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DEFINITIVE ORBIT OF COMET 1911*b* (KIESS),

By LOUIS LINDSEY

Comet 1911*b* was discovered on a plate taken by C. C. KIESS with the Crocker photographic telescope at the Lick Observatory on the morning of July 6, 1911. It was on the edge of the plate and appeared as a distorted object. A faint streamer-like tail attached to the object led to the suspicion that it was a comet. On the following morning the 12-inch telescope confirmed this view. It had a sharp, distinct nucleus and a faint tail. Subsequently it had a streamer tail three degrees in length and on two or three evenings was barely visible to the naked eye.

Preliminary elements were computed and published by H. KOBOLD, S. ELNARSSON and W. F. MEYER of Lick Observatory, L. LINDSEY of the U. S. Naval Observatory, and F. RISTENPART of Santiago.

The similarity between these elements and those of Comet 1790I at once aroused interest. DR. HENRY A. PECK, Director of the observatory at Syracuse University, undertook the computation of a definitive orbit of this comet and invited the author to work with him. On account of a pressure of other work DR. PECK afterwards withdrew and the work was carried on by the author alone.

A set of elements more nearly approximate to the observations were computed from normal places and from these an ephemeris was computed for the interval from July 6 to September 20 during which the comet was visible for observation.

These elements are:

$$\left. \begin{aligned} T &= 1911 \text{ June } 30.28800 \text{ G.M.T.} \\ \omega &= 110^\circ 36' 47''.1 \\ \Omega &= 157^\circ 26' 28''.7 \\ i &= 148^\circ 28' 6''.9 \end{aligned} \right\} 1911.0$$

$$\log. q = 9.835891$$

The constants for the equator 1911.0 are

$$\begin{aligned} x &= r(9.991079) \sin (40^\circ 6' 40''.0 + v) \\ y &= r(9.794449) \sin (145^\circ 0' 46''.8 + v) \\ z &= r(9.907187) \sin (121^\circ 30' 36''.6 + v) \end{aligned}$$

On account of the necessity of compressing the material within the limits of a paper of moderate length it has been necessary to omit the ephemeris.

THE COMPARISON STARS

The catalog of comparison stars contains 190 stars. The greater share of the material has been obtained from the library of Syracuse University and that of the U. S. Naval Observatory. On account of the wide range in declination these positions were obtained from a large number of catalogs. Proper-motions were used where they occurred in standard authorities. In a few cases where the star positions were obtained from various catalogs the proper-motion and resulting star positions were computed by the method of least squares. In general the positions have been reduced to the system of the Astronomische Gesellschaft.

THE OBSERVATIONS

The number of observations collected was not far from six hundred fifty. After the catalog of Comparison Stars was completed it was found that a few stars, although found in the Durchmusterung, could not be found in any catalog of sufficient exactness. A few cases of evident mistakes were also found. The dates are expressed in Greenwich Mean Time and the aberration time has been subtracted. The comparison with the ephemeris follows:

Date	Place		
1911 July		"	"
6.972	Mt. Hamilton	+19.9	-13.2
7.941	Mt. Hamilton	-28.1	+7.6
8.550	Rome C. R.	+10.5	+11.4
8.556	Königstuhl	+11.5	+13.3
8.564	Nice	+4.8	+13.9
8.571	Nice	+7.2	+10.5
8.574	Arcetri	+9.5	+2.1

(109)

