Occultation Newsletter

Volume V, Number 10 January, 1993 ISBN 0737-6766

Published quarterly by the International Occultation
Timing Association
Joan B. Dunham-Editor

Occultation Newsletter

Volume V, Number 10 January, 1993 ISBN 0737-6766

Occultation Newsletter is published by the International Occultation Timing Association. Editor: Joan Bixby Dunham; 7006 Megan Lane; Greenbelt, MD 20770-3012; U.S.A. Please send editorial matters to the above. Send new and renewal memberships and subscriptions, back issue requests, address changes, graze prediction requests, reimbursement requests, special requests, and other IOTA business, but not observation reports, to: Craig and Terri McManus; 1177 Collins; Topeka, KS 66604-1524; U.S.A.

FROM THE PUBLISHER

For subscription purposes, this is the fourth issue of 1992. It is the tenth issue of Volume 5. IOTA annual membership dues, including **ON** and supplements for

U.S.A., Canada, and Mexico	$25.00
for all others	30.00

Annual IOTA membership dues may be paid by check drawn on an American bank, money order, cash, or by charge to Visa or MasterCard. If you use Visa or MasterCard, include your account number, the expiration date, and your signature.

ON subscription (1 year = 4 issues)

for U.S.A., Canada, and Mexico	20.00
for all others	25.00

Single issues are 1/4 of the price shown.

Although they are available to IOTA members without charge, nonmembers must pay for these items:

Local circumstance (asteroidal appulse) predictions	1.00
Graze limit and profile predictions (per graze)	1.50
Papers explaining the use of the predictions	2.50

Asteroidal occultation supplements will be available at extra cost: for South America via Ignacio Ferrin (Apartado 700; Merida 5101-A; Venezuela), for Europe via Roland Boninsegna (Rue de Mariembourg, 33; B-6381 DOURBES; Belgium) or IOTA/ES (see below), for southern Africa via M. D. Overbeek (Box 212; Edenvale 1610; Republic of South Africa), for Australia and New Zealand via Graham Blow (P.O. Box 2241; Wellington, New Zealand), and for Japan via Toshio Hirose (1-13 Shimomaruko 1-chome; Ota-ku, Tokyo 146, Japan). Supplements for all other areas will be available from Jim Stamm (117891 N. Joi Drive; Tucson, AZ 85737; U.S.A.) for $2.50.

Observers from Europe and the British isles should join IOTA/ES, sending DM 40.- to the account IOTA/ES; Bartold-Knaust Strasse 8; 3000 Hannover 91; Postgiro Hannover 555 829 - 303; bank-code-number (Bankleitzahl) 250 100 30.

IOTA NEWS

David W. Dunham

Membership Roster: It is time to update IOTA's membership roster; a new edition is planned for distribution with issue 12 in late April. By the end of March, you should communicate any updates to the McManuses in Topeka to their address in the masthead. We especially want to include telephone and fax numbers, and e-mail addresses, of IOTA members and ON subscribers, to help with rapid dissemination of time-critical events such as astrometric updates of asteroidal occultation predictions. We have telephone numbers for most members from returned information forms; let us know if you do not want your phone number published in the roster. Updates can be sent by e-mail to the McManuses, as described in the next paragraph.

New Electronic Mail Addresses: On p. 224 of the last issue, I gave my Internet e-mail address. I have learned that a more robust address for outside users is: david_dunham@jhuapl.edu
This avoids specification of my host computer for e-mail, which apparently is not known to some systems (a few users never were able to reach me at the previous address, although I could send messages to them). With both my first and last names specified, the e-mail system at Applied Physics Laboratory can find my host computer to route the message. If for some reason that doesn't work, it prints the message and it is sent to me by internal mail. The McManuses can also now be reached by e-mail; from Internet, their address is: 570-0611@mcimail.com
Either I.O.T.A. or CMcManus can be used in place of

the number preceding the "@", but the number is a more robust specification.

FAX We have purchased a FAX/Modem for our home computer. We expect to use it primarily for sending FAXes, but we can, by pre-arrangement, receive them. The FAX/modem will be using the same telephone line as the occultation line answering machine (301,474 4945). We do not have a way of sharing the use of the answering machine, and FAX/-modem on that line except manually. We were offered some hardware that will monitor the type of call coming in and turn on the computer if it is a modem or a FAX, but that doesn't seem particularly practical for our machine. Our machine, a ZEOS 486/66, takes nearly a minute to start up when turned on, by which time most FAXes trying to send a FAX would have given up. We are still testing our FAX/modem. The modem part works fine. We wanted to use the FAX with WinFax Pro 3.0, but the installation program supplied with that software crashes before it finishes.

North American Asteroidal Occultation Supplement for 1993: Predictions of asteroidal occultations visible from North America during 1993, generated by Edwin Goffin, with events selected by Jim Stamm and charts annotated by David Werner, were distributed separately early this month, before the first event, rather than with the last issue, as stated in that issue.

Graze Supplements for 1993: Eberhard Riedel in Germany has used the coastline/border data supplied by me, and his own graze calculations, to generate maps and tables for 1993 hemispheric grazing occultation supplements in a form very similar to those that I have produced during the past few years. The tables do not include Z.C. numbers or double-star data, so I plan to write small programs to read the tables (that were supplied as ASCII files on disk) to add these data as soon as this issue of **ON** is completed. You should be receiving the graze supplement for your hemisphere within about two weeks, probably with the next issue, as noted at the end of this article.

Use of the Hubble Space Telescope (HST) by Amateur Astronomers: A news note inviting amateur astronomers to submit proposals to use HST was published on p. 14 of the February issue of **Sky and Telescope**. The annual April 30th deadline was mutually agreed upon by Steve Edberg, chairman of the (HST) Amateur Astronomers Working Group, and the Space Telescope Science Institute. A form and useful information for writing amateur astronomer HST proposals are available from the Amateur Astronomers Working Group; c/o AAVSO; 25 Birch St.; Cambridge, MA 02138.

Change in ON Production: IOTA member Tony Murray in Georgetown, GA, said that he could duplicate ON at the print shop where he works, and include a cover, for less than we can duplicate it in this area, so this issue will be copied by him. Joan and I thank him for these efforts. Also, this issue will really be distributed from Topeka, KS, rather than from Greenbelt, MD; we thank the McManuses for their work with this.

Next Issue: The main purpose of this issue is to provide IOTA's information about planetary and asteroidal occultations during 1993. Extra work of updating predictions of occultations by (4179) Toutatis, other work, and the holidays prevented me from preparing the 1993 asteroidal occultation data before the start of 1993. The next issue will be distributed in about two weeks and will include important but not as time-critical articles and information that were not included in this issue. Unfortunately, just before printing this issue, the hard disk controller on our new PC misbehaved. Joan managed to recover the critical **ON** files and print this issue, but we will not be able to optimize the page layout of this issue as well as we would like. Because of the volume of material and our delayed schedule, we are effectively breaking up this issue into two issues, so that the next issue will put us approximately back on schedule. The issue after the next one, that is, #12, will contain information about occultations during the June 4th total lunar eclipse. If you plan to submit an article for that issue, we should have it by the second week of April.

CORRECTIONS TO **ON 5**, (5) and (9)

On p. 243 of the last issue, the 3rd sentence of the first full paragraph in the right-hand column should be "SAO 76225 should read SAO 76255". Also, 2 lines above that entry in the table on p. 118 of **ON 5** (5), SAO 975990 should read SAO 075990.

A SOURCE FOR TIMEKUBES

Bob Nederman

As mentioned on p. 223 of the last issue, Tandy Corporation is no longer distributing the easy-to-use time source, the Weatheradio-Timekube, and by now has probably sold off all their remaining units in stock. My company, Astronomical Innovations; P.O. Box 14853; Lenexa, KS 66285, has a supply of 500 of these astronomically useful radios. We are selling them for $22.95 plus $2.05 for shipping, for a normal order of $25 per unit, substantially less than Radio Shack's normal ($39.95 pre-close-out) retail price; a check or money order should be in USA dollars payable to Astronomical Innovations. Orders can be placed by telephone at 1-913-894-5775. Inquire about overseas shipping, which will generally add about $5 to the cost. Our supply should satisfy the astronomical community for 2 or 3 years, after which time Tandy Corporation may start selling the Weatheradio--Timekube, or an equivalent item, again. Until recently, Tandy Corp. did not realize that there was a continuing need for Timekubes in the astronomical community.

SOLAR SYSTEM OCCULTATIONS DURING 1993

David W. Dunham

General: My predictions of occultations of stars by major and minor planets, and by two comets, for 1993 are given in two tables whose contents are described in my articles about predictions of Solar System occultations for 1991 and 1992 in **ON 5** (2) and in **ON 5** (6). Most of the asteroidal occultation prediction material distributed by IOTA was prepared by Edwin Goffin in Belgium and is discussed in the third section. Sources of the predictions, other information, including stellar diameters (when significant), and notes about individual events, are given in the last sections.

For 1993, my annual **Sky and Telescope** article on planetary occultations was published in the February issue, pp. 76-77. Since that article is now limited to only North American events, and no good occultations of major planets occur there, the article was entitled "Asteroid Occultations for 1993". Since there were no events in January, and **Sky and Telescope**'s January issue was full, they decided to run the article in their February issue. **ON** was referenced for events outside of North America.

Reporting Observations: Reports of observations of any of these events should be sent to Jim Stamm; 11781 N. Joi Drive; Tucson, AZ 85737; U.S.A. (see his article elsewhere in this issue). Report positive or negative observations made under good conditions, but clouded-out attempts need not be reported. If a definite occultation is seen that could use some analysis for comparison with others, also send copies of the report to me at 7006 Megan Lane; Greenbelt, MD 20770; U.S.A., and to the chairman of the International Astronomical Union's (I.A.U.) Commission 20 Working Group on Predictions of Occultations by Satellites and Minor Planets, who is Lawrence Wasserman; Lowell Observatory; Mars Hill Road, 1400 West; Flagstaff, AZ 86001; U.S.A. Alternatively, observers may send their reports to their local or regional coordinators, who can then send the results to Stamm, and, when appropriate, to Lowell Observatory. The addresses of the regional coordinators are given in "From the Publisher" on p. 255 of this issue. Forms for reporting the observations can be obtained from Stamm or from the regional coordinators. Please indicate on the forms to whom copies are being sent. These forms are preferred, but the forms of the International Lunar Occultation Centre (ILOC), or the equivalent IOTA/ILOC graze report forms, can be used for reporting timed occultations or appulses. The main difference from reporting lunar events is that the name of the occulting body should be written prominently at the top of the form, and the report should be sent to neither ILOC in Japan nor to Richard Wilds. Also, if the asteroid is visible, the time that it merged with the star to form one apparent object, and the time the two were again noticeably separated, should be reported, with an estimate of whether the asteroid passed north or south of the star, if possible. Copies of the ILOC forms can be obtained from ILOC, from the IOTA secretary-treasurer (the McManuses in Topeka, KS), or from Richard Wilds; 3630 SW Belle Ave.; Topeka, KS 66614; U.S.A.

Event Selection: I made computer comparisons of my combined catalog with ephemerides of all of the major planets, comet P/Swift-Tuttle, the giant comet

P/Schwassmann-Wachmann 1 (P/Sm-Wm-1), and all minor planets for which Edwin Goffin predicted (see section below) at least one event under the selection conditions that we used for the main part of the North American Asteroidal Occultation Supplement for 1992: The star must be brighter than mag. 12.6; the magnitude drop must be at least 0.5; and for angular diameters smaller than 0".021, the star must be brighter than mag. 5.1; 0".021 to 0".050, brighter than mag. 6.1; 0".051 to 0".060, brighter than mag. 7.1; 0".061 to 0".070, brighter than mag. 8.1; and 0".071 to 0".079, brighter than mag. 9.1. In a few cases, these conditions were violated, such as for interesting objects (mainly, unusual light curves that may indicate duplicity) like 44 Nysa, 288 Glauke, 624 Hektor, 1220 Crocus, 2060 Chiron, 3123 Dunham, 5145 Pholus, and the two comets mentioned above. In a few cases, stars just slightly fainter than these limits were accepted when Goffin's prediction indicated that the path might pass over areas with large numbers of observers. The numbers of the minor planets included in my combined catalog searches included 2-4, 8-13, 15, 16, 18-20, 24, 27, 30, 31, 44-46, 49, 51, 52, 56, 58, 59, 70, 75, 78, 80, 85, 87-9, 97, 105, 107, 114, 141, 144, 146, 156, 171, 176, 181, 183, 203, 206, 216, 227, 236, 238, 258, 288, 303, 304, 324, 354, 357, 358, 407, 409, 410, 426, 444, 449, 451, 498, 511, 521, 532, 554, 566, 596, 624, 638, 654, 680, 704, 709, 712, 735, 772, 776, 895, 910, 1220, 2060, 3123, and 5145. Most of these asteroids were selected because occultations by them had been found earlier by Goffin or by Lawrence Wasserman at Lowell Observatory. For many of the asteroids numbered in the high hundreds, those mainly with angular diameters less than 0".08, the searches were not performed for the whole year but only for a period of a few weeks centered on the date of events found by Goffin and Wasserman. In addition, Fresneau Astrographic Catalog (FAC; contains stars to 13th magnitude from declinations +4° to +32°) comparisons were made for 3, 10, 45, 52, 87, 107, 146, 511, 2060, 3123, 5145, and P/Sm-Wm-1. No FAC searches were done for some interesting objects simply because the ephemeris of the object remained outside the declination range of the FAC during all of 1993.

Note that 1 Ceres was not included in the searches. There is one 1993 prediction of an occultation by Ceres listed in my article in **ON** 5 (8), p. 205, where a note discusses the extreme difficulty of the event, such that there is no need to include it in the main 1993 list in this issue.

Asteroidal Occultation Predictions by E. Goffin: The 1993 Asteroidal Occultation Supplement for North American Observers, prepared by Edwin Goffin with finder charts annotated by David Werner, were distributed separately early this month for IOTA members and **ON** subscribers in North America. Copies of Goffin's predictions and charts applicable to other parts of the world were sent by Jim Stamm a few months ago to regional coordinators for distribution to members and subscribers in their regions. For his 1993 predictions, Goffin converted his software to J2000 and used the new Positions and Proper Motions (PPM) J2000 star catalog, augmented with some other catalogs such as the FK5 and my version of the combined Lick-Voyager catalogs converted by him to J2000, rather than my Combined Catalog (CC). For a few asteroids, Goffin also used my version of Fresneau's Astrographic Catalog (FAC) that he converted to J2000. In a few cases, Goffin found occultations of PPM stars that are not in CC. For these, I converted Goffin's J2000 positions to B1950 and manually edited datasets to compute these events, usually successfully. In spite of the different catalogs and systems (my software and catalogs are still B1950), most of our predicted events are in common, and our predicted paths for the common events are generally (but not always) in good agreement. Consequently, we need to publish only a few finder charts in the regular issues of **ON**, since they have already been distributed with Goffin's predictions. In a few cases, we may publish 1° charts for some of the more crowded star fields on Goffin's charts, to facilitate locating the star to be occulted (the "target star"). These will be published alone, to be used in conjunction with Goffin's broader-field charts. Remember that the 1° charts are generated mostly from FAC. They are not needed as much for 1993 as they were for 1992, since Goffin has blown up many of the crowded fields of his plots to prevent this problem.

Comparison with the True Visual Magnitude Atlas (TVMA) often shows that some FAC stars are brighter, fainter, or very faint relative to their plotted magnitudes, indicated with B, F, or VF, respectively. "N" indicates that the star is not shown in TVMA.

Of the events found by Goffin that I tried to com-

pute, I failed for only one occultation, an occultation of 6.4-mag. PPM 574869 (= SAO 207178) by 680 Genoveva that Goffin predicted for Australia on August 24th. My calculation shows that the closest approach will occur a day earlier with the asteroid missing the star by 4'. We both used orbital elements from MPC 16391, so this discrepancy remains unexplained.

