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ASTROMETRIC OBSERVATIONS OF COMETS AND ASTEROIDS
AND SUBSEQUENT ORBITAL INVESTIGATIONS

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Semiannual Progress Report No. 30

For the period 1 May through 31 October 1988

Principal Investigators

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ASTROMETRIC OBSERVATIONS OF COMETS AND ASTEROIDS
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1. Personnel

Observations, data reduction and interpretation of results contributing to this research are performed by Principal Investigator R. E. McCrosky and Co-Investigator B. G. Marsden; and by C.-Y. Shao, C. M. Bardwell and D. W. E. Green as members of their research groups. The services of all except Shao, 25 percent of McCrosky and less than 10 percent of Bardwell are provided at no cost to NASA.

2. Observing Program

The 155-cm reflector was used for observations of comets and minor planets on 28 nights during April-October. The exceptionally poor summer weather meant that this was one of the most unsuccessful semesters for observations in many years, and only 123 positions were secured. May was particularly bad, yielding a total of only eight observations and on only two nights. Table 1 lists the 140 measurements, ten of them referring to observations obtained in 1987 and earlier, published in the MPCs since the last report. Twenty-two of the observations refer to comets, 62 to numbered minor planets (numbered, that is, by the end of the semester: only nine of them refer to minor planets already numbered at the time of the last report), and the remainder to unnumbered minor planets.

The observing and measuring has been done by McCrosky and Shao. Most of the checking of the results and the selection of objects to be observed was done by Bardwell. The reductions were mainly done on the NOVA computer at the Oak Ridge Observatory, while the remaining computations were done on a MicroVAX computer in Cambridge.

3. Results of Special Interest

Observations were made of four new comets discovered during the semester and an fifth discovered in January. There were also continuing observations of the interesting comet Wilson (19861), P/Tempel 2 and two other returning short-period comets.

Among the old numbered minor planets observed were the earth-approaching objects (1685) Toro and (1980) Tezcatlipoca, and the earth-approacher 1980 PA was numbered (3908), in part as a result of our observations, the recovery this year being successful because we caused the arc to be extended from six weeks to five months at the discovery apparition. (1685) and (3908) were the objectives of radar-bouncing efforts. We also followed up the new earth-approaching discoveries 1988 NF, PA, RO1, SM and TA.

The following minor planets were numbered entirely as the result of our observations: (3835) 1977 SD3, (3836) 1979 SR9, (3841) 1983 VG7, (3848) 1982 FH3, (3853) 1981 WGI, (3856) 1976 QX, (3885) 1979 HG5, (3892) 1941 HD, (3894) 1980 PQ2, (3902) 1986 AL, (3905) 1984 QO and (3919) 1984 DS.

4. Orbital Investigations

Computations of preliminary and improved orbits continued in routine fashion. Following our discovery that two of the comets we observed, 1988e and 1988g, had practically identical orbits (but were separated by 76 days), we made a detailed study of the relationship, suggesting that the two comets separated from each other at their previous perihelion passage, some 13 000 years ago, but that the components were orbiting around each other until the relative nongravitational force on them allowed them to escape from each other, evidently at some rather considerable distance from the sun.

5. Publications

Observations from Oak Ridge plates are included in the following publications issued during this half year: Minor Planet Circ. Nos. 13107-13111, 13134-13135, 13222-13224, 13239, 13355-13364, 13402, 13492-13493, 13538-13539, 13636-13640 and 13670-13671; IAU Circ. Nos. 4631, 4637, 4642, 4661 and 4662. Orbital computations are on Minor Planet Circ. Nos. 13143-13145, 13164-13171, 13292-13294, 13304-13314, 13434-13436, 13452-13471, 13580-13596 and 13673-13682; IAU Circ. Nos. 4599-4600, 4615, 4619, 4621, 4627, 4631, 4637-4639, 4642-4643, 4648, 4660-4662 and 4668.

Table 1

Positional measurements

The successive columns give the object's designation (/ = comet, * = new discovery), the UT date and time, the right ascension (in hours, minutes and seconds) and declination (in degrees, minutes and seconds) -- equinox 1950.0.

