ASTRONOMISCHE NACHRICHTEN.

№ 3047-48.

Double Star Observations

made in 1890 with the 36 inch Equatorial of the Lick Observatory.

By *S. W. Burnham.*

The double star observations which follow, represent the principal portion of my work in this direction during the year 1890. Substantially all the work was done between April 1 and December 1. On two nights of the week the large telescope has been used by me for micrometrical work, when the weather on these nights has been favorable. A few measures have been made at other times with the 12 inch, but nearly all of the measures given here were made with the great telescope. The character of the objects selected for re-measurement was such that it was very desirable to attain all the accuracy possible by employing the more powerful instrument, and many of the stars could not be seen at all with the other. Most of the new stars found from time to time, including some of those which were discovered with the 12 inch, are much too close or unequal for satisfactory measurement with that instrument. The large telescope leaves nothing to be desired in this or any other class of micrometrical work. The definition of the object-glass, like that of most, if not all, of the telescopes made by Clark & Sons, is practically perfect with proper atmospheric conditions. The driving clock by Warner & Swasey has worked perfectly from first to last, without a single failure at any time, and is probably as fine a piece of mechanism of its kind as can be found anywhere.

The micrometer by Fauth & Co. is most complete and satisfactory, and with the method employed for illuminating the wires, any object, however faint and difficult, can be measured. I am satisfied that there is no plan in use for illuminating the lines and controlling their brightness so unobjectionable in every respect as the one applied to this micrometer. A description and cut of the 12 inch micrometer, of which the large micrometer is a copy in all essential details, will be found in the introduction to my observations with the Chicago refractor in 1879–80 (Memoirs of the R.A.S. XLVII. 171). The light is furnished by a small oil lamp as in the original device, and after some experiments with electric lighting, I am convinced that the oil lamp is far less trouble to use, and superior to the other method. There is nothing to get out of order, and the sole attention required is to occasionally fill the lamp with sperm oil to which has been added about twenty per cent of kerosene.

The observing chair, with its simple sliding seat, designed by Professor Hough (Monthly Notices, March, 1881) has proved as serviceable here as elsewhere. It is certainly the best arrangement ever invented for use with either a large or a small telescope. It would be almost impossible to get along without it in doing this class of work with the large equatorial. When the driving-clock is attached, the movement of the eyepiece, which is nearly thirty feet from the centre of motion, is so rapid, that it is necessary, every two or three minutes in some positions of the instrument, to raise or lower the seat in order to have the observer in a comfortable and convenient position in using the micrometer, and any but a simple device of this kind would be impracticable.

The 12 inch refractor is provided with similar accessories which work in an equally satisfactory manner. It only remains to be said in this connection that any errors or shortcomings which may appear in the observations following, must be charged entirely to the observer, and not to the instruments with which the work was done.

The methods of observation are the same as heretofore. With few exceptions each star has been measured on at least three nights. The angles are usually from four or five settings of the wires, with three readings for distance on each side of the fixed wire. There appears to be nothing gained by taking any more readings on a single night.

In the selection of stars for re-observation, I have endeavored to take such pairs as could not, or would not, be observed elsewhere, leaving the old binaries and other easy pairs, to be looked after by other observers. Nearly all of the most interesting physical systems, and especially those in rapid motion, are difficult objects to measure, and many of them beyond the reach of any but the most powerful telescopes. These are largely of recent discovery, and of which few measures have been made. Stars of this class have been kept on the working-list, and as far as possible will be measured every year. Another class of stars, principally from my own catalogues, with every indication so far as the distance is concerned, of physical relation, have been measured previous to this time only once; and these have received some attention, with the result of finding some in apparently rapid motion. I have also looked up a good many stars of doubtful duplicity, and the results, negative and otherwise, will be found in the measures. As a rule observations of this kind, when the stars were not seen double, are only noted when the

conditions were sufficiently favorable to warrant the positive statements made regarding the probable duplicity. Negative results with the large telescope, as with any other, are of little value except when obtained on first class nights; and, therefore, when from the lack of good definition, or from other unfavorable conditions, it was doubtful whether a slight elongation could be seen, I have made no note of the observation. The measures and discoveries will show how far it is probable that any pair seen elsewhere would be missed here.

The catalogue of new stars contains 70 pairs, of which number 39 have distances less than 1″, with an average distance of 0″.45. Of the latter number 25 are less than 0″.5, the average distance being 0″.33. The new stars cover a wide range of magnitudes, some of the closest of them being near the limits of the Durchmusterung. The following naked eye stars are included in the list of new stars:

B.A.C. 230	5 Camelop.
Ceti 199	ν Geminorum
95 Piscium	36 Geminorum
χ Persei	65 Geminorum
48 Cephei (H)	τ Herculis
34 Persei	24 Aquarii
B.A.C. 1142	ψ^1 Aquarii
Tauri 248	

The following pairs previously known have been found to be more closely double:

H 1981	Σ 2476
S 409	$O\Sigma$ 425
Σ 809	Σ 12, App. II
$O\Sigma$ (App.) 77	

These are all sufficiently difficult to account for their having been overlooked heretofore.

While no rule, unless it is a very general one, can be laid down for the limits of distance in noting new pairs, it is certainly true that so far as stars are concerned which will probably prove to be binary, it is hardly worth while saving any where the distances of equal stars are not decidedly under 2″. Nearly all the pairs in rapid motion are less than 1″. A new class of doubles, unknown in the older catalogues, consisting of bright naked-eye stars, with very small companions at distances varying from 0″.8 to 2″, has been added within a few years. Down to the commencement of work with the 36 inch telescope, nearly all the examples of this class were discovered with the Chicago 18½ inch. A few were found by the Clarks, and some of these have already been shown to be of the most interesting character, for instance τ Cygni, 99 Herculis, 95 Ceti, etc. It is not improbable some very short periods will be found in this class of stars. Some interesting systems may be expected when the stars of this class discovered here are re-measured in the future.

If my purpose had been to make an imposing catalogue of discoveries by finding as many new pairs as possible without reference to their character, the number in my lists down to this time could easily have been made many times larger, without exceeding the Struve limits of magnitudes and distance; but at this time there would seem to be no good reason for encumbering a double star catalogue with that kind of material. We know now that they can have no interest as double stars in the proper sense of the term. With the large telescope pairs of 5″ or 6″ distance in the lower magnitudes of the Durchmusterung can be found by the score on any night, even when the seeing is too poor for ordinary micrometrical work; and with the 12 inch it would be easy to make a large list in a comparatively short time. I have not allowed myself to find new pairs of the kind recorded here, any faster than they could be thoroughly measured. It may be many years before some of these are re-observed, and it is desirable to have a careful set of measures at this time with which to compare future observations.

At the end of the double star observations will be found a few new nebulae which have been incidentally found in the course of the other work.

All places, as in my previous catalogues, are for 1880.

Seventeenth Catalogue of new double stars.

β 1155. DM. +3°4933.

RA. $0^h0^m40^s$ Decl. +3° 47′.

1890.802	91°.1	0″.45	8.6, 9	36
.824	86.7	0.46	9, 9.5	36
.840	93.4	0.41	8.6, 9.5	36
1890.82	90.4	0.44	8.7, 9.3	

β 1156. DM. +63°48.

RA. $0^h19^m58^s$ Decl. +63° 46′.

1890.725	31.7	0.52	9.5, 9.6	36
.747	33.9	0.57	9.0, 9.1	36
.760	30.2	0.48	9.0, 9.2	36
1890.74	31.9	0.52	9.2, 9.3	

This pair, and the one next following, were found during an examination of the place given by d'Arrest for Tycho Brahe's star. That is a little sp this star.

β 1157. DM. +63°52.

RA. $0^h22^m30^s$ Decl. +63° 35′.

1890.725	89°.7	1″.65	8.5, 11.5	36
.747	90.7	1.68	8.3, 11.5	36
.760	90.1	1.64	8.5, 11.0	36
1890.74	90.2	1.66	8.4, 11.3	

This is 8.0 mag. in DM. Discovered with the 12 inch. Much easier than the preceding pair, which is in the same vicinity.

β 1158. Lal. 718.

RA. $0^h24^m55^s$ Decl. −10° 45′.

B and C.

1890.898	138.6	0.20	8.8, 8.8	36
.900	135.4	0.29	8.5, 8.5	36
.939	140.4	0.28	8.5, 8.5	36
1890.91	138.1	0.26	8.6, 8.6	

A and BC. (H 1981).

1890.898	86°.6	79".22	5.5, —	36
.933	86.4	79.31	7.3, —	36
.939	86.7	79.41	7.8, —	36
1890.91	86.6	79.31	— —	

The wide pair constitutes the double star, H 1981. The RA. in Herschel is 1^m too large. He gave the angle 84°.8, and the estimated distance 60", and the magnitudes 8 and 9. The magnitude of the companion in SD. is $8^m.6$. The different magnitudes given to the principal star cover a wide range. Lalande and Schjellerup 8; Gould 7.5; Schönfeld 7.2; Heis 6.7; and my own estimate in the first observation which made it still brighter. It is not known as a variable star, but it seems hardly possible that the magnitudes could differ so much if there is really no change in brightness. It would be well for variable star observers to give it a little attention.

The new pair is a difficult object, and likely to prove an interesting one.

β 1159. DM. +39°.148.

RA. $0^h32^m28^s$ Decl. +40° 1'.

1890.681	37.2	0.25	10, 10.2	36
.687	43.4	0.29	9.3, 9.5	36
.689	44.6	0.16	9.8, 10	36
1890.68	41.7	0.23	9.7, 9.9	

This unusually minute and difficult pair is involved in the extreme preceding end of the Great Nebula in Andromeda. The magnitude is 8.9 in DM. It is difficult enough to test the powers of even the 36 inch; and probably no other telescope will show it well.

β 1160. B.A.C. 230.

RA. $0^h43^m24^s$ Decl. −14° 13'.

1890.675	114.2	1.39	6, 13	36
.689	112.4	1.18	5.5, 11.5	36
.709	112.7	1.01	6, 11.5	36
1890.69	113.1	1.19	5.8, 12.0	

The magnitude in Gould is 5.9.

β 1161. Lal. 1766.

RA. $0^h55^m50^s$ Decl. +51° 9'.

1890.689	324.2	0.53	6.8, 7.5	36
.709	323.0	0.45	7, 7.5	36
.725	325.5	0.45	7, 8	36
1890.71	324.2	0.48	6.9, 7.7	

β 1162. DM. +35°.215.

RA. $1^h3^m52^s$ Decl. +35° 18'.

1890.675	142.2	0.31	8.8, 9	36
.681	138.2	0.36	9.3, 9.4	36
.689	140.5	0.36	9.5, 9.7	36
1890.68	140.3	0.34	9.2, 9.4	

This close pair is about 25' nf β Andromedae.

β 1163. Ceti 199.

RA. $1^h18^m18^s$ Decl. −7° 32'.

1890.675	195°.1	0".17	6, 6	36
.681	194.5	0.15	6, 6.5	36
.689	187.2	0.24	6, 6	36
1890.68	192.3	0.19	6, 6.2	

β 1164. 95 Piscium.

RA. $1^h21^m26^s$ Decl. +4° 44'.

1890.802	167.0	0.42	7, 7.5	36
.824	168.7	0.39	6.5, 6.8	36
.832	169.4	0.35	6.5, 7	36
1890.82	168.4	0.39	6.7, 7.0	

In the B.A.C. this is 95 Piscium, 7^m. The magnitude in the DM. is 8.0, and in Boss 7.3.

β 1165. W_2 $1^h.510$.

RA. $1^h24^m51^s$ Decl. +40° 27'.

1890.807	61.4	2.02	8.3, 12	12
.829	68.1	1.69	8, 12	12
.835	57.0	1.90	8.7, 12	12
.854	63.2	1.66	8.8, 12.5	12
1890.83	62.4	1.82	8.4, 12.1	

Found and measured with the 12 inch. It is a difficult pair with that instrument.

β 1166. Lal. 2980.

RA. $1^h31^m45^s$ Decl. +37° 53'.

1890.807	346.7	2.64	8.3, 11	12
.829	343.7	2.43	8.5, 11.5	12
.835	347.1	2.81	8.3, 12	12
1890.82	345.8	2.63	8.4, 11.5	

Discovered with the 12 inch.

β 1167. W_2 $1^h.716$.

RA. $1^h33^m16^s$ Decl. +38° 7'.

1890.807	56.5	1.16	9.5, 11	12
.829	56.6	1.29	9.2, 10.5	12
.835	55.4	1.30	9.3, 10.5	12
1890.82	56.2	1.25	9.3, 10.7	

Discovered and measured with the 12 inch. The magnitude in DM. is 8.8.

β 1168. Schj. 534.

RA. $1^h43^m48^s$ Decl. −10° 58'.

1890.675	202.5	0.32	8, 8.2	36
.681	204.0	0.31	8, 8.7	36
.689	202.5	0.36	8.3, 8.5	36
.785	203.2	0.30	7.5, 8	36
1890.71	203.0	0.32	8.0, 8.3	

This close pair is 1^m44^s preceding, and 2'.4 south of ζ Ceti.

β 1169. DM. +51°420.
RA. 1h44m17s Decl. +51° 46′.

1890.835	207°3	2″08	8.5, 12	12
.854	202.8	2.33	8.5, 12.5	12
.856	209.0	2.18	8.5, 12.5	12
1890.85	206.4	2.20	8.5, 12.3	

Discovered with the 12 inch.

β 1170. χ Persei.
RA. 2h9m39s Decl. +56° 58′.

B and C.

1890.687	311.6	0.35	11, 11.5	36
.760	313.4	0.25	12, 12.1	36
.785	314.8	0.20	11.5, 11.5	36
1890.74	313.3	0.27	11.5, 11.7	

A and BC.

1890.687	353.2	70.35	6.3, —	36
.689	353.2	70.48	6.2, 11	36
.785	353.6	70.33	—, —	36
1890.74	353.3	70.39	—, —	

The companion to the principal star in the great cluster in Perseus is an exceedingly minute and close pair, and of the last degree of difficulty. I do not think an other telescope can possibly show this pair. The distance in the first measure was noted as »too large«. It resembles the one found in the nebula of Andromeda, but is very much fainter, and correspondingly more difficult.

The only other measures of this distant companion were made with the Chicago refractor:

1879.55 352°6 70″47 β 2 n.

A still more distant companion makes S 409.

β 1171. DM. +56°556.
RA. 2h12m45s Decl. +56° 18′.

1890.687	23.9	1.11	8.5, 13.5	36
.689	21.2	1.13	8.7, 13.5	36
.760	19.2	0.80	8.7, 12.5	36
1890.71	21.4	1.01	8.6, 13.2	

Another pair in the great Perseus Cluster; the south star of two about 1′ apart. It is 9m2 in DM.

β 1172. DM. +56°635.
RA. 2h21m26s Decl. +56° 42′.

1890.687	238.0	1.65	8.7, 10	36
.689	237.8	1.65	8.6, 11.5	36
.760	239.2	1.63	8.0, 10.5	36
1890.71	238.3	1.64	8.4, 10.9	

This is also in the borders of the Perseus Cluster.

β 1173. Arietis 133.
RA. 2h50m4s Decl. +23° 32′.

A fine triple star, but the close pair is very difficult. The principal star (= Lal. 5468 = W_2 2h1202) is 6m8 in the DM.

A and B.

1890.879	326°0	0″11	7.7, 7.8	36
.882	324.8	0.14	7.5, 7.6	36
.893	325.5	0.13	7.8, 8	36
1890.88	325.4	0.13	7,7, 7.8	

AB and C.