Most of the PPM stars have SAO numbers, which I prefer to use, considering the more widespread availability of the SAO catalog. Also, Goffin assigned sequential numbers to some of the catalog sources, including the FAC, where the stars remain unnumbered in my version. For the Lick-Voyager catalogs, DM numbers are often given (especially for L 3 and L 5 (Lick-Uranus and Lick-Neptune) stars in Sagittarius and Capricornus. Goffin only gave the four least significant digits of the DM numbers of these stars, most of which are from the Cordoba Durchmusterung (all Lick DM numbers south of -22°), where the numbers are all in the 10,000's for stars in Sagittarius and Capricornus. So 10,000 needs to be added to the DM numbers for these stars in Goffin's predictions, for example, for most of the stars occulted by 24 Themis.

Explanation of Data in Tables 1-3: A complete explanation of the data in Table 1, and a partial explanation (actually, covering most of it) of the data in Table 2, was given in my article, "Solar System Occultations during 1991", in **ON 5** (#2, December 1990), starting on p. 39. The explanation of the rest of the Table 2 data was given in my article, "Solar System Occultations during 1992", in **ON 5** (#6, December 1991), starting on p. 132, and an explanation of Table 3 starts on p. 133 of the same article.

Local Circumstance/Appulse Predictions: Joseph E. Carroll; 4261 Queen's Way; Minnetonka, MN 55345; USA, computes the IOTA appulse predictions for all IOTA members. Note that the star source code logic of this program has not been updated, so that the source codes in the appulse predictions will sometimes differ from that given under S in Table 2 described above. In case of disagreements, use the Table 2 code. Hans-Joachim Bode distributes similar predictions to IOTA/ES members. The format of these predictions is nearly self-explanatory and contains virtually all of the information that an observer needs. Columns headed D and S following the SAO number give the double star code and star position source code (but see the remark above), respectively. Next are the star's DM/ID No., then the star's MAG (visual mag.), OCC. DMAG (occultation magnitude drop), and DUR SEC (central occultation duration in seconds). This is followed by the U.T. and distances (in arc seconds, kilometers on the sky plane, and in terms of object diameter) of local closest approach. The distances are positive if the asteroid passes north of the star (this means that the path would be south of the observer's location). The elongation (ELG, angular distance from the star) of the Sun and Moon are given, as is also the Moon's percent sunlit (PSNL).

World Maps: World maps by Mitsuru Sôma are published here only if the event is not included in Goffin's predictions; or if the star is mag. 8.0 or brighter; or if the star is double, and I have drawn a line showing the 2nd component path; or if there is more than about 0".5 discrepancy with Goffin's prediction; or if there is a recent astrometric update. The charts show the Earth as seen from the asteroid at the time of the event; the hatched curve marks the sunrise or sunset terminator, with hatches on the night side.

Regional Maps: The three regional maps showing quarterly Solar System occultations between latitudes +65° and -50° starting on p. 264 are like the ones for the Toutatis occultations starting on p. 237 of the last issue, rather than like the old quarterly maps, such as the ones starting on p. 251 of the last issue. That is, except for some of the occultations by major planets, they will have time lines at 2-minute intervals, but will not have longitude or latitude tick-marks or labels, and the paths will be hand-labelled. "Time lines" that seem out of sequence, or slant the wrong way, are moonrise or moonset lines. The enclosing rectangles will have the same latitudes and longitudes, and the plots are still false projections with horizontal and vertical scales both linear to facilitate plotting or measuring of coordinates. The charts cover the 4 months from February through May, since this issue is too late for the January events, and **ON 5** (12) needs to be distributed in time for the June 4th lunar eclipse.

Finder Charts: Previously, I produced 3° and 1° charts for many events not predicted by E. Goffin. I have not had time to regenerate this capability since losing access to the necessary hardware last September. I plan to produce unlabelled star charts, which can be manually labelled, in time for the next issue.

Table 1
Part A

1993 Date	Universal Time	PLANET Name	Mv	Δ,AU	STAR SAO No	Mv	Sp	TARGET R.A.(1950)	Dec.	Occultation Δm	Dur	Df	P	Possible Path Lo1	La1	Lom	Lam	Loe	Lae	El Sun	M El	O %Snl	O N up	Ephem. Source
Jan 8	10h35m	Jupiter	-2.0	5.289		11.7		12h51m5s	-4° 4'	6959s	45	2	North America, Colombia							94°	87°	100+	all	DE130
Jan 14	0 22-46	Mars	-1.4	0.638	79105	9.2	F5	7 5.7	26 43	935	22	1	48	28	-15	-4	-84	14		170	84	63-	e 26W	DE130
Jan 24	4 21-23	Nemausa	12.2	2.192	158927	7.7	A0	14 54.9	-12 26	4.5 6	12	23	-28	44	0	37	31	31		79	94	2+	none	Goffin87
Jan 25	12 15	Sylvia	12.6	3.010	93401	9.2	K0	3 18.5	17 5	3.5 36	45	16	s.e. Australia?n							107	77	7+	w120E	MPC11507
Jan 27	2 48-81	Mars	-1.0	0.686	78784	8.3	A0	6 46.9	27 4	1304	31	1	1-21	-59	-1	-125	-10			154	106	16+	w 90W	DE130
Jan 31	2 4	Bamberga	11.6	2.210	99138	8.9	F5	10 25.1	10 8	2.8 16	21	14	(Arctic, Lapland)?s							156	112	51+	w 20W	MPC11724
Feb 4	5 4-27	P/Sm-Wm-1	13.2	5.392		11.2		5 9.5	30 24	2.2 15	68	78	-29	43	-109	43	-158	4		124	20	89+	all	MPC18255
Feb 9	18 50-50	Boliviana	12.6	2.833	128400	8.7	F8	23 46.7	4 42	4.0 3	8	31	-13	50	0	51	15	51		39	179	89-	none	MPC14930
Feb 16	0 5- 8	Sylvia	12.9	3.339		10.9		3 28.3	18 28	2.1 16	22	18	-87	51	-48	58	0	54		88	149	26-	none	MPC11507
Feb 16	13 30-40	Chiron	14.7	8.342		11.3		9 17.7	8 11	3.4 11	30	61	-130	0	161	24	71	41		169	133	22-	e161W	Marsden88
Feb 17	10 42-60	Ninina	13.4	2.367	96403	5.8	K0	6 59.4	15 25	7.6 13	35	31	-170	-63	150	-16	107	23		136	175	15-	none	MPC19474
Feb 25	15 50	Jupiter	-2.4	4.623		11.1		12 49.9	-3 41	6068	37	2	HI,w Pacific, Australasia							144	170	15+	w 80E	DE130
Feb 25	21 55-57	Anneliese	16.0	3.358	76216	6.9	A0	3 45.5	24 12	9.0 3	21	92	-85	83	34	79	63	65		83	35	16+	w 47E	MPC16396
Feb 26	0 41-43	Themis	13.3	3.450		11.6	K3	17 57.8	-23 52	1.9 8	14	22	39	22	54	16	72	10		67	116	17+	none	MPC13294
Feb 26	4 3- 7	Juno	9.0	1.601		12.2		6 9.5	8 57	0.1 24	23	9	-141	50	-124	67	-61	81		115	67	18+	all	Goffin86
Feb 26	5 6-16	Juno	9.0	1.601		9.3		6 9.5	8 58	0.6 24	23	9	-157	16	-126	44	-55	61		115	67	19+	w 96W	Goffin86
Mar 2	16 49-63	Io	11.8	2.156	137736	8.4	F2	10 39.4	-3 49	3.5 10	19	20	-171	-29	108	-4	28	30		169	79	61+	w117E	MPC15525
Mar 12	22 43-60	Melpomene	10.3	1.797		9.2		6 56.9	17 29	1.4 17	31	18	-59	-7	-18	14	34	16		112	130	73-	e 5W	Goffin87
Mar 13	23 46107	Thisbe	12.6	2.680	96656	8.3	K0	7 11.2	19 35	4.3113	158	17	-76	46	-29	35	11	17		114	142	62-	e 11W	Goffin89
Mar 15	15 52-63	Concordia	12.3	1.598	118703	9.4	K0	11 8.1	6 48	3.0 9	23	24	-161	21	154	45	77	81		171	105	45-	e153E	EMP 1989
Mar 15	21 20-51	Peraga	11.9	1.438	98690A	7.6	A3	9 36.1	11 0	4.3 16	39	21	90	-11	24	9	-49	25		148	130	43-	e 48E	MPC16209
Mar 15	20 57-87	Peraga	11.9	1.438	98690B	11.6	A3	9 36.1	11 0	0.9 16	39	21	90	-18	27	2	-39	17		148	130	43-	e 51E	MPC16209
Mar 18	14 1	Iduna	13.3	2.644	156367	7.1	A0	10 56.8	-10 3	6.2 7	19	31	(HI, Aleutians, Chukotka)?n							163	136	19-	e165W	MPC15527
Mar 22	18 9-14	Juno	9.5	1.925	95879	8.5	F0	6 32.9	12 13	1.3 15	15	10	9	38	47	46	94	44		97	103	0-	none	Goffin86
Mar 24	0 0-14	Lumen	12.9	2.238	156969	8.6	K5	11 51.2	-12 17	4.4 9	19	24	78	-6	0	-2	-79	23		168	169	1+	none	MPC12303
Mar 27	3 18-24	Mars	0.5	1.165	79187	8.4	K0	7 10.8	25 6	549	17	1	-130	-12	-103	-21	-73	-37		100	58	13+	w106W	DE130
Mar 27	19 9-12	P/Sm-Wm-1	13.6	6.200		10.7		5 19.3	29 13	2.9 5	25	90	4	51	31	39	56	24		75	25	18+	w 45E	MPC18255
Mar 30	6 22-25	Aspasia	12.2	2.443		11.0		19 31.2	-16 45	1.5 7	12	21	-72	-16	-45	-19	-14	-16		77	156	40+	none	MPC16844
Apr 1	15 56-69	Interamnia	11.6	2.614	155934	6.8	B9	10 19.7	-13 9	4.8 28	27	11	167	4	113	20	63	68		144	44	66+	w144E	Schmadel
Apr 2	0 23-28	Hektor	15.2	5.187	211153	7.5	F5	19 15.3	-39 38	7.7 15	28	32	24	11	47	-9	79	-28		87	151	70+	w 24E	MPC16006
Apr 2	14 6-12	Themis	13.0	2.992		9.8	K8	18 29.2	-23 50	3.3 19	28	19	176	32	-159	23	-132	19		96	143	76+	w170W	MPC13294
Apr 6	20 2- 4	Euphrosyne	13.3	4.001	230574	8.0	G0	21 8.9	-42 16	5.3 9	15	23	87	-18	109	-38	147	-59		72	106	100+	all	MPC13294
Apr 14	15 32-32	Mercury	0.1	1.010	147015	7.3	F0	23 57.0	-3 7	120	5	1	-158	-10	-154	-10	-148	-10		26	55	42-	all	DE130
Apr 15	18 48	Venus	-4.3	0.313	109027	8.0	F8	0 5.9	6 20	3655	33	1	South Island (N.Z.)							22	47	31-	all	DE130
Apr 26	17 37-47	Sappho	11.7	1.706	162256	9.3	K2	19 6.7	-14 40	2.5 7	23	30	77	-46	135	-43	178	-21		109	164	21+	none	MPC15524
Apr 29	18 4	Jupiter	-2.4	4.583		11.3		12 23.3	-0 50	5591	34	2	Austrl., Asia, ne Afr., se Eur.							147	54	53+	w102E	DE130
May 2	8 32-36	P/Swft-Tut	9.7	2.209	248548	9.1	G5	2 22.3	-69 42	1.1 2	6	32	-38	-28	-143	-87	171	-21		85	103	81+	w 70W	MPC21235
May 3	15 42-44	Hygiea	11.2	3.385		10.9	F5	7 41.6	19 39	0.9 18	15	11	61	40	82	32	103	23		71	74	91+	all	Goffin86
May 4	2 4-12	Tanete	12.1	1.831	100735	8.5	K0	13 48.0	18 3	3.7 8	18	22	23	-26	-16	-33	-52	-62		144	32	94+	all	MPC13146
May 7	13 54-56	Mars	1.1	1.558	80215	9.3	G5	8 27.4	21 2	289	10	1	101	52	123	41	143	30		78	121	97-	e108E	DE130
May 9	17 2- 4	Mars	1.1	1.577	80264	9.2	K0	8 31.8	20 44	282	10	1	66	58	83	48	100	39		77	149	85-	e 87E	DE130
May 10	0 33-37	Hippo	13.3	2.547	98077	8.6	K0	8 41.2	10 28	4.7 6	15	29	-92	-5	-66	-18	-33	-29		81	148	82-	e 56W	MPC12305
May 12	19 27-27	Pallas	10.4	3.496	107612	9.0	F2	22 0.3	10 12	1.6 28	19	10	153	-69	161	-63	171	-56		76	27	57-	all	Goffin87
May 22	4 52	Tanete	12.3	1.940	100629	7.6	F2	13 32.9	15 9	4.8 9	19	23	(Brit.Col., nwUSA)?s							131	124	0+	none	MPC13146
May 24	23 44-47	Vesta	7.4	1.984	165106	9.4	G5	22 26.2	-13 10	0.2 31	15	5	28	29	49	27	71	27		90	131	13+	none	Goffin86
May 26	0 38-53	Elpis	11.6	1.939	140990	7.6	K0	16 6.3	-8 5	4.0 13	21	16	68	4	-4	10	-82	30		167	122	21+	w 39W	MPC13145
May 27	7 57-58	Hygiea	11.3	3.655		11.0		8 7.6	18 24	0.9 13	12	12	152	-22	164	-27	179	-33		55	17	34+	all	Goffin86
May 28	22 1-24	Moira	12.3	1.303	159886	8.8	K5	16 20.0	-13 5	3.5 8	26	28	112	-12	30	-29	-62	-24		172	87	52+	w 28E	MPC18085
May 30	16 8	Flora	9.7	1.479	159783	8.8	K0	16 10.2	-13 55	1.3 12	20	15	(Japan, ne Asia)?s							171	60	71+	w136E	Goffin86
May 30	19 23-23	Eugenia	12.9	3.392	109785	8.4	G0	1 14.7	4 24	4.6 6	10	23	151	-69	169	-65	-174	-60		50	165	73+	none	MPC13294
Jun 5	16 25-44	Kassandra	12.2	1.775	161154	8.1	B8	18 8.3	-15 54	4.1 10	24	25	-159	-13	123	-21	46	-6		161	7	98-	all	MPC12191
Jun 8	22 15	Sappho	10.6	1.228	143188	9.3	K0	19 13.1	-9 35	1.6 14	36	22	(Indochina, cen. Asia)?s							147	24	80-	all	MPC15524
Jun 11	3 50	Mercury	0.1	0.940	78967	8.5	A2	6 57.8	24 33	131	5	1	northwestern USA							24	125	60-	none	DE130
Jun 11	18 13-14	Glauke	15.9	3.759		11.4		1 34.5	6 2	4.5 1	13	143	133	-4	146	-1	163	2		56	40	55-	all	EMP 1991
Jun 13	12 32-46	Themis	11.8	2.329		10.7	A0	18 17.4	-24 16	1.5 17	23	15	-97	-29	179	-48	90	-29		168	92	38-	e169W	MPC13294
Jun 15	9 30-41	Massalia	11.2	1.711	184751	9.0	M2	16 50.3	-21 36	2.3 13	21	16	-47	-54	-161	-69	111	-44		170	134	22-	e 77W	MPC11982
Jun 17	10 36-36	Pales	12.6	2.534	109157	9.4	F2	0 18.7	4 58	3.2 6	12	24	-140	52	-137	54	-134	56		79	48	8-	e135W	MPC15524
Jun 19	13 57-77	Hypatia	12.6	2.295		9.8	G0	22 15.2	1 17	2.9 24	45	21	139	-26	-177	-11	-140	15		111	105	0-	none	MPC14753
Jun 21	23 16-17	Julia	11.4	2.569	75188	6.0	K2	2 8.3	25 42	5.3 4	8	23	44	15	58	25	74	39		52	77	4+	none	MPC12190
Jun 23	22 54-69	Aspasia	11.0	1.559	144153	8.3	F5	20 8.9	-6 18	2.7 21	30	13	119	-79	12	-53	-39	-30		146	159	18+	w 31W	MPC16844
Jun 25	3 16-16	Venus	-4.2	0.820	93286	8.7	F8	3 5.0	14 27	476	7	1	8-10		19	-7	34	-1		45	111	30+	none	DE130
Jul 3	5 59-61	Themis	11.8	2.345	186204	6.0	Oe5	18 0.8	-24 22	5.9 17	23	15	-84	58	-100	55	-117	58		169	3	99+	all	MPC13294
Jul 6	5 7-21	Themis	11.9	2.357		11.4	M9	17 58.4	-24 22	1.0 18	24	15	-25	19	-85	3	-149	15		166	41	95-	e139W	MPC13294
Jul 6	21 41	Moira	12.9	1.498	159613	9.0	G0	15 55.7	-15 6	4.0 17	62	32	Brazil							136	78	91-	none	MPC18085
Jul 7	15 22-44	Philosophia	12.	1.652	209943	9.7	B9	18 13.4	-34 42	2.5 9	27	27	-152	-16	121	-32	47	7		163	57	87-	e 75E	MPC16003
Jul 15	5 10-27	Aspasia	10.8	1.493	143896	9.3	G5	19 51.6	-5 21	1.7 16	23	13	9	-35	-74	-36	-157	-28		163	118	20-	e 27W	MPC16844
Jul 17	4 16-17	Berbericia	12.6	3.249	94332	5.0	G0	5 4.5	18 35	7.6 4	9	26	1	-20	13	-15	27	-9		37	8	7-	e 3E	MPC19478
Jul 17	14 23-41	Kassandra	12.5	1.895	160676	9.0	K0	17 33.2	-16 24	3.5 13	34	27	-159	-32	135	-54	30	-59		148	172	4-	none	MPC12191
Jul 17	18 37-39	Glauke	15.7	3.298		10.2		2 6.2	8 19	5.5 2	20	126	128	-61	155	-53	-177	-46		82	60	4-	e174E	EMP 1991
Jul 18	10 50-52	Lucina	13.4	3.011		11.5		2 56.1	5 23	2.1 6	14	31	-131	9	-112	13	-90	17		72	59	1-	e 92W	MPC15384
Jul 29	13 56-74	Eurydike	11.5	1.130		10.0	K	0 30.4	0 8	1.7 8	27	28	137	-35	-173	-18	-134	8		119	108	84+	w163W	MPC12189
Jul 31	17 26-38	Honoria	10.9	1.389	145096	8.5	A2	21 3.7	-5 45	2.6 11	27	22	-171	-36	142	-55	41	-82		166	30	97+	w176W	MPC19472
Aug 2	5 4-16	Panopaea	12.0	1.820	129531	8.3	G5	1 48.4	-0 32	3.7 13	28	21	-78	-11	-37	-5	2	5		104	80	100+	all	MPC12118
Aug 8	23 5-19	Eleonora	10.8	2.107		10.9		20 18.4	-13 28	0.7 11	20	19	65	35	1	-5	-76	-31		167	83	66-	e 8W	MPC11509
Aug 9	0 35-37	Julia	11.2	2.171	56655	8.7	K2	3 39.7	35 49	2.6 6	11	20	16	-6	36	11	61	33		75	35	65-	all	MPC12190