Date	Place			Date	Place		
1911 July		"	"	1911 July		"	"
8.574	Arcetri	+ 9.3	- 3.6	13.544	Utrecht	- 6.7	- 7.8
8.585	Nice	+ 5.4	+ 9.4	13.549	Leipzig	+ 0.1	+ 6.8
8.586	Königstuhl	+ 9.3	+11.4	13.565	Besancon	- 1.7	-10.2
8.972	Mt. Hamilton	+ 6.2	- 0.3	13.572	Nice	-11.1	+ 0.3
9.517	Bergedorf	+13.1	+ 3.2	13.577	Uccle	- 5.3	- 0.5
9.560	Rome C. R.	+ 0.2	- 1.5	13.579	Marseilles	- 4.3	- 7.6
9.582	Turin	+ 3.6	+ 0.2	13.583	Paris	-12.2	- 5.0
9.582	Turin	+ 1.6	- 0.3	13.584	Marseilles	-10.7	+10.1
9.583	Rome C. R.	+ 0.2	- 5.6	13.590	Uccle	- 4.2	- 0.1
9.585	Königstuhl	+ 4.9	- 0.1	13.592	Nice	- 3.0	- 0.9
9.587	Nice	- 2.2	- 1.1	13.594	Nice	- 7.4	- 3.8
9.597	Marseilles	- 9.3	+ 3.3	13.601	Nice	- 6.8	+ 2.6
9.823	Washington	+ 3.6	+ 2.9	13.879	Northfield	- 1.9	+ 2.8
10.536	Bergedorf	+ 4.1	+ 3.8	13.879	Northfield	- 5.8	(-34.5)
10.539	Bamberg	+ 1.6	- 1.0	13.959	Mt. Hamilton	- 6.6	+12.3
10.567	Nice	- 6.7	- 2.9	14.519	Leipzig	+ 0.4	+ 6.4
10.570	Königstuhl	+ 2.3	+ 1.9	14.541	Leipzig	+10.6	+ 3.7
10.578	Nice	+ 2.5	+ 1.7	14.549	Königstuhl	- 7.8	+ 1.8
10.579	Uccle	- 1.7	(+32.5)	14.561	Paris	- 7.0	+ 6.5
10.582	Nice	- 9.7	- 3.4	14.561	Nice	- 7.0	+ 0.2
10.595	Bordeaux	- 5.8	- 1.9	14.563	Königstuhl	- 9.9	+ 1.5
10.595	Besancon	+ 2.2	- 1.7	14.573	Padua	+ 2.1	- 2.8
10.615	Bordeaux	- 5.6	+10.9	14.581	Marseilles	- 5.2	- 2.7
10.895	Northfield	+ 5.3	+ 7.7	14.591	Königstuhl	- 6.3	+ 2.6
11.499	Kopenhagen	- 3.0	- 2.8	15.507	Leipzig	-17.0	+ 2.4
11.528	Königstuhl	- 0.1	+ 1.3	15.515	Leipzig	- 8.5	+ 1.2
11.536	Bothkamp	- 0.4	- 0.5	15.525	Leipzig	-15.1	- 1.4
11.560	Nice	- 3.6	+ 0.1	15.548	Bothkamp	- 7.4	- 1.3
11.561	Nice	- 3.5	- 0.8	15.563	Nice	- 6.2	+ 0.1
11.563	Königstuhl	- 0.9	+ 0.8	15.566	Nice	-11.1	- 1.2
11.568	Besancon	- 0.1	- 0.9	15.571	Marseilles	-12.1	- 2.0
11.583	Nice	- 6.1	- 0.4	15.576	Marseilles	- 7.0	- 2.2
11.613	Bordeaux	- 4.2	+ 0.5	15.613	Palermo	- 0.4	+11.2
11.882	Chicago	.....	.....	15.621	Lyons	-11.3	+ 2.0
11.945	Mt. Hamilton	- 1.1	+ 6.3	15.947	Mt. Hamilton	- 8.1	- 0.2
12.510	Bothkamp	- 1.4	+ 3.1	16.476	Kopenhagen	-10.5	- 4.4
12.525	Bergedorf	- 4.2	- 6.1	16.541	Paris	-11.5	- 0.6
12.533	Leiden	- 2.6	- 4.5	16.544	Turin	-14.3	- 4.4
12.547	Bamberg	- 2.2	- 3.7	16.560	Marseilles	- 8.8	-10.7
12.555	Königstuhl	+ 0.2	+ 1.0	16.562	Turin	-14.0	- 4.5
12.570	Besancon	+ 0.4	- 1.2	16.569	Nice	-12.6	- 2.5
12.591	Strassburg	.....	(-44.4)	16.571	Milan	- 5.7	- 1.6
12.581	Königstuhl	- 0.7	+ 1.3	16.595	Milan	- 3.7	+ 0.8
12.588	Marseilles	+ 7.2	- 1.4	16.895	Chicago	-11.3	+ 3.5
12.588	Marseilles	+ 2.5	- 7.4	17.539	Munich	- 9.3	- 4.9
12.593	Königstuhl	- 2.5	+ 1.1	17.552	Paris	-15.5	+ 1.8
12.834	Washington	- 1.0	+ 1.0	17.556	Königstuhl	-13.3	+ 3.4
13.495	Kopenhagen	- 5.0	- 8.4	17.565	Marseilles	- 4.5	- 5.0
13.526	Leipzig	-11.2	+ 4.0	17.567	Arcetri	- 1.7	- 5.4
13.532	Bothkamp	- 6.7	- 1.1	17.567	Arcetri	- 8.9	- 5.1
13.535	Leipzig	- 6.9	+ 0.8				