1890.879	283.7	4.54	7.5, 12.5	36
.882	285.1	4.64	—, 13.5	36
.893	282.0	4.72	—, 13	36
1890.88	283.6	4.63	—, 13	

β 1174. Lal. 5683.
RA. 2h57m46s Decl. —11° 26′.

1890.802	304.9	1.25	7.8, 11	36
.832	305.7	1.16	7.5, 12	36
.840	307.1	1.24	7.7, 11	36
1890.82	305.9	1.22	7.7, 11.3	

Discovered with the 12 inch.

β 1175. Lal. 5636.
RA. 2h57m47s Decl. +43° 14′.

1890.673	282.8	0.25	7, 8.5	36
.675	280.0	0.22	7, 8.5	36
.681	280.0	0.30	8, 9	36
1890.68	280.9	0.26	7.3, 8.7	

β 1176. 48 Cephei (H).
RA. 3h5m9s Decl. +77° 17′.

A and B.

1890.633	281.1	1.21	—, 11	36
.652	274.9	1.06	—, 13	36
.673	276.7	1.26	—, 13.5	36
1890.65	277.6	1.18	—, 12.5	

A and C.

1890.610	228.0	10.81	5.5, 13.5	36
.633	228.0	11.11	5.5, 13	36
.652	227.8	10.94	6, 13.5	36
1890.63	227.9	10.95	5.7, 13.3	

A fine triple, but not a very easy one. The outside companion was measured twice before the close star was detected. This is B.A.C. 979.

β 1177. Lamont 464.
RA. $3^h12^m45^s$ Decl. −1° 28′.

1890.802	24°.0	0″.45	9.3, 9.3	36
.824	24.6	0.38	9, 9	36
.832	25.4	0.32	9, 9	36
1890.82	24.7	0.38	9.1, 9.1	

Found during one of the many attempts to see that most singular double star, 95 Ceti. This new pair is 31ˢ.7 f, and 5′ 42″ s of that star. The magnitude in SD. is 9.3.

β 1178. Tauri 7 = Lal. 6267.
RA. $3^h17^m20^s$ Decl. +4° 27′.

1890.882	347.5	0.90	6.5, 12	36
.890	346.2	1.11	6.7, 12	36
.898	349.7	0.97	6.5, 13	36
1890.89	347.8	0.99	6.6, 12.3	

The magnitude in the DM. is 7.7, and in Boss 7.3; while Gould gives 6.6. It is certainly as bright as that now.

β 1179. 34 Persei.
RA. $3^h20^m47^s$ Decl. +49° 6′.

1890.610	162.0	0.68	6.5, 11	36
.633	161.6	0.76	6, 11	36
.652	164.1	0.68	5.5, 12.5	36
.660	166.0	0.60	5.5, 12	36
1890.64	163.4	0.68	5.9, 11.6	

A more difficult pair than the distance and relative magnitudes would indicate.

β 1180. Lal. 6417.
RA. $3^h22^m23^s$ Decl. −4° 59′.

A and B.

1890.802	24.7	0.42	8.5, 9	36
.824	24.6	0.46	8.5, 9	36
.832	25.2	0.45	8, 10	36
1890.82	24.8	0.44	8.3, 9.3	

A and C.

1890.802	117.6	7.09	—, 12	36
.824	118.3	7.16	—, 11.5	36
.832	117.8	7.15	—, 11	36
1890.82	117.9	7.13	—, 11.5	

β 1181. Lal. 6685.
RA. $3^h32^m53^s$ Decl. +45° 31′.

1890.652	270.5	0.36	8, 8.1	36
.660	266.9	0.31	8.3, 8.5	36
.673	274.2	0.38	8, 8.3	36
1890.66	270.5	0.35	8.1, 8.3	

Near $O\Sigma$ 59.

β 1182. Lal. 6759.
RA. $3^h35^m28^s$ Decl. +48° 9′.

A and B.

1890.610	260°.3	4″.56	6, 13.5	36
.630	262.1	4.24	6.5, 14.5	36
.633	—	4.31	6.8, 14.5	36
1890.62	261.2	4.37	6.4, 14.2	

A and C.

1890.610	242.9	19.56	—, 13	36
.630	242.4	19.20	—, 13.5	36
.633	—	19.04	—, 14	36
1890.62	242.6	19.27	—, 13.5	

The micrometer was disturbed during the evening of the last measure, and some of the position-angles were lost.

β 1183. B.A.C. 1142.
RA. $3^h37^m35^s$ Decl. +45° 18′.

1890.610	139.3	6.44	6, 14.5	36
.660	139.8	6.19	6.5, 14.5	36
.673	140.5	6.82	6.5, 15	36
1890.65	139.9	6.48	6.3, 14.7	

β 1184. DM. +21°526.
RA. $3^h41^m14^s$ Decl. +22° 0′.

1890.785	272.9	0.66	8.2, 8.3	36
.851	271.8	0.61	8.0, 8.5	36
.867	272.0	0.59	8.0, 8.2	36
1890.83	272.3	0.62	8.1, 8.3	

β 1185. W_2 4^h376.
RA. $4^h18^m52^s$ Decl. +18° 35′.

1890.660	33.6	0.15	7.6, 8.5	36
.681	18.3	0.16	8.0, 8.5	36
.689	25.1	0.18	8.0, 8.5	36
.775	25.4	0.14	7.5, 8.0	36
1890.70	25.6	0.16	7.8, 8.4	

The magnitude in DM. is 7.5.

β 1186. Tauri 248 = Lal. 8372.
RA. $4^h20^m51^s$ Decl. +10° 56′.

1890.906	185.0	0.63	6.8, 9.5	36
.911	180.4	0.61	6.7, 9	36
.939	181.0	0.53	6.8, 10.5	36
1890.92	182.1	0.59	6.8, 9.7	

In Argelander and Heis 6^m, and as bright as that in most of the catalogues.

β 1187. 5 Camelopardi.
RA. $4^h45^m14^s$ Decl. +55° 4′.

1890.775	245.4	12.86	5.5, 12	36
.777	245.3	12.90	5.5, 13.5	36
.785	244.9	12.90	5.5, 13	36
1890.78	245.2	12.89	5.5, 12.8	

β 1188.
RA. $5^h 44^m 33^s$ Decl. $-1° 28'$.

A and B.

1890.832	103°0	1″01	7.8, 10.5	36
.840	108.4	1.29	8 , 10.5	36
.851	106.7	1.38	7.8, 10	36
1890.84	106.0	1.23	7.9, 10.3	

A and C. (= Σ 809).

1890.840	98.5	25.38	— , 9	36
.851	98.1	25.22	— , 8.5	36
.862	98.4	25.37	7.8, 8.5	36
1890.85	98.3	25.32	— , 8.7	

The new pair is the principal star of Σ 809. The Struve star appears to be fixed:

1831.16	101°2	25″70	Σ 3 n.
1868.56	99.6	25.25	De 4 n.
1879.02	98.3	25.22	β 2 n.

β 1189. Schj. 1985.
RA. $5^h 51^m 8^s$ Decl. $+0° 23'$.

A and B.

1890.879	267.4	0.23	8 , 9	36
.890	271.2	0.13	8.3, 9	36
.939	269.8	0.23	8 , 9.2	36
1890.90	269.5	0.20	8.1, 9.1	

AB and C.

1890.840	194.5	58.02	— , 8	36
.862	194.5	58.21	8 , 8	36
1890.85	194.5	58.11	— , 8	

The magnitudes of A and B in the DM. are 9.0 and 9.2. DM. +0°1230, 1229.

β 1190. W_1 5^h1269.
RA. $5^h 51^m 17^s$ Decl. $+0° 1'$.

A and B.

1890.840	341.2	1.25	7 , 10.5	36
.851	339.5	1.37	7.8, 11	36
.862	339.7	1.61	7.5, 11	36
1890.85	340.1	1.41	7.4, 10.8	

A and C.

1890.840	95.2	6.72	— , 13	36
.851	95.2	6.62	— , 12	36
.862	96.0	6.62	— , 12.5	36
1890.85	95.5	6.65	— , 12.5	

A triple star near the last. The distant companion is noted in the Harvard Zones, where it is called 17 magnitude, and distance estimated 8″.

β 1191. Lal. 12262.
RA. $6^h 19^m 9^s$ Decl. $+18° 50'$.

1890.890	163°0	1″45	6.8, 14	36
.939	162.3	1.42	7.0, 14.5	36
.955	159.1	1.13	7.3, 13	36
1890.93	161.5	1.33	7.0, 13.8	

A difficult pair most of the time.

β 1192. ν Geminorum.
RA. $6^h 21^m 50^s$ Decl. $+20° 17'$.

B and C.

1890.879	341.0	0.14	9.0, 9.2	36
.882	349.1	0.18	8.5, 8.6	36
.890	348.4	0.12	8.5, 8.7	36
1890.88	346.2	0.15	8.7, 8.8	

A and BC. (= $O\Sigma$ App. 77).

1890.854	329.3	112.48	— , —	36
.862	329.2	112.80	— , —	36
.879	329.5	112.80	— , —	36
1890.86	329.3	112.69	— , —	

This is one of the bright stars with distant companions given in $O\Sigma$'s Catalogue of wide pairs. This companion star is an exceedingly close double, and one not likely to be found with any much smaller telescope. One would expect rapid motion in such a pair. The only other measures of this from the large star are the following:

1876.02 329°1 112″54 De 3 n.

Evidently there has been no change. If the principal star has any proper motion it is extremely small. The large telescope shows a number of faint stars nearer than this companion. I have measured most of them. The nearest one is quite difficult to measure, but the others are easily seen.

A and a.

1890.862	359.3	22.30	— , 15	36
.879	356.9	22.78	— , 15	36
.890	357.9	22.86	— , 15	36
1890.88	358.0	22.65	— , 15	

A and b.

1890.862	13.6	53.99	— , 13	36
.879	13.0	53.80	— , 14.5	36
1890.87	13.3	53.90	— , 13.8	

A and c.

1890.862	254.3	57.06	— , 12	36
.890	255.0	56.47	— , 13	36
1890.87	254.6	56.76	— , 12.5	

A and d.

1890.862	11.5	92.22	— , 12	36
.879	11.7	92.04	— , 14	36
1890.87	11.6	92.13	— , 13	

β 1193. 36 Geminorum.
RA. $6^h42^m52^s$ Decl. +21° 56′.

1890.879	355°.8	10″.62	6 , 15	36
.890	355.2	11.05	5 , 14.5	36
.939	354.1	10.76	6 , 14	36
1890.90	355.0	10.81	5.7, 14.5	

A very small companion.

β 1194. 65 Geminorum.
RA. $7^h22^m21^s$ Decl. +28° 10′.

1890.879	289.1	13.89	5 , 14	36
.882	289.7	14.06	5.5, 14.5	36
.890	289.8	13.77	6 , 13.5	36
1890.88	289.5	13.91	5.5, 14	

A faint attendant similar to the last.

β 1195. Lal. 15331.
RA. $7^h45^m35^s$ Decl. −9° 6′.

1890.903	81.7	0.46	7.5, 8	36
1.052	80.8	0.43	7.0, 7.2	36
1.055	81.8	0.49	7.5, 7.7	36
1891.00	81.4	0.46	7.3, 7.6	

β 1196. DM. +60°1127.
RA. $8^h8^m55^s$ Decl. +59° 57′.

1890.882	63.0	0.44	8.5, 10.5	36
1.052	61.0	0.46	8.5, 10.5	36
1890.97	62.0	0.45	8.5, 10.5	

This is 63^s f a 6^m star, and 40″ n. The magnitude in DM. is 9.2.

β 1197. Lac. 5791.
RA. $13^h56^m4^s$ Decl. −31° 6′.

1890.375	176.3	0.94	6.5, 7.5	36
.436	179.4	0.97	7 , 8.5	12
.438	180.9	0.66	7 , 8.2	12
1890.41	178.9	0.86	6.8, 8.1	

Discovered wich the 12 inch.

β 1198. τ Herculis.
RA. $16^h16^m8^s$ Decl. +46° 36′.

1890.334	325.3	6.76	4 , 13.5	36
.340	325.1	6.34	4 , 14	36
.356	324.3	6.67	— , 14	36
.373	326.5	6.50	— , 14	36
1890.35	325.3	6.57	— , 13.9	

A very minute companion.

β 1199. Messier 13.
RA. 16^h37^m Decl. +36° 41′.

A and B.

1890.422	131.9	2.64	10.5, 11	36
.458	129.1	2.35	11 , 11.5	36
.460	130.0	2.85	11 , 11.7	36
1890.45	130.3	2.61	10.8, 11.4	

B and C.

1890.422	59°.4	0″.84	— , 12	36
.458	59.8	0.96	— , 12.5	36
.460	58.9	0.84	— , 14	36
1890.45	59.4	0.88	— , 12.8	

This is one of the principal stars, and near the central portion, of the great Cluster in Hercules. It was the only pair close enough to be called a double star, I could find on this occasion, but the conditions were not specially favorable. Of course there are many stars within, say, 2″ of each other, but in all of the bright compressed clusters which I have examined with this and other instruments, there seems to be a remarkable absence of real double stars; and this seems to be true of star clusters generally.

β 1200. Lal. 31421.
RA. $17^h11^m5^s$ Decl. +14° 49′.

1890.422	13.5	1.41	8 , 11.5	36
.447	12.7	1.52	7.5, 12.5	36
.458	10.5	1.33	8 , 12.5	36
1890.44	12.6	1.42	7.8, 12.2	

This is the preceding of two 8^m stars, same declination, and 33^s apart. Near α Herculis.

β 1201. AOe. 17215.
RA. $17^h26^m40^s$ Decl. +67° 52′.

1890.463	339.0	0.43	7 , 7	36
.496	337.1	0.39	8 , 8.2	36
.499	338.4	0.48	8.3, 8.3	36
1890.49	338.2	0.43	7.8, 7.8	

β 1202. DM. +3°3564.
RA. $17^h55^m33^s$ Decl. +3° 33.

A and B.

1890.463	351.6	0.75	8 , 9	36
.479	353.5	0.83	8.5, 10	36
.496	354.1	0.65	8 , 9	36
1890.48	353.1	0.74	8.2, 9.3	

C and D.

1890.463	92.2	3.85	8.7, 11.5	36
.479	93.2	3.99	10 , 11	36
.496	94.3	3.89	9.5, 11.5	36
1890.48	93.2	3.91	9.4, 11.3	

AB and C.

1890.463	28.2	104.00	— , —	36
.473	28.4	104.02	— , —	12
.476	28.3	103.73	— , —	36
.479	28.1	103.72	— , —	36
1890.47	28.2	103.87	— , —	

AB and E.

1890.473	138°.4	90″.18	9 , 8.8	12
.476	138.4	90.44	8.5 , 8.4	36
.479	138.6	90.34	8.5 , 8.4	36
1890.47	138.5	90.32	8.7 , 8.5	

A and C are respectively Lamont 2849 and 2852, but the declination of the latter should be 1′ more. The magnitudes of these stars in DM. are the same, 8.2.

β 1203. Serpentis 191.

RA. $18^h\,19^m56^s$ Decl. +0° 44′.

1890.652	67.4	0.30	7 , 7.3	36
.675	66.9	0.31	8 , 8.2	36
.689	69.1	0.29	7.5 , 7.7	36
1890.67	67.8	0.30	7.5 , 7.7	

A very close and nearly equal pair. This is Lal. 34015.

β 1204. Aquilae 56.

RA. $19^h\,6^m1^s$ Decl. +2° 25′.

A and B.

1890.556	3.6	0.51	7 , 8	36
.564	4.6	0.44	8 , 8.5	36
.573	3.3	0.38	8 , 9	36
1890.56	3.8	0.44	7.7 , 8.5	

A and C.