Table 2
Part A

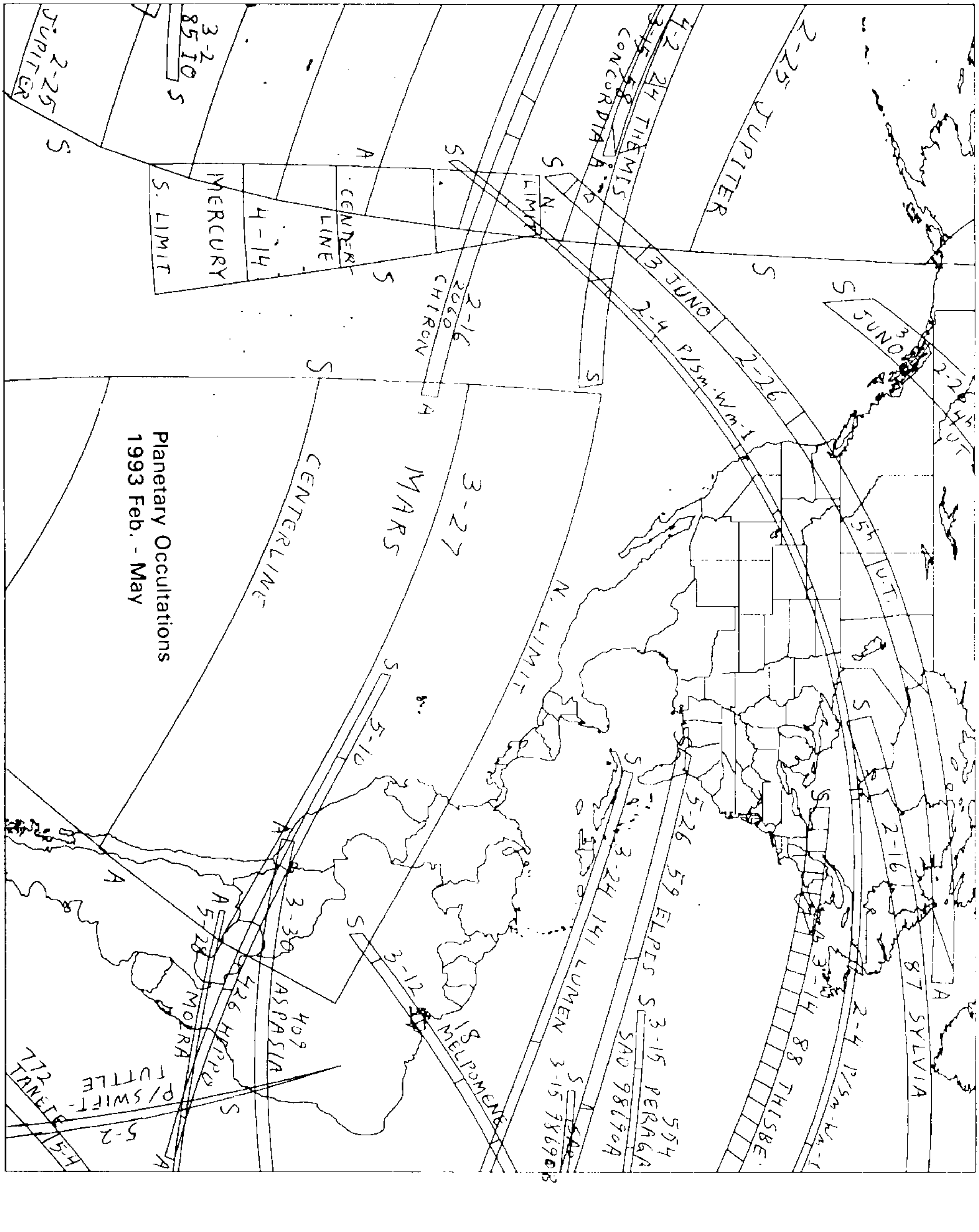
1993 Date	No.	MINOR PLANET Name	km-diam.	-//	RSOI	Type	Motion °/day	P.A.	STAR SAO No	DM/Id No	D	Min. Geocentric U. T.	Sep.	S	Comparison Data AGK3 No	Shift	Time	APPARENT R.A.	Dec.
Jan 8		Jupiter	140904	18.37			0.063	108°9		L 2 387		10h34m9	7"86n	H			m	12h53m7	-4°18'
Jan 14		Mars	6782	14.66			0.376	277.7	79105	+26°1463		0 34.3	7.07s	UR	N26° 765	0"21	-0.1	7 8.4	26 38
Jan 24	51	Nemausa	137	0.09	458	CU	0.374	95.6	158927	-12 4173		4 23.8	2.76n	UX		0.26	0.1	14 57.2	-12 37
Jan 25	87	Sylvia	271	0.12	1969	P	0.084	47.5	93401	+16 425		12 14.8	3.04s	UX	N17 294	0.04	-0.1	3 21.0	17 14
Jan 27		Mars	6782	13.63			0.251	271.9	78784	+27 1240		3 5.5	6.01s	UR	N27 727	0.22	0.0	6 49.7	27 1
Jan 31	324	Bamberga	228	0.14	1391	CP	0.213	280.1	99138	+10 2153		2 3.6	5.22n	UX	N10 1327	0.08	0.5	10 27.4	9 55
Feb 4		P/Sm-Wm-1	100	0.03	773		0.041	224.5				5 19.1	0.05s	C				5 12.2	30 27
Feb 9	712	Boliviana	132	0.06	421	C	0.512	73.4	128400	+ 4 5054		18 48.1	1.75n	UX	N 4 3172	0.10	0.0	23 48.9	4 57
Feb 16	87	Sylvia	271	0.11	1978	P	0.166	65.0				0 2.8	1.21n	C				3 30.8	18 36
Feb 16	2060	Chiron	200	0.03	3394	B	0.075	290.6				13 35.2	0.35n	C				9 20.0	8 0
Feb 17	357	Ninina	110	0.06	468	CX	0.120	323.2	96403	+15 1431		10 52.9	1.44s	PU	N15 722	0.06	1.7	7 1.9	15 21
Feb 25		Jupiter	140904	21.01			0.083	295.1		L 2 305		15 49.9	6.39n	H				12 52.1	-3 55
Feb 25	910	Anneliese	53	0.02	168		0.171	76.7	76216	+23 553		21 54.3	2.21n	E	N24 350			3 48.1	24 20
Feb 26	24	Themis	228	0.09	1420	C	0.259	90.7		C2313761		0 44.5	1.29n	H				18 0.4	-23 52
Feb 26	3	Juno	267	0.23	1239	S	0.227	47.1				3 59.7	3.42n	C				6 11.9	8 56
Feb 26	3	Juno	267	0.23	1239	S	0.227	47.2				5 7.0	1.66n	C				6 11.9	8 57
Mar 2	85	Io	157	0.10	794	FC	0.233	300.6	137736	- 3 2977		16 56.1	0.06n	UR		-0.16	0.2	10 41.6	-4 3
Mar 12	18	Melpomene	148	0.11	546	S	0.159	60.9		A1752275		22 48.3	1.24s	C				6 59.5	17 25
Mar 13	88	Thisbe	232	0.12	1463	CF	0.025	100.0	96656	+19 1654		24 0.7	1.38n	UH	N19 693	0.33	-10.0	7 13.7	19 30
Mar 15	58	Concordia	98	0.08	323	C	0.227	301.2	118703	+ 7 2423		15 57.7	4.30n	UX	N 6 1404	0.08	-0.6	11 10.4	6 34
Mar 15	554	Peraga	99	0.09	297	FC	0.141	288.1	98690	+11 2071	A	21 37.4	0.49n	UZ	N11 1130	0.64	0.3	9 38.4	10 48
Mar 15	554	Peraga	99	0.09	297	FC	0.141	288.1	98690	+11 2071	B	21 13.7	0.38s	U		0.86	23.7	9 38.4	10 48
Mar 18	176	Iduna	125	0.07	649	G	0.212	313.6	156367	- 9 3182		14 0.8	3.46n	PY		-0.24	0.7	10 59.0	-10 18
Mar 22	3	Juno	267	0.19	1274	S	0.311	70.0	95879	+12 1208		18 8.3	1.85n	UA	N12 768	-0.15	-0.2	6 35.3	12 10
Mar 24	141	Lumen	135	0.08	651	CPF	0.228	285.7	156969	-11 3200		0 7.1	0.75n	S				11 53.4	-12 32
Mar 27		Mars	6782	8.03			0.351	100.9	79187	+25 1613		3 17.3	4.67s	AG	N25 832	0.17	0.4	7 13.5	25 1
Mar 27		P/Sm-Wm-1	100	0.02	775		0.107	98.8				19 7.8	0.70n	C				5 22.1	29 15
Mar 30	409	Aspasia	168	0.09	680	CX	0.342	68.8		L 5 30		6 26.3	0.45n	H				19 33.7	-16 39
Apr 1	704	Interamnia	333	0.18	2718	F	0.151	307.9	155934	-12 3147		16 2.4	2.35n	YG		0.51	-1.1	10 21.9	-13 23
Apr 2	624	Hektor	234	0.06	2410	D	0.103	105.9	211153	C3913218		0 29.5	0.19n	S				19 18.3	-39 33
Apr 2	24	Themis	228	0.11	1439	C	0.136	88.7		C2314467		14 12.6	2.02n	HC		-0.59	-0.8	18 31.8	-23 48
Apr 6	31	Euphrosyne	248	0.09	1915	C	0.219	95.5	230574	P42 9237		20 5.3	0.83s	S				21 11.7	-42 5
Apr 14		Mercury	4880	6.66	20000		1.335	68.3	147015	- 3 5741		15 34.7	1.70n	U				23 59.2	-2 53
Apr 15		Venus	12220	53.82			0.353	205.8	109027	+ 5 2		18 48.8	3.31s	UX	N 6 10	0.07	-0.0	0 8.1	6 35
Apr 26	80	Sappho	82	0.07	215	S	0.216	56.8	162256	-14 5307		17 45.7	1.14s	US		-0.44	-0.5	19 9.2	-14 36
Apr 29		Jupiter	140904	21.20			0.091	291.5		S00 1732		18 4.1	20.98n	A				12 25.5	-1 5
May 2		P/Swft-Tut	100	0.06	302		0.692	107.8	248548	P70 147		8 34.1	1.48s	S				2 22.9	-69 30
May 3	10	Hygiea	429	0.17	3670	C	0.235	100.7		L 4 2454		15 40.1	1.34n	H				7 44.1	19 33
May 4	772	Tanete	123	0.09	476	C	0.267	242.4	100735	+18 2788		2 8.1	4.09s	AG	N18 1280	1.82	-2.9	13 50.1	17 50
May 7		Mars	6782	6.00			0.499	105.9	80215	+21 1853		13 52.6	3.95n	UR	N21 946	0.16	0.0	8 30.0	20 53
May 9		Mars	6782	5.93			0.504	106.2	80264	+21 1867		17 1.2	4.50n	UR	N20 986	0.04	-0.0	8 34.4	20 35
May 10	426	Hippo	126	0.07	472	C	0.271	113.8	98077	+10 1861		0 31.6	0.55s	UH	N10 1133	-0.18	-0.3	8 43.6	10 18
May 12	2	Pallas	533	0.21	5396	B	0.182	61.8	107612	+ 9 4967		19 29.6	2.07s	A	N10 3010	0.29	1.4	22 2.4	10 25
May 22	772	Tanete	123	0.09	476	C	0.245	218.6	100629	+15 2597		4 52.6	3.75n	RA	N15 1388	-0.47	1.1	13 35.1	14 55
May 24	4	Vesta	560	0.39	3795	V	0.306	79.3	165106	-13 6199		23 48.5	3.05n	UX		0.40	0.1	22 28.5	-12 57
May 26	59	Elpis	173	0.12	860	CP	0.219	283.8	140990	- 7 4205		0 46.0	1.53n	UP		-0.26	0.3	16 8.7	-8 12
May 27	10	Hygiea	429	0.16	3639	C	0.291	102.9				7 55.1	1.13s	C				8 10.1	18 16
May 28	638	Moira	68	0.07	167		0.223	264.1	159886	-12 4494		22 12.3	1.96s	US		-0.04	0.9	16 22.5	-13 11
May 30	8	Flora	141	0.13	536	S	0.266	273.6	159783	-13 4378		16 7.9	5.95n	US		-0.59	0.7	16 12.6	-14 1
May 30	45	Eugenia	214	0.09	1148	FC	0.346	72.1	109785	+ 3 179		19 24.3	2.13s	UA	N 4 160	-0.13	0.3	1 17.0	4 38
Jun 5	114	Kassandra	103	0.08	371	T	0.201	271.7	161154	-15 4849		16 34.0	0.47s	PS		0.05	0.3	18 10.8	-15 54
Jun 8	80	Sappho	82	0.09	206	S	0.162	308.6	143188	- 9 5062		22 15.5	5.76n	US		0.50	-0.9	19 15.5	-9 31
Jun 11		Mercury	4880	7.16	17826		1.312	100.2	78967	+24 1491		3 50.1	10.45n	UR	N24 757	-0.13	0.1	7 0.5	24 29
Jun 11	288	Glauke	38	0.01	100	S	0.268	71.8				18 16.4	0.47n	C				1 36.8	6 15
Jun 13	24	Themis	228	0.13	1476	C	0.186	267.2		C2414194		12 39.1	1.55s	H				18 20.1	-24 15
Jun 15	20	Massalia	151	0.12	650	S	0.233	276.9	184751	-21 4438		9 35.4	3.81s	UX		0.58	2.3	16 52.9	-21 40
Jun 17	49	Pales	154	0.08	628	CG	0.329	63.1	109157	+ 4 39		10 36.8	3.36n	UX	N 4 38	-0.10	0.0	0 20.9	5 12
Jun 19	238	Hypatia	156	0.09	709	C	0.095	54.4		+ 0 4845		14 13.1	0.52n	A	N 1 2706			22 17.5	1 30
Jun 21	89	Julia	159	0.09	544	S	0.502	61.7	75188	+25 362		23 18.0	2.27n	UA	N25 199	-0.24	0.3	2 10.8	25 54
Jun 23	409	Aspasia	168	0.15	693	CX	0.173	294.7	144153	- 6 5397	A	23 1.6	4.55s	YG		0.22	1.1	20 11.3	-6 10
Jun 25		Venus	12220	20.55			1.036	74.3	93286	+14 516		3 19.7	0.30n	UX	N14 278	0.40	0.1	3 7.4	14 37
Jul 3	24	Themis	228	0.13	1486	C	0.185	269.5	186204	C2413814		6 0.2	3.68n	H7		-0.02	0.7	18 3.5	-24 22
Jul 6	24	Themis	228	0.13	1487	C	0.179	269.9		C2413760		5 14.6	1.74n	H				18 1.1	-24 22
Jul 6	638	Moira	68	0.06	169		0.087	204.1	159613	-14 4323		21 41.2	3.79n	UX		-0.28	-0.1	15 58.2	-15 13
Jul 7	227	Philosophia	90	0.08	291		0.191	287.2	209943	C3412655		15 33.0	0.32n	S				18 16.3	-34 41
Jul 15	409	Aspasia	168	0.16	697	CX	0.232	273.6	143896	- 5 5100		5 18.3	3.05s	S				19 54.0	-5 14
Jul 17	776	Berbericia	183	0.08	803	C	0.423	77.9	94332	+18 779	O	4 18.7	0.54s	UZ	N18 413	-0.62	0.3	5 7.1	18 38
Jul 17	114	Kassandra	103	0.07	379	T	0.141	257.9	160676	-16 4559		14 32.9	3.10s	US		-0.30	0.8	17 35.8	-16 26
Jul 17	288	Glauke	38	0.02	100	S	0.177	77.1				18 39.9	2.16s	C				2 8.5	8 31
Jul 18	146	Lucina	140	0.06	613	C	0.271	78.6				10 53.8	0.98n	C				2 58.4	5 33
Jul 29	75	Eurydike	58	0.07	105	M	0.224	56.5		+ 0 82		14 9.6	0.40s	XA	N 0 42			0 32.7	0 22
Jul 31	236	Honoria	91	0.09	267	S	0.204	246.7	145096	- 6 5674		17 32.1	5.39s	US		-0.12	-1.3	21 6.0	-5 34
Aug 2	70	Panopaea	127	0.10	422	C	0.174	74.2	129531	- 1 252		5 14.5	0.37n	UR	S 0 191	0.17	-0.6	1 50.6	-0 19
Aug 8	354	Eleonora	162	0.11	824	S	0.229	234.4		L 5 3323		23 12.4	0.42n	H				20 20.9	-13 19
Aug 9	89	Julia	159	0.10	556	S	0.402	63.6	56655	+35 740		0 38.8	0.73n	A	N35 375			3 42.5	35 57

