander 1859-1903\)](#)  
The Bonner Durchmusterung catalog (325037 rows)

[1903BD...C.....0A](#)

[ReadMe+ftp](#)



<a href="#">Full</a>	<a href="#">_r</a>	<a href="#">RAJ2000</a>	<a href="#">DEJ2000</a>	<a href="#">zonesign</a>	<a href="#">zone</a>	<a href="#">num</a>	<a href="#">suppl</a>	<a href="#">mag</a>	<a href="#">RA1855</a>	<a href="#">DE1855</a>	<a href="#">RA.icrs</a>	<a href="#">DE.icrs</a>
	arcmin	"h:m:s"	"d:m:s"		deg			mag	"h:m:s"	"d:m:s"	"h:m:s"	"d:m:s"
<a href="#">1</a>	1.36	03 07 47.79	+64 27 06.1	+	63	391		9.0	02 55 37.0	+63 53.1	03 07 47.8	+64 27 06

Results of a VizieR search for BD +63 391 show RA and Dec coordinates compatible with what was written in AJC #39 page 63.

Encouragingly, the 1855 epoch data for the BD catalog gives us Declination that matches the information from AJC #39 and an RA of 2 hours, 55 minutes and 37 seconds. Converting the minutes and seconds into decimal minutes ( $55 + 37/60$ ) yields 55.61667, which could simply be rounded to 55.6, matching the information provided in what we now assumed was the RA column.

We tested a few other identifiers across the other volumes to make sure this wasn't just a one off fluke, and they all matched. After this investigation we feel confident in concluding that the pages of the AJC volumes that follow these patterns should be transcribed with 5 columns representing the Number, DM catalog identifier, Right Ascension, Declination, and Magnitude of a star.

Author   Recent Posts



### Katie Frey

Assistant Head Librarian at [Center for Astrophysics | Harvard & Smithsonian](#)

Katie Frey leads the development of the Unified Astronomy Thesaurus, a community supported linked data vocabulary for sorting, filtering, and exploring astronomical literature, data sets, images, etc.





## About Katie Frey

Katie Frey leads the development of the Unified Astronomy Thesaurus, a community supported linked data vocabulary for sorting, filtering, and exploring astronomical literature, data sets, images, etc.



◀ Major Philip Sidney Coolidge (1830 – 1863)

▶ Visual Astronomy Display: June 2020



## Leave a Comment

Comment\*

Name\*

Email\*

Website

Post Comment

Enter Keywords...



# Archives

Select Month

# Tags

ASTRONOMICAL PLATES

ASTRONOMY

ASTRONOMY THESIS COLLECTION

CFA BIBLIOGRAPHY

CFA HISTORY

CFA NEWS

CULTURAL ASTRONOMY SERIES

EVENTS

HISTORY

METADATA

METASAT

ORCID

PHAEDRA

UNIFIED ASTRONOMY THESAURUS

VISUAL ASTRONOMY DISPLAY

WOLBACH LIBRARY

ZOONIVERSE