1890.553	195.0	12.42	— , 14	36
.556	195.6	12.92	— , 14	36
.573	194.9	13.11	— , 14	36
.610	194.5	13.10	— , 14	36
1890.57	195.0	12.89	— , 14	

A and D.

1890.556	159.9	20.80	— , 14.5	36
.610	160.2	21.54	— , 14.5	36
.675	159.6	21.35	— , 15.5	36
1890.61	159.9	21.23	— , 14.8	

A and E.

1890.556	316.9	26.38	— , 14.5	36
.594	318.0	26.23	— , 14	36
1890.57	317.4	26.30	— , 14.2	

A and F.

1890.553	292.8	27.89	— , 14	36
.556	292.4	27.72	— , 14	36
.594	292.3	27.69	— , 14	36
1890.57	292.5	27.77	— , 14	

A and G. (= Σ 2476).

1890.553	214.0	31.32	7.5 , 10.5	36
.556	213.6	31.41	6.8 , 10	36
1890.55	213.8	31.36	7.1 , 10.2	

Not only is the principal star of Σ 2476 a close double, but there are at least four other stars nearer than the Σ companion. One of these, D, is extremely difficult to measure. There does not seem to be any change in the distant star:

1830.61 214°.7 31″.41 Σ.

β 1205. Lal. 38649.

RA. $20^h\,5^m46^s$ Decl. −8° 27′.

1890.644	51°.5	0″.51	8 , 9.5	12
.647	49.1	0.57	8.3 , 9.5	12
.649	49.3	0.60	8 , 9.2	36
1890.65	50.0	0.56	8.1 , 9.4	

Discovered with the 12 inch. In the SD. this star is 7.0 magnitude.

β 1206. Lal. 39115.

RA. $20^h\,14^m36^s$ Decl. +36° 23′.

1890.518	2.8	1.77	8 , 10.5	36
.523	1.6	2.12	8 , 11	12
.534	4.6	1.80	7.5 , 11	36
1890.52	3.0	1.90	7.8 , 10.8	

β 1207. Lal. 39198.

RA. $20^h\,16^m25^s$ Decl. +43° 28′.

1890.573	217.7	5.74	7.5 , 13	36
.575	217.1	5.79	8 , 13.5	36
.592	218.7	5.75	7.5 , 14	36
1890.58	217.8	5.76	7.7 , 13.5	

One of the Wolf-Rayet stars in Cygnus. Perfectly round and sharp with the highest powers.

β 1208. Lal. 39656.

RA. $20^h\,28^m38^s$ Decl. +6° 28′.

1890.537	335.4	2.77	7.3 , 12	36
.556	336.3	3.00	7.5 , 12	36
.564	334.8	3.04	7.5 , 12.5	36
1890.55	335.5	2.94	7.4 , 12.2	

β 1209. SD. −17°.6025.

RA. $20^h\,34^m9^s$ Decl. −17° 48′.

1890.649	293.8	0.51	9 , 10.5	36
.652	291.4	0.43	9 , 10	36
.673	297.7	0.42	9 , 9.3	36
1890.66	294.3	0.45	9 , 9.9	

Discovered with the 12 inch. It is 22ˢ.4 preceding, and 0′.4 south of the 7ᵐ star, B.A.C. 7151.

β 1210. Pi. 20^h440.

RA. $20^h\,56^m6^s$ Decl. +48° 13′.

A and B.

1890.613	120.5	2.16	7.5 , 13	36
.630	118.4	2.35	7.6 , 12	36
.633	120.8	2.38	7.7 , 12	36
1890.63	119.9	2.30	7.6 , 12.3	

C and D. (= $O\Sigma$ 425).

1890.613	133°8	4″17	11 , 11.5	36
.630	134.1	4.17	10.5, 11	36
.633	134.7	4.49	10.8, 11.1	36
1890.63	134.2	4.28	10.8, 11.2	

A and C. (= $O\Sigma$ 425).

1890.613	28.6	13.89	— , —	36
.630	28.8	13.80	— , —	36
.633	28.4	13.70	— , —	36
1890.63	28.6	13.80	— , —	

The new star, B, is much nearer the principal star than those which constitute $O\Sigma$ 425. The distance of D has never been measured directly before. $O\Sigma$ gives the distance of CD, derived from the angles, in connection with the measures of AC, as 4″11 (1851.7). There has probably been no change in these stars unless the distance of C has increased. The following are all the measures:

1847.49	27°6	12″33	$O\Sigma$	3 n.
1867.00	29.9	12.72	De	3 n.

β 1211. Lal. 40744.

RA. $20^h\,57^m15^s$ Decl. —18° 35′.

1890.644	343.8	0.65	8 , 8.3	36
.649	345.6	0.58	7.5, 8	36
.652	344.6	0.50	7 , 8	36
1890.65	344.7	0.58	7.5, 8.1	

The following of a small triangle; discovered with the 12 inch.

β 1212. 24 Aquarii.

RA. $21^h\,33^m20^s$ Decl. —0° 36′.

1890.725	256.5	0.44	6.8, 7.5	36
.760	254.9	0.45	6.5, 6.7	36
.777	252.0	0.45	6.2, 6.5	36
1890.75	254.5	0.45	6.5, 6.9	

A fine moderately close pair, and it is safe to say at the outset that it will prove to be a binary. The proper motion of this star is 0″215 in the direction of 81°5, and it is evident that it is common to both stars.

β 1213. DM. +12°4710.

RA. $21^h\,48^m26^s$ Decl. +13° 0′.

A and B.

1890.675	258.7	62.21	8 , —	36
.678	258.9	62.40	8 , —	36
.709	258.8	62.25	8 , —	36
1890.69	258.8	62.29	8 , —	

B and C.

1890.675	312°7	0″91	9 3 , 9.6	36
.678	311.5	0.75	9 , 9.5	36
.709	311.5	0.78	9 , 9.5	36
1890.69	311.9	0.81	9.1, 9.5	

I found this triple with the Chicago refractor in 1884, but it has not been given in any of my previous lists of new pairs.

β 1214. DM. +33°4387.

RA. $21^h\,51^m23^s$ Decl. +33° 45′.

A and B.

1890.633	205.8	1.44	9 , 10.3	36
.652	204.3	1.33	9 , 10.5	36
.673	204.8	1.40	9 , 10	36
1890.65	205.0	1.39	9 , 10.3	

C and D.

1890.633	246.3	5.07	10.5, 11	36
.652	245.6	4.98	9.5, 10.8	36
.673	245.6	5.12	9.3, 10.5	36
1890.65	245.8	5.06	9.8, 10.8	

A and C.

1890.633	18.4	112.16	— , —	36
.652	18.1	112.55	— , —	36
.673	18.5	112.58	— , —	36
1890.65	18.3	112.43	— , —	

This quadruple star was noted by me in 1884, but is not included in any of my previous catalogues. There is a faint star about 20″ from C in the direction of 285°; and a 5″ pair of faint stars between AB and CD. A good many smaller stars in the field. C is No. 4388 of the DM.; magnitude 9.3.

β 1215. SD. —11°5781.

RA. $22^h\,6^m46^s$ Decl. —11° 46′.

1890.802	89.7	1.58	9 , 9	36
.824	90.0	1.53	9 , 9.1	36
.840	90.9	1.49	9 , 9	36
1890.82	90.2	1.53	9 , 9	

Near the last pair; discovered with the 12 inch.

β 1216. Lal. 43605.

RA. $22^h\,14^m41^s$ Decl. +28° 55′.

1890.496	318.6	0.65	8.3, 8.5	36
.518	316.1	0.68	8.5, 9	36
.526	318.5	0.60	8.5, 8.5	36
1890.51	317.7	0.64	8.4, 8.7	

I found this pair Sept. 3, 1885 with the 16 inch refractor of the Warner Observatory during an evening spent with Dr. Swift at that place. Recently the slip of paper containing a memorandum of the place of the star was found, and it is now measured for the first time.

β 1217. Lal. 43635.
RA. $22^h15^m33^s$ Decl. $+30°42'$.

1890.499	216°8	0″68	7.3, 9.5	36
.518	221.6	0.65	7.5, 10	36
.564	218.3	0.50	7.5, 11.5	36
1890.53	218.9	0.61	7.4, 10.3	

This pair has proved exceedingly troublesome to measure. On several occasions when the seeing appeared to be excellent there was not the least trace of the companion. The magnitude in DM. is 7.0.

β 1218. W_2 22^h476.
RA. $22^h22^m32^s$ Decl. $+29°5'$.

1890.523	51.7	1.48	8.7, 8.9	12
.526	54.0	1.44	8.6, 8.8	36
.534	54.8	1.40	8.5, 8.8	36
1890.52	53.5	1.44	8.6, 8.8	

Discovered with the 12 inch.

β 1219. SD. $-11°5931$.
RA. $22^h42^m27^s$ Decl. $-11°42'$.

1890.802	310.0	0.56	8.7, 9.2	36
.824	309.3	0.55	8.8, 9.5	36
.840	304.3	0.52	8.7, 9.5	36
1890.82	307.9	0.54	8.7, 9.4	

This is a difficult pair, although it was discovered with the 12 inch. About 5′ np there is a 6″ pair.

β 1220. ψ^1 Aquarii.
RA. $23^h9^m35^s$ Decl. $-9°44'$.

B and C.

1889.689	267.1	0.14	—, —	36
1890.610	96.2	0.20	9.5, 9.6	36
.630	109.2	0.25	9.0, 9.1	36
.633	—	0.22	9.0, 9.1	36
.660	97.7	0.23	9, 9	36
1890.63	101.1	0.22	9.1, 9.2	

A and BC. (Σ 12, App. II).

1889.673	311.8	49.27	—, —	36
.687	311.8	49.25	—, —	36
.689	311.8	49.48	—, —	36
1889.68	311.8	49.33	—, —	

I found in 1889 that the Herschel-Struve companion was a close double star, but was able to get but a single measure that year. It seemed to be much easier the following year, and the difference of the components in magnitude was obvious. The late measures indicate a considerable increase in the angle as well as in the distance. The mean result given above includes only the measures of 1890. The micrometer was disturbed during the night on which the last measure but one was made, and the position-angle was, therefore, lost.

This star has remained absolutely fixed with reference to ψ^1 since the measures by Struve. The large star has a considerable proper motion, given as 0″350 annually in the direction of 89°8, and this is evidently common to both stars. It is not unlikely that this will prove to be a triple system of the class of which μ Herculis and μ Bootis are familiar examples, with the close pair in rapid orbital motion. It is probably a difficult object at all times, or it would have been detected by some of the many observers who have measured the wide pair. In 1880 I made a set of measures with the Chicago 18.5 inch, but saw nothing of the close pair.

β 1221. DM. $+41°4788$.
RA. $23^h22^m12^s$ Decl. $+41°46'$.

1890.496	145°7	1″93	9.5, 10.5	36
.499	144.7	1.91	9.5, 10.5	36
.518	145.2	1.89	9, 10.5	36
1890.50	145.2	1.91	9.3, 10.5	

Discovered by me at the Warner Observatory in 1885 on the occasion referred to in the note to No. 1216 of this list.

β 1222. DM. $+2°4669$.
RA. $23^h22^m23^s$ Decl. $+2°54'$.

1890.802	37.3	1.23	9.2, 9.3	36
.824	37.4	1.07	8.6, 8.7	36
.840	37.5	1.13	9.0, 9.0	36
1890.82	37.4	1.14	8.9, 9.0	

Discovered with the 12 inch.

β 1223. DM. $+4°5046$.
RA. $23^h39^m10^s$ Decl. $+4°27'$.

1890.802	297.0	1.35	8, 11	36
.824	298.9	1.34	8.5, 11	36
.840	299.9	1.30	7.7, 10.5	36
1890.82	298.6	1.33	8.1, 10.8	

Discovered with the 12 inch.

β 1224. Lal. 46942.
RA. $23^h50^m52^s$ Decl. $+55°10'$.

1890.725	200.9	3.98	6.7, 13	36
.747	204.8	3.94	6.7, 13.5	36
.760	204.2	3.90	6.5, 13.5	36
1890.74	203.3	3.94	6.6, 13.3	

The magnitude of this star in the DM. is 7.5.

Measures of Double Stars.

Σ 2.

RA. $0^h 2^m 36^s$ Decl. $+79° 3'$.

1890.785	173°.1	0″.27	7 , 7	36
.802	179.9	0.30	6.6 , 6.6	36
.879	178.3	0.30	6.5 , 6.8	36
1890.82	177.1	0.29	6.7 , 6.8	

This pair has been single, or non-measurable for the last thirty years. The angular motion since the last measure of *OΣ* in 1858 has been more than 150°. It is not a difficult pair now, and the distance should be steadily increasing, with but little change in the angle. The measures indicate a period of about 450 years, with a maximum distance of 1″.

β 484.

RA. $0^h 3^m 30^s$ Decl. $+51° 22'$.

1890.898	153.0	1.88	7.5 , 11.5	36
.900	156.2	2.01	7.7 , 11.5	36
.911	154.6	1.84	7.8 , 12	36
1890.90	154.6	1.91	7.7 , 11.7	

The only other measures of this pair are:

1878.66 156°.3 1″.95 β 2 n.

β 255.

RA. $0^h 5^m 38^s$ Decl. $+27° 45'$.

1890.862	96.7	0.70	7.5 , 8	36
.879	99.0	0.53	7.5 , 9	36
.882	97.9	0.53	7.6 , 8.3	36
1890.87	97.9	0.59	7.5 , 8.4	

Probably not much change yet, as De found:

1875.76 99°.0 0″.38 De 4 n.

β 393.

RA. $0^h 12^m 12^s$ Decl. $-21° 48'$.

1890.879	18.4	0.70	7.6 , 8	36
.893	17.5	0.73	7.5 , 8	36
.898	12.1	0.71	7.5 , 8.3	36
1890.89	16.0	0.71	7.5 , 8.1	

Change is uncertain.

OΣ 10 rej.

RA. $0^h 21^m 16^s$ Decl. $+15° 22'$.

1890.785 Neither star double. Good seeing. 36

The smaller star of this wide pair (237° : 96″) at one time was supposed to be a close pair, but it was rejected by *OΣ* in the catalogue of 1850. Ma in 1844 made a measure of it, marked »very uncertain«. I found it single in 1878 with the $18\frac{1}{2}$ inch, and at other times. Clearly there is no occasion for any further examination of this star.

H. 1968.

RA. $0^h 21^m 33^s$ Decl. $-17° 4'$.

1890.851	88°.4	4″.19	7 , 9.5	36
.854	86.1	4.17	7 , 9.3	12
.856	88.3	3.75	7.8 , 9.5	12
.867	88.4	3.80	8 , 10.5	12
1890.86	87.8	3.98	7.5 , 9.7	

The proper motion of this star (Lal. 593) is given as 0″.252 in the direction of 92°. If the direction and amount of this motion is correct, the measures of this pair show that the small star has a proper motion of its own of 0″.18 per annum in the direction of 195°.5, nearly at right angles to the motion of the other star. On the other hand, if B is fixed in space, then the correct proper motion of A is 0″.35 in the direction of 61°.2. An extended examination of these motions will be found in a paper by the present writer in Monthly Notices for January, 1891.

Ho. 212. 13 Ceti.

RA. $0^h 29^m 3^s$ Decl. $-4° 15'$.

1890.785 Cannot see any trace of duplicity in the large star. Tried all powers; seeing fairly good. 36

Hough, with the Chicago refractor, thought this was a close pair, (90° : 0″.3), but I could see nothing of it.

OΣ 15.

RA. $0^h 29^m 14^s$ Decl. $+48° 22'$.

