ACCURATE POSITIONS OF ASTEROIDS OBSERVED IN BUCHAREST DURING THE YEAR 1931

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Abstract. The paper contains the observations of minor planets performed in 1931 in Bucharest Astronomical Observatory with 380/6000 mm astrograph. Both Turner's (constants) and Schlesinger's (dependences) methods were used in the computation of the normal coordinates of the objects.

Keywords: photographic astrometry – minor planets.

1. INTRODUCTION

At Bucharest Observatory, within the framework of the Wide-Field Plate Archive Programme, part of the activities of the IAU Commission 9, 13 000 plates were catalogued. They were obtained through a systematic work beginning with the year 1930 until now, by means of the Prin-Merz refractor (f = 6 m, D = 38 cm). After a careful investigation of the whole plate archive, among other things, we discovered that a series of observations were not capitalized, such as a set of minor planets that were observed during 1930–1955. The lack of accurate star catalogues containing positions and proper motions, was one of the reasons for which the completion of the reductions has been neglected in that period. It is worth mentioning that the SAO Catalogue was issued starting from that period. Another thing worth mentioning is that the first Zeiss measuring machine was bought by the Observatory in 1957.

However, systematic work on plate processing at Bucharest Observatory started beginning with 1956.

The first paper on this subject was published by Cristescu et al. (1960).

158 plates were exposed in 1931 and following their analysis 48 plates were detected that contained measurable minor planets. The observers were G. Demetrescu and G. Petrescu. They performed only some test-reductions using mechanical computing machines mainly for the observed comets.

2 ACCURATE POSITIONS OF ASTEROIDS

To determine more precise positions, we tried to take into account 4−6 reference stars, wherever possible. We used *Positions and Proper Motions* (*PPM*) *Star Catalogue* J 2000.0, referring all the results to the epoch 2000.0.

For the observations, the 380/6000 mm astrograph with the field of 2º×2º was used. The plates exposed were Imperial 13×18 cm and the measurements were performed by means of an ASCORECORD measuring machine.

In the computations the same program was used for all plates. By means of 4−6 reference stars, situated around the object, but not farther than 1º from the plate center, the position of the object – mainly a minor planet was computed.

The two systems of equations were solved using the Cracovian formulation, which is very convenient for computer programming. All the computations were performed in double precision. Both Turner's (constants) and Schlesinger's (dependencies) methods were used for the computation of the normal coordinates of the object (Bugoslavskaya 1947).

In the method of the constants, the values were determined together with their errors – the residuals were computed for every star (*Kleine Planeten 1931*; *The Nautical Almanac and Astronomical Ephemeris for the Year 1931*). Table 1 below contains: the asteroids names, observation time (year, month, day and fraction of the day in UT), $\alpha_{2000.0}$, $\delta_{2000.0}$.

Table 1

Asteroids observed during 1931 in Bucharest Observatory

Asteroid name	Observation time [UT]	$\alpha_{2000.0}$ h	m	s	$\delta_{2000.0}$ °	′	″
1	2	3				4	
6 Hebe	1931 12 08.89849	5	03	17.172	− 1	54	59.91
″	1931 12 08.90068	5	03	16.770	− 1	54	59.11
11 Parthenope	1931 06 19.92956	19	01	19.571	−18	40	36.09
″	1931 06 19.93783	19	01	10.153	−18	40	37.40
17 Thetis	1931 10 12.84987	1	26	09.502	− 0	23	02.11
″	1931 10 12.85645	1	26	09.114	− 0	23	04.59
28 Bellona	1931 12 17.84053	4	45	44.826	7	55	01.05
″	1931 12 17.84469	4	45	44.585	7	55	01.34
30 Urania	1931 11 05.95855	4	13	57.030	24	58	11.71
″	1931 11 05.96342	4	13	56.795	24	58	11.50
59 Elpis	1931 07 19.86165	20	01	44.932	− 9	10	31.61
″	1931 07 19.86747	20	01	44.627	− 9	10	34.06
69 Hesperia	1931 10 10.93426	2	20	07.292	8	46	07.06

″	1931 10 10.93900	2	20	07.007	8	46	04.27
76 Freia	1931 10 10.84353	0	24	45.612	3	56	04.64
″	1931 10 10.84999	0	24	45.332	3	56	02.83
80 Sapho	1931 12 15.86892	4	46	57.709	12	34	54.47
″	1931 12 15.87186	4	46	57.488	12	34	53.24
88 Thisbe	1931 10 07.84267	0	49	17.769	14	35	14.00
″	193110 07.84887	0	49	17.445	14	35	12.16
92 Undina	1931 12 08.87610	4	24	55.075	13	32	58.37
″	1931 12 08.88171	4	24	54.796	13	32	58.38
97 Klotho	1931 07 07.93383	20	56	16.297	− 6	28	40.52
″	1931 07 07.94038	20	56	16.052	− 6	28	41.89
110 Lydia	1931 12 15.84953	4	38	10.300	24	58	36.46
″	1931 12 15.85383	4	38	10.080	24	58	36.76
113 Amalthea	1931 10 14.82088	0	59	08.242	− 2	11	39.99
″	1931 10 14.82603	0	59	07.875	− 2	11	41.43
128 Nemesis	1931 10 12.90389	2	02	03.474	3	30	43.06
″	1931 10 12.90920	2	02	03.184	3	30	41.92
134 Sophrosine	1931 12 15.88831	5	42	08.272	43	25	19.40
″	1931 12 15.89251	5	42	07.980	43	25	19.31
136 Austria	1931 12 17.89940	6	14	30.934	7	31	23.89
″	1931 12 17.90359	6	14	30.764	7	31	12.72
152 Atala	1931 12 15.82979	4	13	29.885	30	43	37.12
″	1931 12 15.83475	4	13	29.648	30	43	36.79
162 Laurentia	1931 10 20.84302	1	14	54.355	5	15	01.13
″	1931 10 20.84907	1	14	54.117	5	15	00.32
173 Ino	1931 06 19.86169	17	57	56.606	− 4	03	21.36
″	1931 06 19.87081	17	57	56.085	− 4	03	22.28
174 Phaedra	1931 11 04.86848	3	06	39.849	35	17	13.00
″	1931 11 04.87455	3	05	13.331	35	42	27.20
196 Philomela	1931 10 14.91124	2	36	55.929	8	12	20.25
″	1931 10 14.91807	2	36	55.617	8	12	19.29
221 Eos	1931 07 20.88772	20	27	08.961	−12	50	01.75
″	1931 07 20.89460	20	27	09.856	−12	50	06.59
335 Roberta	1931 10 07.87453	0	51	42.818	− 1	07	26.65
″	1931 10 07.88145	0	51	42.442	− 1	07	28.66
345 Tercidina	1931 11 03.88022	3	06	33.221	13	48	18.07
″	1931 11 03.88594	3	06	32.943	13	48	15.38
364 Isara	1931 10 13.90498	2	46	04.020	3	44	45.29
″	1931 10 13.91132	2	46	03.745	3	45	04.40
379 Huena	1931 11 03.84040	2	43	31.695	13	51	10.23

