

PLANETS 1580 BETULIA AND 1620 GEOGRAPHOS IN 1976

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Almost every year the "recreational celestial mechanics" brings us something new. In 1975 we had the closest approach of Eros of the present century, and later the close Pallas-Vesta conjunction. In 1976, it's the interesting motions of 1580 Betulia and 1620 Geographos which have our attention.

Betulia, discovered in 1950, has the highest orbital inclination (52°) of all numbered minor planets. With a perihelion distance of 1.12 AU, Betulia is a member of the Amor group; its orbital eccentricity is high (0.49).

The perihelic oppositions of Betulia repeat at intervals of 13 years (4 times the revolution period of 3.25 years), and it was at such a perihelic opposition that the minor planet was discovered in 1950. The next perihelic opposition took place in 1963, and the next one will occur in 1976.

At a perihelic opposition, Betulia is near the descending node of its orbit, and thus moving rapidly southwards.

Betulia will reach the perihelion of its orbit on 1976 May 3, at 1.119 AU from the Sun, and its descending node on May 24. The opposition in celestial longitude will occur on May 21, and that in right ascension the next day. The least distance to the Earth will occur on May 22; the planetoid will then move six degrees southward with respect to the stars, and will be of photographic magnitude 11.7.

At the beginning of August 1976 Betulia will be a faint object of magnitude 18, at declination -68° in the constellation of Musca.

It is remarkable that in 1976 Betulia will be closer to the Earth than ever since the time of its discovery in 1950. Here are the least distances to the Earth at the three mentioned perihelic oppositions:

1950 May 18		0.188 AU
1963 May 20		0.156 AU
1976 May 22		0.130 AU

Geographos, discovered in 1951, is a member of the Apollo group of minor planets: its perihelion lies inside the Earth's orbit, at 0.827 AU from the Sun.

In 1976 Geographos will not be brighter than magnitude 15, but the interesting point is that the planetoid will be twice in opposition, and between these oppositions the object will be in inferior conjunction with the Sun.

The first opposition will take place on 1976 January 25, this being the date of the opposition in celestial longitude. At that instant Geographos will be 1.41 AU distant from the Sun.

Geographos will cross the Earth's orbit ($r = 1$) on April 14 and accelerate further as it will fly to his perihelion. The minor planet will reach perihelion on June 7; on that date, its heliocentric longitude will increase each day by 1.56 degree (Earth: 0.96 degree). Moving faster than the Earth, Geographos will be in inferior conjunction on 1976 June 12. However, as seen from the Earth, the minor planet will be 42° south of the Sun. Still going faster than Earth, but now receding from the Sun, Geographos will again be at 1 AU from the Sun on July 31, but now preceding the Earth in its motion. Finally, the Earth will again overtake Geographos, resulting in a second opposition on 1976 October 11.

Geographos' extreme distances to the Earth will be as follows:

minimum:	0.385 AU	on 1976 February 22
maximum:	0.413 AU	on 1976 April 4
minimum:	0.271 AU	on 1976 June 23

Oppositions of Geographos are not frequent. Here are the dates when Geographos and the Earth will have the same heliocentric longitude, from A.D. 1977 to 1994:

1979 Dec 12	1986 Dec 25
1983 Feb 28	1990 Nov 17
1983 Apr 11 (inf. conj.)	1994 Jan 8
1983 Nov 3	

These dates have been calculated by the author, without taking perturbations into account; it is expected that they are not more than 1 day in error. Thus these are the dates in the near future when Geographos will be in opposition (in celestial longitude), except in April 1983 when the minor planet will be in inferior conjunction with the Sun. In 1983 we will have a situation similar to that of 1976: two oppositions and one inferior conjunction, although the configuration will not have the symmetry of that of 1976 (see the dates).

MINOR PLANET NEWS

Dr. David W. Dunham of Cincinnati Observatory reports that planet 1 Ceres (magnitude 7.0) will be occulted on 1976 January 13 around 2^h U.T. by an 80% sunlit waxing Moon as seen from a wide area of Latin America. The northern limit for this event crosses El Salvador, Southern Honduras, and passes near Guadeloupe in the Lesser Antilles. The southern limit passes near Arequipa, Peru; La Paz, Bolivia; and north of Rio de Janeiro, Brazil.

Planet 3 Juno will be occulted on 1976 February 16 around 22^h by a 98% sunlit waning Moon for observers in much of Africa and the Indian Ocean. Juno will be magnitude 8.8 at the time. The northern limit passes near the Strait of Gibraltar, northern Algeria, central Tunisia, northern Libya, northern Egypt, the northern Indian Ocean to the sunrise point west of Sumatra. The southern limit of the event passes south of Liberia, enters Africa just north of the equator, passes over southern Lake Tanganyika, the northern tip of Lake Nyasa, central Malagasy Republic, and goes south of Reunion and Mauritius Islands.

Unfortunately none of our present subscribers have addresses in these areas, but possibly some might be travelling in these areas at the time, or may have astronomer friends in these areas whom they might contact.

FOOTNOTES

PERSONAL. The Editor regrets not getting this second part of Vol. 3, no. 2 into subscriber hands much sooner. Due to a serious illness in the family, and heavy teaching responsibilities this past semester (five different courses) he has been hindered, and also fallen behind on correspondence. Your patience is appreciated. A lengthy issue with many promised articles of interest will appear (Lord willing) in 1976 January. Then we should be back on schedule.

THE MINOR PLANET BULLETIN is edited by Prof. Richard G. Hodgson, who is also ALPO Minor Planets Section Recorder. Subscriptions, changes of address and items for publication should be sent to him at Dordt College, Sioux Center, Iowa 51250, U.S.A. His home telephone is (712)-722-4081. Subscriptions are \$ 3.00/yr; air mail overseas (highly recommended) \$ 5.00/yr, U.S. funds preferred. If checked, your subscription expires () with this issue; () with next issue.