1890.879	122.9	0.20	7.5 , 8.5	36
.882	121.0	0.11	7 , 8.5	36
.898	121.0	0.15	7.3 , 8	36
1890.88	121.6	0.15	7.3 , 8.3	

This star seems to have been rejected by *OΣ* as being really single. Apparently no one but Mädler has ever seen it double. He gave, 97°.3 : 0.3± (1851.7), and noted it as single the following year. It was very doubtful to De, 1865. I could see no certain elongation with the Hanover 9.4 inch in 1874, and found it single with the Chicago $18\frac{1}{2}$ inch 1879, and had come to the conclusion that it was not a double star. Even if there has been no change, the closeness of the components would account for the failures heretofore to see it double. (See A.N. 3017).

β 395.

RA. $0^h 31^m 9^s$ Decl. $-25° 26'$.

1890.802	114.4	0.77	6 , 6.1	36
.824	111.4	0.75	6 , 6.2	36
.832	111.9	0.69	6 , 6	36
1890.82	112.6	0.74	6 , 6.1	

Certainly a binary, but the motion is slow. This star has a large proper motion, which, according to Argelander, is 1″.436 in the direction of 90°.3.

β 491. δ Andromedae.
RA. $0^h 32^m 54^s$ Decl. $+30° 12'$.

1890.556	299°.5	28".26	— , 12	36
.564	299.2	28.07	— , 12.5	36
.573	299.6	28.22	— , —	36
1890.56	299.4	28.18	— , —	

No change since my first measures.

$O\Sigma$ 515. φ Andromedae.
RA. $1^h 2^m 32^s$ Decl. $+46° 36'$.

1890.575	249.6	0.30	5 , 6	36
.594	247.8	0.30	— , —	36
.610	255.0	0.36	— , —	36
1890.59	250.8	0.32	— , —	

Ho. 215. 45 Andromedae.
RA. $1^h 4^m 26^s$ Decl. $+37° 5'$.

1890.630	Not double.	36
.660	Absolutely round with powers to 1500, and fine conditions. Cannot be double.	36
.675	Perfectly round. Seeing magnificent.	36

Ho. gave the angle 259°.1 (1889.97) 1 n. There is probably some mistake about this star, as it would be a very easy pair with this telescope according to the description in Ho.

β 1029. ζ Piscium.
RA. $1^h 7^m 27^s$ Decl. $+6° 56'$.

B and C.

1890.903	249.4	0.75	— , 13.5	36
.911	248.6	1.02	— , 13.5	36
.939	248.5	0.77	— , 13.5	36
1890.92	248.8	0.85	— , 13.5	

A and B. (Σ 100).

1890.911	63.2	23.76	— , —	36
.939	63.9	23.65	— , —	36
1890.92	63.5	23.70	— , —	

There does not seem to be any change in the small star since my measures in 1888.

Polaris.
RA. $1^h 14^m 46^s$ Decl. $+88° 40'$.

A and C.

1890.785	83.0	44.70	— , 14.5	36
.802	83.7	44.67	— , 15.5	36
1890.79	83.3	44.68	— , 15	

A and D.

1890.785	169°.2	82".80	— , 14	36
.802	170.7	82.86	— , 14	36
1890.79	170.0	82.83	— , 14	

In 1884 I examined Polaris with the Chicago refractor, and measured the places of the nearest stars I could see with that instrument. The measures, which have never been published, are as follows:

1884.74	88°.0	43".28	— , 13	1 n.
1884.74	172.2	82.68	— , 12	1 n.

These are small stars with the 36 inch. There is nothing nearer than the Σ companion.

β 4.
RA. $1^h 14^m 59^s$ Decl. $+10° 55'$.

1890.851	69.6	0.41	8 , 9	36
.879	69.7	0.40	7.5 , 8.5	36
.882	67.2	0.42	7.5 , 8.5	36
.903	70.2	0.38	8 , 9	36
1890.88	69.2	0.40	7.8 , 8.8	

Some of the measures made heretofore are very discordant, and would appear to indicate rapid motion; but it is now quite certain that the change is rather slow. Both angle and distance seem to be diminishing.

β 506. η Piscium.
RA. $1^h 25^m 4^s$ Decl. $+14° 44'$.

1890.725	13.0	0.95	— , 11.5	36
.777	16.0	1.02	— , 10.5	36
.840	14.1	1.01	— , 11	36
1890.78	14.8	0.99	— , 11	

H. 2061.
RA. $1^h 30^m 2^s$ Decl. $-18° 8'$.

1890.936	322.7	63.13	7.5 , 9.5	36
.939	322.2	62.98	7.5 , 10	36
1890.94	322.4	63.05	7.5 , 9.7	

This star has a large proper motion, 0".414 in the direction of 116°.5. There are no other measures of the companion with which to compare these. Herschel gave the angle 326°.7, and estimated distance 30". Evidently there would be but little change in the angle.

β 736.
RA. $1^h 39^m 38^s$ Decl. $+38° 20'$.

A and B.

1890.898	209.4	0.75	8.5 , 11	36
.900	208.3	0.80	8.5 , 11	36
.911	210.2	0.75	8.5 , 11	36
1890.90	209.3	0.77	8.5 , 11	

A and C. (Σ 157).

1890.898	116°6	12″63	— , 8.6	36
.900	115.6	12.59	— , 8.7	36
.911	115.5	12.46	— , 8.7	36
1890.90	115.9	12.56	— , 8.7	

There is no change in the wide pair since the measures of Σ in 1832. The close pair was discovered with the 6 inch on Mt. Hamilton in 1879. These are the only other measures:

1879.94 209°0 0″86 β 3 n.

β 1016.

RA. $1^h42^m52^s$ Decl. +32° 29′.

1890.898	27.1	0.59	8.5, 8.5	36
.900	28.0	0.56	8.5, 8.5	36
.911	28.4	0.63	8.5, 8.5	36
1890.90	27.8	0.59	8.5, 8.5	

There are no other measures of this pair.

Ho. —.

RA. $1^h44^m32^s$ Decl. +24° 4′.

1890.903	179.3	0.36	8 , 8.2	36
.911	176.9	0.39	7 , 7.1	36
.939	176 3	0.35	7.5, 7.7	36
1890.92	177.5	0.37	7.5, 7.7	

Discovered by Hough. From Gould's Journal, No. 215.

β 512.

RA. $1^h47^m12^s$ Decl. +18° 42′.

1890.564	25.8	1.60	8 , 12.5	36
.573	24.0	1.69	8.7, 11	36
.610	21.5	1.64	9 , 11.5	36
1890.58	23.8	1.64	8.6, 11.7	

This star is the distant companion to γ Arietis, measured by Sh. The only other measures of this pair are:

1878.01 27°3 1″45 β 2 n.

Σ 186.

RA. $1^h49^m41^s$ Decl. +1° 15′.

1890.879	229.4	0.33	7.5, 7.5	36
.882	225.8	0.32	6.5, 6.5	36
.890	226.1	0.28	— , —	36
1890.88	227.1	0.31	7.0, 7.0	

The angular motion has been about 160° since 1831. Some of the measures are very discordant. The period cannot be less than 120 years. (Sidereal Messenger, February, 1891).

β 513. 48 Cassiopeiae.

RA. $1^h52^m7^s$ Decl. +70° 19′.

1890.594	309°1	0″60	5 , 7.5	36
.610	309.9	0.48	— , —	36
.633	306.6	0.58	— , —	36
.652	308.7	0.56	— , —	36
1890.62	308.6	0.55	— , —	

This will soon be a very difficult object. The change will be principally in distance, and in a few years it will probably be out of the reach of the large telescope. The measures down to this time indicate a period of a little less than 40 years.

$O\Sigma$ 38. γ Andromedae.

RA. $1^h56^m32^s$ Decl. +41° 45′.

B and C.

1890.526	Elongation doubtful with 1900. Distance much less than 0″1.	36
.573	Seems to be slightly elongated in 304°6. Distance decidedly less than 0″1.	36
.594	Elongation, if any, too uncertain to measure with the highest power.	36
.660	Tried with all powers, and the elongation, if any, is so slight that any measure would have no value. Seeing magnificent, and the star nearly in the zenith.	36

It will probably be several years before this pair separates sufficiently to be fairly measurable with the largest instruments. When the distance is not less than 0″15, a set of measures can be made which will give the period with general accuracy, when taken in connection with the old measures.

Hastings.

RA. $2^h10^m3^s$ Decl. —18° 47′.

1890.939	342.3	2.26	8 , 8.2	36
.955	341.6	2.27	8 , 8.3	36
.974	340.3	2.11	8 , 8.4	36
1890.95	341.4	2.21	8 , 8.3	

The change in this pair is clearly the result of proper motion, but this does not correspond to the proper motion derived from the meridian observations which is about 0″24 in the direction of 186°. Considering A as fixed, the apparent motion of B is about 0″1 annually in the direction of 54°. These stars are probably similar to the components of 61 Cygni, and have each a different proper motion.

Mira Ceti.

RA. $2^h13^m17^s$ Decl. —3° 31′.

1890.709	87.9	73.70	— , 12.5	36
.840	88.4	74.18	— , 13	36
1890.77	88.1	73.94	— , 12.7	

I found this faint star at Chicago. It is between the variable and Herschel's companion. The only other measures are:

1878.88 90°.0 74".70 β 2 n.

H. 3498.

RA. $2^h 16^m 43^s$ Decl. −28° 25′.

1890.840 No companion of any kind seen. 36
Good seeing.

H gave the magnitudes 7 and 16, and the distance 10"±, with the note, »Triple? Excessively difficult«. The principal star is Lac. 711.

β 740.

RA. $2^h 40^m 29^s$ Decl. +29° 11′.

1890.652 Large star certainly not double. 36
.840 Not double. Both stars round. 36

As a wide pair this is β 307. Subsequently I examined it with the 6 inch, and thought the large star was a very close double. This is probably not the case.

H. 3535.

RA. $2^h 44^m 42^s$ Decl. −28° 26′.

1890.832 Not double. 36

This star, B.A.C. 883, Herschel thought was a close pair. I have never been able to see, nor has any one else, so far as I know, except that it was noted as elongated by Wilson at Cincinnati. I do not think it can be really double.

β 524. 20 Persei.

RA. $2^h 46^m 9^s$ Decl. +37° 51′.

A and B.

1890.594	287°.5	0".17	5 , 6	36
.610	288.0	0.20	5 , 6	36
.630	287.2	0.17	— , —	36
1890.61	287.6	0.18	5 , 6	

AB and C. (Σ 318).

1890.594	237.5	14.07	— , 9.0	36
.610	237.1	14.06	— , 9.5	36
.630	237.1	14.10	— , —	36
1890.61	237.2	14.08	— , 9.2	

The close pair is in rapid motion. The change in angle is about 50° since 1878. The distance is steadily decreasing.

β 525. B.A.C. 920.

RA. $2^h 52^m 0^s$ Decl. +21° 8′.

1890.851	123.2	0.36	6.7 , 6.8	36
.867	120.1	0.31	7.5 , 7.5	36
.879	303.2	0.32	7.5 , 7.6	36
1890.87	122.2	0.33	7.2 , 7.3	

The distance has certainly diminished since I found this pair in 1875, and the angle seems to be slowly increasing. It is a binary beyond question.

Algol.

RA. $3^h 0^m 21^s$ Decl. +40° 30′.

1890.660 At first a suspicion of a slight 36
elongation with 2600 in a nearly
north and south direction, but too
vague to place any reliance on.
First class night. $0^h 15^m$ S. T.
.687 Star appears symmetrical under 36
all powers. $23^h 50^m$ S. T.

None of the stars which have been supposed from spectroscopic observations, to be close doubles have shown any evidence of the fact when examined with the large telescope under the most favorable conditions. It is possible that some other explanation will be found for the recurrent phenomenon first discovered by Miss Maury in the Harvard spectrum photographs. At all events, it is hardly worth while, until the method has been verified upon some of the numerous known pairs suitable for this purpose, to consume the valuable time of the great telescope in a further examination of objects of this class.

β 84.

RA. $3^h 10^m 5^s$ Decl. −6° 22′.

1890.882	28°.0	0".72	6.7 , 7.2	36
.890	30.2	0.66	6.5 , 6.6	36
.893	24.7	0.75	7.0 , 7.5	36
.906	26.2	0.78	7.0 , 8.0	36
1890.89	27.3	0.73	6.8 , 7.3	

This pair is much easier now than it was when I found it with the 6 inch in 1872. It is not certain that there has been much change in the angle.

1875.85 10°.3 0".44 De 5 n.
1879.39 32.4 0.72 β 5 n.

A.C. 2. 95 Ceti.

RA. $3^h 12^m 12^s$ Decl. −1° 22′.

1890.882 Nothing seen of the companion. 36
Good seeing.
.867 Tried all powers with favorable 36
conditions, but the small star
could not be seen.

This is the most mysterious and strange double star in the heavens. I have tried it, first and last, perhaps hundreds of times with apertures all the way from 6 to 36 inches without being able to see any trace of the little star. At the time of its discovery by Alvan Clark with a 7 1/2 inch refrator, the distance was 0".7, and the angle was measured by Dawes in 1854. In 1888 I got two measures of it with this telescope, but it was very difficult, the distance being 0".45. If the small star is not variable, and it is not at all probable that it is, it must be in very rapid motion. I hope to watch it carefully here after. A new pair was found in a low power field with this star, which is given in the accompanying list of new stars (β 1177).

β 878. 66 Arietis.

RA. $3^h 21^m 26^s$ Decl. $+22° 23'$.

1890.882	79°7	1″40	6 , 13.5	36
.890	72.9	1.25	6 , 13.5	36
.898	75.8	1.23	5.5 , 14	36
1890.89	76.1	1.29	5.8 , 13.7	

The only other measures are:

1881.06 78°0 1″10 β 2 n.

β 536.

RA. $3^h 39^m 8^s$ Decl. $+23° 49'$.

1890.689	317.7	0.22	8 , 8.5	36
.867	325.1	0.14	8 , 8.5	36
.879	324.3	0.21	8 , 8.5	36
1890.81	322.4	0.19	8 , 8.5	

This is one of the stars in the Pleiades, and is the principal star of the wide pair, S 437. It is $1^m 13^s$ preceding Alcyone, and 4′ 52″ north. The change has been principally in distance, and it is now a difficult pair. The only other measure is:

1878.69 336°4 0″44 β 3 n.

β 537.

RA. $3^h 39^m 53^s$ Decl. $+24° 28'$.

1890.879	185.8	0.45	8.5 , 10.5	36
.882	186.0	0.44	8.2 , 9.5	36
.890	182.5	0.55	8.5 , 9.5	36
1890.88	184.8	0.48	8.4 , 9.8	

This is also in the Pleiades. Probably unchanged.

1877.91 185°9 0″60 β 3 n.

H. 338. 30 Eridani.

RA. $3^h 46^m 47^s$ Decl. $-5° 43'$.

1890.867 Large star certainly single. 36

De thought the large star elongated in 165°. I always found it round with the 6 inch, and it is surely single now.

β 545.

RA. $3^h 59^m 24^s$ Decl. $+37° 42'$.

1890.775	310.6	1.17	8 , 10.5	36
.785	311.5	1.05	8 , 10	36
.802	309.6	1.18	8 , 11	36
.824	308.8	0.97	8 , 10.8	36
1890.79	310.1	1.09	8 , 10.6	

β 545 and $O\Sigma$ 531.

1890.775	208.1	235.60	— , —	36
.785	208.2	235.43	— , —	36
1890.78	208.1	235.51	— , —	

β 545 is the star used for measuring the parallax of $O\Sigma$ 531, the latter having the same proper motion as 50 Persei. $O\Sigma$ suspected the latter to have a very minute companion. The 36 inch failed to show any near attendant. There is probably no change in the pair above measured.