Date	Place			Date	Place		
1911 July				1911 July			
17.572	Nice	-15.1	+ 0.1	21.504	Munich	-11.6	+ 3.7
17.588	Königstuhl	-11.4	+ 4.4	21.521	Leipzig	-25.0	- 3.8
17.588	Lyons	- 9.5	- 0.1	21.525	Bergedorf	-18.5	- 2.8
17.596	Palermo	- 8.5	+19.8	21.534	Marseilles	- 4.2	-21.4
17.597	Nice	-17.5	+ 4.0	21.541	Bergedorf	-17.9	+ 0.2
17.605	Marseilles	-15.8	- 3.9	21.549	Turin	-18.5	- 8.6
18.505	Bergedorf	-13.3	- 9.3	21.549	Turin	-18.1	- 9.5
18.517	Leipzig	-17.2	+ 0.3	21.550	Paris	-16.1	+ 0.2
18.528	Munich	- 3.8	+ 5.1	21.569	Uccle	-16.9	+ 1.0
18.529	Leipzig	-18.7	- 0.8	21.569	Nice	-18.1	+ 1.1
18.540	Paris	-15.0	+ 0.9	21.571	Utrecht	-10.1	- 1.8
18.545	Leipzig	-15.1	+ 0.2	21.572	Königstuhl	-17.1	+ 2.0
18.561	Uccle	-12.7	- 2.6	21.585	Milan	-14.2	+ 4.0
18.565	Arcetri	- 7.9	- 4.1	21.586	Lyons	-15.6	- 4.1
18.583	Palermo	-16.7	-12.0	21.591	Königstuhl	-15.9	+ 1.0
18.607	Marseilles	-14.4	- 3.0	21.949	Mt. Hamilton	- 2.5	-27.5
18.848	Washington	-12.7	+ 1.4	22.504	Leipzig	-28.6	+ 0.8
18.942	Mt. Hamilton	- 7.6	- 8.4	22.511	Munich	-16.4	- 1.4
19.474	Kopenhagen	-28.9	- 6.0	22.526	Leipzig	-22.9	+ 2.8
19.503	Bergedorf	-14.3	+ 5.0	22.532	Paris	-14.8	- 1.4
19.520	Vienna	-12.4	- 0.3	22.535	Rome C. R.	-16.8	- 4.9
19.526	Rome C. R.	-13.9	- 5.0	22.545	Königstuhl	.....	.....
19.534	Königstuhl	-15.2	+ 0.2	22.546	Marseilles	-18.0	- 3.0
19.553	Utrecht	-16.9	- 7.1	22.548	Leipzig	-25.5	+ 1.8
19.554	Königstuhl	-12.4	+ 0.8	22.561	Padua	-20.5	+ 1.2
19.557	Uccle	-14.0	- 2.9	22.582	Nice	-19.5	- 0.2
19.568	Nice	-14.4	- 1.8	22.589	Padua	-13.9	- 4.9
19.570	Marseilles	-16.8	- 5.7	22.592	Königstuhl	.....	.....
19.571	Paris	-14.0	+ 0.1	22.608	Marseilles	-27.8	-24.8
19.574	Königstuhl	-13.4	- 1.3	23.490	Kopenhagen	-19.2	- 9.7
19.591	Palermo	-14.4	(+32.5)	23.492	Munich	-24.9	- 2.9
19.591	Marseilles	-14.5	- 2.9	23.508	Leipzig	-23.0	+ 0.2
19.886	Northfield	- 8.0	+ 1.6	23.523	Padua	-36.0	+ 5.3
19.976	Mt. Hamilton	-13.2	.....	23.536	Leipzig	-24.4	- 2.5
20.471	Kopenhagen	-20.6	-14.0	23.555	Padua	-17.4	- 7.9
20.545	Königstuhl	-15.5	- 1.1	23.559	Utrecht	-20.2	- 2.8
20.545	Munich	-12.3	- 4.9	23.578	Milan	- 9.5	-12.2
20.554	Marseilles	-15.2	- 6.4	23.586	Uccle	-20.0	- 6.9
20.562	Paris	-15.7	- 0.6	23.588	Padua	-16.0	- 3.2
20.562	Milan	-13.3	- 0.1	23.601	Nice	-19.7	- 2.7
20.565	Königstuhl	-13.5	- 0.9	23.606	Marseilles	-17.0	- 8.5
20.568	Nice	-16.5	- 3.6	23.643	Algiers	-24.4	- 2.4
20.569	Padua	-15.4	-11.3	23.865	Northfield	-14.2	- 3.1
20.576	Lyons	-24.6	- 3.7	23.900	Chicago	-18.7	- 1.6
20.581	Turin	-16.6	- 5.5				
20.581	Turin	-16.5	- 6.7	24.516	Leipzig	-25.7	- 3.5
20.583	Milan	-11.7	- 9.7	24.516	Bergedorf	-23.3	+ 0.2
20.585	Königstuhl	-14.5	+ 2.4	24.526	Leipzig	-30.8	- 5.2
20.608	Bordeaux	-17.2	- 4.3	24.538	Marseilles	-10.7	-14.7
20.622	Bordeaux	-19.0	+ 1.2	24.542	Leipzig	-23.7	- 2.8
20.944	Mt. Hamilton	- 2.6	- 3.5	24.568	Padua	-27.4	- 2.2

