57. *Improved Elements of the Orbits of Asteroids.*

(Sixth Report.)

By Kiyotsugu HIRAYAMA and Kaoru AKIYAMA.

Astronomical Observatory, Azabu, Tokyo.

(Comm. by K. HIRAYAMA, M.I.A., Mar. 12, 1934.)

This is a report of our work relating to the motion of asteroids. The expence for the calculation was granted by the Nippon Gakujutsu Shinkokwai (Society for the Promotion of Science in Japan) to which the authors are greatly indebted.

The method of reduction is exactly same as was briefly mentioned in the first report.¹⁾ The observations selected for the calculations are as follows :

No.	U.T.			α	δ	Observation by	Publ.
677 Aaltje							
1	1909	Jan.	18.97	115.25 + 16.57		Kopff, Heidelberg	A.N. 180 101
2	1911	July	30.91	304.96 - 12.76		Palisa, Vienna	A.N. 191 79
3	1922	Sept.	30.92	6.91 + 16.51		Jekhosky, Algier	J.O. 6 67
4	1927	Sept.	28.92	0.00 + 13.62		Reinmuth, Heidelberg	B.Z. 65
5	1931	June	19.00	278.29 - 23.21		Wolf, Heidelberg	A.N. 243 369
854 Frostia							
1	1916	Apr.	3.87	195.72 - 5.75		Simeis	— ²⁾
2	1916	Apr.	24.87	191.40 - 2.62		"	—
3	1916	June	4.85	190.04 - 0.36		"	—
4	1920	July	9.90	266.87 - 11.07		Lagrula, Marseille	B.Z. 51
917 Lyka							
1	1915	Sept.	16.96	351.55 - 1.83		Poulkova	P.C. 8 18
2	1926	Sept.	9.96	345.49 - 5.79		Mündler, Heidelberg	A.N. 230 7
3	1928	Jan.	29.11	138.98 + 20.22		Reinmuth, Heidelberg	B.Z. 10
4	1930	Nov.	24.91	48.89 + 27.38		Boyer-Filippoff, Algier	J.O. 14 79
5	1932	Mar.	6.03	161.19 + 8.28		Reinmuth, Heidelberg	B.Z. 577
951 Gaspra							
1	1916	Aug.	23.89	326.73 - 4.63		Neujmin, Simeis	A.N. 205 198
2	1926	Sept.	28.85	2.12 + 9.97		Delporte, Uccle	A.N. 229 156
3	1929	July	8.96	303.46 - 14.66		Deutsch, Simeis	B.Z. 58
4	1931	Febr.	24.95	147.53 + 5.79		Neujmin, Simeis	A.N. 242 194

1) Proc. **3** (1927), 53.

2) Communicated from the Recheninstitut.

No.	U.T.	α	δ	Observation by	Publ.
985 Rosina					
1	1922 Oct. 17.80	24.41 + 20.25		Mündler, Heidelberg	A.N. 218 262
2	1924 Mar. 5.23	157.09 + 4.78		Struve, Williams Bay	A.J. 36 13
3	1927 Jan. 28.99	118.55 + 19.65		Reinmuth, Heidelberg	B.Z. 9
4	1929 Oct. 5.03	36.06 + 23.64		Neujmin-Beljawsky, Simeis	B.Z. 83

all the positions being referred to the mean equator and equinox of the beginning of each year.

The elements assumed for the preliminary reductions were taken from V.R.I. Nr. 45, except those of the asteroids 917 and 951, which were taken from A.N. **212** 303 and **216** 413. The epochs were chosen as follows:

677; 1909 Jan. 17.5 U.T.