1878.24 310°0 1″02 β 4 n.

Σ 518. 40 Eridani.

RA. $4^h 9^m 52^s$ Decl. $-7° 47'$.

1890.681	99°5	2″73	— , —	36
.709	99.0	2.80	— , —	36
.760	100.9	2.43	— , —	36
.775	100.4	2.75	— , —	36
1890.73	100.0	2.68	— , —	

$O\Sigma$ 79. 55 Tauri.

RA. $4^h 13^m 2^s$ Decl. $+16° 14'$.

1890.660	85.7	0.35	7 , 8	36
.673	89.8	0.48	6 , 7.5	36
.675	89.6	0.36	6 , 7.5	36
.681	86.6	0.35	6.5 , 7.5	36
1890.67	87.9	0.38	6.4 , 7.6	

Certainly a binary, but the period will be rather long. The angular movement has been 63° since 1846.

71 Tauri.

RA. $4^h 19^m 30^s$ Decl. $+15° 21'$.

1890.681 Certainly not double. 36

This star was suspected to be a close pair by the observers at Cambridge. I have examined it a good many times with various instruments, but never saw anything suspicious. I do not think it is worth while following this up any longer.

Σ 547.

RA. $4^h 19^m 48^s$ Decl. $-1° 40'$.

1890.802	28.9	2.07	8.5 , 9.5	36
.824	28.3	1.92	8.3 , 9.5	36
.832	28.3	2.05	8.7 , 10	36
1890.82	28.5	2.01	8.5 , 9.7	

The change in this pair is due to proper motion (See Observatory, Jan. 1891). The apparent annual movement of the small star is 0″052 in the direction of 137°8.

Σ 554. 80 Tauri.

RA. $4^h 23^m 17^s$ Decl. $+15° 23'$.

1890.879 Single with all powers. 36

It was examined on several other nights with the same result.

β 550. Aldebaran.
RA. $4^h 29^m 2^s$ Decl. +16° 16′.

A and B.

1890.856	108°.5	31″.40	— , 14	36
.862	109.9	31.37	— , 14	36
.890	108.6	31.24	— , 14.5	36
1890.87	109.0	31.34	— , 14.2	

C and D. (β 1031).

1890.851	278.9	1.78	11 , 13	36
.862	277.5	2.08	— , —	36
.867	281.3	1.94	11 , 13.5	36
.882	278.6	1.57	11 , 14	36
1890.86	279.1	1.84	11 , 13.5	

A and C. (Σ 2, App. II).

1890.854	34.4	117.36	— , —	12
.856	34.1	117.19	— , —	12
.862	34.6	116.98	— , —	36
.867	34.3	116.55	— , —	36
1890.86	34.3	117.02	— , —	

The measures show that B has the same proper motion as Aldebaran; and also that C has a proper motion of its own of 0″.095 in the direction of 109°.6. D appears to be moving with C. For a full examination of the various measures of these stars and their motions, see paper by the present writer in Monthly Notices for March 1891.

β 883.
RA. $4^h 44^m 33^s$ Decl. +10° 52′.

A and C.

1891.052	152.2	18.22	6.8 , 13	36

I have looked at this star a number of times without seeing any trace of the close pair, so that there is no doubt of rapid change. The only measures are:

1879.00	17°.5	0″.35	β 1 n	A and B.
1879.00	148.5	18.35	β 1 n	AB and C.

β 552.
RA. $4^h 45^m 3^s$ Decl. +13° 27′.

1890.898	154.3	0.30	6.8 , 10	36
0.939	160.2	0.39	6.8 , 10.5	36
1.055	155.5	0.30	7 , 10	36
1890.96	156.7	0.33	6.9 , 10.2	

This was discovered with the Chicago telescope in 1877. It was not measured, but the distance was estimated 0″.8, and the position-angle 360°, the magnitudes being given as 7 and 10. There has been a wonderful change in the distance, and it is now one of the most difficult pairs I have measured with the large telescope. I have examined the original record made at the time of the discovery, and there is no reason for supposing that an error of 180° was made in estimating the angle. If it was correctly put down, there has been rapid motion in the angle as well as the distance. It is more than probable that it will prove to be a very rapid binary.

De 5. 7 Camelopardi.
RA. $4^h 47^m 41^s$ Decl. +53° 34′.

A and B.

1890.775	297°.9	1″.05	— , 10.5	36
.777	301.5	1.03	5.5 , 10	36
.785	306.8	1.04	— , 10	36
1890.77	302.1	1.04	— , 10.2	

Discovered by De in 1864. There is little, if any, change.

1865.33 309°.1 1″.24 De 8 n.

The distant star which makes Σ 610 is relatively fixed.

β 555. β Orionis.
RA. $5^h 8^m 47^s$ Decl. −8° 20′.

B and C.

1890.775 Small star appears to be single with all powers. 36
.829 Small star absolutely round with all powers. 36
.840 Carefully examined with all powers up to the highest. No indication of duplicity. 36
.890 Fine seeing. B is round. 36

This star has resisted all recent attempts to resolve or elongate it. It may not be double after all, but should be watched for a few years longer.

β 190. Orionis 82.
RA. $5^h 14^m 38^s$ Decl. −8° 9′.

A and B.

1890.939	359.9	0.50	8 , 8.1	36
0.955	359.9	0.61	8 , 8.1	36
1.055	355.6	0.52	— , —	36
1890.98	358.5	0.54	8 , 8.1	

AB and C. (Σ 692).

1890.939	4.2	34.82	— , 8.7	36
1.052	3.6	34.97	— , —	36
1890.99	3.9	34.90	— , —	

The close pair was discovered with the 6 inch in 1874. The Σ companion is fixed, and there is not much change in the new pair:

1876.15 355°.3 0″.71 De 4 n.

β 888. σ Aurigae.

RA. 5h 16m 29s Decl. +37° 17′.

1890.936	167°.2	8″.64	6 , 13.5	36
0.939	168.1	8.69	6 , 13	36
1.033	166.1	8.46	— , 13	36
1890.97	167.1	8.60	6 , 13.2	

There would seem to be a change in the distance. The following are the only other measures:

1880.14 171°.0 7″.91 β 4 n.

Σ 711.

RA. 5h 21m 38s Decl. +54° 35′.

1890.838 Fine seeing; nothing seen of any third star. 36

.840 Both stars round. Certainly not double. 36

In 1865 De. thought the larger star was double.

β 557.

RA. 5h 23m 16s Decl. +3° 3′.

B and C.

1890.882	148.5	0.38	9 , 9	36
.890	145.7	0.35	9 , 9	36
.939	147.8	0.35	9 , 9	36
1890.90	147.3	0.36	9 , 9	

A and BC. (Σ 721).

1890.890	150.1	24.55	— , 7.5	36
.939	149.5	24.68	— , 7.6	36
1890.91	149.8	24.61	— , —	

There is no change in the Σ pair. The only other measure of the close pair is:

1878.16 142°.4 0″.46 β 2 n.

β 1032. σ Orionis.

RA. 5h 32m 43s Decl. −2° 40′.

1890.785	348.6	0.31	4 , 5	36
.829	351.6	0.30	— , —	36
.832	354.6	0.25	— , —	36
1890.81	351.6	0.29	— , —	

The first set of measures gives:

1888.81 357°.0 0″.26 β 4 n.

β 1007. 126 Tauri.

RA. 5h 34m 22s Decl. +16° 28′.

1890.785 Single with 1000. 36

I have not tried this star before since I found it with the 12 inch on Mt. Hamilton in 1881.

β 752.

RA. 5h 39m Decl. +47° 46′.

1890.660 This star is certainly not double. 36

This was suspected to be a very close pair with the 6 inch on Mt. Hamilton in 1879.

β 1056. μ Orionis.

RA. 5h 55m 47s Decl. +9° 39′.

1890.775	272°.4	17″.01	4 , 14	36
.840	273.1	17.17	4 , 15	36
.974	272.5	17.15	— , 13.5	36
1890.86	272.7	17.11	— , 14.2	

β 1058. 4 Geminorum.

RA. 6h 3m 13s Decl. +23° 1′.

1890.939	283.0	0.27	6.1 , 6.2	36
1.052	277.7	0.27	6.5 , 6.6	36
1.055	283.3	0.31	6.3 , 6.5	36
1891.01	281.3	0.28	6.3 , 6.4	

Comparing these measures with those of last year, a change in the distance seems probable.

1889.13 104°.3 0″.41 β 2 n.

β 1008. η Geminorum.

RA. 6h 7m 38s Decl. +22° 32′.

1890.903	295.3	1.12	3.5 , 11	36
.939	295.5	1.11	— , 11	36
.955	297.6	1.02	— , 10	36
1890.93	296.1	1.08	— , 10.7	

Ho. 237.

RA. 6h 35m 47s Decl. +3° 22′.

1890.939 No double star found here. All the stars round. 36

Ho. describes this as an equal pair of 7m.5 stars, with a distance of 0″.3. There is certainly no double star in or near this place. All the stars in the vicinity were examined.

A.G.C. 1. Sirius.

RA. 6h 39m 53s Decl. −16° 33′.

1890.252	359.6	4.17	— , —	36
.269	361.6	4.20	— , —	36
.304	356.8	4.19	— , —	36
1890.27	359.7	4.19	— , —	

1890 785. The seeing seems to be very good, and although Sirius is perhaps an hour and a half from the meridian, apparently the companion should be seen if it can be seen at all this year.

1890.829. Followed it a long time, using various powers but could not see anything of the companion. The seeing is excellent.

1890.840. Followed Sirius for some time under favorable conditions. The companion could not be seen.

1890.939. Fine seeing. Tried all powers; no trace of the small star.

I am surprised to find that the companion has passed beyond the reach of the large telescope. I had supposed that it would be measurable even at the minimum distance if the theory of its movement is substantially correct. It will probably not be seen again for several years. The measures given above were made with great difficulty. In consequence of my absence on the eclipse expedition, the measures were delayed two or three months beyond the usual time, and Sirius was long past meridian when these observations were made. The present indications are that the period will probably not be more than 53 years. I have recently compiled a complete list of the measures of the companion down to this time which will be found in Monthly Notices for April 1891.

β 756.

RA. $6^h 41^m$ Decl. $+39° 35'$.

1890.785 No double found in or near this place. 36

This star was suspected to be a close pair with the 6 inch.

$O\Sigma$ 165. 45 Geminorum.

RA. $7^h 1^m 29^s$ Decl. $+16° 9'$.

1890.939	54°.0	3″.29	6 , 13	36
.955	51.5	3.35	6 , 12	36
.974	53.5	3.12	6 , 12.5	36
1890.96	53.0	3.25	6 , 12.5	

The change in this pair is due to proper motion. The apparent motion of B is about 0″.1 per annum in the direction of 358°.4.

β 1009. τ Geminorum.

RA. $7^h 3^m 30^s$ Decl. $+30° 26'$.

1980.903	177.0	1.75	4.5 , 12.5	36
0.939	180.9	1.94	— , 14	36
0.955	173.9	1.51	— , 13.5	36
1.052	178.6	1.79	— , 13	36
1890.96	177.6	1.75	— , 13.2	

There has been no material change in this pair since my measures in 1882.

$O\Sigma$ 171.

RA. $7^h 18^m 53^s$ Decl. $+31° 52'$.

1890.890	130.0	1.16	7.5 , 9	36
.903	130.4	1.19	7.8 , 10.5	36
.936	132.4	1.04	8 , 9.5	36
1890.91	130.9	1.13	7.8 , 9.7	

There is very little, if any, change in this pair since the first measures.

β 22.

RA. $7^h 25^m 30^s$ Decl. $+33° 7'$.

1890.898	150°.5	6″.46	8.3 , 9.5	36
.903	150.3	6.55	8 , 10	36
.936	150.3	6.24	8.5 , 10.5	36
1890.91	150.4	6.42	8.3 , 10	

No change in this pair.

Procyon.

RA. $7^h 33^m 1^s$ Decl. $+5° 33'$.

1890.785 Carefully examined with various powers. Nothing nearer than the old companion. 36

β 579.

RA. $7^h 26^m 40^s$ Decl. $+33° 23'$.

1890.890	213.7	0.86	8 , 10	36
.898	214.3	0.83	7.7 , 9.5	36
.903	213.8	1.01	8 , 10.5	36
1890.90	213.9	0.90	7.9 , 10	

The only other measure of this is:

1878.24 219°.1 0″.84 β 1 n.

The principal star with two distant companions make $O\Sigma$ 173. The close star was discovered with the 6 inch.

Σ 1143.

RA. $7^h 41^m 41^s$ Decl. $+5° 42'$.

This is one of the missing pairs of Σ. As it could not be found by Struve himself, it is hardly worth while attempting to recover it. It is evidently in some other part of the sky. I examined all the stars in this vicinity with the 36 inch, and there is certainly no pair here answering Struve's description.

β 101. 9 Argus.

RA. $7^h 46^m 13^s$ Decl. $-13° 35'$.

1890.249	88.3	0.28	— , —	36
.252	84.8	0.29	— , —	36
.255	83.0	0.31	— , —	36
.269	82.4	0.34	— , —	36
1890.26	84.6	0.31	— , —	
1890.903	89.6	0.34	5.5 , 6.5	36
0.939	82.9	0.44	6 , 6	36
1.052	92.4	0.31	6 , 6.4	36
1890.96	88.3	0.36	— , —	

A binary in rapid motion but the measures are too few for the accurate determination of the period. The angular motion since 1875 is about 160°.

$O\Sigma$ 185.

RA. $7^h 51^m 7^s$ Decl. $+1° 27'$.

1890.903	8°.1	0″.20	6.8, 6.9	36
0.939	3.6	0.21	6.8, 7.2	36
1.052	6.2	0.24	7.0, 7.2	36
1890.96	6.0	0.22	6.9, 7.1	

There are very few measures of this pair. It has generally been noted as single, or doubtful. It may be in rapid motion, but the measures are insufficient to decide.

β 205.

RA. $8^h 27^m 54^s$ Decl. $-24° 12'$.

1890.274	82.2	0.65	7.5, 7.5	36
.282	81.6	0.75	—, —	36
1890.28	81.9	0.70	—, —	

Retrograde motion. The angles in the following measures are changed, when necessary, to the same side.

1874.19	130°±	0″.7±	β
1878.53	100.3	0.63	$Cinc_5$ 3 n.
1882.21	96.6	0.5±	Sp 3 n.
1886.17	90.1	0.80	Wilson 2 n.

ε Hydrae.

RA. $8^h 40^m 25^s$ Decl. $+6° 52'$.

A and B.

1890.903	171.8	0.21	3.5, 5.5	36
.939	168.3	0.17	3.5, 6.0	36
1890.92	170.0	0.19	—, —	

The close pair, discovered by Schiaparelli in 1888, appears to be in rapid motion. These are the only measures:

1888.28	142°.0	0″.21	Shp. 6 n.
1888.98	154.4	0.26	β 2 n.

The measures indicate a motion of 16° per annum.

β 1071. θ Ursae Majoris.

RA. $9^h 25^m 50^s$ Decl. $+52° 11'$.

1890.356	78.1	5.11	—, 13.5	36
.375	80.2	4.62	—, —	36
.422	79.0	4.88	—, —	36
1890.38	79.1	4.87	—, —	

It is evident that the companion has the same proper motion as the large star. The measures of last year were:

1889.23 74°.9 5″.09 β 3 n.

As the bright star has a proper motion of 1″.12 in the direction of 240°, the distance of the companion at the date of the above measures should be a little more than 6″ if it had not the same movement. The stars are certainly physically connected.