Date	Place			Date	Place		
1911 July		"	"	1911 July		"	"
24.572	Palermo	-20.2	+ 2.0	26.593	Marseilles	-32.2	- 7.9
24.574	Padua	-15.4	- 7.9	26.597	Königstuhl	-20.3	- 4.5
24.579	Turin	-25.3	- 2.0	26.960	Mt. Hamilton	-13.4	- 3.5
24.579	Turin	-22.9	- 8.3	27.426	Pulkova	-21.9	-15.7
24.583	Naples	-32.3	+ 2.0	27.494	Bergedorf	-20.4	- 9.2
24.583	Naples	-33.0	- 1.0	27.502	Leipzig	-41.3	- 1.4
24.589	Marseilles	-28.7	+11.2	27.519	Padua	-32.2	-12.4
24.596	Milan	-10.6	- 8.9	27.521	Leipzig	-29.3	- 9.4
24.601	Palermo	-17.4	(-25.5)	27.523	Kopenhagen	-29.3	-20.9
24.609	Algiers	-22.9	- 4.4	27.523	Uccle	-26.9	- 6.9
24.612	Nice	-26.5	- 4.9	27.537	Padua	-17.3	- 9.6
25.539	Leipzig	-28.8	- 5.3	27.546	Leipzig	-25.8	- 5.5
25.540	Königstuhl	-20.6	- 0.7	27.556	Naples	-26.1	- 7.8
25.542	Marseilles	-19.7	- 6.6	27.556	Naples	-30.3	- 5.6
25.543	Padua	-20.0	- 8.7	27.556	Naples	-28.5	- 9.9
25.546	Naples	-19.1	+ 3.3	27.558	Paris	-22.2	- 3.8
25.546	Naples	-18.0	- 2.0	27.562	Leiden	-24.9	-11.3
25.549	Padua	-18.4	- 8.5	27.566	Königstuhl	-18.4	- 3.1
25.558	Nice	-23.2	- 6.3	27.588	Milan	-17.3	-18.3
25.559	Königstuhl	-20.8	- 1.8	27.595	Turin	-22.5	-15.0
25.560	Milan	-15.9	- 8.7	27.595	Turin	-26.5	-14.4
25.568	Naples	-16.1	+ 1.5	27.604	Nice	-22.7	- 4.5
25.568	Naples	-14.8	- 3.3	27.973	Mt. Hamilton	-21.0	- 9.2
25.576	Turin	-26.6	- 5.1	28.434	Pulkova	-20.5	- 2.5
25.576	Turin	-25.1	- 6.6	28.508	Leipzig	-32.3	- 9.1
25.597	Uccle	-25.2	- 9.8	28.510	Padua	-37.3	- 7.4
25.892	Chicago	-32.2	+ 0.3	28.518	Bergedorf	-24.2	-11.0
26.481	Munich	-24.2	- 7.4	28.518	Berdeforf	-25.0	- 9.7
26.494	Bergedorf	-21.7	- 6.3	28.521	Marseilles	-23.6	-12.4
26.502	Munich	-22.9	-10.0	28.522	Leipzig	-30.3	- 9.1
26.505	Padua	-31.2	- 5.7	28.529	Leiden	-28.0	-13.9
26.522	Königstuhl	-22.2	- 5.7	28.529	Bothkamp	-23.0	-10.0
26.522	Marseilles	-14.3	-17.3	28.531	Naples	-25.3	-12.6
26.534	Leipzig	-37.7	- 5.4	28.533	Leipzig	-26.5	- 9.3
26.535	Padua	-17.4	- 6.0	28.537	Padua	-17.9	-10.3
26.540	Milan	-23.9	- 2.5	28.539	Naples	-27.6	-14.0
26.542	Uccle	-24.4	- 7.8	28.541	Leipzig	-25.0	-10.3
26.542	Paris	-21.4	- 2.4	28.564	Breslau	.....	- 5.5
26.544	Utrecht	-19.7	- 7.4	28.567	Palermo	-30.3	-10.1
26.544	Leiden	-10.4	- 4.9	28.567	Breslau	-25.5	.....
26.548	Leipzig	-26.3	- 5.9	28.572	Nice	-24.2	- 8.1
26.556	Naples	-26.3	-11.3	28.580	Turin	-29.5	- 5.2
26.557	Nice	-21.8	- 5.8	28.580	Turin	-27.2	- 6.7
26.558	Naples	-24.2	-10.4	28.580	Turin	-28.8	- 8.4
26.559	Leipzig	-24.2	- 6.1	28.588	Palermo	-40.7	-31.7
26.574	Naples	-25.7	- 9.7	29.472	Kopenhagen	-27.5	-14.5
26.574	Naples	-26.0	-10.0	29.483	Bergedorf	-23.7	-12.9
26.581	Königstuhl	-20.1	- 4.8	29.505	Utrecht	-19.9	-12.2
26.588	Turin	-26.3	- 5.3	29.524	Rome C. R.	-29.3	-20.6
26.588	Turin	-28.8	- 7.3	29.528	Uccle	-27.8	-15.3
26.588	Turin	-26.2	- 8.5	29.532	Königstuhl	-25.0	- 9.4

