0.20±0.02m. However, consultations with Robert Stevens of Santana Observatory led me to revise the period upward to nearly double this. Using his much larger data set as a guide for analysis, I now derive a period of 14.64±0.01h with an amplitude of 0.24±0.01m. However, there is a rather large hole in the curve, so these parameters could well change somewhat with better coverage. The lightcurve is shown in Figure 4.

1825 Klare

This asteroid was discovered by K. Reinmuth at Heidelberg in 1954. 438 images were taken between December 27, 2003 and January 1, 2004, in five sessions. The measured synodic period was 4.744±0.009h with an amplitude of 0.75±0.02m. The large amplitude would suggest a highly irregular shape. It was observed at phase angles varying from 6 to 3.5 degrees. The lightcurve is presented in Figure 5.

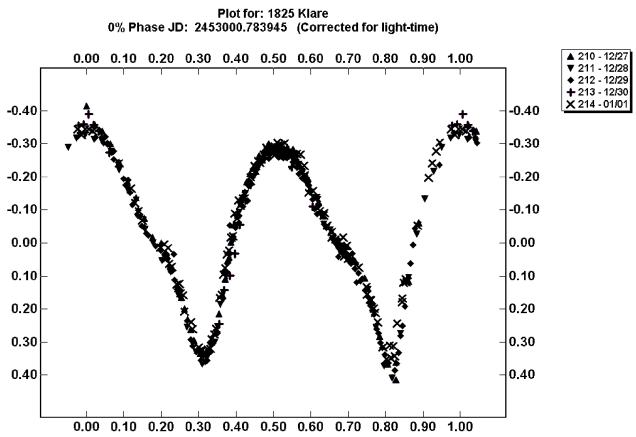

Figure 5. The lightcurve for 1825 Klare. The measured synodic period was 4.744±0.009h with an amplitude of 0.75±0.02m.

Acknowledgments

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LIGHTCURVE ANALYSIS FOR NUMBERED ASTEROIDS 1351, 1589, 2778, 5076, 5892, AND 6386

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The lightcurves of six numbered asteroids obtained in late 2003 were analyzed. The following synodic periods and amplitudes were determined. 1351 Uzbekistania: 73.90±0.02h, 0.34±0.02m; 1589 Fanatica: 2.58±0.05h, 0.16±0.02m; 2778 Tangshan: 3.461±0.020h, 0.25±0.03m; 5076 Lebedev-Kumach: 3.2190±0.0005h, 0.14±0.02m; (5892) 1981 YS_1: 10.60±0.02h, 0.26±0.03m; and (6386) 1989 NK_1: 3.1381±0.0005h, 0.08±0.02m.

Equipment and Procedures

The asteroid lightcurve program at the Palmer Divide Observatory has been previously described in detail (Warner 2003) so only a summary is provided now. The main instrument at the Observatory is a 0.5m f/8.1 Ritchey-Chretien telescope using a Finger Lakes Instruments IMG camera with Kodak KAF-1001E chip. A second instrument also in use was a 0.3m f/9.3 Schmidt-Cassegrain using an SBIG ST-9E camera. For this set of asteroids, only the 0.5m scope was used.

Initial targets are determined by referring to the list of lightcurves maintained by Dr. Alan Harris (Harris 2003), with additions made by the author to include findings posted in subsequent issues of the *Minor Planet Bulletin*. In addition, reference is made to the Collaborative Asteroid Lightcurve Link (CALL) web site maintained by the author (http://www.MinorPlanetObserver.com/astlc/default.htm) where researchers can post their findings pending publication. MPO Canopus, a custom software package written by the author, is used to measure the images. It uses aperture photometry with derived magnitudes determined by calibrating images against field or, preferably, standard stars. Raw instrumental magnitudes are used for period analysis, which is included in the program. The routine is a conversion of the original FORTRAN code developed by Alan Harris (Harris et al., 1989).

Note: in the following, the orbital elements are taken from the IAU MPCORB data file available at the Minor Planet Center web site (ftp://cfa-ftp.harvard.edu/pub/MPCORB/). The date of osculation for the elements was 2453000.5.