854; 1916 Apr. 10.5 „

917; 1915 Aug. 14.5 „

951; 1916 June 29.5 „

By considering the perturbations by Jupiter, except for the asteroid 985, the following residuals were determined:

No.	677		854		917		951		985	
	$\Delta\alpha$	$\Delta\delta$	$\Delta\alpha$	$\Delta\delta$	$\Delta\alpha$	$\Delta\delta$	$\Delta\alpha$	$\Delta\delta$	$\Delta\alpha$	$\Delta\delta$
1	-0.09	+0.03	+0.01	-0.01	+0.02	+0.01	-0.04	-0.03	-0.03	+0.01
2	+0.04	+0.12	0.00	0.00	-1.03	-0.54	-0.08	-0.05	+1.15	-0.34
3	+1.19	+0.49	+0.01	-0.01	-0.21	+0.12	-0.07	-0.02	+3.16	-0.80
4	+1.46	+0.64	+1.10	+0.24	-0.96	-0.25	+1.27	-0.62	+0.74	+0.18
5	+2.18	+0.34			-0.27	+0.15				

The following corrections of the elements were determined from the above residuals:

	677	854	919	985
dM_0	-1.490	0.000	-0.168	-2.035
$d\omega$	+1.520	-0.261	+0.270	+2.345
$d\Omega$	0.000	+0.262	0.000	-0.800
di	0.000	+0.108	0.000	-0.167
$d\varphi$	+0.030	0.000	+0.002	+1.296
	//	//	//	//
dp	+0.550	+0.900	-0.319	+0.030

For the asteroids 677 and 917, the corrections for the node and inclination were thought unnecessary, and for the asteroid 951 any corrections for the assumed elements were thought premature. Final residuals are as follows:

No.	677		854		917		985	
	$\Delta\alpha$	$\Delta\delta$	$\Delta\alpha$	$\Delta\delta$	$\Delta\alpha$	$\Delta\delta$	$\Delta\alpha$	$\Delta\delta$
1	+0.03	-0.01	+0.02	+0.03	0.00	0.00	0.00	+0.02
2	-0.03	-0.05	+0.02	0.00	-0.02	-0.01	+0.01	-0.01
3	+0.01	+0.02	-0.02	-0.04	-0.01	+0.04	+0.05	-0.01
4	-0.06	-0.02	+0.04	+0.01	+0.02	0.00	-0.03	-0.03
5	0.00	-0.06			+0.03	0.00		

Notes. For the asteroid 677, making use of the fixed elements at 1909 Jan. 17.5 U.T., the identity of the asteroid 1906 UP was confirmed. The residuals are as follows:

	$\Delta\alpha$	$\Delta\delta$	
1906 Aug. 13.96 U.T.	-0.16	-0.10	A.N. 172 176
20.01 „	-0.19	-0.06	„

The observation of the asteroid 677 in 1912 at Heidelberg, and also that in 1931 at Simeis are doubtful, the residuals being

	$\Delta\alpha$	$\Delta\delta$	
1912 Oct. 12.82 U.T.	+6.09	+2.45	A.N. 193 16
1931 June 19.95 „	+0.37	-0.18	A.N. 244 143

The observation of the asteroid 854 in 1924 and that of the asteroid 917 in 1919, both of which were made at Simeis, are more or less doubtful, the residuals being

	$\Delta\alpha$	$\Delta\delta$	
1924 Sept. 6.89 U.T.	-0.44	+0.08	B.Z. 51
1919 Nov. 1.02 „	+0.20	-0.04	A.N. 216 412

The results of our calculations are as follows:

Epoch and osculation, 1925 Jan. 1.0 U.T.
Ecliptic and mean equinox, 1925.0

	M_0	ω	Ω	i	φ	μ	Log a
677	347.685	269.713	273.835	8.484	2.575	698.297	0.47064
854	86.901	81.558	191.041	6.187	9.880	975.879	0.37374
917	197.104	357.957	343.513	5.142	11.562	965.725	0.37677
951	158.144	128.046	253.131	4.092	10.026	1080.604	0.34423
985	247.089	59.925	289.982	3.912	17.354	1016.949	0.36181