Date	Place			Date	Place		
1911 Aug.		"	"	1911 Aug.		"	"
29.541	Munich	-21.7	- 7.7	2.419	Kazan E.	.....	-22.3
29.544	Breslau	-26.3	-18.0	2.419	Kazan E.	-25.0	.....
29.545	Bothkamp	(-64.3)	-11.0	2.465	Pulkova	-27.6	-21.1
29.553	Paris	-22.2	- 8.3	2.512	Marseilles	-18.0	-20.5
29.555	Nice	-23.3	- 7.1	2.514	Leipzig	-41.5	-16.2
29.556	Padua	-27.0	-10.8	2.515	Utrecht	-27.8	-22.5
29.559	Naples	-31.9	-10.2	2.530	Marseilles	-29.1	- 7.6
29.569	Königstuhl	-24.1	- 7.2	2.532	Leipzig	-34.3	-12.6
29.571	Naples	-25.2	- 9.5	2.537	Bergedorf	-31.7	-17.3
29.577	Milan	-25.2	-20.8	2.541	Rome C. R.	-32.8	-11.8
29.584	Naples	-20.6	- 9.2	2.544	Königstuhl	-28.4	-12.8
30.493	Bergedorf	-28.2	-12.5	2.548	Leipzig	-38.6	-14.5
30.505	Kopenhagen	-41.2	-14.7	2.548	Bergedorf	-33.2	-13.9
30.542	Munich	-19.0	- 9.7	2.559	Bothkamp	-30.9	-10.6
30.550	Naples	-38.1	-10.0	2.566	Besancon	-31.8	-19.4
30.550	Naples	-35.4	-10.6	2.572	Nice	-32.9	-11.6
30.550	Naples	-35.7	-12.2	2.573	Königstuhl	-38.1	-23.2
30.550	Naples	-35.9	-12.1	2.587	Paris	-26.3	- 6.7
30.555	Breslau	.....	-18.0	2.617	Paris	-26.0	- 1.6
30.558	Breslau	-28.9	.....	2.972	Mt. Hamilton	-28.4	-12.4
30.572	Padua	.....	.....	3.489	Leiden	-23.2	-23.8
30.574	Königstuhl	-22.9	- 5.9	3.513	Marseilles	-35.3	-19.3
31.489	Munich	-23.2	-10.6	3.537	Marseilles	-26.5	-31.1
31.508	Kopenhagen	-29.9	-12.7	3.548	Padua	-23.6	-15.7
31.514	Bergedorf	-28.9	-12.9	3.549	Padua	-50.4	-22.7
31.515	Leipzig	-31.6	- 9.6	3.554	Uccle	-27.2	-16.3
31.522	Uccle	-25.8	- 9.5	3.563	Nice	-25.5	-13.1
31.528	Marseilles	-24.4	-16.4	3.593	Arcetri	-20.2	-16.9
31.532	Leipzig	-33.8	- 8.7	3.593	Arcetri	-18.1	-18.1
31.538	Bothkamp	-20.6	- 9.6	3.623	Algiers	-32.4	-21.2
31.546	Nice	-26.1	-11.3	3.923	Santiago	-55.6	+ 2.2
31.561	Vienna	-26.0	+13.4	4.516	Marseilles	-46.5	-15.2
31.563	Paris	-25.3	- 7.7	4.520	Utrecht	-38.9	-29.0
31.580	Marseilles	-26.8	- 8.1	4.521	Padua	-63.8	-10.4
31.609	Algiers	.....	.....	4.525	Marseilles	-48.7	-21.6
31.918	Santiago	-32.8	- 7.9	4.565	Königstuhl	-45.1	-12.4
31.929	Santiago	-36.5	- 3.3	4.565	Nice	-59.7	-27.8
1911 Aug.				4.566	Uccle	-41.6	-19.5
1.508	Bergedorf	-26.6	- 9.7	4.567	Rome C. R.	-47.7	-16.8
1.515	Padua	-40.4	-16.6	4.576	Rome C. R.	-46.3	-18.1
1.520	Marseilles	-26.6	-17.6	4.591	Turin	-50.2	-25.7
1.520	Leipzig	-29.3	- 9.6	4.657	Algiers	-47.5	-14.5
1.537	Padua	-17.8	-18.3	4.858	Denver	-57.1	-18.0
1.537	Kopenhagen	-32.4	-20.6	4.864	Chicago	-60.1	-12.4
1.539	Leipzig	-29.4	-14.9	4.865	Denver	-66.3	-20.9
1.560	Milan	-23.5	-31.7	4.876	Santiago	-63.7	.....
1.581	Königstuhl	-23.9	-11.9	4.877	Santiago	.....	-18.8
1.584	Nice	-25.2	- 9.7	4.946	Mt. Hamilton	-59.1	-11.7
1.563	Bothkamp	-25.6	- 9.3	5.373	Kazan E.	-36.2	.....
1.890	Chicago	-24.4	- 5.1	5.385	Kazan E.	.....	-30.3
				5.510	Munich	-27.8	-19.4