A.C. 5. 8 Sextantis.

RA. $9^h 46^m 34^s$ Decl. $-7° 32'$.

1890.252	114°.6	0″.25	—, —	36
.269	113.9	0.36	—, —	36
.280	111.2	0.30	—, —	36
.301	116.8	0.39	—, —	36
1890.27	114.1	0.32	—, —	

An interesting binary, of which there are too few measures. The period will probably be not far from 60 years.

Regulus.

RA. $10^h 2^m 0^s$ Decl. $+12° 33'$.

B and C.

1890.255	86.0	3.01	—, —	36
.269	86.8	3.36	—, —	36
.282	84.2	2.78	—, —	36
1890.27	85.7	3.05	—, —	

There is no change in the double companion to Regulus since my first measures in 1878, and therefore both have the same proper motion as the large star, which is 0″.267 in the direction of 274°.5.

β 1077. α Ursae Majoris.

RA. $10^h 56^m 19^s$ Decl. $+62° 24'$.

1890.249	317.4	0.87	—, —	36
.252	322.9	0.83	—, —	36
.255	321.3	0.79	—, —	36
.269	318.6	1.00	—, —	36
1890.26	320.1	0.87	—, —	

The angle appears to be diminishing:

1889.19 326°.1 0″.91 β 4 n.

β 794.

RA. $11^h 47^m 13^s$ Decl. $+74° 26'$.

A and B.

1890.326	125.8	0.40	—, —	36
.337	129.1	0.59	—, —	36
.373	127.3	0.53	—, —	36
.375	125.4	0.48	—, —	36
1890.35	126.9	0.50	—, —	

AB and C.

1890.373	72.0	5.64	—, 14	36
.375	71.7	5.79	—, 13.5	36
1890.37	71.8	5.71	—, 13.7	

AB and D.

1890.373	78.7	26.79	—, 13	36
.375	78.5	26.67	—, 13	36
1890.37	78.6	26.73	—, 13	

The two distant companions are now seen and measured for the first time. There seems to be considerable change in the close pair.

1881.34 106°6 0″42 β 5 n.

β 1082. 78 Ursae Majoris.

RA. 12h 55m 35s Decl. +57° 1′.

1890.252	77°4	1″35	— , —	36
.255	78.1	1.43	— , —	36
.280	75.1	1.61	— , —	36
1890.26	76.9	1.46	— , —	

Σ 1728. 42 Comae.

RA. 13h 4m 10s Decl. +18° 10′.

1890.326	8.0	0.84	— , —	36
.331	10.2	0.54	— , —	12
.334	7.8	0.66	— , —	36
.337	11.4	0.78	— , —	36
1890.33	9.3	0.70	— , —	

Σ 1733.

RA. 13h 10m 27s Decl. +17° 53′.

1890.331	126.0	4.50	8.5, 10	12
.334	126.6	4.93	— , —	36
.337	125.8	4.97	— , —	36
1890.33	126.1	4.80	— , —	

No change since Struve.

β 800. Comae 201.

RA. 13h 10m 49s Decl. +17° 40′.

1890.331	113.5	2.13	8 , 10.5	12
.334	116.0	1.96	7 , 10	36
.337	116.9	1.98	7.5, 10	36
1890.33	115.5	2.02	7.5, 10.2	

The following are all the measures:

1881.36 121°5 1″27 β 4 n.
1888.39 120.2 2.22 Comstock 3 n.

β 806.

RA. 14h 33m 27s Decl. −25° 46′.

A and B. (New).

1890.375	96.9	0.70	7.5, 10	36
.383	96.1	0.72	7 , 9	36
.406	95.9	0.59	7.5, 9	36
1890.39	96.3	0.67	7.3, 9.3	

C and D.

1890.375	343.2	1.34	8 , 9	36
.383	345.6	1.20	8.5, 9.5	36
.406	345.9	1.07	8.5, 9	36
1890.39	344.9	1.20	8.3, 9.2	

A and C.

1890.375	67°2	71″28	— , —	36
.383	67.5	71.60	— , —	36
.406	67.3	71.57	— , —	36
1890.39	67.3	71.48	— , —	

A and a. (New).

1890.375	330.2	17.78	— , 13.5	36
.383	329 0	17.79	— , 13.5	36
1890.38	329.6	17.78	— , 13.5	

The double companion to the principal star was discovered at the Washburn Observatory in 1881. The 36 inch shows that the larger star is also double, so that it is now a fine quadruple group. The following are the only other measures:

1881.44 347°8 1″22 CD β 3 n.
1881.42 67.4 71.50 AC β 3 n.

β 31.

RA. 14h 46m 59s Decl. +19° 13′.

A and B.

1890.340	190.8	1.33	8.3, 9.5	36
.356	191.1	1.40	8.5, 10	36
.364	188.9	1.46	8.3, 9.7	36
1890.35	190.3	1.40	8.4, 9.7	

A and C.

1890.340	162.1	9.13	— , 12	36
.356	162.2	8.95	— , 12.5	36
.364	163.8	9.00	— , 12	36
1890.35	162.7	9.03	— , 12.2	

This pretty triple star is near ξ Bootis. The close pair was discovered with the 6 inch. It is pretty certainly moving in angle.

1874.94 181°6 1″11 De 2 n.
1878.84 188.1 1.35 β 2 n.
1883.71 193.2 1.51 En 6 n.

The only other measures of C are:

1878.25 161°4 9″04 β 1 n.

Σ 3091.

RA. 15h 9m 43s Decl. −4° 26′.

1890.375	46.7	0.33	— , —	36
.406	46.8	0.36	— , —	36
1890.39	46.8	0.35	— , —	

The measures of this pair are discordant, and perhaps on the whole do not show much change in the angle, but the distance for the last thirty years has been less than it was at the time of Σ, and probably about the same as it is now.

H. 1281.

RA. $15^h 50^m 17^s$ Decl. $-15° 41'$.

1890.364	229°8	35″12	6.5, 12	36

Herschel called the companion 20th magnitude, and gave the angle and distance (estimated) 215°: 18″. There are no other measures. I could not see the small star on two occasions in 1875 with the 6 inch. Herschel's 18 to 20 magnitudes as a rule represent stars which would be called about 12 in the scale used here.

β 1087. τ Coronae.

RA. $16^h 4^m 35^s$ Decl. $+36° 46'$.

1890.280	168.8	3.03	—, —	36
.334	168.5	3.32	—, 13.5	36
.340	167.5	3.02	—, —	36
1890.32	168.3	3.12	—, —	

As pointed out at the time of the discovery of this pair, if the companion is not moving through space with the large star, its distance should increase 0″34 per annum, that being the proper motion of τ in the direction of 348°. The measures show the stars to be relatively fixed, and therefore this motion is common to both.

1889.21 169°1 3″11 β 3 n.

Σ 2032. σ Coronae.

RA. $16^h 10^m 12^s$ Decl. $+34° 10'$.

A and B.

1890.280	209.5	4.05	—, —	36
.337	207.1	3.99	—, —	36
.383	206.9	4.20	—, —	36
1890.33	207.8	4.08	—, —	

A and C.

1890.280	214.7	12.57	—, —	36
.337	211.4	12.29	—, —	36
.383	213.5	12.80	—, —	36
1890.33	213.2	12.55	—, —	

The change in the small star is due to the proper motion of AB.

β 625. ϖ Herculis.

RA. $16^h 19^m 52^s$ Decl. $+14° 19'$.

A and B.

1890.375	178.2	1.78	—, 12	36
.383	178.3	1.74	—, 11.5	36
1890.38	178.2	1.76	—, 11.7	

A and C.

1890.364	103.8	33.32	—, 12	36
.375	103.4	33.50	—, 12.5	36
.388	103.3	33.40	—, —	36
1890.37	103.5	33.41	—, 12.2	

These are the only other measures:

1879.21 176°8 1″91 β 3 n.
1879.05 103.5 33.89 β 4 n.

β 815.

RA. $16^h 23^m 16^s$ Decl. $+43° 11'$.

1890.326	344°0	7″93	—, —	36
.331	344.7	7.62	8.5, 10	36
.337	344.6	7.72	8.3, 9.5	36
1890.33	344.4	7.76	8.4, 9.7	

The change in this pair is due to proper motion, which measures show is about 0″17 per annum.

β 241.

RA. $16^h 48^m 24^s$ Decl. $-21° 22'$.

1890.452	157.3	0.68	7, 7	12
.458	162.2	0.83	7.5, 7.5	36
.463	160.5	0.75	—, —	36
1890.46	160.0	0.75	7.2, 7.2	

Change is doubtful.

β 1117. 24 Ophiuchi.

RA. $16^h 49^m 34^s$ Decl. $-22° 57'$.

1890.406	262.7	0.63	—, —	36
.452	265.2	0.45	—, —	36
.479	264.9	0.65	—, —	36
1890.45	264.3	0.58	—, —	

There seems to be no change since the measures of last year.

Σ 2120.

RA. $17^h 0^m 0^s$ Decl. $+28° 15'$.

1890.534 Large star not double. 36

The principal star of this pair was thought to be double by Perrotin in 1883.

β 1118. η Ophiuchi.

RA. $17^h 3^m 30^s$ Decl. $-15° 34'$.

1890 406	268.8	0.30	—, —	36
.447	271.6	0.41	—, —	36
.452	271.2	0.42	—, —	12
.496	272.9	0.40	—, —	36
1890.45	271.1	0.38	—, —	

The measures of last year were:

1889.39 274°7 0″35 β 4 n.

α Herculis.

RA. $17^h 9^m 10^s$ Decl. $+14° 32'$.

A and D.

1890.422	39.1	84.91	—, 10.5	36
.447	38.9	84.60	—, 10.5	36
.458	39.1	84.87	—, 10.8	36
1890.44	39.0	84.79	—, 10.6	

Σ 2173.

RA. 17h 24m 14s Decl. −0° 58′.

1890.630	No third star.	36
.633	No third star.	36

In 1883 Wilson at Cincinnati measured a third star C, 10m, 291°.0 : 7″±. As this has never been seen anywhere else, and is invisible now, it probably has no real existence.

β 1090. β Draconis.

RA. 17h 27m 43s Decl. +52° 23′.

1890.334	13°.1	4″.20	—, 14	36
.340	10.3	4.14	—, 13.5	36
.356	15.1	4.20	—, 14	36
1890.34	12.8	4.18	—, 13.8	

The measures of last year gave:

1889.26 13°.4 3″.97 β 4 n.

β 962. 26 Draconis.

RA. 17h 33m 44s Decl. +61° 58′.

1890.334	130.0	0.83	—, —	36
.383	134.5	0.71	—, —	36
.406	130.0	0.90	—, —	36
1890.37	131.5	0.81	—, —	

The distance of this interesting binary is slowly diminishing.

A.C. 7. μ Herculis.

RA. 17h 41m 47s Decl. +27° 48′.

B and C.

1890.356	9.3	0.63	—, —	36
.375	11.4	0.76	—, —	36
.383	9.2	0.61	—, —	36
.395	7.7	0.65	—, —	36
1890.38	9.4	0.66	—, —	

H. I. 41.

RA. 17h 42m 17s Decl. +72° 59′.

1890.452	341.3	1.55	8.5, 8.5	12
.455	341.1	1.24	8.3, 8.3	12
.463	342.1	1.28	8.2, 8.2	36
1890.46	341.5	1.36	8.3, 8.3	

Trifid nebula.

RA. 17h 55m 6s Decl. −23° 1′.

A and B.

1890.537	23.0	6.07	—, 11	36
.542	23.1	5.84	8, 10.8	12
.548	21.5	6.27	—, 10	12
1890.54	22.5	6.06	8, 10.6	

A and C.

1890.537	210°.6	10″.75	7.5, —	36
.542	212.6	10.83	—, 9	12
.548	213.7	10.54	8, 8.7	12
1890.54	212.3	10.71	7.7, 8.8	

C and D.

1890.537	281.2	2.17	8.5, 10.5	36
.556	282.3	2.17	9, 10.5	36
1890.55	281.7	2.17	8.7, 10.5	

C and E.

1890.537	191.1	6.24	—, 13.5	36
.553	191.8	6.09	—, 11.8	36
.556	189.6	6.25	—, 12	36
1890.55	190.8	6.19	—, 12.4	

A and F.

1890.537	106.0	22.22	—, 14	36
.553	106.5	21.96	—, 13.5	36
.556	106.7	21.99	—, 14	36
1890.55	106.4	22.06	—, 13.8	

C and G.

1890.537	212.2	29.69	—, 13	36
.553	211.6	29.54	—, 13	36
.556	211.9	29.46	—, 13.5	36
1890.55	211.9	29.56	—, 13.2	

Like the stars in the Orion nebula, these stars have remained relatively fixed, and are as uninteresting as the famous trapezium, aside from their accidental surroundings. The large telescope does not show any additional stars in the group near enough to be worth measuring.

β 1125. 68 Ophiuchi.

RA. 17h 55m 40s Decl. +1° 19′.

1890.447	18.8	0.93	5, 8.5	36
.463	20.4	0.94	—, —	36
.496	19.8	0.87	—, 9	36
1890.47	19.7	0.91	—, —	

No certain change since last year.

A.C. 15. 99 Herculis.

RA. 18h 2m 28s Decl. +30° 23′.

1890.406	285.2	0.57	5.5, 11	36
.463	285.0	0.61	—, —	36
.496	285.0	0.51	—, —	36
1890.45	285.1	0.56	—, —	

Mr. Gore has recently computed an orbit for this interesting binary, using these measures, and finds a period of 53.55 years.

β 641.

RA. $18^h16^m43^s$ Decl. $+21°27'$.

1890.447	346°.4	1".03	7 , 9	36
.455	341.2	1.15	7.5, 9	12
.458	350.2	0.85	7.5, 9	36
1890.45	345.9	1.01	7.3, 9	

There seems to be slow motion in the angle.

1878.68	356°.4	1".07	De 1 n.
1880.12	349.2	1.00	β 5 n.

Σ 2384.

RA. $18^h38^m33^s$ Decl. $+67°0'$.

1890.534	306.3	0.42	8 , 8.1	36
.573	305.6	0.41	— , —	36
.575	308.4	0.39	8 , 8.2	36
1890.56	306.8	0.41	— , —	

Probably a binary, but there has been little change in the angle.

$O\Sigma$ 365.

RA. $18^h52^m20^s$ Decl. $+44°4'$.

1890.575 Certainly not double. First rate 36 night.

This is the principal star of Σ 3130. I have examined this star many times with different instruments, and never saw the least suspicion of duplicity. On the whole, the weight of the evidence is against its really being double.

ζ Sagittarii.

RA. $18^h55^m0^s$ Decl. $-30°3'$.

1890.452	250.4	0.65	— , —	12
.499	253.6	0.90	— , —	36
.523	249.3	0.74	— , —	12
1890.49	251.1	0.76	— , —	

A binary of short period. Gore, 18.69 years.

Σ 2438.

RA. $18^h55^m29^s$ Decl. $+58°4'$.

1890.499	47.0	0.25	6.5, 6.7	36
.537	41.3	0.23	— , —	36
.573	45.6	0.27	— , —	36
1890.54	44.6	0.25	— , —	

This binary is now opening out, but the motion is slow. The measures here, taken in connection with those of Σ and $O\Sigma$, indicate a period of about 120 years. Herschel's angle in 1783 seems to be some 20° too small to fall in with the later observations.

β 973.

RA. $18^h55^m59^s$ Decl. $+8°34'$.

A and B.