/1986l	1988	04	20.04276	06	48	26.39	+21	46	15.6
/1987g	1988	06	10.13630	15	35	58.45	+03	14	34.7
/1987g	1988	07	11.12219	15	24	15.58	-03	30	07.8
/1987g	1988	08	09.07873	15	52	37.58	-13	42	33.7
/1987g	1988	08	16.05755	16	05	23.03	-16	19	09.6
/1987g	1988	09	12.01572	17	14	42.79	-25	25	31.9
/1987p	1988	04	13.10344	07	08	53.46	+52	26	45.2
/1987p	1988	04	20.08968	07	32	32.28	+51	33	03.6
/1987r	1988	04	14.06032	06	02	47.34	+23	32	58.7
/1988a	1988	06	12.11114	11	12	46.35	+46	27	14.5
/1988a	1988	06	15.10797	11	20	40.84	+43	28	11.6
/1988a	1988	07	11.09981	12	06	15.10	+23	37	44.3
/1988e	1988	05	15.30110	22	30	23.22	+42	02	24.8
/1988g	1988	06	12.24741	22	16	29.94	+42	27	23.7
/1988g	1988	07	14.14356	21	33	14.04	+56	12	21.9
/1988h	1988	07	11.16911	19	46	59.03	+15	36	09.0
/1988h	1988	08	09.14049	19	13	37.37	+09	27	40.0
/1988h	1988	08	13.08792	19	09	23.15	+08	24	17.8
/1988h	1988	09	09.11461	18	46	51.79	+00	37	04.2
/1988h	1988	09	11.12834	18	45	44.25	+00	02	03.7
/1988j	1988	08	09.35080	04	58	30.41	+00	24	48.5
/1988j	1988	08	09.35829	04	58	33.30	+00	24	47.0
929	1988	09	12.26800	23	02	19.19	+00	42	23.4
929	1988	09	15.31087	22	59	32.16	+00	19	50.1
951	1988	09	09.03677	18	08	07.90	-19	28	16.5
1685	1988	06	11.30953	21	25	59.15	-11	59	54.6
1685	1988	06	14.29653	21	31	13.13	-10	45	06.6
1685	1988	07	11.29086	22	27	57.31	+08	47	35.2
1980	1988	06	11.27143	17	07	19.27	-05	47	57.2
1980	1988	07	14.10779	16	16	33.07	+12	47	23.3
3451	1988	09	12.26800	23	03	40.03	+01	02	21.6
3834	1988	04	13.19023	12	25	38.95	+16	51	28.3
3835	1988	03	19.17702	12	14	38.64	+00	44	03.1
3835	1988	04	13.14238	11	56	39.55	+04	11	38.6
3845	1988	04	18.14867	11	52	48.85	+00	19	49.0
3846	1988	04	19.23356	13	25	35.67	-13	31	09.9
3847	1988	04	18.17658	11	54	14.12	+05	04	42.7
3853	1988	04	18.22538	13	14	00.35	+04	18	28.8
3853	1988	05	15.18384	12	58	13.16	+05	34	45.7
3856	1987	11	19.42802	07	36	54.81	+23	26	55.1
3856	1988	02	17.06623	06	39	27.03	+24	45	12.2
3857	1985	09	12.19283	23	01	02.57	-11	17	35.6
3857	1988	04	20.27950	15	01	20.80	-16	04	02.8
3860	1987	11	21.37419	06	23	13.88	+28	26	32.2
3861	1988	04	20.31074	16	32	24.25	-16	36	40.0
3861	1988	06	10.15922	15	54	18.41	-12	40	37.9
3862	1988	05	15.23273	14	22	43.99	+01	30	11.8
3862	1988	06	14.12064	14	07	40.61	-00	33	00.5
3863	1988	04	13.30689	15	37	39.83	-07	48	12.5
3863	1988	05	13.25707	15	15	07.11	-03	39	19.6
3868	1987	05	02.05016	09	55	28.59	+12	13	50.4
3868	1988	06	14.24992	18	17	39.61	-09	13	46.6
3868	1988	07	14.20255	17	49	44.50	-09	58	05.5
3872	1988	04	14.34881	16	10	39.79	-05	10	35.7
3877	1988	05	15.11604	10	15	51.77	-04	02	05.9
3881	1988	03	18.37335	12	35	39.56	-00	19	00.2
3881	1988	04	13.16714	12	12	02.05	+01	33	34.5
3882	1988	04	14.30212	15	15	00.02	-14	27	06.7