Date	Place			Date	Place		
1911 Aug.		"	"	1911 Aug.		"	"
5.527	Padua	-55.1	-25.9	8.588	Uccle	-30.1	-30.3
5.527	Leipzig	-39.8	-13.7	8.590	Marseilles	-41.5	-41.3
5.548	Uccle	-31.5	-24.9	8.653	Algiers	-34.9	-25.7
5.571	Marseilles	-36.8	-51.6	9.507	Marseilles	.....	.....
5.587	Milan	-21.0	-32.7	9.555	Marseilles	-41.7	-24.8
5.593	Königstuhl	-27.6	-19.0	9.566	Nice	-35.9	-29.8
5.596	Nice	-32.2	-14.8	9.574	Königstuhl	-30.7	-24.7
5.652	Algiers	-32.6	-15.1	9.579	Bothkamp	-35.4	-26.1
5.885	Santiago	-55.9	-14.5	9.586	Uccle	-29.0	-31.0
6.406	Kazan E.	.....	-33.0	9.879	Washington	-34.7	-26.4
6.414	Kazan E.	-42.3	.....	10.533	Bothkamp	-34.8	-37.3
6.500	Leiden	-22.9	-37.9	10.571	Leipzig	-41.0	-30.9
6.534	Padua	-65.2	.....	10.579	Leipzig	-47.5	-35.0
6.551	Padua	.....	-21.4	10.606	Algiers	-32.9	-33.6
6.577	Nice	-30.6	-14.9	10.608	Königstuhl	-36.0	-30.5
6.584	Königstuhl	-28.1	-18.9	11.572	Nice	-36.7	-30.9
6.585	Arcetri	-13.0	-23.3	11.577	Königstuhl	-35.1	-33.3
6.608	Uccle	-24.5	-24.9	11.619	Königstuhl	-31.5	-34.6
6.884	Denver	-36.9	-19.9	11.634	Algiers	-36.8	-31.3
6.893	Denver	-36.6	-20.4	11.921	Santiago	-68.8	-41.4
7.505	Rome C. R.	-27.4	-26.6	11.932	Denver	-48.3	-43.9
7.506	Leipzig	-50.9	-20.1	11.944	Denver	-49.8	-45.8
7.509	Marseilles	-31.0	-44.4	12.542	Königstuhl	-34.8	-33.7
7.516	Padua	-49.3	- 5.7	12.592	Nice	-39.0	-40.3
7.520	Leipzig	-45.5	-26.8	12.605	Königstuhl	-35.9	-39.1
7.533	Bergedorf	-32.3	-25.0	12.636	Nice	.....	-47.0
7.535	Uccle	-31.2	-26.4	12.637	Nice	-46.8	.....
7.535	Leiden	-22.2	-32.5	12.646	Algiers	-50.8	-47.7
7.538	Marseilles	-35.5	-24.4	13.582	Nice	-41.7	.....
7.539	Leipzig	-44.6	-24.1	13.587	Nice	.....	-42.6
7.545	Uccle	-32.0	-28.0	13.591	Algiers	-43.2	-41.4
7.546	Bergedorf	-38.5	-26.8	13.594	Nice	-44.9	.....
7.552	Breslau	.....	(+64.3)	13.908	Denver	-51.3	-58.8
7.553	Padua	-38.3	-23.4	13.916	Denver	-49.2	-56.5
7.556	Königstuhl	-32.6	-27.6	14.614	Algiers	-38.8	-36.6
7.560	Breslau	-32.9	+ 4.6	14.906	Denver	-57.1	-56.1
7.561	Leipzig	-38.6	-26.6	14.912	Denver	-56.1	-57.3
7.569	Nice	-35.0	-25.6	15.908	Denver	-53.2	-57.7
7.575	Paris	.....	.....	15.917	Denver	-60.0	-60.2
7.586	Königstuhl	-29.2	-23.1	16.535	Marseilles	-53.2	-20.2
7.600	Utrecht	-30.9	-30.9	16.573	Bergedorf	-44.9	-48.0
7.895	Denver	-40.3	-25.2	16.580	Bergedorf	-41.3	-37.7
7.903	Denver	-36.0	-21.4	16.623	Algiers	-31.7	-30.2
7.936	Santiago	(-76.7)	- 6.4	16.716	Santiago	-35.4	-35.6
8.494	Bergedorf	-40.3	-22.2	16.733	Santiago	-34.8	-44.8
8.498	Munich	-39.5	.....	16.905	Denver	-50.9	-51.9
8.515	Munich	.....	-25.1	16.913	Denver	-51.2	-52.9
8.548	Bothkamp	-33.8	-26.4	17.356	Johannesburg	-29.9	-57.4
8.548	Königstuhl	-34.4	-23.7	17.382	Johannesburg	-40.2	(-75.5)
8.565	Leipzig	-41.3	-31.7	17.408	Johannesburg	-30.3	(-71.8)
8.575	Nice	-30.1	-19.2	17.648	Algiers	-34.8	(-94.6)

Date	Place			Date	Place		
1911 Aug.		"	"	1911 Aug.		"	"
18.442	Cape of Good Hope	-30.0	-30.8	24.736	Cordoba	+ 9.7	.....
18.557	Algiers	-25.8	-24.2	24.756	Cordoba	.....	- 3.9
18.891	Denver	-38.4	-26.1	25.333	Cape of Good Hope	+ 3.6	- 9.1
18.903	Denver	-36.1	-24.2	25.503	Santiago	- 1.7	- 4.8
19.346	Johannesburg	-22.2	-29.6	25.580	Cordoba	+15.7	- 9.2
19.370	Cape of Good Hope	- 5.5	-28.6	25.645	Cordoba	+ 5.5	- 6.6
19.597	Santiago	-13.7	-17.6	25.705	Cordoba	+ 9.4	.....
19.605	Santiago	-10.4	- 8.3	25.780	Cordoba	+ 1.2	- 6.7
19.634	Santiago	.....	-14.4	26.248	Cape of Good Hope	+ 9.1	- 3.2
19.634	Santiago	-15.0	- 8.0	26.297	Johannesburg	- 6.1	+ 1.1
19.650	Santiago	-19.8	- 5.0	26.618	Cordoba	.....	- 3.3
19.656	Santiago	-15.9	-18.0	26.645	Santiago	- 2.4	- 7.4
19.670	Santiago	-17.4	+ 2.3	26.811	Cordoba	+ 2.5	- 6.6
19.809	Santiago	.....	-22.6	26.857	Cordoba	+ 1.1	.....
19.823	Santiago	-15.6	.....	27.266	Johannesburg	(+12.6)	(-69.8)
19.918	Santiago	-19.8	-16.2	27.509	Santiago	- 1.6	- 6.4
20.328	Johannesburg	-24.9	+ 2.3	27.735	Cordoba	+10.5	- 5.6
21.298	Johannesburg	-12.1	- 6.7	27.805	Cordoba	+ 0.6	-12.7
21.357	Johannesburg	- 7.5	- 1.0	28.246	Johannesburg	+ 1.4	- 2.0
22.247	Johannesburg	+ 2.9	-12.9	29.285	Johannesburg	- 5.7	-12.8
22.445	Johannesburg	-14.1	- 6.3	30.253	Johannesburg	+14.9	- 5.9
22.606	Santiago	- 5.9	- 7.2	30.282	Cape of Good Hope	+11.4	+ 1.7
22.640	Santiago	+ 2.4	- 6.3	31.235	Johannesburg	+ 2.3	- 8.3
22.793	Santiago	+ 4.1	- 5.1	31.266	Cape of Good Hope	- 4.4	- 9.7
22.832	Santiago	+10.6	- 8.3	1911 Sept.			
22.886	Santiago	+ 7.7	- 4.3	1.267	Cape of Good Hope	- 1.1	- 9.3
23.350	Johannesburg	-25.3	-16.8	2.249	Cape of Good Hope	- 1.7	-16.7
23.525	Santiago	- 2.8	-11.0	5.391	Cape of Good Hope	- 3.5	- 4.4
23.587	Santiago	- 1.8	-15.8	9.324	Cape of Good Hope	+ 2.3	- 5.9
23.644	Cordoba	+11.7	- 5.7	10.239	Johannesburg	- 5.8	-17.2
23.771	Santiago	- 4.1	-12.3	12.404	Cape of Good Hope	+ 2.3	- 8.0
23.790	Cordoba	+ 5.4	- 8.4	17.247	Johannesburg	+ 3.6	-14.5
24.273	Johannesburg	+15.4	+ 2.3	18.251	Johannesburg	+ 0.2	- 8.8
24.305	Cape of Good Hope	+10.2	-10.5				
24.697	Cordoba	.....	- 6.9				
24.710	Cordoba	+10.4	.....				