1890.594	350.1	1.49	9 , 11.5	36
.610	350.0	1.72	9 , 12	36
.630	350.0	1.59	9 , 10.8	36
1890.61	350.0	1.60	9 , 11.6	

C and D. (Howe).

1890.594	259°.3	3".27	11 , 11.1	36
.610	261.3	3.23	11 , 11.3	36
.630	259.8	3.23	11 , 11.2	36
1890.61	260.1	3.24	11 , 11.2	

A and C.

1890.594	18.6	11.03	— , —	36
.610	21.2	11.02	— , —	36
.630	19.5	11.12	— , —	36
1890.61	19.8	11.06	— , —	

A and D. (Σ 2435).

1890.594	12.6	10.04	— , —	36
.610	11.8	10.16	— , —	36
1890.60	12.2	10.10	— , —	

There has been no change in the Struve star, and probably none in the close pairs.

1880.13	350°.7	1".43	β 5 n.
1880.13	262.7	2.90	β 5 n.

H. N. 126.

RA. $18^h57^m10^s$ Decl. $-21°43'$.

1890.452	353.8	0.55	8 , 8.2	12
.496	355.1	0.62	— , —	36
.499	350 6	0.58	8 , 8	36
1890.48	353.2	0.58	8 , 8.1	

This pair seems to be moving rapidly. In 1873, finding it had never been observed apparently since the time of Herschel, and as his description of it was limited to giving it as belonging to his class I, I looked it up, and fortunately estimated the angle and distance. Subsequently it was measured at Cincinnati, and these are all the observations down to this time. The distance is certainly diminishing, and probably the motion in angle is rapid.

1873	40°±	1"±	β
1879.53	22.4	0.83	Cin. 2 n.
1890.48	353.2	0.58	β 3 n.

β 975.

RA. $19^h10^m4^s$ Decl. $+34°21'$.

B and C.

1890.613	222.0	0.84	9.0, 9.7	36
.633	219.8	0.74	10 , 11.3	36
.649	225.0	0.91	9 , 9.5	36
1890.63	222.3	0.83	9.3, 10.2	

A and B. ($O\Sigma$ 367).

1890.633	227.3	33.34	7.5, —	36

No change in the wide pair, and probably none in the other.

1880.59	221°.8	0".77	β 3 n.

β 248. 2 Vulpeculae.

RA. $19^h 12^m 39^s$ Decl. $+22° 49'$.

1890.613	126°.9	1".71	— , —	36
.630	124.6	1.97	— , —	36
.649	124.8	1.89	— , —	36
1890.63	125.4	1.86	— , —	

Some of the measures of this pair are not very accordant, but on the whole there is little evidence of change.

1876.11 125°.0 1".86 De 6 n.

H. A. Howe.

RA. $19^h 14^m 37^s$ Decl. $+2° 43'$.

1890.556	333.2	0.35	8.5 , 8.5	36
.564	335.8	0.40	8.0 , 8.2	36
.573	333.0	0.43	8 , 8.2	36
1890.56	334.0	0.39	8.2 , 8.3	

No evidence of change since its discovery by Howe at Cincinnati.

1879.52 336°.0 0".4± $Cinc_5$ 3 n.

β 141.

RA. $19^h 16^m 50^s$ Decl. $+22° 17'$.

1890.613	81.5	0.81	— , —	36
.649	79.0	0.84	— , —	36
.652	77.0	0.75	7.5 , 8.5	36
1890.64	79.2	0.80	— , —	

This is the principal star of the wide pair, H. 2867. The large telescope also shows that H.'s companion, 26" from the larger star, is a 4" or 5" pair. Thus far there is no evidence of change in the pair measured above.

De. 21.

RA. $19^h 25^m 1^s$ Decl. $-2° 22'$.

A and B.

1890.675	67.7	1.03	7.5 , 9	36
.706	67.0	1.05	7 , 9	36
.709	65.9	1.03	7.5 , 9	36
1890.70	66.9	1.04	7.3 , 9	

A and C. (Σ 2535).

1890.675	298.0	26.15	— , 9	36
.706	297.9	26.17	— , 9	36
.709	298.1	26.30	— , 9.5	36
1890.70	298.0	26.21	— , 9.2	

The close pair is the principal star of Σ 2535, discovered by De. in 1865. There is very little evidence of change thus far:

1865.76 70°.0 1".22 De 2 n.

I observed this star principally for the purpose of finding whether the third star near A, suspected by De., had any real existence. I have never been able to see it with other large telescopes, and as the 36 inch fails to show it, it will not be necessary to make any further search.

A. G. C. 10.

RA. $19^h 39^m 15^s$ Decl. $+10° 29'$.

A and B.

1890.594	143°.6	0".24	8.5 , 8.6	36
.610	145.8	0.25	8 , 8	36
.630	146.0	0.22	8.3 , 8.5	36
1890.61	145.1	0.24	8.3 , 8.4	

AB and C. (Σ 2570).

1890.594	275.9	4.33	— , 9.7	36
.610	278.0	4.38	— , 9.5	36
.630	279.0	4.20	— , 9	36
1890.61	277.6	4.30	— , 9.4	

The close pair was discovered by Mr. Clark in 1875 with the 12 inch which is now at the Lick Observatory. There is no change in the Σ companion. The following are all the measures of AB:

1878.35 145°.5 0".29 β 3 n.
1880.22 147.6 0.29 β 3 n.

A. G. C. 11. ζ Sagittae.

RA. $19^h 43^m 39^s$ Decl. $+18° 51'$.

A and B.

1890.496	179.7	0.13	— , —	36
.537	175.7	0.12	— , —	36
.573	183.8	0.10	— , —	36
1890.53	179.7	0.12	— , —	

This pair was also discovered with the 12 inch, now belonging to the Lick Observatory, by Mr. Clark in 1875. It has now become a very close and difficult object. The change has been largely in distance. Special attention was given in these measures to the proper quadrant for the smaller component. The angle found last year should be increased 180°. This pair will have a moderately short period, but will always be a difficult object, as the maximum distance cannot much exceed 0".3.

Ho. 276.

RA. $19^h 53^m 16^s$ Decl. $-10° 16'$.

1890.655 Apparently single. First class 12 night.
.709 Nothing seen, but not the best 36 seeing.

Described by Ho. as elongated in the direction of 172°.9 (1887.75). This star has a large proper motion of 0".507 in 221°.8.

$O\Sigma$ 392.

RA. $19^h 53^m 54^s$ Decl. $+41° 56'$.

A and B.

1890.675	305.3	0.28	7 , 8.5	36
.687	306.8	0.32	8 , 9	36
.689	306.4	0.28	7 , 8	36
1890.68	306.2	0.29	7.3 , 8.5	

A and C. (Σ 2607).

1890.675	289°.9	3″.19	— , 9	36
.687	293.0	3.19	— , 9	36
.689	291.6	3.11	— , 8.5	36
1890.68	291.5	3.16	— , —	

There is no change in Σ 2607 since 1831. There may be a little retrograde motion in the close pair, but it is only a few degrees at most since the first measures in 1844.

Σ 2652.

RA. $20^h 7^m 3^s$ Decl. +61° 43′.

1890.675	263.6	0.31	7.5 , 7.8	36
.687	263.3	0.31	7.5 , 7.6	36
.689	265.0	0.30	7.5 , 7.6	36
1890.68	264.0	0.31	7.5 , 7.7	

Certainly binary, but the motion is very slow. The angle has diminished only 19° since the measures of Σ in 1836, and the distance has remained nearly constant.

β 668. B. A. C. 7080.

RA. $20^h 25^m 49^s$ Decl. −10° 16′.

1890.556	24.8	4.80	7 , 11	36
.573	24.1	4.74	6.7 , 11	36
.575	26.0	4.87	6.7 , 11.5	36
1890.57	25.0	4.80	6.8 , 11.2	

The large star has a proper motion of 0″.286 in the direction of 66°.7. As this is common to both stars, they undoubtedly form a physical system. The following are all the measures:

1878.63	29°.0	4″.64	β 3 n.
1881.67	26.1	4.99	β 4 n.

β 151. β Delphini.

RA. $20^h 31^m 55^s$ Decl. + 14° 11′.

A and B.

1890.447	322.7	0.50	— , —	36
.496	323.6	0.37	— , —	36
.499	324.4	0.57	— , —	36
.526	326.1	0.36	— , —	36
1890.49	324.2	0.45	— , —	

AB and C.

1890.447	117.2	26.78	— , —	36
.458	117.5	26.85	— , —	36
.479	117.2	27.05	— , —	36
1890.46	117.3	26.89	— , —	

The distance of this rapid binary is increasing, and it will be comparatively easy to measure for a few years. The last computed orbit of 16 years is certainly too short. It will probably be about 28 years.

β 677. T Cygni.

RA. $20^h 42^m 23^s$ Decl. +33° 56′.

A and B.

1890.499	121°.2	9″.93	5 , 12.5	36
.518	121.0	9.64	5.5 , 12	36
.534	120.6	10.15	6.2 , 12	36
1890.52	120.9	9.91	— , 12.2	

A and C.

1890.499	194.5	12.40	— , 13.5	36
.518	193.9	12.51	— , 13	36
.534	194.9	12.14	— , 13.5	36
1890.52	194.4	12.35	— , 13.3	

The principal star is T Cygni of the variable star catalogues. The second companion, C, is now observed for the first time. My original measures of B require a correction of 180° in the angle.

1878.41	121°.3	9″.66	β 1 n.

Secchi.

RA. $20^h 58^m 43^s$ Decl. +3° 3′.

B and C.

1890.675	152.1	1.16	9.5 , 9.5	36
.678	148.8	1.17	9 , 9	36
.681	151.7	1.12	9 , 9	36
1890.68	150.9	1.15	9.2 , 9.2	

A and B. (Σ 2749).

1890.675	155.6	3.11	7.5 , —	36
.678	152.3	2.96	7.3 , —	36
.681	155.6	3.01	7.7 , —	36
1890.68	154.5	3.03	7.5 , —	

The close pair was discovered by Secchi in 1856. There has been some change.

1856.60	127°.0	0″.6	Se
1863.88	141.7	0.8	De 1 n.
1877.79	148.9	1.13	β 1 n.

The Struve star has remained fixed.

β 368. Aquarii 45.

RA. $21^h 1^m 1^s$ Decl. −8° 43′.

A and B.

1890.630	89.2	0.64	7.0 , 7.5	36
.649	88.3	0.56	7.0 , 8.0	36
.652	88.6	0.53	6.7 , 7.8	36
1890.64	88.7	0.58	6.9 , 7.8	

C and D. (New).

1890.630	317.7	6.09	14 , 14.5	36
.673	318.1	6.20	14 , 15	36
1890.65	317.9	6.15	14 , 14.7	

AB and C.

1890.630	27°.5	12″.07	— , —	36
.673	27.0	11.98	— , —	36
1890.65	27.2	12.02	— , —	

The close pair was discovered with the 6 inch in 1873. The large telescope shows a double companion not seen before. Slow retrograde motion in AB.

1876.78 97°.1 0″.55 De 5 n.
1881.63 90.4 0.63 β 3 n.

Σ 2758. 61 Cygni.

RA. 21h 1m 14s Decl. +38° 8′.

1890.862	121.0	21.38	— , —	12
.867	121.9	21.17	— , —	12
.873	122.3	21.01	— , —	12
.876	122.3	21.02	— , —	12
1890.87	121.9	21.15	— , —	

An examination of the measures of the last sixty years shows, assuming the proper motion of A, 5″.196 in the direction of 51°.5, to be correct, that the proper motion of B is 5″.113 in the direction of 53°.5. The measures show conclusively that this motion is uniform and rectilinear. (See Sidereal Messenger, January, 1891).

Ho. 283.

RA. 21h 6m 14s Decl. +35° 49′.

1890.649 Cannot see large star double. 36
Good night.
.652 No close star seen. 36

Described by Hough, 178° ± : 0″.8 ± : 6.8 , 12. As there is a distant companion, there is no doubt of the identity of the star examined.

A. G. C. 13. τ Cygni.

RA. 21h 10m 0s Decl. +37° 32′.

A and B.

1890.526	20.8	0.45	— , —	36
.537	21.3	0.66	— , —	36
.556	20.1	0.52	— , —	36
1890.54	20.5	0.54	— , —	

A and C.

1890.496	245.4	19.65	— , —	36
.537	245.2	19.88	— , —	36
.556	245.5	19.80	— , —	36
1890.53	245.4	19.78	— , —	

One of the most interesting of the binary stars, and now a difficult pair to measure.

14 Aquarii.

RA. 21h 9m 52s Decl. −9° 43′.

1890.777 Certainly not double. Fine seeing. 36

Discovered by Dembowski in 1875. He seems to have had some doubt as to whether the elongation measured was real. I have never been able to see it with any instrument, and hardly think it can be double.

β 164.

RA. 21h 19m 13s Decl. +8° 52′.

A and B.

1890.675	241°.3	0″.50	7 , 7.3	36
.681	239.5	0.51	7.8, 8	36
.709	239.9	0.49	8 , 8.1	36
1890.69	240.2	0.50	7.6, 7.8	

A and C. (Σ 2793).

1890.675	241.4	27.00	— , 8.5	36
.681	241.4	27.00	— , 9	36
.709	241.6	26.97	— , 8.7	36
1890.69	241.5	26.99	— , 8.7	

The close pair discovered with the 6 inch, 1873. No sensible change in the Σ companion, and very little, if any, in the other since it has been observed.

1875.46 241°.6 0″.57 De 4 n.

β 684.

RA. 21h 23m 53s Decl. −5° 57′.

1890.675	128.1	1.20	8.7, 9	36
.678	125.0	1.13	8.5, 8.7	36
.681	127.1	1.03	8.8, 9	36
1890.68	126.7	1.12	8.7, 8.9	

Perhaps some angular motion:

1878.62 133°.9 1″.11 β 1 n.

β 72.

RA. 21h 23m 43s Decl. −5° 55′.

1890.675	40.3	1.90	8.3, 8.7	36
.678	44.5	1.87	8.3, 9	36
.681	41.8	1.76	8.3, 9	36
1890.68	42.2	1.84	8.3, 8.9	

These two pairs are in a low power field with β Aquarii.

1878.17 43°.1 1″.90 β 2 n.

β 989. κ Pegasi.

RA. 21h 39m 12s Decl. +25° 6′.

1890.526	191.2	0.08	— , —	36
.573	176.5	0.10	— , —	36
.575	202.8	0.10	— , —	36
.610	178.0	0.10	— , —	36
1890.57	187.1	0.10	— , —	

The measures seem to indicate that this will have the shortest period of any double-star known, about eleven

years, so that near the end of the present year it will be in the same position as at the time of discovery. (For a history of this pair, and a discussion of the measures to this time, see a paper by the present writer in Monthly Notices for March, 1891.

H. A. Howe.

RA. $21^h\,40^m57^s$ Decl. $-13°\,42'$.

A and B.

1890.630	104°.6	0".70	8 , 9	36
.644	105.1	0.59	8 , 9.3	36
.652	104.4	0.64	8 , 9	36
1890.64	104.7	0.64	8 , 9.1	

A and C. (Σ 2826).

1890.630	82.6	4.27	— , 8.5	36
.644	81.5	4.28	— , 8.7	36
.652	81.6	4.29	— , 8.7	36
1890.64	81.9	4.28	— , 8.6	

Probably unchanged:

1879.64 285°.0 0".8± $Cinc_5$ 1 n.

The Struve star is fixed.

β 275.

RA. $21^h\,53^m38^s$ Decl. $+60°\,43'$.

1890.675	2.6	0.44	7.7 , 8	36
.687	6.7	0.38	7.5 , 7.6	36
.689	2.1	0.34	7.5 , 8	36
1890.68	3.8	0.39	7.6 , 7.8	

The only other measures are:

1876.04 2°.7 0".28 De 4 n.