Table 1
Part B

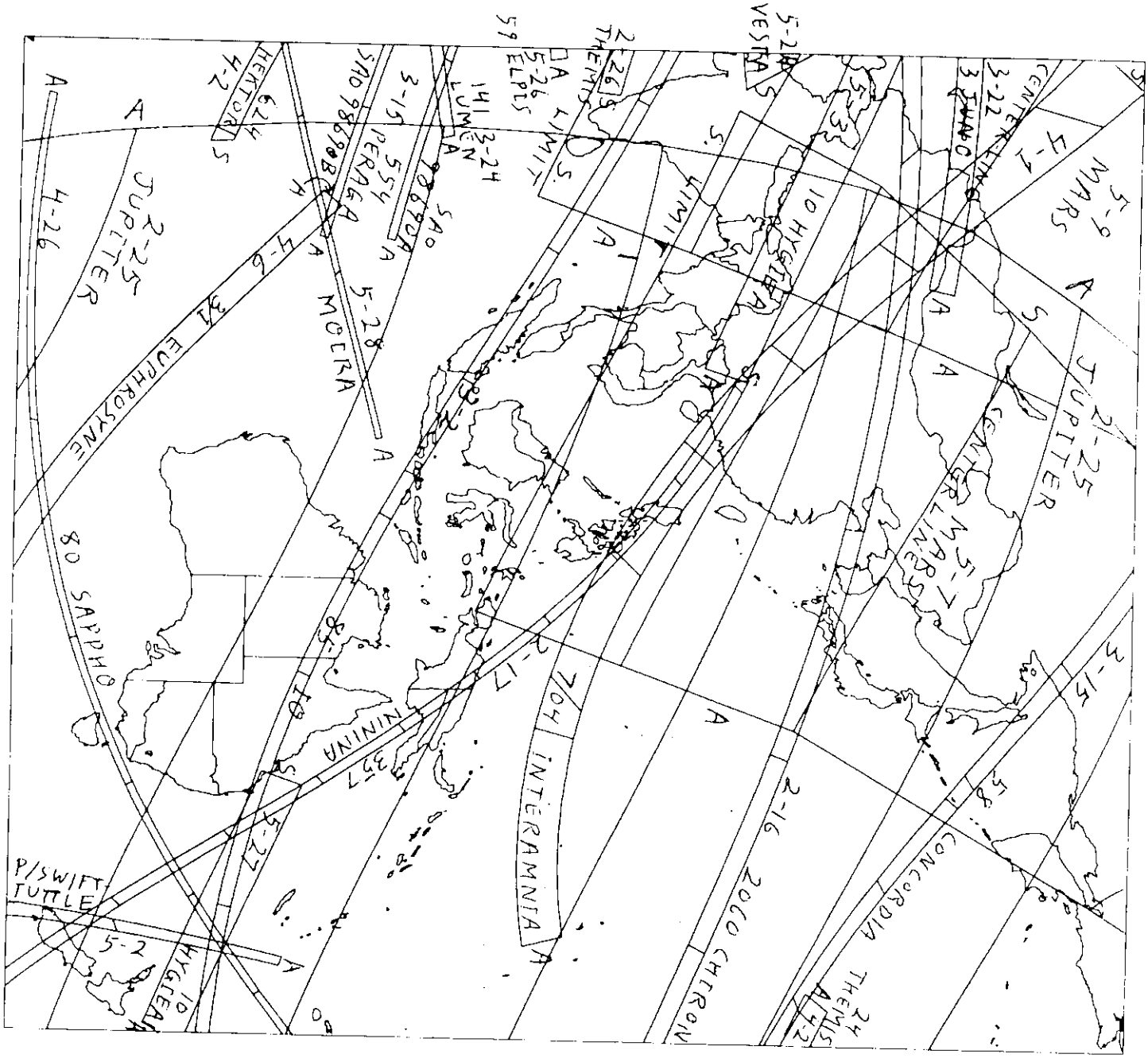
1993 Date	Universal Time	PLANET Name	PLANET Mv	PLANET Δ AU	STAR SAO No	STAR Mv	STAR Sp	STAR R.A.(1950)	STAR Dec.	Occultation Δm	Occultation Dur	Occultation Df	Occultation P	Possible Path Lo1	La1	Lom	Lam	Loe	Lae	El Sun	MOON El	MOON %Snl	MOON up	Ephem. Source
Aug 12	7h 14-35m	Josephina	13.0	2.120	146585	4.2	M0	23h 11.7m	-6°19'	8.7	11s	31	30	-19°	-6°	-90°	21°	172°	25°	153°	81°	34-	e 86W	MPC17797
Aug 13	9 20-20	Ophelia	13.6	3.768	79782	6.9	M0	7 51.3	21 14	6.7	3	9	45	-77	31	-73	33	-67	35	24	34	24-	all	MPC13294
Aug 13	22 40	Eleonora	10.8	2.127	163419	8.6	A0	20 14.7	-14 7	2.4	12	21	19	Indian Ocean?n						161	146	19-	e 98E	MPC11509
Aug 17	18 52-60	Chloris	13.3	2.611	111107	8.5	G5	3 15.4	6 18	4.8	12	29	30	78	16	114	18	152	18	96	95	0-	none	MPC18085
Aug 17	20 38-65	Olga	11.5	0.966	128584	8.0	K2	0 3.7	-1 31	3.5	10	27	20	17	61	60	0	12	-69	144	144	0-	none	MPC16384
Aug 18	2 57-76	Fortuna	10.3	1.394	163155	8.2	A2	19 56.2	-18 6	2.2	23	31	12	-17	46	-70	24	-125	17	153	149	0+	none	MPC13923
Aug 21	18 13-13	Venus	-4.0	1.239	79587	8.8	K0	7 36.5	20 57		277	5	1	109	69	109	69	109	69	36	91	21+	none	DE130
Aug 22	19 8-43	Euterpe	10.6	1.476		10.0	K2	0 53.2	3 2	1.1	61	125	18	160	-28	143	-49	143	-72	136	154	33+	w143E	EMP 1987
Aug 24	16 46-60	Euphrosyne	12.4	2.871		9.8		20 58.9	-52 50	2.7	18	24	17	170	-6	96	-35	30	9	136	62	53+	w123E	MPC13294
Aug 30	8 16-17	Boliviana	12.6	2.639	96566	7.9	F8	7 6.5	16 38	4.7	3	8	29	-70	-17	-55	-15	-37	-13	51	149	97+	w 51W	MPC14930
Aug 31	21 9	Fortuna	10.5	1.467		11.3		19 48.9	-18 37	0.4	48	67	12	(sScandinavia,U.K.)?s						138	39	100+	all	MPC13923
Sep 2	13 10-10	Europa	11.8	3.352		9.9	G6	7 26.2	18 26	2.1	8	10	17	-177	69	-175	70	-169	72	49	115	98-	all	MPC12188
Sep 5	22 58-97	Eugenia	12.1	2.224		12.5		2 36.3	7 51	0.6	60	82	15	-730	7	-687	9	-643	4	123	10	78-	all	MPC13294
Sep 6	13 8	Helio	14.2	2.795		10.0	A2	19 28.9	1 54	4.2	23	51	28	(NZ, se Australia)?n						127	106	75-	all	MPC14931
Sep 7	2 54-67	Themis	13.1	3.048	185772	9.4	G5	17 44.9	-24 11	3.8	25	38	19	-127	-20	-87	-15	-46	0	103	143	71-	e 70W	MPC13294
Sep 11	9 11	Fringilla	12.6	1.590	146070	8.8	F8	22 21.7	-1 42	3.8	9	22	23	(Alaska, nw Canada)?s						166	127	29-	e100W	MPC17797
Sep 15	2 7-46	Eurydike	10.5	0.891		9.9	K2	0 28.7	3 10	1.1	11	37	22	49	-10	-27	-6	-107	-7	164	149	2-	e 40E	MPC12189
Sep 19	18 0- 0	Sylvia	13.3	3.997		10.5		7 57.9	25 37	2.9	9	13	21	156	-34	162	-32	169	-29	60	110	18+	none	MPC11507
Sep 19	19 38-38	Europa	11.8	3.162		9.6		7 51.5	17 36	2.3	9	11	16	130	-45	137	-43	144	-42	60	111	19+	none	MPC12188
Sep 22	2 12-27	Scheila	13.4	2.124	147554	9.0	F5	0 56.4	-15 26	4.4	9	22	26	47	12	-22	-17	-108	-23	159	106	42+	w 37W	MPC16996
Sep 23	9 8	P/Sm-Wm-1	13.6	6.358		10.0	G5	7 34.3	26 13	3.7	5	23	92	South America?n						69	164	56+	none	MPC18255
Sep 26	8 23-25	Vibilia	12.2	2.106		10.4		6 31.7	22 47	2.0	8	15	21	-88	-34	-70	-27	-48	-21	85	143	83+	w 77W	MPC14752
Sep 28	4 0-15	Julia	10.7	1.712	39807	7.5	B5	4 48.0	43 30	3.2	17	27	16	-60	-12	-35	27	10	71	107	98	94+	w 10W	MPC12190
Sep 28	13 12-12	Hygiea	11.2	3.949	118612	8.0	A0	10 58.0	4 0	3.3	10	9	13	-120	47	-120	47	-118	47	21	175	95+	none	Goffin86
Sep 29	18 2- 5	Crocus	15.1	2.654		10.5		6 35.6	16 9	4.6	3	18	70	122	-41	141	-37	162	-35	87	104	99+	all	EMP 1991
Oct 1	12 57-79	Istria	12.1	1.171	214187	6.1	K0	22 53.1	-31 54	6.0	5	27	47	166	48	140	-9	86	-60	138	51	99-	e 89E	MPC15527
Oct 2	23 41-44	Sylvia	13.2	3.829		9.7		8 11.3	25 30	3.6	11	16	20	36	1	58	10	84	18	70	86	96-	all	MPC11507
Oct 3	9 15	Pluto	15.6	30.446		12.4		15 36.8	-5 7	3.2	81	38	19	(eAustralia,PNG,Japan)?n						45	158	94-	e159E	DE130
Oct 3	15 51-59	Stereoskopia	14	2.914	188137	9.1	G0	19 24.3	-26 2	4.6	15	30	24	45	-47	89	-32	125	-12	99	112	93-	e 73E	MPC12306
Oct 4	3 55-57	Camilla	12.8	3.522		9.7	K0	8 33.1	10 36	3.2	8	12	22	-26	25	-4	26	19	25	63	81	90-	all	MPC15525
Oct 9	6 59-79	Euterpe	9.8	1.229	128735	8.4	K0	0 21.1	-0 49	1.7	13	24	15	-41	48	-124	26	164	5	169	106	45-	e113W	EMP 1987
Oct 9	8 38-41	Crocus	15.0	2.526		10.7		6 43.7	16 2	4.3	4	23	67	-140	59	-106	67	-55	70	95	12	44-	all	EMP 1991
Oct 10	14 47	Hersilia	13.1	2.075	94649	5.7	B3p	5 30.6	18 30	7.4	21	53	27	(Siberia, Alaska)?s						114	46	31-	e121W	MPC12304
Oct 13	2 59-59	Themis	13.5	3.595		10.7	M7	18 10.9	-24 7	2.8	10	16	23	-132	52	-132	52	-131	52	73	107	9-	none	MPC13294
Oct 14	8 18-25	Berbericia	12.2	2.362	79194	8.7	F5	7 11.5	24 6	3.5	12	20	19	-111	-13	-80	4	-44	21	94	78	2-	e 53W	MPC19478
Oct 14	13 30-30	Hestia	13.5	2.744		8.9		17 9.4	-20 56	4.7	4	10	30	82	-41	103	-36	123	-30	58	71	1-	none	Yeomans
Oct 15	1 23-32	Urania	10.9	1.538	78016	8.2	K0	6 5.4	25 59	2.8	13	30	21	-60	50	-26	68	74	78	110	104	0-	none	MPC12680
Oct 17	21 59-62	Marghanna	11.5	0.994	93152	8.8	F8	2 49.4	10 35	2.7	8	21	19	3	-63	-2	-54	-16	-49	160	164	8+	all	EMP 1988
Oct 17	23 32-51	Gyptis	11.0	1.447	93255	8.2	K5	3 0.8	10 30	2.8	18	25	12	90	22	31	-8	-33	-55	157	165	9+	w 28W	MPC14930
Oct 19	12 30-67	Herculina	10.9	2.602	191185	9.1	K2	22 27.1	-28 6	2.0	52	76	17	-162	-70	111	-44	77	-2	121	69	21+	all	Goffin88
Oct 20	1 29-31	Camilla	12.7	3.316		11.4		8 49.2	9 16	1.6	10	15	20	0	37	28	37	58	32	74	136	27+	none	MPC15525
Oct 21	11 59-72	Glauke	14.6	2.335		12.0		1 56.1	5 18	2.7	2	20	89	-102	28	177	13	101	-10	174	102	41+	w163E	EMP 1991
Oct 25	4 30-34	Sylvia	13.1	3.522		11.2		8 29.3	25 35	2.1	17	23	19	-73	48	-43	63	25	76	88	148	76+	w 47W	MPC11507
Oct 31	4 46-47	Eunomia	10.2	2.366		11.7		19 49.6	-15 21	0.2	12	14	13	-164	43	-151	49	-135	56	79	108	100-	all	Goffin87
Oct 31	9 48-74	Crocus	14.7	2.241		12.2		6 55.2	15 55	2.6	12	66	59	-166	33	-123	44	-67	48	114	56	99-	all	EMP 1991
Nov 1	2 17-19	Ophelia	13.2	2.923	98805	8.1	G5	9 48.1	14 21	5.1	5	13	35	-19	47	17	51	57	47	74	89	98-	all	MPC13294
Nov 1	7 49-52	Eunomia	10.2	2.378		11.5		19 51.0	-15 16	0.3	12	13	13	158	7	179	16	-153	25	79	121	97-	e165E	Goffin87
Nov 4	15 5-24	Hamburga	12.6	1.513	92942	7.6	B9	2 23.0	10 17	5.0	8	22	25	-150	9	129	5	47	-18	174	62	77-	e 97E	MPC15384
Nov 9	20 25-27	Melete	14.1	3.341	118362	8.1	K5	10 31.4	2 53	6.0	5	14	41	83	41	113	37	141	29	68	12	22-	e 86E	MPC12189
Nov 13	0 27-34	Boliviana	12.1	1.946	117308	9.0	F5	8 55.2	4 10	3.2	8	17	21	-6	22	33	11	64	-14	95	82	1-	e 61E	MPC14930
Nov 13	3 41-52	Apollonia	13.8	2.259	165042	7.2	K0	22 21.5	-10 27	6.6	9	29	36	-141	-5	-101	7	-57	20	103	114	1-	none	EMP 1984
Nov 20	21 44-58	Glauke	14.9	2.462	110007	8.5	A0	1 33.8	3 32	6.4	4	30	94	77	54	0	46	-66	32	145	58	48+	w 22E	EMP 1991
Nov 21	20 22-23	Eunomia	10.3	2.586	163507	8.9	G5	20 19.9	-13 24	1.6	9	11	14	-34	9	-14	16	11	25	65	33	57+	all	Goffin87
Nov 23	2 30-32	Fortuna	11.5	2.271	164056	8.6	G5	20 57.6	-15 57	2.9	6	11	19	-131	23	-110	31	-84	41	72	40	69+	all	MPC13923
Nov 23	4 55-72	Arachne	12.3	1.504	75811	8.6	K2	3 12.2	28 52	3.7	9	23	22	26	50	-101	55	-167	11	167	59	70+	w 47W	MPC16385
Nov 23	6 12-44	Crocus	14.4	1.993		11.8		6 54.7	16 18	2.7	11	55	53	-14	7	-72	31	-145	33	137	109	70+	w 75W	EMP 1991
Nov 25	19 56-58	Zelinda	13.6	2.748	126605	8.7	A0	21 9.1	0 28	5.0	6	15	30	-11	-26	9	-24	31	-23	77	65	89+	all	Goffin87
Nov 27	18 40-61	Gyptis	11.2	1.548	110612	7.9	K0	2 30.8	5 29	3.4	25	35	13	130	70	36	47	-17	19	151	15	98+	all	MPC14930
Nov 29	6 49	Jupiter	-1.7	6.246	158379	6.8	A2	14 5.8	-11 36		1878	13	2	UK,nwEur.,CanaryI,neBraz.						33	147	0E	all	DE130
Nov 30	21 22-45	Vibilia	11.4	1.543		9.7	K5	6 59.0	24 33	1.9	20	34	15	125	22	62	49	-28	43	145	17	97-	all	MPC14752
Dec 11	1 38-57	Victoria	10.7	1.554	93335	7.4	A2	3 9.6	16 20	3.4	14	29	19	24	-1	-31	-9	-84	-44	151	177	7-	none	MPC12187
Dec 11	3 23-33	Artemis	12.5	1.904	131238	9.0	F8	4 26.5	-7 12	3.5	9	20	22	15	-26	-39	-36	-106	-45	148	147	7-	e 5W	MPC12190
Dec 11	23 40-55	Xanthippe	13.1	2.053	96091	9.7	B9	6 43.5	15 26	3.5	10	22	24	98	33	15	30	-58	7	157	140	3-	e 89E	EMP 1986
Dec 13	2 35-48	Aurelia	13.1	2.220		10.0	K2	4 36.5	19 41	3.2	9	19	24	35	24	-47	32	-126	8	170	174	0-	none	MPC16386
Dec 17	1 7-28	Urania	9.8	1.175	77562	9.1	A	5 44.6	25 58	1.2	11	23	16	75	28	-20	46	-109	18	177	135	15+	w 73W	MPC12680
Dec 21	11 10-13	Metis	10.6	1.904	128628	6.8	G5	0 8.6	-3 36	3.8	11	15	15	157	-56	169	-42	-171	-34	92	10	55+	all	MPC11234
Dec 22	2 41-61	Klotho	9.9	1.134	115514	7.7	A5	7 26.7	3 29	2.3	14	34	19	3	-49	-50	-37	-101	-31	151	101	61+	w 39W	MPC15525
Dec 26	5 44-71	Diana	11.1	1.284	57127	9.2	A2	4 13.8	35 46	2.1	17	31	15	-9	37	-109	46	-173	-1	151	15	93+	w 11W	MPC12189
Dec 26	11 3-21	Pompeja	12.4	1.674	79240	9.3	K2	7 13.9	26 58	3.2	11	23	20	-77	16	-156	41	112	23	167	42	94+	w 96W	EMP 1988
Dec 30	23 18-22	Euterpe	11.1	1.834		10.0	G0	0 31.4	1 44	1.4	6	15	23	-85	38	-55	50	-11	59	89	115	95-	e 70W	EMP 1987
Dec 31	3 10-12	Parthenope	11.2	2.091	109579	8.9	K0	0 57.0	0 24	2.4	10	17	19	-165	60	-158	69	-155	80	94	112	94-	e157W	MPC12686
Dec 31	18 25-41	Crocus	13.9	1.821		11.0		6 27.1	18 32	3.0	4	21	48	153	-12	81	19	-7	23	174	38	91-	e 18E	EMP 1991
Dec 31	22 57-72	Vibilia	11.1	1.513	78468	8.3	A2	6 29.1	26 13	2.9	13	21	15	104	22	26	54	-87	41	176	41	90-	e 55W	MPC14752
Dec 31	23 36-43	Eucharis	11.2	1.651	117042	8.9	G	8 40.0	5 44	2.5	13	32	22	105	36	95	53	113	69	147	10	89-	all	MPC16996