Observations from Tacubaya, Rio de Janeiro and Simeis have not been used on account of apparent systematic errors.

These results were combined as follows to form eight normal places: July 6-14—July 11.6; July 15-23—July 19.9; July 24-31—July 28.0; Aug. 1-8—Aug. 5.0; Aug. 9-17—Aug. 13.4; Aug. 18-25—Aug. 22.0; Aug. 26-Sept. 5—Aug. 29.4; Sept. 9-18—Sept. 13.5.

By plotting the positions of the comet and the various planets it was determined that the *Earth* and *Jupiter* were the only ones whose perturbations would have any appreciable effect on the comet's path. The perturbations for these two planets were computed by the method of Mechanical Quadrature—WATSON'S *Theoretical Astronomy*, p. 448. For the given normal places they were as follows (in seconds of arc).

Time	$\cos \delta \, da$	$d\delta$
July 11.6	0''.00	-0''.01
July 19.9	0 .00	-0 .02
July 28.0	+0 .02	-0 .04
Aug. 5.0	+0 .08	-0 .04
Aug. 13.4	+0 .30	+0 .03
Aug. 22.0	-0 .30	-0 .35
Aug. 29.4	-0 .49	-0 .05
Sept. 13.5	-0 .34	+0 .04

These perturbations were subtracted from the differences for the eight normal places giving:

Time	wt.	$\cos \delta \, da$	wt.	$d\delta$
July 11.6	80	- 1''.31	78	+ 1''.00
July 19.9	119	-14 .70	117	- 2 .53
July 28.0	140	-25. 23	140	- 8 .33
Aug. 5.0	108	-35 .86	109	-19 .97
Aug. 13.4	45	-42 .26	41	-40 .15
Aug. 22.0	39	- 6 .76	39	-11 .25
Aug. 29.4	17	+ 2 .10	17	- 6 .51
Sept. 13.5	5	- 0 .86	5	-10 .92

Since the preliminary system was a parabola the differential equations for each of the normal places were formed using KLINKERFUES p. 700.

The solution of these equations gives:

For all equations		For R.A. only		For Dec. only	
$\cos \delta \, da$	$d\delta$	$\cos \delta \, da$	$d\delta$	$\cos \delta \, da$	$d\delta$
" "	" "	" "	" "	" "	" "
-11.81 -0.70	+ 0.71 + 542.29	- 1.22 -1.72			
- 2.64 +0.16	+ 4.46 + 689.87	+10.99 -0.94			
+ 3.92 +1.12	+ 1.35 + 923.90	+19.59 +0.20			
+ 7.47 +2.06	- 3.74 +1403.71	+26.32 +1.96			
- 2.36 -6.48	- 5.11 +2643.85	+25.37 -1.71			
+ 0.26 +6.01	+ 8.71 + 129.02	+18.18 +1.35			
+ 5.21 -1.77	-22.40 + 605.19	+13.66 -5.77			
+ 3.32 +1.36	-45.08 + 212.89	+10.70 +0.27			

Using both right ascensions and declinations we have

$\Sigma(vv) = 350.52$ and $\Sigma(pvv) = 248.07$, and the elements reduced to the mean ecliptic of 1911.0 are

$$\begin{aligned}
 T &= \text{June } 30.256876 \\
 \omega &= 110^\circ 33' 6''.83 \\
 \Omega &= 157^\circ 26' 7''.49 \\
 i &= 148^\circ 27' 31''.82 \\
 e &= 0.999060 \\
 q &= 0.6849663 \\
 \log q &= 9.835669
 \end{aligned}$$

We now return to the normal equations and solve for each of the other unknowns in terms of de and substitute these in (vv) for the unweighted equations and by setting equal to zero the first derivative of the resulting quadratic in de we obtain the minimum values for de in terms of units of the 6th decimal place.

$$\begin{aligned}
 \text{For all equations } de &= -3893 \\
 \text{For R. A. only} &= -3894 \\
 \text{For Dec. only} &= -3888
 \end{aligned}$$

In a similar manner for the weighted equations we have

$$\begin{aligned}
 \text{For all equations } de &= -4459 \\
 \text{For R. A. only} &= -4528 \\
 \text{For Dec. only} &= -4067
 \end{aligned}$$

Using -4459 the residuals for the normal equations are

$\cos \delta \, da$	$d\delta$
-1''.47	-2''.40
-3 .79	-0 .71
-1 .27	+0 .24
+2 .72	+1 .96
+0 .54	-1 .25
+0 .72	0 .00
-3 .18	-4 .98
-4 .92	+1 .54

and the minimum for $\Sigma(pvv) = 47.73$ and the elements now are

$$\begin{aligned}
 T &= \text{June } 30.155359 \\
 e &= 0.995541 \\
 q &= 0.683597 \\
 1911.0 \left\{ \begin{aligned} \omega &= 110^\circ 19' 20''.45 \\ \Omega &= 157^\circ 24' 48''.81 \\ i &= 148^\circ 25' 36''.99 \end{aligned} \right.
 \end{aligned}$$

and the period is approximately 1903 years.