The Phase Angle Bisector

The observation table for each asteroid gives the date, phase angle, and phase angle bisector longitude and latitude. The PAB was developed by Alan Harris and Edward Bowell. Harris states (Harris 2003a), "The significance is that the direction that bisects the directions to the sun and the line of sight is a best approximation to a single 'viewing direction.' As an extreme example, if you viewed a rotating 'cigar' from its pole it would have no lightcurve amplitude if the sun were also shining from the pole direction, but if the sun were shining at the equator (90° phase angle), then you would see a big amplitude. Now if you reverse the Earth and sun positions so you are viewing from the equator and the sun is shining on the pole, you likewise get a big amplitude, even though in this case the illuminated area is constant, you just see different amounts of it as it rotates. The best approximation you can make to a zero phase angle viewing aspect is a single line half way in between the illumination and viewing directions. This we call the 'phase angle bisector', since it is the line that bisects the phase angle."

Results

1351 Uzbekistania

Uzbekistania was discovered by G.N. Neujmin at Simeis on 1934 October 5. It's carried the designations 1925 CA, 1928 QJ, 1931 FK, 1934 TF, A917 SL, and A920 FA. It's named in honor of the (former) Uzbek Soviet Republic where the discoverer lived during WW II. Kozai (1979) puts the asteroid in his group 63, which includes, among others, 48 Doris and 52 Europa. The IRAS survey (Tedesco 1989) gives an effective diameter of 64.91 ± 4.31km and mean albedo of 0.0606 ±0.0090. The IAUs MPCORB database gives values of 9.6 and 0.15 respectively for H and G. The principal orbital elements for Uzbekistania are: semi-major axis, 3.197AU; inclination, 9.703°; and eccentricity, 0.0610.

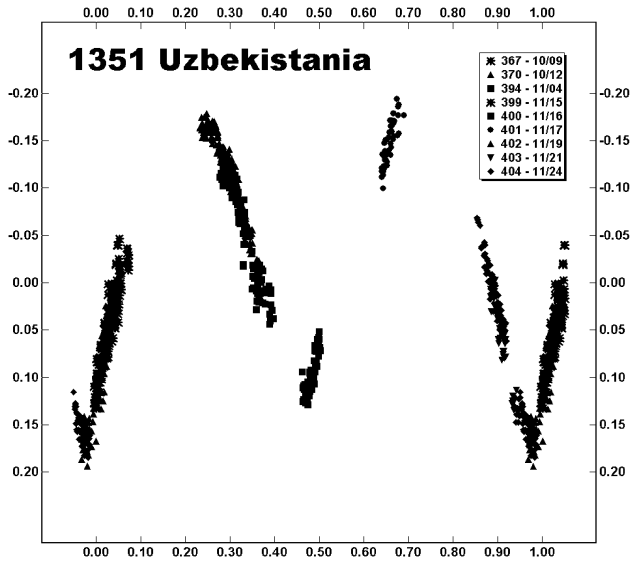

Figure 1. The lightcurve for 1351 Uzbekistania. The synodic period is 73.9±0.02h and the amplitude 0.34±0.02m.

DATE 2003	Phase Angle	PAB Long	PAB Lat
Oct. 09	15.0	58.2	7.5
Oct. 12	14.3	58.5	7.6
Nov. 04	7.7	59.4	8.6
Nov. 15	4.5	59.4	9.0
Nov. 16	4.3	59.4	9.0
Nov. 17	4.1	59.4	9.1
Nov. 19	3.8	59.4	9.1
Nov. 21	3.6	59.4	9.2
Nov. 24	3.7	59.4	9.3

There were 871 data points used in the final analysis that gave a synodic period of 73.90±0.02h and amplitude of 0.34±0.02m. Figure 1 shows the observations phased against this period. The amplitude implies a ratio of 1.37:1 for the projected a/b axes of the assumed triaxial ellipsoid. The table below provides a summary of the individual observation runs.

1589 Fanatica

M. Itzigsohn discovered 1589 Fanatica on 1950 September 13 at La Plata. The name is in honor of Eva Peron whose devotion and enthusiasm for the people of Argentina led her to champion the cause of workers. The name literally means a fanatical woman or feminine zealot. The asteroid has been designated 1935 RD, 1937 CF, 1946 OE, 1950 RK, 1950 TM_3, and A924 WC.