Table 2
Part B

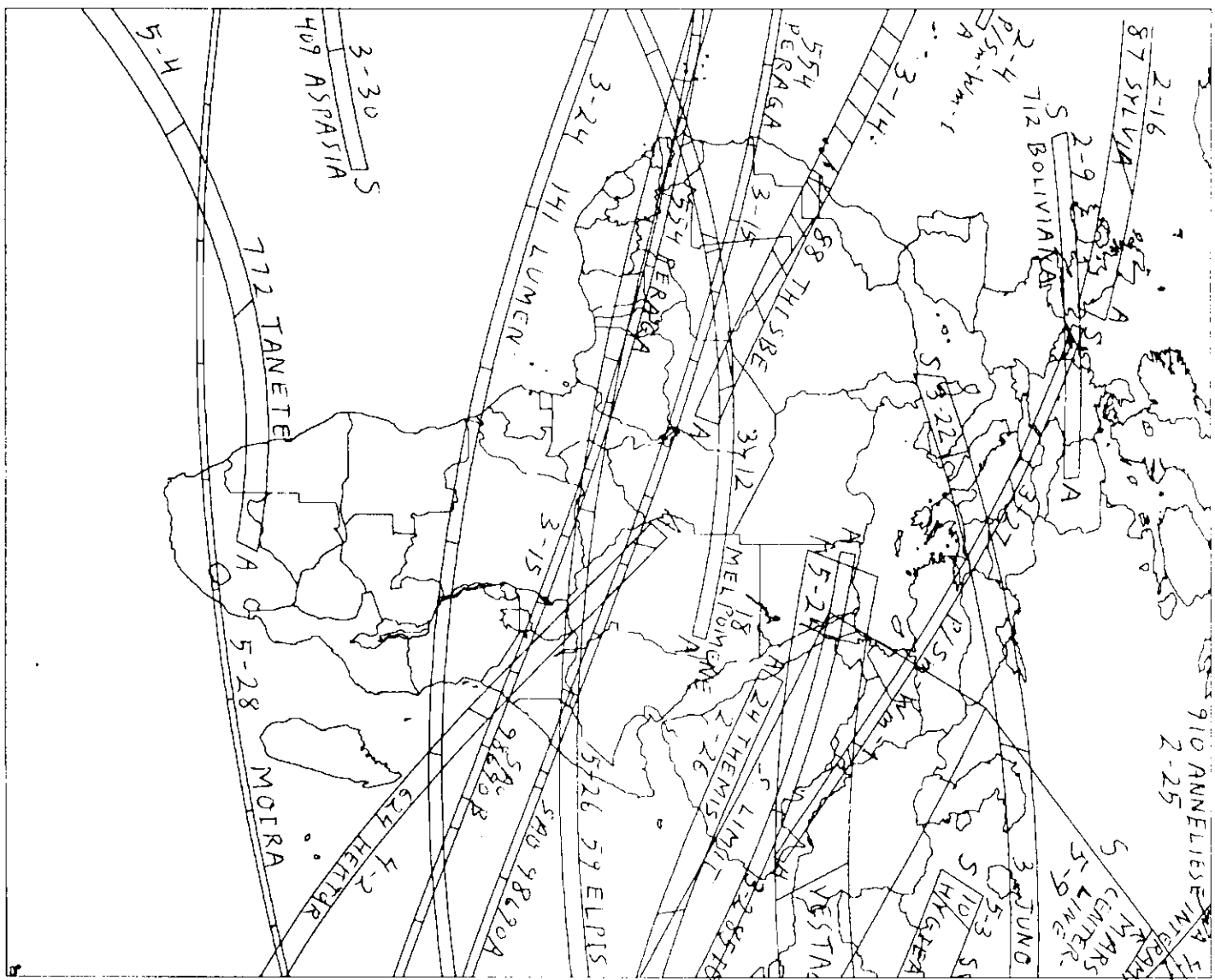
1993 Date	No.	MINOR PLANET Name	km-diam.	-//	RSOI	Type	Motion °/day	P.A.	STAR SAO No	DM/Id No	D	Min. Geocentric U. T.	Sep.	S	Comparison Data AGK3 No	Shift	Time	APPARENT R.A.	Dec.
Aug 12	303	Josephina	103	0.07	411		0.146	258°4	146585	- 6°6170		7 23.8	0"96s	F		-0"04	-0.1	23 14.0	-6° 5'
Aug 13	171	Ophelia	121	0.04	493	C	0.395	99.9	79782	+21 1714		9 22.2	0.84n	UR	N21° 876	-0.22	-0.0	7 53.8	21 7
Aug 13	354	Eleonora	162	0.10	824	S	0.217	232.8	163419	-14 5703		22 39.6	5.06s	UH		0.20	-1.3	20 17.2	-13 59
Aug 17	410	Chloris	128	0.07	541	C	0.140	93.0	111107	+ 5 471		19 0.9	0.71n	UA	N 6 344	-0.15	0.1	3 17.8	6 28
Aug 17	304	Olga	69	0.10	139	C	0.247	176.1	128584	- 2 6099		20 51.7	3.44w	UR	S 1 6	-0.01	-0.2	0 6.0	-1 16
Aug 18	19	Fortuna	171	0.17	674	G	0.176	255.0	163155	-18 5553		3 7.7	4.09n	UZ		-0.74	-0.5	19 58.7	-17 58
Aug 21		Venus	12220	13.60			1.179	96.9	79587	+21 1658		18 14.5	6.37n	UR	N20 877	0.02	0.0	7 39.1	20 51
Aug 22	27	Euterpe	118	0.11	381	S	0.043	224.7		+ 2 131		19 11.6	4.78s	XA	N 3 110	-0.02	0.2	0 55.5	3 17
Aug 24	31	Euphrosyne	248	0.12	1843	C	0.163	284.0		M 621138		16 53.2	0.93n	O				21 2.1	-52 40
Aug 30	712	Boliviana	132	0.07	419	C	0.481	105.2	96566	+16 1400		8 17.9	1.97s	UR	N16 733	0.15	0.0	7 9.0	16 34
Aug 31	19	Fortuna	171	0.16	667	G	0.081	248.4		L 5 1485		21 8.6	6.85n	H				19 51.5	-18 30
Sep 2	52	Europa	278	0.11	1671	CF	0.365	97.2		L 4 1194		13 10.9	2.30n	H				7 28.7	18 21
Sep 5	45	Eugenia	214	0.13	1170	FC	0.053	97.2				-58 49.1	2.30w	C				2 38.7	8 2
Sep 6	895	Helio	147	0.07	803	FCB	0.077	235.1		+ 1 4022		13 8.3	3.13s	A	N 1 2303			19 31.2	2 0
Sep 7	24	Themis	228	0.10	1514	C	0.098	89.6	185772	C2413492		2 55.1	0.17n	UX	C2413492	-2.15	7.0	17 47.6	-24 12
Sep 11	709	Fringilla	100	0.09	332	X	0.232	272.8	146070	- 2 5751		9 11.0	6.75n	UA	S 1 2736	-0.22	0.9	22 24.0	-1 28
Sep 15	75	Eurydike	58	0.09	107	M	0.189	271.9		+ 2 60		2 25.9	1.65s	XA	N 3 52	0.01	-0.0	0 31.0	3 25
Sep 19	87	Sylvia	271	0.09	2068	P	0.243	92.9				18 2.3	1.65s	C				8 0.6	25 30
Sep 19	52	Europa	278	0.12	1669	CF	0.337	99.3				19 39.1	2.44s	C				7 54.0	17 29
Sep 22	596	Scheila	117	0.08	502	PCD	0.208	249.8	147554	-15 179		2 19.2	0.11s	S				0 58.6	-15 11
Sep 23		P/Sm-Wm-1	100	0.02	782		0.115	98.5		+26 1612		9 7.9	1.61s	XA	N26 844	0.22	-2.7	7 37.0	26 7
Sep 26	144	Vibilia	146	0.10	513	C	0.297	88.6		L 1 1153		8 26.5	2.83s	HC		-2.34	1.1	6 34.3	22 45
Sep 28	89	Julia	159	0.13	574	S	0.185	46.4	39807	+43 1096		4 10.8	1.55n	AG	N43 511	2.16	5.2	4 51.1	43 34
Sep 28	10	Hygiea	429	0.15	3472	C	0.377	113.9	118612	+ 4 2408		13 14.2	0.88n	UR	N 4 1468	-0.19	0.3	11 0.3	3 46
Sep 29	1220	Crocus	55	0.03	147		0.221	93.4				18 5.7	2.59s	C				6 38.1	16 7
Oct 1	183	Istria	36	0.04	57	S	0.221	203.5	214187	C3217312		13 10.3	0.80n	G				22 55.5	-31 40
Oct 2	87	Sylvia	271	0.10	2073	P	0.214	91.7				23 45.7	0.18s	C				8 14.0	25 22
Oct 3		Pluto	2300	0.10			0.031	115.4		P 20		9 15.1	0.46s	H				15 39.2	-5 15
Oct 3	566	Stereoskopia	175	0.08	962	C	0.130	78.1	188137	C2614198		15 51.0	1.10s	XS		-0.00	-0.0	19 27.0	-25 57
Oct 4	107	Camilla	237	0.09	1499	C	0.281	107.6		+10 1830		3 58.8	0.28n	HA	N10 1117	-0.06	-0.2	8 35.5	10 27
Oct 9	27	Euterpe	118	0.13	366	S	0.250	247.9	128735	- 1 41		7 9.0	3.29n	UR	S 0 39	-0.10	0.4	0 23.4	-0 34
Oct 9	1220	Crocus	55	0.03	147		0.181	93.8				8 41.9	2.81n	C				6 46.2	15 59
Oct 10	206	Hersilia	111	0.07	397	C	0.086	104.0	94649	+18 877		14 46.8	4.32n	UZ	N18 460	-0.58	-0.9	5 33.2	18 32
Oct 13	24	Themis	228	0.09	1527	C	0.221	88.1		C2414069		2 57.8	2.31n	H				18 13.6	-24 6
Oct 14	776	Berbericia	183	0.11	838	C	0.208	70.8	79194	+24 1578		8 25.5	0.05s	UX	N24 805	-0.12	-0.1	7 14.2	24 1
Oct 14	46	Hestia	131	0.07	457	P	0.407	96.1		B2165509		13 27.6	1.23s	C				17 12.0	-20 59
Oct 15	30	Urania	104	0.09	287	S	0.176	87.7	78016	+25 1128		1 30.5	4.59n	UR	N25 632	-0.03	0.0	6 8.1	25 58
Oct 17	735	Marghanna	75	0.10	164	C	0.310	296.7	93152	+10 382		22 0.7	8.62s	UX	N10 301	0.05	-0.2	2 51.8	10 46
Oct 17	444	Gyptis	170	0.16	685	C	0.215	227.9	93255	+10 408		23 40.9	2.02s	UX	N10 326	-0.57	-0.9	3 3.2	10 41
Oct 19	532	Herculina	217	0.12	1329	S	0.053	321.4	191185	C2817792		12 50.6	0.81s	S				22 29.6	-27 52
Oct 20	107	Camilla	237	0.10	1499	C	0.242	110.2		L 1 4768		1 33.3	0.73n	H				8 51.6	9 6
Oct 21	288	Glauke	38	0.02	100	S	0.218	249.5				12 5.3	0.51n	C				1 58.4	5 31
Oct 25	87	Sylvia	271	0.11	2082	P	0.149	85.0				4 33.5	1.94n	C				8 32.0	25 25
Oct 31	15	Eunomia	272	0.16	1382	S	0.314	75.4		L 5 1534		4 44.1	2.97n	H				19 52.1	-15 14
Oct 31	1220	Crocus	55	0.03	147		0.066	87.6				10 7.6	2.13n	C				6 57.8	15 51
Nov 1	171	Ophelia	121	0.06	482	C	0.294	107.1	98805	+14 2157		2 20.8	1.46n	UR	N14 1055	-0.07	-0.1	9 50.5	14 9
Nov 1	15	Eunomia	272	0.16	1380	S	0.318	75.4		L 5 1648		7 47.5	1.08n	H				19 53.5	-15 9
Nov 4	449	Hamburga	89	0.08	271	C	0.247	255.1	92942	+ 9 318		15 14.7	0.66s	UA	N10 255	0.24	-0.6	2 25.4	10 29
Nov 9	56	Melete	117	0.05	508	P	0.252	114.4	118362	+ 3 2388		20 28.6	0.76n	UR	N 2 1391	0.09	-0.1	10 33.6	2 39
Nov 13	712	Boliviana	132	0.09	441	C	0.271	132.4	117308	+ 4 2086		0 33.4	1.51s	UA	N 4 1257	0.45	-0.7	8 57.5	4 0
Nov 13	358	Apollonia	92	0.06	303		0.148	74.9	165042	-10 5904		3 42.1	0.50n	U7		0.02	0.7	22 23.8	-10 14
Nov 20	288	Glauke	38	0.02	100	S	0.139	257.3	110007	+ 3 219		21 51.6	2.36n	UX	N 3 191	0.61	1.3	1 36.2	3 45
Nov 21	15	Eunomia	272	0.15	1359	S	0.385	74.0	163507	-13 5651		20 20.1	0.77n	UH		-0.08	0.6	20 22.3	-13 15
Nov 23	19	Fortuna	171	0.10	628	G	0.401	75.3	164056	-16 5759		2 28.7	2.15n	UX		-0.13	0.6	21 0.1	-15 47
Nov 23	407	Arachne	98	0.09	310	C	0.235	243.9	75811	+28 509		5 3.6	2.71n	UR	N28 333	-0.10	0.7	3 14.9	29 2
Nov 23	1220	Crocus	55	0.04	147		0.085	293.0				6 24.3	0.65n	C				6 57.3	16 15
Nov 25	654	Zelinda	132	0.07	529	C	0.258	83.7	126605	+ 0 4679		19 54.2	1.61s	RP	N 0 2655	0.01	0.3	21 11.3	0 39
Nov 27	444	Gyptis	170	0.15	702	C	0.148	241.8	110612	+ 5 356		18 51.7	3.76n	UR	N 5 266	0.00	0.7	2 33.2	5 41
Nov 29		Jupiter	140904	15.55			0.199	109.4	158379	-11 3671		6 48.9	4.72s	U7		-0.31	-0.2	14 8.2	-11 48
Nov 30	144	Vibilia	146	0.13	549	C	0.154	291.8		+24 1499		21 31.4	2.03n	XA	N24 760	0.12	0.7	7 1.8	24 29
Dec 11	12	Victoria	117	0.10	401	S	0.180	238.6	93335	+15 447		1 48.6	3.28s	UZ	N16 275	-0.04	0.1	3 12.1	16 30
Dec 11	105	Artemis	123	0.09	490	C	0.233	260.8	131238	- 7 823		3 28.9	2.56s	S				4 28.6	-7 6
Dec 11	156	Xanthippe	126	0.08	544	C	0.203	257.9	96091	+15 1313		23 46.9	1.23n	UA	N15 673	0.07	0.1	6 46.0	15 23
Dec 13	419	Aurelia	133	0.08	631	F	0.227	259.5		+19 750		2 41.7	0.80n	XA	N19 367	0.13	0.1	4 39.1	19 46