Now using these elements and computing the normal places we have the following residuals:

$\cos \delta \, da$	$d\delta$
-5''.6	+1''.0
+4 .8	+1 .9
+1 .2	+0 .7
-4 .1	-0 .9
-2 .3	+3 .1
+1 .1	+3 .6
+3 .9	+3 .5
+2 .0	-0 .1

Putting $de = 0$ we have the parabolic elements

$$\begin{aligned}
 T &= \text{June } 30.28398 \\
 q &= 0.685332 \\
 \log q &= 9.835901 \\
 \omega &= 110^\circ 36' 47''.50 \\
 \Omega &= 157^\circ 26' 28''.50 \\
 i &= 148^\circ 27' 53''.44
 \end{aligned}$$

and the residuals are

$\cos \delta \, da$	$d\delta$
+14''.57	+0''.26
+ 2 .33	-0 .38
- 5 .31	-1 .33
- 8 .75	-2 .06
+ 3 .24	+7 .97
- 0 .07	-7 .45
- 7 .40	-0 .94
- 5 .49	-1 .30
$\Sigma(pvv) = 369.$	

According to GALLE, Comet 1790I was discovered by MISS HERSCHEL and observed with difficulty four times: Jan. 9, 19, 20, 21.

Two sets of elements were published by SARON, the first in *Mem. de Paris* 1790, p. 312, the second in *Ast. Jahrb.* 1794, p. 94.

These are

T = Jan. 16.79688	T = Jan. 15.21875
$\omega = 114^{\circ}25'17''$	$\omega = 115^{\circ}57'14''$
$\Omega = 172^{\circ}50' 2''$	$\Omega = 176^{\circ}11'46''$
$i = 150^{\circ}15'53''$	$i = 148^{\circ} 5'45''$
$\log q = 9.873516$	$\log q = 9.879725$

The comet was a faint nebulous object and for the comparison stars used the longitude of the first and the latitude of the other two were approximate. The observations used were those of Jan. 9, 19, 21.

The uncertainty of these elements was such that the two comets may well be considered as belonging to the same family but the eccentricity of the orbit of KIESS' comet is such that it could not have so short a period as 122 years.

Syracuse University,
Syracuse, N. Y.,
September, 1932.

OBSERVATIONS OF COMETS AT THE YERKES OBSERVATORY,*

By G. VAN BIESBROECK

(A) MICROMETRIC MEASURES WITH THE 40-INCH TELESCOPE

U. T.	$\Delta\alpha$	$\Delta\delta$	n	α	δ	Parall. fact.	★
<i>Comet 1932b</i> (HOUGHTON)							
1932	m s	' "		h m s	° ' "		
Apr. 27.15757	-0 42.08	+0 50.2	25-5	12 43 50.62	-23 29 14.1	8.810n 0.903	1
May 23.21156	+0 31.56	-1 53.1	25-5	12 46 58.54	+11 26 3.8	9.419 0.679	2
<i>Comet 1932c</i> (CARRASCO)							
Apr. 27.09530	-0 12.33	+2 9.5	8-8	12 10 51.91	+23 21 13.8	9.249n 0.485	3
May 11.17020	+1 19.56	-0 45.4	25-5	11 58 30.66	18 38 46.3	9.230 0.567	4
23.18989	+1 27.43	+2 58.4	25-5	11 53 7.25	14 48 54.9	9.477 0.653	5
<i>Comet 1932d</i> (PERIODIC GRIGG-SKJELLERUP).							
May 3.10856	+0 12.83	-1 24.8	8-8	7 9 44.62	+10 35 31.8	9.597 0.724	6
June 11.20462	+0 57.52	+0 48.7	25-5	12 16 9.67	49 59 11.3	9.767 0.131	7
24.23097	-0 29.90	+0 21.5	25-5	15 3 0.76	45 59 55.9	9.611 9.771	8

Comparison Stars

★	α	δ	Authority
	h m s	° ' "	
1	12 44 32.70	-23 30 4.3	Hyd. ph. -23°, 55394
2	12 46 26.98	+11 27 56.9	Tou. ph. +11°, 12 ^h 44 ^m , 55
3	12 11 4.24	23 19 4.3	Par. ph. +23°, 12 ^h 12 ^m , 17; +24°, 12 ^h 8 ^m , 121
4	11 57 11.10	18 39 31.7	Par. ph. 19°, 11 ^h 56 ^m , 45
5	11 51 39.82	14 45 56.5	Bord. II 14°, 426
6	7 9 31.79	10 36 56.6	Tou. ph. 11°, 7 ^h 8 ^m , 1345
7	12 15 12.15	49 58 22.6	Kü. 5448
8	15 3 30.66	45 59 34.4	Hels. ph. 15 ^h 0 ^m , 46°, 70