″	1931 11 03.84616	2	43	31.398	13	51	08.57
383 Ianina	1931 10 14.86657	1	40	43.012	6	11	00.64
″	1931 10 14.87319	1	40	42.727	6	10	58.95
384 Burdigala	1931 10 08.88427	0	52	23.638	− 0	21	45.99
″	1931 10 08.88973	0	52	23.293	− 0	21	47.13
392 Siri	1931 10 13.88108	2	38	08.416	15	56	54.29
″	1931 10 13.88720	2	38	09.020	15	57	01.89
393 Lampetia	1931 11 03.86013	2	47	15.358	12	40	29.51
″	1931 11 03.86572	2	47	15.046	12	40	26.08
441 Bathilde	1931 12 30.85447	5	11	05.807	20	28	34.16
″	1931 12 30.86053	5	11	05.504	20	28	32.37
451 Patientia	1931 11 03.90135	3	51	44.961	5	07	54.85
″	1931 11 03.90660	3	51	44.710	5	07	54.66
490 Veritas	1931 11 09.84372	3	59	16.516	5	01	57.86
″	1931 11 09.85310	3	59	16.177	5	01	55.43
497 Iva	1931 12 17.29566	4	25	19.553	29	31	21.24
519 Sylivana	1931 11 04.82416	2	52	03.099	15	43	49.94
″	1931 11 04.82944	2	52	02.780	15	43	49.61
534 Nassovia	1931 12 17.33448	5	02	20.081	21	25	37.79
″	1931 12 17.33915	5	02	19.811	21	25	38.30
556 Phylis	1931 12 30.44113	7	05	44.161	23	18	30.54
″	1931 12 30.44616	7	05	43.842	23	18	29.71
570 Kylhera	1931 10 14.84062	1	15	40.987	9	16	52.03
″	1931 10 14.85776	1	15	40.680	9	16	50.13
611 Valeria	1931 07 25.97288	21	26	07.164	1	39	20.63
″	1931 07 25.98248	21	26	06.735	1	39	18.62
613 Ginevra	1931 11 09.82349	1	56	07.570	20	29	16.17
″	1931 11 09.82873	1	56	07.853	20	28	43.40
694 Ekard	1931 12 30.37430	5	05	42.403	9	24	01.49
″	1931 12 30.38076	5	05	42.647	9	23	24.88
849 Ara	1931 07 21.94948	21	52	06.995	18	03	33.77
″	1931 07 21.95874	21	52	07.383	18	03	35.22
″	1931 07 25.91228	21	45	31.651	18	07	32.62
″	1931 07 25.92198	21	45	31.396	18	07	25.75
″	1931 07 25.94281	21	55	20.873	18	55	24.14
″	1931 07 25.95280	21	55	21.183	18	55	18.75
914 Palisana	1931 10 13.86215	1	39	47.037	44	09	29.01
″	1931 10 13.86752	1	39	47.275	44	10	00.58
1071 Berta	1931 10 08.90655	0	52	22.344	− 0	21	50.51
″	1931 10 08.91208	0	52	22.047	− 0	21	51.63

We must mention that the observation time was based on the fundamental Riefler pendulum, mounted in the observatory's cellar − in permanent survey.

3 CONCLUSIONS

The year 1931 brought the first results (performed in Bucharest) in the observation of minor planets. Systematic astrometric measurements had begun one year earlier but, with only one exposure, it was impossible to put into evidence the asteroids on the plate. This was typical for the beginning of this kind of observations; often the results were not the expected ones. After many tests and failures, a standard style was adopted:

− First exposure: 1−2 minutes,

− Break (pause) of 1−2 minutes for a movement in declination (up or down),

− Second exposure: 10−12 minutes.

In some cases the time intervals were too short or too long – for the exposures and for the break. The excellent quality of the sky and the good storage conditions for such a long time (80 years) led to good images. However, we tried to capitalize the efforts of the previous observers made in very difficult conditions. Learning from mistakes, but endowed with an excellent skill and astronomical knowledge, they obtained good photographic plates that contain valuable astrometric data.

In our opinion the recovery of all this old observational data will be useful as in the period concerned there were not many minor planet observations. These accurate positions are fit to improve the orbits of the observed minor planets. Our goal is to recover all the unreduced data from our archive and to include them in the astronomical database.

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