The H value from the MPCORB database 12.00. Using a formula provide by Harris (2003), which assumes the asteroid's albedo (0.18) and type (S) based on the semi-major axis, the approximate diameter is 12 km. Kosai (1979) includes Fanatica in his group 15 along with 11 Parthenope and 17 Thetis. The principal elements are: semi-major axis, 2.417AU; inclination, 5.261°; and eccentricity, 0.0927.

Observations were obtained on three nights in late November and early December, with a total of 261 data points used in the final period analysis (see Figure 2). The synodic period was found to be 2.58±0.05h and the amplitude to be 0.16±0.02m, or a projected

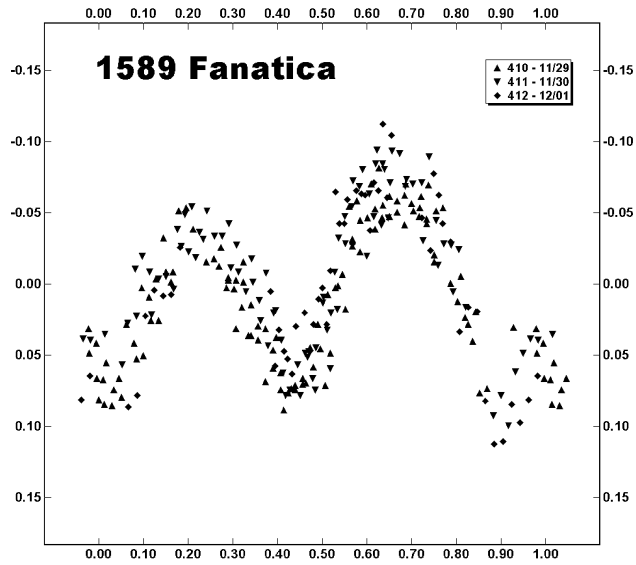

Figure 2. The lightcurve for 1589 Fanatica phased against a synodic period of 2.58±0.05h. The amplitude is 0.16±0.02m.

DATE 2003	Phase Angle	PAB Long	PAB Lat
Nov. 29	7.9	52.7	−4.1
Nov. 30	8.4	52.8	−4.0
Dec. 01	8.9	52.8	-4.0

a/b ratio of 1.16:1 for the assumed triaxial ellipsoid. The table below provides a summary of the individual observation runs.

2778 Tangshan

Tangshan is named for a city in the Hebei province in northern China. It was discovered at the Purple Mountain Observatory at Nanking on 1979 December 14. Its last designation was 1979 XP with its earliest designation being 1948 WL. Using the formula by Harris (2003), the approximate diameter is 8 km when using the MPCORB H value of 13.00 and albedo of 0.18. The principal elements are: semi-major axis, 2.281AU; inclination, 4.616°; and eccentricity 0.1212.

Figure 3 shows the 265 data points obtained on Nov. 26 and Nov. 28, 2003, that were used in the final period analysis. The synodic period of the lightcurve is 3.461±0.020h and its amplitude is 0.25±0.03m, which yields a projected a/b axis ratio of 1.26:1 for the assumed triaxial ellipsoid. The table below provides a summary of the individual observation runs.

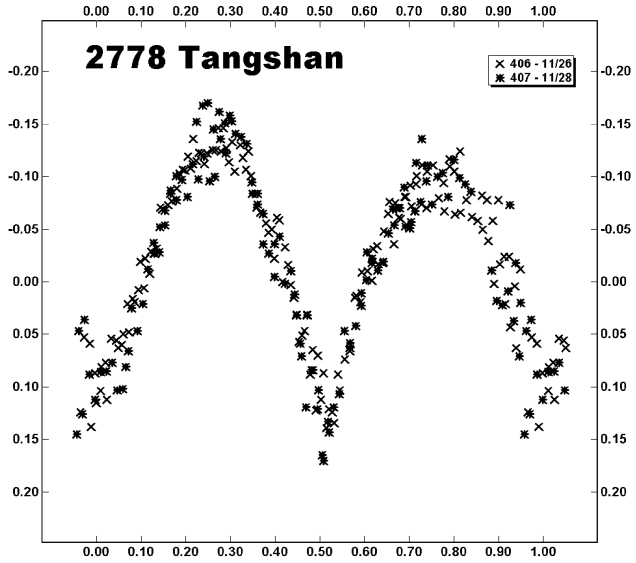

Figure 3. The lightcurve for 2778 Tangshan. The data is phased against a synodic period of 3.461±0.020h. The amplitude is 0.25±0.03m.