Leavenworth.

RA. $22^h\,4^m8^s$ Decl. $-11°\,40'$.

1890.802	164.6	0.93	9.2 , 9.3	36
.824	161.2	0.80	8.7 , 8.9	36
.840	166.3	0.82	9.0 , 9.1	36
1890.82	164.0	0.85	9.0 , 9.0	

Discovered by Leavenworth at the Mc Cormick Observatory. This star is SD. $-11°5771$.

1886.79 164°.6 0".93 L 2 n.

Ho. 290.

RA. $22^h\,6^m44^s$ Decl. $+57°\,21'$.

A and B.

1890.649	No suspicion of Ho.'s star.	36
.655	Nothing seen. Magnificent seeing.	12
.675	No trace of any close star.	36

As a wide pair this star is β 436. In 1889 Hough measured a star 11^m at a distance of 0".53 from A in the direction of 208°.5. There is no trace of any such star now.

Σ 2881.

RA. $22^h\,9^m6^s$ Decl. $+28°\,59'$.

1890.499	100°.4	1".58	8 , 8.5	36
.518	99.7	1.64	8 , 8.3	36
.523	99.5	1.63	8.3 , 8.5	36
1890.51	99.9	1.62	8.1 , 8.4	

The change in this pair is very slow. The distance is about the same as it was in 1830, but the angle is 11° less.

Σ 2912. 37 Pegasi.

RA. $22^h\,23^m54^s$ Decl. $+3°\,49'$.

1890.526	343.8	0".1±	36
.610	350.1	less than 0.1	36
1890.56	347.0		

This star is opening out now, with the small star on the opposite side from that on which it has always been seen heretofore. The plane of the apparent orbit must be nearly in the line of sight, as the change in position angle is small. I found the angle 130°.0 in 1878, and En 131°.4 in 1885. It is possible that the angle given above is in the wrong quadrant, but I think not, as I found it apparently single with the 36 inch last year.

β 1147. 2 Andromedae.

RA. $22^h\,57^m5^s$ Decl. $+42°\,7'$.

1890.575	311.0	0.27	5.5 , 10	36
.610	311.1	0.30	— , —	36
.675	316.9	0.25	5 , 8	36
1890.62	313.0	0.27	— , —	

The measures at the time of discovery were:

1889.54 317°.8 0".28 β 3 n.

$O\Sigma$ 487.

RA. $22^h\,59^m10^s$ Decl. $+80°\,8'$.

1890.673	206.8	0.22	7 , 9	36
.687	211.5	0.12	6.8 , 8.5	36
.689	206.7	0.25	7 , 8.5	36
1890.68	208.3	0.20	6.9 , 8.7	

This close pair has never before been measured. It was seen elongated by $O\Sigma$ from 1844 to 1858, the approximate angle being about 49°. (See A. N. 3017).

β 180.

RA. $23^h\,2^m9^s$ Decl. $+60°\,11'$.

A and B.

1890.633	175.2	0.63	8 , 9.2	36
.652	175.2	0.62	8 , 9.5	36
.673	175.3	0.62	8 , 9.0	36
1890.65	175.2	0.62	8 , 9.2	

A and C.

1890.633	106°.7	34″.25	— , 9.3	36
.652	106.5	34.45	— , 9.5	36
.673	106.5	34.59	— , 9.5	36
1890.65	106.6	34.43	— , 9.4	

The only prior measures are:

1875.08	176°.8	0″.57	De 4 n.
1875.54	106.3	34.30	De 2 n.

β 385.

RA. $23^h 4^m 31^s$ Decl. +31° 50′.

A and B.

1890.673	128.9	0.50	7.7, 8.5	36
.687	130.2	0.46	7.5, 7.8	36
.689	132.0	0.43	7.5, 8	36
1890.68	130.4	0.46	7.6, 8.1	

AB and C. (H. 5532).

1890.673	77.2	58.09	— , 9	36
.687	77.3	57.83	— , 8.3	36
.689	77.4	58.16	— , 9	36
1890.68	77.3	58.03	— , 8.8	

H. has no measures of the distant star.

1876.40	135°.8	0″.42	De 7 n.
1885.46	143.2	0.41	En 4 n.
1876.72	77.1	58.05	De 2 n.

β 715. Aquarii 290.

RA. $23^h 8^m 25^s$ Decl. −11° 20′.

1890.630	255.8	3.56	6.8, 11.7	36
.652	257.8	3.58	6.5, 12	36
.660	257.2	3.35	6.5, 11.5	36
1890.65	256.9	3.50	6.6, 11.7	

The Cincinnati observers in 1877 measured the large star as a close pair, 1°.5 : 0″.32. This was carefully looked for with the 36 inch in making the above measures, and there was no trace of any elongation at any time. There seems to be no change in the measured star:

1878.29	256°.0	3″.35	β 4 n.

β 992.

RA. $23^h 10^m 48^s$ Decl. +63° 29′.

1890.630	162.0	0.31	8.3, 8.3	36
.633	163.2	0.37	8.3, 8.3	36
.652	159.2	0.34	8.0, 8.2	36
1890.64	161.5	0.34	8.2, 8.3	

The only other measures are:

1880.59	170°.5	0″.41	β 5 n.

Ho. 199. 95 Aquarii.

RA. $23^h 12^m 43^s$ Decl. −10° 16′.

1890.610	216°.9	1″.15	5 , 13	36
.630	220.3	1.13	— , 11.5	36
.633	—	1.16	— , 11	36
1890.62	218.6	1.15	— , 11.8	

During the evening of the last measure, the micrometer was disturbed, and this with other angles were lost.

β 278.

RA. $23^h 15^m 20^s$ Decl. +61° 33′.

1890.630	174.0	12.68	6.5, 11.5	36
.633	173.7	12.62	6.5, 11.5	36
.652	173.9	12.69	6.8, 12.5	36
1890.64	173.9	12.66	6.6, 11.8	

No other measures.

Ho. 300. 66 Pegasi.

RA. $23^h 17^m 1^s$ Decl. +11° 39′.

1890.652 Not the least trace of duplicity 36 with 1900.

According to Ho. this is an equal pair, elongated (1889.85) in the direction of 312°.1. I could see nothing to indicate this with any power on the 36 inch. The conditions were favorable.

β 774.

RA. $23^h 25^m 18^s$ Decl. +63° 40′.

1890.630	5.9	0.46	8.5, 8.8	36
.633	0.6	0.59	8.5, 8.8	36
.652	5.7	0.52	8.0, 8.2	36
1890.64	4.1	0.52	8.3, 8.6	

Discovered with the 6 inch on Mt. Hamilton in 1879. The only other measures are:

1880.58	6°.7	0″.51	β 3 n.

β 720. 78 Pegasi.

RA. $23^h 28^m 0^s$ Decl. +30° 40′.

1890.526	147.8	0.32	— , —	36
.556	146.9	0.39	— , —	36
.564	150.1	0.41	— , —	36
1890.55	148.3	0.37	— , —	

This is certainly a binary system. The change is principally in angle, which amounts to about 20° since it was discovered in 1878.

β 733. 85 Pegasi.

RA. $23^h 55^m 52^s$ Decl. $+26° 27'$.

A and B.

1890.526	138°.1	0".73	— , —	36
.556	139.6	0.82	— , —	36
.564	137.2	0.80	— , —	36
.573	141.1	0.78	— , —	36
1890.55	139.0	0.78	— , —	

A and C.

1890.496	357°.0	23".53	— , —	36
.499	356.7	23.56	— , —	36
.564	356.5	23.68	— , —	36
1890.52	356.7	23.59	— , —	

The measures agree well with the computed place from Schaeberle's orbit. The period of 22.3 years cannot be far wrong.

New Nebulae.

In the course of my double-star work a faint nebula is occasionally found, usually in the field with some bright star under examination. These are almost invariably new, or wanting in Dreyer's General Catalogue, and when near enough to a prominent star to be measured directly with the micrometer, I have saved them as far as it could be done without interfering with the regular work. With the high powers and small fields of the eye-pieces used in observing double stars, a nebula would rarely be seen except when near a star. The lowest power used has a field of only 5', much too small for very faint, diffused objects. The following nebulae have been measured with the 36 inch. The places given are those of the stars from which the nebulae are measured, the star in each instance being the primary.

ϱ Piscium and nebula.

RA. $1^h 19^m 47^s$ Decl. $+18° 33'$.

1890.564	62°.7	158".12	— , —	36
.610	62.6	160.36	— , —	36
.633	—	159.38	— , —	36
1890.60	62.6	159.29	— , —	

94 Piscium and nebula.

RA. $1^h 20^m 13^s$ Decl. $+18° 37'$.

1890.564	117.4	211.63	— , —	36
.610	118.3	211.70	— , —	36
1890.59	117.8	211.66	— , —	

A little brighter than the preceding.

Star and nebula.

RA. $2^h 53^m 48^s$ Decl. $+37° 17' 52''$.

1890.698	114.6	95.33	9.5, —	36
.709	114.8	95.48	10 , —	36
1890.70	114.7	95.40	9.7, —	

The comparison star is not in the DM. The place given was determined by Mr. Barnard with the micrometer from W_2 $2^h.1203$. There is a faint star about 12" from the nebula in the direction of 248°.

Star and nebula. (South)

RA. $3^h 7^m 26^s$ Decl. $+37° 25' 18''$.

1890.698	221°.5	49".16	— , —	36
.709	220.0	49.64	11.5, —	36
1890.70	220.7	49.40	11.5, —	

Star and nebula. (North).

1890.698	304.2	76.29	— , —	36
.709	303.6	76.06	— , —	36
1890.70	303.9	76.17	— , —	

Both nebulae are measured from the same star. Its place as given above was obtained by Mr. Barnard from BB.VI $+37°.753$, which is $3^m 21^s.7$ f, and 4' 24".5 n.

DM. $+2°.684$ and nebula.

RA. $4^h 12^m 48^s$ Decl. $+2° 48'$.

1890.709	224.8	210.39	9.5, —	36
.760	224.9	211.22	9.5, —	36
.785	224.4	209.73	— , —	36
1890.75	224.7	210.45	— , —	

Very faint.

Dreyer 1550 and nebula.

RA. $4^h 13^m 23^s$ Decl. $+2° 7'$.

1890.760	163.5	187.88	— , —	36
.785	162.9	189.43	— , —	36
1890.77	163.2	188.66	— , —	

This is in the field with one of d'Arrest's nebulae, with which the new one is compared. That found by d'Arrest is at least six or eight times brighter than the other. There is a faint star, about 13^m, between the two.

Lal. 29710 and nebula.

RA. $16^h 11^m 29^s$ Decl. $+36° 52'$.

1890.383	200.3	105.55	— , —	36
.395	200.1	104.95	— , —	36
.422	200.1	104.79	— , —	36
1890.40	200.1	105.10	— , —	

The star is seventh magnitude.

Ueber grosse Nebelmassen im Sternbilde des Schwans.

(Vorläufige Mittheilung).

Wie in den Sternbildern Monoceros und Orion*), so zeigt sich auch im Schwan die interessante Erscheinung, dass helle Sterne durch Nebelmassen mit einander und der Constellation der Milchstrasse verbunden sind.

Aus drei mir vorliegenden Platten, deren letzte und beste 1891 Juni 1 bei 3^h Exposition mit dem fünfzölligen Kranz-Aplanat erhalten wurde, ergiebt sich das Folgende: Es gruppirt sich um die Gegend $\alpha = 20^h9$ und $\delta = +44°$ ein sehr grosser und heller, äusserst fein gezeichneter, fächerförmiger Nebel, dessen hellste Partien bislang als G.C. 4621 bekannt waren. Dieser Nebel setzt sich ziemlich hell nach allen Seiten hin fort. Nach Osten und Norden dringt er mindestens 8° weit in die Gegend der dichten Sternwolken der Milchstrasse und umhüllt dieselben in augenscheinlichem Zusammenhang. Er scheint sich aber noch viel weiter nach Osten fortzusetzen. Nach Westen zwischen den Sternen 57 und 55 Cygni und nördlich von letzterem in grossem Bogen herumziehend nähert er sich dem Stern α Cygni (Deneb) und umschliesst diesen Stern. Ein südlicher Ast, der seine stärkste Verdichtung bei den Sternen 56 und 57 hat, nähert sich dem Stern α von Südosten her.

Nördlich von α über die Sterne 51, ω^1, ω^2, ω^3 hin, sowie ebensoweit gegen Westen und Süden lassen sich in continuirlichem Zuge deutliche, diffuse Nebelmassen verfolgen, die gegen γ Cygni hin wieder dichter werdend in kräftige Nebelmassen übergehen, die diesen Stern weithin umgeben.

Das schlechte Wetter gestattete bis jetzt nicht diese Nebel nach Westen und nach Süden über γ hinaus weiter zu verfolgen, doch zeigen schon diese Resultate, wie mehr und mehr ein Zusammenhang zwischen jenen hellen Sternbildern in sich und der Milchstrasse wahrscheinlich wird.

*) Vergl. Sirius 1891 pag. 108.

Heidelberg 1891 Juni 10. *Max Wolf.*

Beobachtung des Mercurdurchgangs 1891 Mai 9

auf der Sternwarte des Polytechnikums in Riga.

Nach mittl. Zeit des Beobachtungsortes sind die beiden von mir beobachteten Momente:

Austritt, innere Berührung: $18^h18^m56^s$
Austritt, äussere Berührung: 18 23 5.

Die Beobachtung wurde im Thurm des Polytechnikums in Riga am Fraunhofer'schen Refractor mit 4 zölligem Objectiv angestellt unter Anwendung einer 60 fachen Vergrösserung. Der Sonnenaufgang hatte 15^h55^m stattgefunden und der Austritt Mercurs konnte unter relativ sehr günstigen Umständen beobachtet werden.

Geographische Lage des Beobachtungsortes:

$\varphi = 56° 57' 7''$
$\lambda = 0^h42^m53^s$ östl. von Berlin.

Riga 1891 Juni. *A. Beck.*

Genäherte Elemente und Ephemeride des Encke'schen Cometen für 1891*).

Von *O. Backlund.*

Mit Berücksichtigung der Störungen durch die Planeten Venus, Erde, Mars, Jupiter und Saturn 1884 Dec. 18.0 – 1888 März 7.0, der Störungen durch Jupiter allein 1888 März 7.0 – 1891 Mai 31.0 sowie der empirischen Correctionen $\Delta M = -16''.20$ und $\Delta\mu = -0''.012249$ wurden aus den Elementen:

Epoche und Osculation 1884 Dec. 18.0 M. Z. Berlin

$M = 336° 15' 11''.09$
$\varphi = 57\ 45\ 18.63$
$\pi = 158\ 32\ 45.21$
$\Omega = 334\ 36\ 56.32$ } M. Aequin. 1885.0
$i = 12\ 54\ 0.76$
$\mu = 1073''.012513$
$\mu' = +\ 0.053121.$
$\varphi' = -\ 1.88$

das folgende System abgeleitet:

Epoche und Osculation 1891 Mai 31.0 M. Z. Berlin

$M = 318° 12' 48''.96$
$\varphi = 57\ 49\ 48.64$
$\pi = 158\ 38\ 46.35$
$\Omega = 334\ 41\ 26.74$ } M. Aequin. 1891.0
$i = 12\ 54\ 57.86$
$\mu = 1074''.379285$
$\mu' = +\ 0.053121$
$\varphi' = -\ 1.88$

*) Abdruck aus den Mélanges math. et astr. tirés du Bulletin de l'Académie imp. des sciences de St. Pétersbourg. Tome VII.