Dec 17	30	Urania	104	0.12	295	S	0.261	265.1	77562	+25 979		1 17.1	2.69n	UX	N25 558	-0.03	0.1	5 47.4	25 58
Dec 21	9	Metis	190	0.14	731	S	0.305	56.5	128628	- 4 7		11 10.6	4.23s	UR		-0.10	-0.0	0 10.9	-3 21
Dec 22	97	Klotho	87	0.11	214	M	0.179	284.0	115514	+ 3 1693		2 48.8	5.55s	RP	N 3 1011	-0.04	0.3	7 29.0	3 23
Dec 26	78	Diana	125	0.13	395	C	0.186	236.4	57127	+35 836		5 58.2	0.66n	A	N35 432			4 16.8	35 53
Dec 26	203	Pompeja	120	0.10	447	DCX:	0.219	277.2	79240	+27 1350		11 11.7	1.31n	UX		-0.02	0.5	7 16.6	26 53
Dec 30	27	Euterpe	118	0.09	342	S	0.330	64.2		+ 1 84		23 17.2	2.67n	XA	N 1 58			0 33.7	1 59
Dec 31	11	Parthenope	162	0.11	632	S	0.259	59.2	109579	- 0 152		3 8.8	3.71n	UX	N 0 89	-0.01	-0.3	0 59.3	0 38
Dec 31	1220	Crocus	55	0.04	147		0.231	289.4				18 33.2	0.17n	C				6 29.7	18 30
Dec 31	144	Vibilia	146	0.13	567	C	0.249	279.8	78468	+26 1261	K	23 4.6	2.89n	UX	N26 672	-0.16	-0.1	6 31.9	26 11
Dec 31	181	Eucharis	107	0.09	361	S	0.161	311.5	117042	+ 6 2017		23 38.1	4.89n	UA	N 5 1283	0.36	0.9	8 42.4	5 34


Planetary Occultations
1993 Feb. - May
2-25 JUPITER
3-2 85 IO
MERCURY
4-14
S. LIMIT
CENTER LINE
N. LIMIT
4-2 24 THEMIS
3-6 58 CONCORDIA
2-16 2060 CHIRON
3 JUNO
2-4 P/Sm.-Wm.-1
2-26
3 JUNO 2-26
4h U.T.
5h U.T.
3-27
MARS
CENTERLINE
N. LIMIT
5-10
5-26 59 ELPIS
3-24 141 LUMEN
3-15 554 PERAGA
SAO 98690A
3-15 98690B
3-14 88 THISBE
2-4 P/Sm.-Wm.-1
87 SYLVIA
2-16
3-12 18 MELPOMENE
3-30 409 ASPASIA
426 HIPPO
5-28 MOIRA
P/SWIFT-TUTTLE
5-2
772 TANETE
5-4

Planetary Occultations 1993 Feb. - May



Planetary Occultations 1993 Feb. - May



Priority List: A priority list of events most likely to have last-minute astrometric updates will be given in the next issue.

Occultations by Major Planets: I have included all occultations of major planets given by L. Wasserman, E. Bowell, and R. Millis in **Astronomical Journal (AJ) 103** (103), p. 2089, as well as a few additional events that my search revealed. The occultations by Jupiter will be very difficult; I included them only because they were listed by Wasserman et al. No occultations by Saturn were found, but some very difficult events, perhaps visible in infrared bands with large telescopes, are given by Bosh and McDonald in **AJ 103** (103), p. 983. Similarly, some difficult occultations of faint stars by Uranus and Neptune are given by D. Mink and A. Klemola in **AJ 102**, p. 389. Possible occultations by Pluto or by Charon are listed by D. Mink, A. Klemola, and M. Buie in **AJ 101**, p. 2255. One of the best Pluto occultations of the rest of this decade, involving a 12.4-mag. star possibly visible from Japan or eastern Australia, is predicted to occur on October 3rd. Wolfgang Beisker and some other members of IOTA/ES are making plans to try to observe the event from Australia. Unfortunately, the small elongation from the Sun will make last-minute astrometry difficult, but Pluto's motion is so small that a good prediction may be possible from plates taken a few months before when the elongation is larger.

Notes about Individual Events: No notes are given for events in January, since this issue will unfortunately be distributed after those events.

Feb. 4: This is the giant periodic comet Schwassmann-Wachmann 1, in a nearly circular orbit beyond Jupiter; its diameter is only a guess. In December, the comet underwent an outburst, and in late January, it was still brighter than usual, but still much fainter than the star. Dimming in the coma may occur within one or two hundred km of the path, whose location is quite uncertain due to the AC source for the star's position and the object's relatively large distance from the Earth (so the event might occur anywhere in North America). A recent position for the star will probably be obtained before the event to improve the prediction. I will try to make a finder chart for the star before the event, but distribution of it to potential observers will be a problem, and may be possible only by FAX.

Feb. 16, Chiron: Chiron is also apparently a giant comet nucleus, although at its greater distance, it is not as active as Schwassmann-Wachmann 1. Like the Feb. 4 event, the prediction is very uncertain due to the AC source for the star's position, so an update of the star would again help. The world map shows that the event could be visible almost anywhere in the Pacific Ocean, eastern Asia, or Australia.

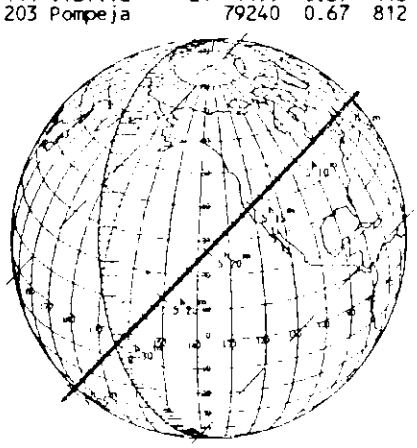
Feb. 25: Jupiter will have a negligible 0".12 defect of illumination.

Feb. 26, Juno: The two occultations by Juno on this date are predicted by E. Goffin to occur over 1" southeast of my paths. The first event, with a very small magnitude drop, would normally not be included, but it is presented here because of the other more favorable event an hour later.

Notes about individual events after February will be given in the next issue.

Table 3. Stellar Angular Diameter Information

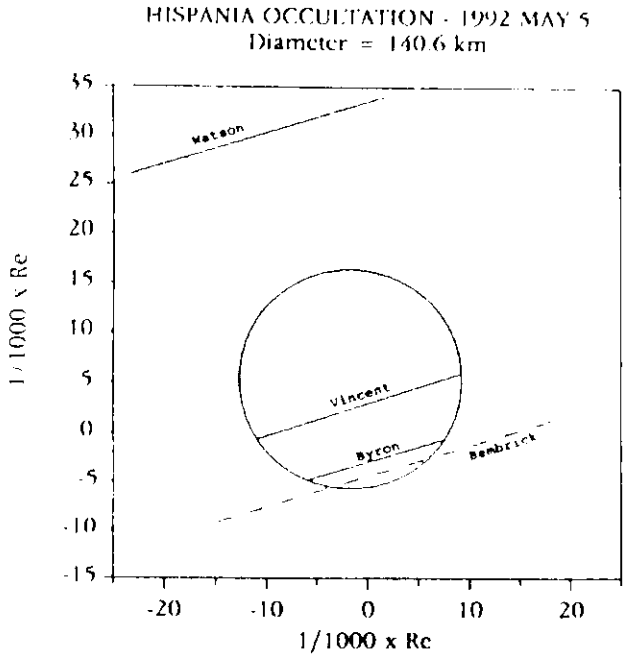
1993 Date	PLANET No.	PLANET NAME	STARD SAO/DM/Id	Stellar Diameter m//	m	Time	df
Feb 17	357	Ninina	96403	1.44	2471	289^{ms}	8.1
Mar 13	88	Thisbe	96656	0.28	546	266	1.7
Mar 24	141	Lumen	156969	0.67	1080	70	3.7
Apr 2	624	Hektor	211153	0.23	847	53	1.9
May 26	59	Elpis	140990	0.64	896	70	3.3
May 28	638	Moira	159886	0.61	574	65	2.5
Jun 15	20	Massalia	184751	0.74	924	77	3.6
Jun 21	89	Julia	75188	1.89	3524	90	11.1
Jul 17	776	Berbericia	943320	0.91	2151	52	6.1
Aug 9	89	Julia	56655	1.36	2149	81	7.4
Aug 12	303	Josephina	146585	5.94	9127	974	31.8
Aug 13	171	Ophelia	79782	1.97	5376	120	14.0
Aug 17	304	Olga	128584	0.53	371	51	1.9
Aug 22	27	Euterpe	+ 2° 131	0.27	293	152	1.2
Aug 31	19	Fortuna	L 5 1485	0.18	190	53	0.8
Oct 1	183	Istria	214187	1.82	1548	198	7.3
Oct 10	206	Hersilia	94649	0.22	327	61	1.1
Oct 15	30	Urania	78016	0.48	536	66	2.2
Oct 17	444	Gyptis	93255	0.78	817	87	3.4
Oct 19	532	Herculina	191185	0.19	365	88	1.1
Nov 9	56	Melete	118362	0.85	2049	80	5.7
Nov 13	358	Apollonia	165042	0.75	1232	122	4.2
Nov 27	444	Gyptis	110612	0.55	620	90	2.5
Nov 30	144	Vibilia	+24° 1499	0.37	416	58	1.7
Dec 26	203	Pompeja	79240	0.67	812	73	3.2



Anonymous by P/SM-WM-1 93 Feb 4

OCCULTATION OF SAO 181281 BY (804) HISPANIA ON 1992 MAY 5

This occultation was observed by Keith Vincent at Havelock North, New Zealand (duration 11.4 seconds); Jeff Byron, Sydney, N.S.W., Australia (duration 7.5 seconds); and Colin Bembrick, Bathurst, N.S.W. (duration uncertain, 2.5 to 5.5 seconds); details are given in Graham Blow's article on pages 13 and 14 of Circular CQ 92/2 (September 1992) of the Occultation Section of the Royal Astronomical Society of New Zealand, from which the figure below is reproduced.