3883		1988	04	14.32447	16	08	55.69	-04	34	05.4
3883		1988	05	13.27998	15	50	45.58	-01	11	03.0
3885		1988	04	19.25883	14	07	51.04	-04	46	08.6
3885		1988	05	15.21031	13	48	09.62	-02	54	24.8
3888		1987	02	25.15169	07	54	40.31	-01	42	59.6
3888		1988	06	12.30848	20	19	38.69	+18	53	13.1
3892		1988	07	11.24790	21	24	51.45	-03	37	49.0
3892		1988	08	09.22832	21	04	11.65	-07	19	00.4
3893		1988	05	15.26580	19	25	45.24	+12	42	40.9
3893		1988	06	11.29234	19	34	47.51	+21	25	10.0
3893		1988	06	15.26347	19	34	15.33	+22	26	38.9
3894		1988	07	14.17260	16	55	17.40	-02	45	26.1
3894		1988	08	10.07857	16	52	31.50	-05	56	48.5
3902		1988	07	11.22454	20	39	27.08	-14	54	54.4
3902		1988	08	10.19964	20	13	39.45	-14	01	26.0
3905		1988	08	10.31725	22	45	24.76	-13	55	34.7
3905		1988	09	14.15588	22	07	57.83	-13	56	44.0
3906		1988	09	14.28848	00	04	20.98	-18	36	11.6
3907		1988	07	11.26758	21	52	41.02	-03	51	14.9
3907		1988	08	09.24466	21	32	38.62	-02	44	38.1
3908		1988	08	09.20517	21	56	31.26	-03	49	08.7
3908		1988	09	09.22575	22	07	32.02	+08	22	53.2
3908		1988	09	12.18368	22	11	08.23	+10	24	46.5
3913		1988	08	09.32991	22	52	04.00	-05	12	22.3
3919		1988	06	14.18740	17	18	55.71	-14	35	17.6
3919		1988	08	10.09973	17	05	54.03	-17	35	39.6
1931	UE	1988	03	18.12331	08	05	32.16	+19	22	11.3
1948	WF	1988	06	14.16654	17	11	30.40	-12	48	26.5
1971	OH	1988	06	12.20823	18	22	57.50	-05	38	46.6
1971	OH	1988	07	14.22102	17	53	55.88	-06	52	04.0
1977	CD	1988	04	18.27483	13	50	23.18	+07	55	04.2
1977	CU	1988	08	09.31333	22	27	13.01	-10	23	24.8
1977	QW2	1988	08	13.23330	22	20	17.38	-02	24	00.1
1977	RH7	1988	09	14.31718	00	02	54.95	-03	30	19.9
1977	SS2	1988	08	13.30807	23	10	09.30	-02	33	51.0
1977	SS2	1988	09	09.28611	22	55	19.00	-07	05	56.6
1978	RS	1988	08	10.25725	21	34	12.68	-14	02	01.9
1978	RS	1988	09	16.10563	21	07	39.78	-15	07	38.7
1978	TU5	1988	08	10.23471	21	20	10.41	-14	18	30.3
1981	JA2	1987	02	28.20058	09	22	41.28	+12	05	57.6
1981	WG9	1987	05	02.19563	13	29	07.77	-05	15	59.8
1981	WG9	1988	08	13.28962	22	38	03.30	-08	19	02.3
1981	WG9	1988	09	14.17758	22	12	35.35	-11	51	02.2
1982	TL1	1987	11	23.05711	00	16	55.52	+03	47	49.4
1982	UP6	1988	06	12.12607	14	08	14.34	-02	39	53.6
1982	UP6	1988	07	16.08318	14	30	47.02	+00	02	58.0
1982	UG7	1988	08	10.34072	22	49	28.03	-02	22	50.1
1982	UG7	1988	09	12.24732	22	26	55.38	-05	29	46.1
1983	AY	1988	09	12.16017	21	42	29.32	-06	22	51.1
1983	BE	1988	04	18.04047	07	58	44.83	+26	29	15.6
1984	EN	1988	04	19.20883	13	15	29.51	-13	57	42.6
1985	PB1	1988	06	10.18833	15	58	27.73	-10	39	51.4
1985	RF	1988	06	15.19580	16	35	48.67	-16	50	58.5
1985	UL	1988	09	12.26800	23	02	10.68	+01	04	19.5
1985	UL	1988	09	15.31087	22	59	17.87	+00	43	54.7
1985	VK2	1988	04	20.06977	08	39	33.56	+41	14	57.5
1986	CH	1988	08	09.27036	21	35	51.66	-03	07	23.2
1986	RC2	1988	04	14.21696	13	03	33.74	+07	28	14.1