DATE 2003	Phase Angle	PAB Long	Lat
Nov. 26	2.5	61.1	−3.4
Nov. 28	3.3	61.2	−3.3

5076 Lebedev-Kumach

Discovered by L. I. Chernykh on 1973 September 26 at Nauchnyj, Lebedev-Kumach is named for Vasilij Ivanovich Lebedev-Kumach (1898-1949), prominent poet and song-writer, known for his lyrical and patriotic verses for songs for many Soviet films. The principal elements are: semi-major axis, 2.416AU; inclination, 9.481°; and eccentricity 0.2327. Assuming an albedo of 0.18 per Harris (2003) and the H value of 13.00 from the MPCORB data file, the approximate diameter is 8 km.

Observations were obtained in October and November 2003, with 150 data points used in the final period analysis. The synodic period of the lightcurve was found to be 3.2190±0.0005h and the amplitude to be 0.14±0.02m. Assuming a triaxial ellipsoid, the amplitude gives a ratio of 1.14:1 for the projected a/b axes. Figure 4 shows a phased plot against this period. The table below provides a summary of the individual observation runs.

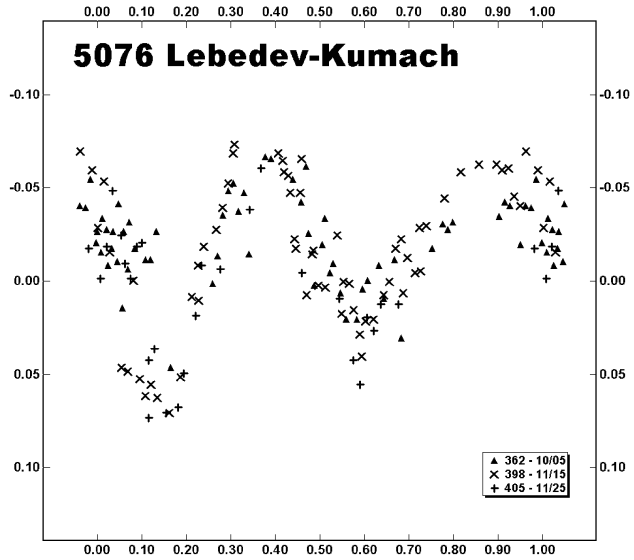

Figure 4. The lightcurve for 5076 Lebedev-Kumach. The synodic period is 3.2190±0.0005h with an amplitude of 0.14±0.02m.

DATE 2003	Phase Angle	PAB Long	Lat
Oct. 05	6.2	2.3	1.1
Nov. 15	25.8	8.8	−2.7
Nov. 25	28.3	11.6	−3.5

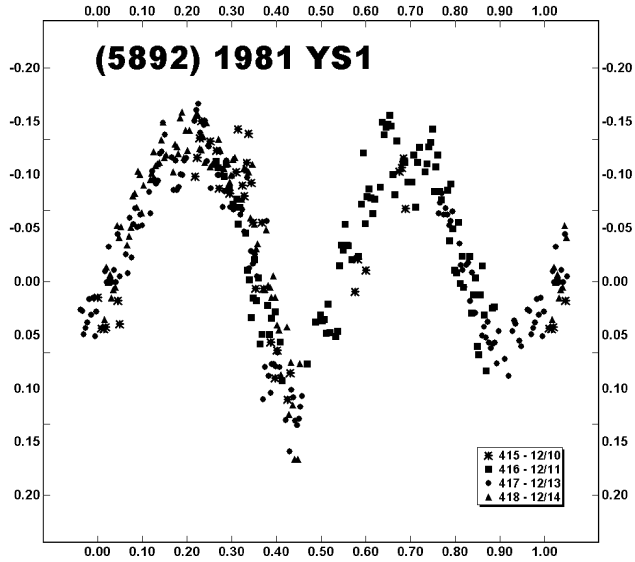

Figure 5. A phased lightcurve for (5892) 1981 YS1 using a synodic period of 10.60±0.02h. The amplitude is 0.26±0.03m.