ASTEROID (MAINLY TOUTATIS) NEWS

David W. Dunham

Predictions of occultations by (4179) Toutatis during its close approach to the Earth were given in an article starting on p. 233 of the last issue. None of the Toutatis occultations is known to have been observed. The weather was bad in most of North America for the events that occurred there, and I have heard of only a few appulse observations. I got the first orbit updated with radar data from Don Yeomans at the Jet Propulsion Laboratory (JPL) on December 7th, but I did not have time to make the changes needed to produce an accurate ephemeris for an object passing so close to the Earth. By about December 12th, we worked out an arrangement where Don sent me a B1950 ephemeris by e-mail, and I was able to generate updated predictions with these data. The last updated ephemeris came on the 18th, but already by the 12th, the radar-updated ephemeris was so good that the new radar observations showed that Toutatis was within about 1 km of its predicted distance. However, the cross-track error might be a little larger, so that successful occultation observations might be useful to supplement the radar data to provide accurate 3-dimensional data for Toutatis that could be used to refine the predictions for future close approaches by this object (an improved position for the star, which is expected from Hipparcos satellite observations now in progress, would be needed for this). The updated predictions were near the centers of the uncertainty zones that I plotted on the three maps in the last issue. The only practical way to distribute the updated predictions before the holidays was by e-mail, and I sent predictions to about 30 observers around the world that way. John Spencer at Lowell Observatory copied some of my data to a larger e-mail list of mainly professional astronomers coordinating astronomical observations of Toutatis, and this established some new contacts that will be useful for future asteroidal occultations.

By late December, current star position errors seriously magnified the width of the uncertainty zones as Toutatis rushed away from the Earth. These errors (half-widths) are given in km in the table below:

Cat. source		C or S	A	R or U	L	5	Hipparcos
Error		1".0	0".6	0".3	0".1	0".05	0".002
1992	Dist.						
Dec. 8	0.024	18	11	5	2	1	0.04
Dec. 15	0.050	37	22	11	4	2	0.07
Dec. 23	0.100	74	44	22	8	4	0.15
Dec. 31	0.155	114	68	34	12	6	0.23

The star catalog source codes, or "Cat. source" in the table, for occulted stars were given under "S" in the 2nd table on p. 235 of the last issue. C = Astrographic Catalog, S = SAO, A = AGK3, R = AGK3R, U = USNO Zodiacal Zone (Z.Z.), L = PPM high-precision subset, and 5 = FK5. The distance of Toutatis in astronomical units is listed after the 1992 date. Since the radar data (spectacular radar images have been published in **Science News**, **Space News**, and elsewhere) show that the long axis of Toutatis is about 5 km, the problem of spacing enough observers

across the uncertainty zone to really catch the occultation is apparent with current star positions. Hopefully, when Toutatis makes an almost identical flyby in December 1996, Hipparcos (specifically, Tycho catalog) positions accurate to a few milliarcseconds will be available for most of the stars so that observers can be precisely positioned to catch the occultations. I presented the above material at a workshop on first results of the Toutatis flyby that was held at the University of Arizona in Tucson on January 4th, just before a meeting on hazards due to comets and asteroids that I also attended.

JPL's Steve Ostro recently showed me the impact that upgrades to the radars at Goldstone and Arecibo during the next two years can have on asteroid science. These will allow crude imaging of virtually all main-belt asteroids larger than 200 km, and many of the inner-belt objects over 100 km. If enough observations can be scheduled, the upgraded radar data will also allow precision orbits to be determined for these asteroids. The better orbits coupled with good star positions determined from Hipparcos observations should make possible accurate prediction of occultation paths months and years in advance, without the need for last-minute astrometry.

Steve Ostro has said that the radar observations of Toutatis, which have a distance binning of 19 meters, have revealed no satellites or debris clouds. This might be expected for an asteroid that has probably made previous very close approaches to the Earth that would tend to perturb any possible satellites away from the week gravity of Toutatis. Nevertheless, on January 18th, Petr Pravec in the Czech Republic made a remarkable discovery - he found an object about 2.5 magnitudes fainter than Toutatis about 40" away and moving with a similar motion. The object was about 90" away the next night, in spite of Toutatis' daily motion of over 1000". However, Alan Stern soon pointed out that the gravitational sphere of influence of Toutatis would be at most 3". Brian Marsden solved the mystery when he found that another asteroid, 1992 YG3, that had been discovered in Japan on December 30th, did indeed pass near Toutatis in the sky on January 18th, and had a remarkably similar motion at that time.

CORRECTIONS TO GRAZING OCCULTATION PREDICTIONS

David W. Dunham

Northern-limits: During the last two years, dark-limb northern-limit waxing-phase grazes, which generally occur from February through June, have usually been shifting south of IOTA's prediction version 80M and 80N by a few tenths of an arc second, and this is expected to continue during 1993. You should adjust your coverage to expect anywhere from no shift to a 0".5 southward shift of the shadow, using the vertical scale on the left side of your ACLPPP profile. I would recommend aiming for a location 0".3 south of the most interesting part of the profile (that is, the horizonal line that is closest, say within 0".2 of, the most predicted profile points), but, if this is within 0".7 of the highest mountain top on the profile, you should be sure that someone observers from 0".7 under the highest mountain, to give a high probability of seeing something during the graze, and not just a miss (no occultation). In general, with 3 or more stations, it is best to try to cover a full arc second of vertical distance, at least covering from highest mountain top to either 0".7 south of it, or 0".3 south of the most interesting region, whichever is farthest south.

Southern-limits: Dark-limb southern-limit waxing-phase grazes near the lunar South Pole, in particular, from Watts angles 165° to 180° when the profile points are plotted as numbers from 3 to 7, have also been shifting south, usually by 0".4 to 0".5. These events usually occur in the evenings from October through March. Fortunately, there are large mountains in this region, so that the danger of seeing a miss is much less than for the smooth features usually found in the northern polar regions. There is some evidence that most of the southern Cassini region, where the profile points are mostly plotted as numbers from 2 to 4, is all a little farther south (higher) than our current ACLPPP predictions indicate, so this correction may affect waning-phase grazes, also, to Watts angle 187°.

REPORTS OF ASTEROIDAL APPULSES AND OCCULTATIONS

Jim Stamm

If you do not have a regional coordinator who forwards your reports, they should be sent to me at: 11781 N. Joi Dr. Tucson, AZ 85737 USA. Names and addresses of regional coordinators are given in "From the Publisher" on *Occultation Newsletter's* front page. All times in this report are UTC.

I have summarized all of the reports that I have received for the last half of 1990 in the following two tables and section of notes. Table 1 lists the 1990 date, minor planet, occulted star, IDs of successful observers, and references to any notes. Table 2 lists the observer's ID, name, nearest town to location of observation, country (includes state or province for North America and Australia),and the total number of observations made in the period. The notes section details those events that included positive observations, or other significant information that could not be reported in the tables. I am not including notes on those observations that may have been spurious unless there is some sort of confirmation, or the fact that something may have happened is relevant to another observation. Instead, I will place an asterisk (*) in the Notes column to indicate that I have received a report with more than a "no event....." in it.

Table 1. Asteroidal appulses and occultations: Jul-Dec 1990.

1990	Minor	Planet	Cat	Star	Observers	Notes
Jul 02	8	Flora	SAO	186885	SmcHutAndDlk	
Jul 04	176	Iduna	AGK3	+16° 2602	BqsBulCanDssGbf GrcIelMddNelRuzVgl	
Jul 06	6	Hebe	SAO	120195	SmcHutAnd	
Jul 09	39	Laetitia	SAO	119674	GrhGrt	
Jul 09	8	Flora	LickV	5980	Dlk	
Jul 10	196	Philomela	LickV	2003	SmcLap	
Jul 10	86	Semele	LickV	5597	CooOveMltVnbLapSmc	
Jul 12	598	Octavia	LickV	872	StgSmc	
Jul 14	224	Oceana	SAO	183675	Sta	
Jul 15	3	Juno	AGK3	-01° 1862	OveCooMlt	1
Jul 19	679	Pax	LickV	6945	HozHon	
Jul 20	211	Isolda	SAO	109396	Dlk	
Jul 28	8	Flora	DM	-22° 4543	AndSmcDlk	
Jul 28	8	Flora	LickV	2309	ProVnbAndSmc	
Jul 28	8	Flora	SAO	186216	DaeProVnb	
Jul 29	8	Flora	SAO	186209	Hon	
Jul 31	732	Tjilaki	AGK3	+01° 2810	BlkStgAndSmc	
Jul 31	454	Mathesis	SAO	209137	BlkLapCal	
Aug 09	10	Hygiea	AGK3	+00° 2899	DlkStg	
Aug 09	679	Pax	SAO	186343		2
Aug 10	86	Semele	LickV	1633	BlkBrySmc	
Aug 13	516	Amherstia	SAO	189599	CooOveSmiKni	
Aug 19	38	Leda	AGK3	+00° 2856	CooKniOveSmiVnb	
Aug 23	145	Adeona	SAO	129413	HutSmc	
Aug 24	441	Bathilde	SAO	159572	Sta	
Sep 01	81	Terpsichore	AGK3	+29° 0648	WabKelSamHonWel	
Sep 02	679	Pax	SAO	186284	GarTavLyzChl	
Sep 02	704	Interamnia	FAC	895087	And	
Sep 06	377	Campania	AGK3	+09° 0045	Sml	
Sep 07	501	Urhixidur	SAO	190967	DaeProBlkLoaSmc	3
Sep 08	40	Harmonia	SAO	190308	Wid	*
Sep 09	276	Adelheid	AGK3	+12° 0511	Hak	
Sep 09	260	Huberta	LickV	5131	Sta	
Sep 11	20	Massalia	SAO	164484	Sta	
Sep 16	121	Hermione	AC	2350	DwdHavSatSms	
Sep 22	689	Zita	SAO	146303	CooOveWesMltSml	
Sep 24	19	Fortuna	AGK3	+22° 0623	DflDssKocKsz MeuMlnMosSzaZal	4
Sep 29	19	Fortuna	AGK3	+22° 0643	BilBnnBulDflDss ErnFauGbfHokHolKhl MeuMlnMosShtSzcVlr	
Sep 29	160	Una	LickV	5951	Stg	
Sep 30	51	Nemausa	SAO	163983	TamRbbDeaMonGea PryLyzChlWimJoh	
Sep 30	451	Patientia	FAC	104734	Dlk	5
Oct 02		Flora	AC	11836	Sta	
Oct 11	196	Philomela	LickV	6717	OveSmiBlnVnb	
Oct 14	537	Pauly	SAO	189034	Ven	
Oct 14	306	Unitas	SAO	128623	StaSmcAnd	
Oct 14	494	Virtus	DM	+19° 0547	Sta	
Oct 22	120	Lachesis	AGK3	+15° 0115	StaKrtSpr	
Oct 22	185	Eunike	AGK3	+02° 1213	BlkSmcAnd	6
Oct 22	139	Juewa	AGK3	+07° 0061		7
Oct 24	127	Johanna	SAO	189449	BqsDssGcvGrcLooVgl	
Oct 30	804	Hispania	AGK3	+25° 1097	Hon	
Oct 30	661	Cloelia	AGK3	+35° 0563	HonStaManPal	
Oct 30	506	Marion	LickV	2928	CmbDflDssGen	
Nov 12	60	Echo	AGK3	+13° 0263	PryStaManPal	
Nov 15	704	Interamnia	FAC	885701	VenHonStaManPal	
Nov 17	924	Toni	AGK3	+09° 0488	BrrDflFauFenFrb GloGrcPrcThm	
Nov 17	216	Kleopatra	FAC	11.2 mag	Rel	8
Nov 19	537	Pauly	SAO	189987	SmlJoo	
Nov 20	838	Seraphina	AGK3	+10° 0029	SmlVnbAouDf lDssIelKkn	
Nov 23	323	Brucia	SAO	193254	DlkBlkAnd	
Nov 26	614	Pia	AGK3	+08° 0147	CooBln	
Dec 04	31	Euphrosyne	AGK3	+05° 1819	Sta	
Dec 05	701	Oriola	AGK3	+18° 0239	LapBlkSmc	
Dec 05	107	Camilla	LickV	2528	DssGbfLqn	
Dec 09	704	Interamnia	FAC	900107	GrhHonStaSamWar	9
Dec 10	451	Patientia	FAC	87231	CanGrc	
Dec 14	17	Thetis	LickV	23215	Dss	
Dec 15	121	Hermione		Anon.	And	
Dec 15	121	Hermione		Anon.	And	
Dec 19	451	Patientia	AGK3	+08° 0360	MamCvgDssGdlAnd	*
Dec 20	860	Ursina	AGK3	+33° 0237	GeaSta	
Dec 25	121	Hermione		Anon.	LapBlk	
Dec 28	121	Hermione	FAC	188065	BulDflMos	
Dec 31	205	Martha	DM	+04° 0190	AouDflDssHilMos	

Table 2. Observers and locations of events: Jul-Dec 1990.

ID	Observer	Town	Country	No.
And	Anderson, Peter	The Gap	Queensland - AUS	12
Aou	Arnaout, W.	Kalaa Sghira	Tunisia	2
Bni	Baroni, Sandro	Milano	Italy	1
Brz	Barruezo, Jose	Granada	Spain	1
Brh	Barthes, Jacques	Castres	France	1
Bff	Baruffetti, Pietro	Massa	Italy	1
Bat	Bath, K.-L.	Emmerdingen	Germany	1
Bel	Bellot, Luis	Granada	Spain	1
Bnr	Benier, Jacky	Varades	France	1
Bln	Bentlin,	Freiburg	Germany	1
Bln	Blane, D.	Henly on Klip	South Africa	2
Blk	Blanksby, Jim	Wandin	Victoria - AUS	8
Bsc	Blasco, Julian	Zaragoza	Spain	1
Bnn	Bonninsegna, R.	Dourbes	Belgium	3
Brr	Borras, Vincente	Benicarlo	Spain	2
Bss	Bossalaers, Mark	Berchem	Belgium	1
Bgs	Bourgeois, Jean	Ciney	Belgium	4
Bil	Bril, Henk	Urmond	Netherlands	2
Bry	Bryant, Ken	Langwarrin	Victoria - AUS	1
Bul	Bulder, Henk	Zoetermeer	Netherlands	4
Cll	Callens, B.	Gent	Belgium	1
Cal	Camilleri, Paul	Cobram	Victoria - AUS	1
Cns	Canales, Oscar	Pinsoro	Spain	1
Can	Candela, Bernard	Sollies-Pont	France	1

Tab. 1 (Cont.) Asteroidal appulses/occultations: Jul-Dec '90.