1986	TM	1988	04	13.12372	11	56	17.14	+05	40	17.0
1987	OV1 *	1987	07	29.30547	21	48	03.04	-07	56	07.2
1987	QG9 *	1987	08	22.19266	21	25	09.84	-10	28	20.1
1988	BN	1988	04	14.02782	08	50	30.54	-03	05	59.7
1988	BX1	1988	03	17.12842	07	06	30.04	+44	27	50.7
1988	BX1	1988	04	13.08119	07	15	07.99	+43	28	32.6
1988	BY1	1988	03	17.15385	07	28	48.42	+45	05	23.2
1988	BY1	1988	04	13.05297	07	36	39.51	+43	09	13.2
1988	DE2	1988	02	19.19590	07	40	47.73	+24	42	06.9
1988	JB1	1988	07	11.14682	17	01	36.97	+08	29	42.8
1988	JB1	1988	08	09.10138	17	11	07.22	-00	24	20.2
1988	NF	1988	08	09.18690	23	28	58.49	+49	45	38.0
1988	NF	1988	09	15.37086	23	53	10.38	+59	55	22.0
1988	NF	1988	09	15.38175	23	53	10.47	+59	55	22.6
1988	NF	1988	10	06.40941	23	59	16.80	+57	13	55.6
1988	PA	1988	08	16.26060	20	37	19.56	-04	50	43.2
1988	PA	1988	08	16.28420	20	37	21.17	-04	51	21.6
1988	PA	1988	09	09.14761	21	13	04.65	-13	58	45.6
1988	ROI	1988	10	06.17148	00	36	07.81	-03	14	35.4
1988	SM	1988	10	07.09096	22	21	01.16	-05	03	21.2
1988	TA	1988	10	10.32720	01	27	10.10	+07	35	31.7
1988	TA	1988	10	13.18552	01	24	35.41	+06	20	38.3
2321	T-3	1988	08	09.29242	22	11	44.64	-00	18	22.5
2321	T-3	1988	09	09.17317	21	46	06.65	-02	54	33.5

Addendum

The final stage of the work authorized as a special supplement to this grant in connection with supernova 1987A in the Large Magellanic Cloud was essentially completed during this semester.

Arrangements were completed in July allowing the IAU Circulars to be e-mailed to institutions and individuals who subscribe to the Central Bureau for Astronomical Telegrams' Computer Service. More than half of the 140 Computer Service subscribers are now being serviced in this way. The possibility that users can still also log in to a MicroVAX to obtain the Circulars is very desirable because of the delays and losses all too frequently experienced with e-mail.

As discussed in the last report, ports were finally inserted on the MicroVAX CFAPS2 in September. This immediately allowed us to use the MicroVAXes, rather than two antiquated TWX machines, for communication by telex and over other commercial networks. Modernization is therefore complete.

The supernova still continues to be of interest, but the number of IAU Circulars devoted to it has now become rather small. Somewhat surprisingly, although professional interest remains, the monitoring of the supernova's brightness by amateur astronomers dropped dramatically during this semester, even though the object is still significantly brighter than the novae that occur in the LMC from time to time and command a fair bit of amateur interest.