DATE 2003	Phase Angle	PAB Long	Lat
Dec. 10	12.5	64.0	−7.6
Dec. 11	13.1	64.2	−7.6
Dec. 13	14.2	64.6	-7.6
Dec. 14	14.7	64.8	-7.5

(5892) 1981 YS1

This is another discovery from Purple Mountain Observatory at Nanking (1981 December 23). The asteroid has also carried the designations 1971 BS_1, 1988 QG_1, and 1988 UZ. Again using the formula from Harris (2003) and assumed albedo of 0.18, the H value of 13.60 gives an approximate diameter of 6 km. The principal elements are: semi-major axis, 2.384AU; inclination, 4.585°; and eccentricity 0.3020.

358 observations obtained on four nights in December 2003 were used to find a synodic period for the lightcurve of 10.60±0.02h and amplitude of 0.26±0.03m. The latter implies a ratio of 1.27:1 for the projected a/b axes of a triaxial ellipsoid. Figure 5 shows a phased plot of the observations and the table below gives a summary for each run.

(6386) 1989 NK1

H.E. Holt discovered 1989 NK_1 on 1989 July 10 at Palomar. It has also been designated 1955 RG_1 and 1991 FW_4. Assuming an albedo of 0.18, based on Harris (2003), and using the H value of 12.70 from the MPCORB table, the approximate diameter is 9 km. The principal elements are: semi-major axis, 2.271AU; inclination, 8.737°; and eccentricity 0.3008.

Observations were made in October and November 2003. The 211 data points used for analysis are shown in Figure 6 against the derived synodic period of 3.1381±0.0005h. The amplitude of the curve is 0.08±0.02m. This would give a ratio of 1.08:1 for the projected a/b axes of a triaxial ellipsoid. The table below provides the viewing aspects for each of the observation runs.

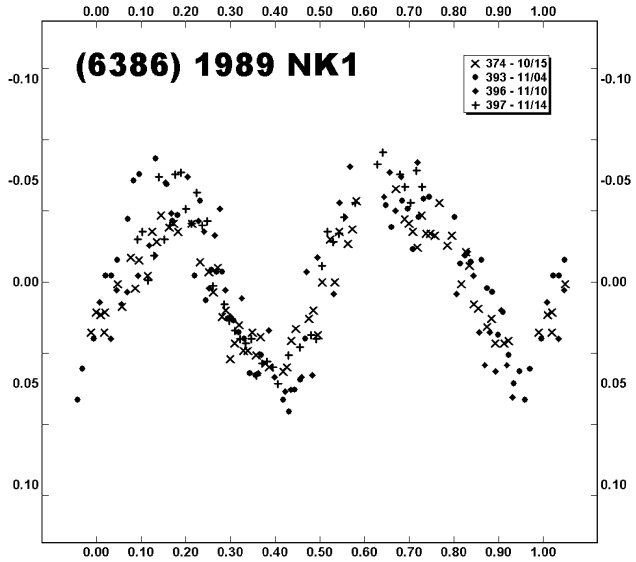

Figure 6. A phased lightcurve for (6386) 1989 NK1 using a synodic period of 3.1381±0.0005h. The amplitude is 0.08±0.02m.

DATE 2003	Phase Angle	PAB Long	PAB Lat
Oct. 15	14.9	27.1	-15.7
Nov. 04	15.9	31.4	-15.4
Nov. 10	17.9	32.8	-15.1
Nov. 14	19.3	33.8	-14.8

Acknowledgments

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References Note: Asteroid names and discovery information are from Schmadel (1999).

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CALL FOR OBSERVATIONS

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Observers who have made visual or photographic measurements of positions of minor planets in calendar 2003 are encouraged to report them to this author on or before April 1, 2004. This will be the deadline for receipt of reports which can be included in the "General Report of Position Observations for 2003," to be published in *MPB* Vol. 31, No. 3.