Tab. 2 (Cont.) Observers/locations of events: Jul-Dec 1990.

Cvg	Cavagna, Marco	Sormano	Italy	2
Chl	Child, Jack	Table Mountain	California - USA	2
Cmb	Colomba, Armando	Reggio Calabria	Italy	1
Coo	Cooper, Tim	E. Rand/Malelane	South Africa	6
Dfl	Daiffallah, K.	Alger	Algeria	7
Dae	Dale, S.	Pietermaritzburg	South Africa	2
Dea	Dean, Fred	Victoria	Brit. Col. - CAN	1
Dik	Dickie, Ross	Gore	New Zealand	7
Dwd	Dunham, David W.	Greenbelt	Maryland - USA	1
Dss	Dusser, Raymond	Kalaa Sghira	Tunisia	12
Ern	Ernst, Christoph	Graz	Austria	2
Stv	Estever, Carles	Els Hostalets	Spain	1
Fau	Faure, G.	Varces	France	3
Fdr	Federspiel, Martin	Freiburg	Germany	1
Fld	Feldmann, J.-B.	Dijon	France	1
Fen	Fernandes, J.	Pedrogao Pequeno	Portugal	1
Fgl	Foglia, Sergio	Lacona	Italy	1
Glo	Gallo, Vicenzo	Salerno	Italy	1
Grc	Garcia, Joaquim	Lisboa	Portugal	5
Gur	Garcia, Ruben	Montevideo	Uraguay	1
Gen	Genovese, Marco	Torino	Italy	1
Geo	George, Anthony	Salem	Oregon - USA	2
Gip	Gigli, Paolo	Pistoia	Italy	2
Gbt	Gobet, Franck	Villefranche/S.	France	3
Gcv	Goncalves, Rui	Lisboa	Portugal	2
Grn	Gracias, Nuno		Portugal	1
Grh	Graham, Frances	East Pittsburg	Penn. - USA	2
Grt	Graham, Theresa	East Pittsburg	Penn. - USA	1
Gdi	Gualdoni, Carlo	Sormano	Italy	1
Gth	Guenther, Eike	Freiburg	Germany	1
Hav	Harvey, Roger	Concord	N. Carolina - USA	1
Hak	Hauk, Robert	Portland	Oregon - USA	1
Hol	Holler, Gert	Graz	Austria	1
Hok	Holler, Klaus	Graz	Austria	2
Hll	Hollis, Andrew	Northwich	United Kingdom	1
Hoz	Holtz, John	Russellton	Penn. - USA	1
Hon	Honkus, Edward	Carnegie Russellton	Penn. - USA	7
Hst	Horst, Schmidt	Freiburg	Germany	1
Hut	Hutcheon	Sheldon/Warwick	Queensland - AUS	3
Iel	Ielo, Antonio	Reggio Calabria	Italy	3
Joh	Johnson, Randy	Seattle	Washington - USA	1
Joo	Jooste, J.	Reitz	South Africa	1
Ksz	Kasz, Laszlo	Boly	Hungary	1
Kel	Keith, Lee	Meene	Wisconsin - USA	1
Kom	Klemencic, R.	Gorenja Vas	Yugoslavia	1
Knl	Knight, J.	East Rand	South Africa	2
Koc	Kocsis, Antal	Balatonkenese	Hungary	1
Kfd	Kohl, Ferdinand	Uster	Switzerland	1
Khl	Kohl, Mike	Wald	Switzerland	2
Kkn	Kosa-Kiss, Attila	Salonta	Romania	1
Kbl	Kosir, B.	Ljubljana	Yugoslavia	1
Krt	Kretlow, Mike	Siegen	Germany	2
Lap	Larkin, Patricia	The Basin	Victoria - AUS	5
Lat	Laurent, Dirk	Gent	Belgium	1
Lgm	Le Guern, Vincent	Villeneuve d'A.	France	3
Loa	Loader, Brian	Black Birch Christchurch	New Zealand	1
Lyz	Lyzenga, Greg	Table Mt.	California - USA	2
Mam	Majumdar, T. K.	Calcutta	India	1
Mun	Munly, Peter	Central	Arizona - USA	3
Mti	Marti, Josep	Mataro	Spain	1
Mrx	Marx, Harald	Stuttgart	Germany	1
Maj	Mazalrey, Jean	Vernon	France	1
Maz	Mazalrey, Pierre	Vernon	France	1
Mih	Michon, Jean-Pol	Herment	France	1
Mdo	Middleton, R.W.	Brightling, Col.	United Kingdom	1
Mit	Mitchell, H.	Pennington	South Africa	3
Mon	Montoya, Mike	Mariposa	California - USA	1
Mrt	Moretti, Stefano	Forli	Italy	1
Mln	Morillon, Eric	Liguge	France	2
Mos	Mostefaoui, Toufik	Alger	Algeria	4
Nel	Neel, Regis	Venissieux	France	2
Bno	Observ. De Brno	Brno	Switzerland	1
Meu	Obsev. De Meudon	Meudon	France	2
Ove	Overbeek, Danie	East Rand	South Africa	6
Pal	Palles, Leroy	Central	Arizona - USA	3

Tab. 2 (Cont.) Observers/locations of events: Jul-Dec 1990.

Pnn	Pannier, Lutz	Gorlitz	Germany	1
Prr	Pereira, Alfredo	Lisboa	Portugal	1
Pgk	Piqulski, Andrzej	Wroclaw	Poland	1
Por	Porcel, Aniceto	Granada	Spain	1
Prc	Porcini, Roberto	Salerno	Italy	2
Ppl	Pouplier, Alphonse	Ciney	Belgium	1
Pro	Prosser, G.	Pietermaritzburg	South Africa	3
Pry	Pryal, Jim	Seattle/Easton	Washington - USA	2
Blt	Ramon, Luis	Granada	Spain	1
Rsp	Raspadori, G.	Bologna	Italy	1
Rdn	Raudino, Paolo	Civitavecchia	Italy	1
Rbb	Robb, Russ	Victoria	Brit. Col. - CAN	1
Frb	Rodriquez, F.	Sevilla	Spain	1
Ruz	Ruiz Fernandez, J.	Santander	Spain	1
Rui	Ruiz Mazo, S.	Granada	Spain	1
Sat	Salthouse, Andrew	Millington	New Jersey - USA	1
Sam	Samolyk, G.	Milwaukee Greenfield	Wisconsin - USA	2
Sau	Sauter, Christof	St. Margarethen	Switzerland	1
Sch	Schnabel, Carles	Barcelona	Spain	1
Shk	Schoenmaker, A.A.	Roden	Netherlands	1
Sht	Scholten, Alex	Eerbeek	Netherlands	1
Sch	Schwaenen, Jean	Marcinelle	Belgium	1
Smi	Smit, J.	Pretoria	South Africa	7
Smc	Smith, Charlie	Woodridge	Queensland - AUS	14
Sms	Smith, Scott	Fultondale	Alabama - USA	1
Spl	Speil, Jerzy	Walbrzych	Poland	1
Spr	Springob, C	Siegen	Germany	2
Stg	St. George, Lou	Auckland	New Zealand	4
Sta	Stamm, Jim	Tucson	Arizona - USA	14
Sut	Sutterlin, Peter	Freiburg	Germany	1
Sza	Szabo, Sandor	Boly	Hungary	2
Szc	Szolcsanyi, Gyorgy	Pilisszen	Hungary	1
Szl	Szollosi, Attila	Kecskemet	Hungary	1
Tam	Tatum, Jeremy	Victoria	Brit. Col. - CAN	1
Tav	Taverez, Gabriel	Montevideo	Uraguay	1
Tsi	Tesi, Luciano	Pistoia	Italy	2
Thm	Thomas, S.	Aix-en-Prov.	France	1
Tso	Tissot, M.	Villeneuve d'A.	France	1
Trl	Torrell, Sebastia	Barcelona	Spain	1
Vbj	Van Ballegoy, E.	Druten	Netherlands	1
Vnb	Van Blommestein, P.	Simon's Town	South Africa	6
Vgl	Van Gestel, Jan	Geel	Belgium	4
Loo	Van Loo, E.	Ciney	Belgium	2
Vso	Van Soom, H.	Gent	Belgium	1
Ven	Venable, Roger	Wrens Hard Labor Cr. S.P. Ft. Gordon	Georgia - USA	2
Vid	Vidal, Joaquin	Monegrillo	Spain	1
Vlr	Voller, Wolfgang	Graz	Austria	1
War	Waraczynski, Sally	Muskego Co. Park	Wisconsin - USA	1
Wab	Warner, Brian	Colorado Springs	Colorado - USA	1
Wei	Weier, David	Brooklyn	Wisconsin - USA	1
Whk	Weith-Knudsen, N	Tisvildeleje	Denmark	1
wes	West, D.	Lanseria	South Africa	1
Wld	Widdop, H.J.	Pierrefonds	Quebec - CAN	1
Wlm	Williams, Ernie	Table Mountain	California - USA	1
Wls	Wils, P.	St-Cat.-Wav.	Belgium	1
Wbb	Wubbena, E.K.	Oosterhout	Netherlands	1
Zal	Zalezsak, Tamas	Balatonkenese	Hungary	1

NOTES (Jul-Dec 1990):

1. Jul (Jun) 15 Juno. See [O.N. 5(4), p.93]. This is a corrected date.
2. Aug 09 Pax. See [O.N. 5(4), p.93]. Observers were: BelBatBffBgsBlaBltBnlBnnBno BnrBrhBrrBrzBscBssCanCnsCvgDssEtvFauFdrFgl FldGcvGipGreGrnGthHstJelKfdKhlKgnMaJMazMih MtiMttNelPorPplProPrrRdnRspRuiSauSebSchSut SzlTrlTsiVczVglVld.
3. Sep 07 Urhixidur. Dae represents both S. Dale and R. Dale.

NOTES (Cont.) (Jul-Dec 1990):

4. Sep 24 (19) Fortuna. See [O.N.5(4),p.93]. This is a corrected date.
5. Sep 30 Patientia. After playing back his tape on Nov 07, Dik realized that he may have seen somthing. His eyepiece had fogged, but he recorded a "definite" fading of the star "by half its brightness." The times obtained: D at 15:25:26.8 and R at 15:28:04.7.
6. Oct 22 Eunike. Blk recorded a D at 18:03:07.6 and a R at 18:03:23.4 (No PEs applied) from Long. E 145° 29' 37.4", Lat. S 37° 22' 36.1", Elev. 260 meters. This shifts the nominal path about 0.7 arcsec south.
7. Oct 22 Juewa. 30 observers (BgsBilBnnBul CllDssErnGipHokKbjKlmKrtLgnLntLooMrxPgkPnn ShkSplSprSzaTslTsoVbgVglVsoWbbWhkWls) from 25 stations moonitored this event. Wbb reported a positive event, with no other information, and Dss may have seen something.
8. Nov 17 Kleopatra. Harold Reitsema recorded an 11.0 sec. occultation from Dillon, Colorado.
9. Dec 09 Interamnia. See [O.N. 5(4), p.93].

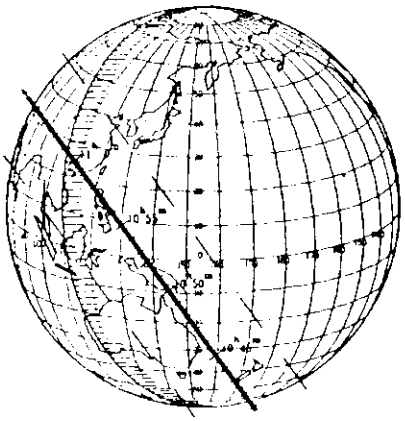
Correction: The observation of AGK# +18°0627 on Mar 13, 1990 [O.N.5(4),p.93] by David Dunham was from Westminster, Maryland.

EARLY NEWS ABOUT LAST DECEMBER'S TOTAL LUNAR ECLIPSE

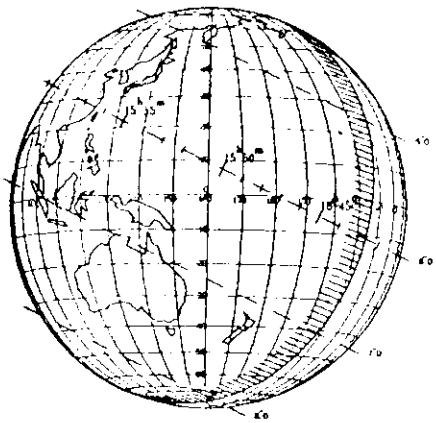
David W. Dunham

Observers in the northeastern USA and southeastern Canada had a good view of this dark eclipse. Skies were mostly overcast in other areas with large numbers of observers, including the central USA, northwestern Europe, and southern Africa. The eclipse was dark, but there were large variations in brightness within the umbra. Ton Shoenmaker in the Canary Islands and I, observing from Sperry Observatory in Union, NJ, both estimated that the Moon as a whole was about 2nd magnitude near mid-totality, which compares with estimates as low as 4th magnitude for the 1963 December 30th eclipse that was blackened by the recent eruption of Mt. Agung. Although Pinatubo was a larger eruption, apparently the 1.5 years since its eruption has allowed much of the upper-level material that darkens eclipses to settle out of the atmosphere.

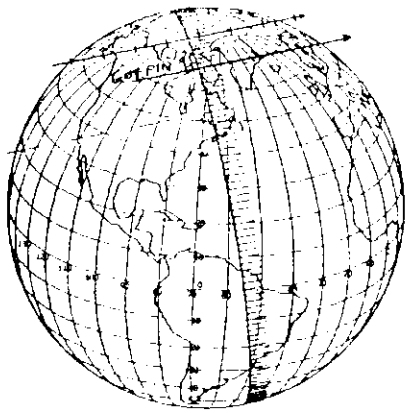
If the eclipse had been as dark as the one at the end of 1963, it might have been possible to time large numbers of occultations of 13th-magnitude stars. As it was, most 11th-magnitude stars just merged with the Moon's edge without sharp events, like a bright-limb occultation. That was my experience using my 20-cm telescope with image-intensified video in New Jersey, and also Wayne Warren's experience observing visually with a 40-cm Cassegrain telescope at the Goddard Space Flight Center Optical Facility. We each timed about 15 occultations of mostly 9th and 10th-magnitude stars. The geometry of the star field for us was such that most of the events were reappearances. I had hoped to use the 61-cm telescope at Sperry Observatory, but other workers there and I were unable to make a practical mechanical connection of my video camera/intensifier with the telescope, so I used my own telescope. The only graze that I now know was observed during the eclipse was the northern-limit one of 7.8-mag. SAO 77019, recorded by Harold Povenmire and a few other observers near Melbourne, FL. Relatively large telescopes were used due to low altitude and some thin cirrus clouds.



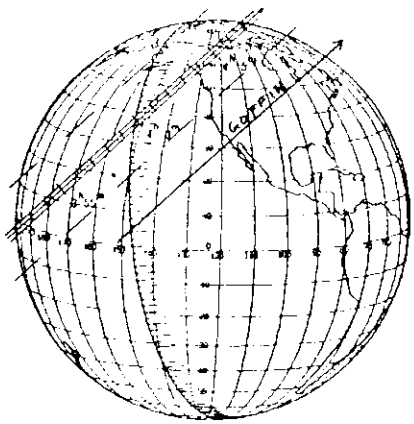
SAO 96403 by Ninina 93 Feb 17



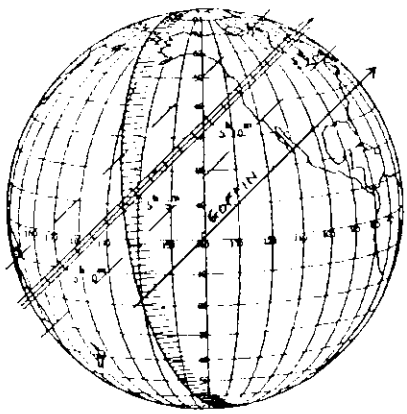
L2 305 by Jupiter 93 Feb 25



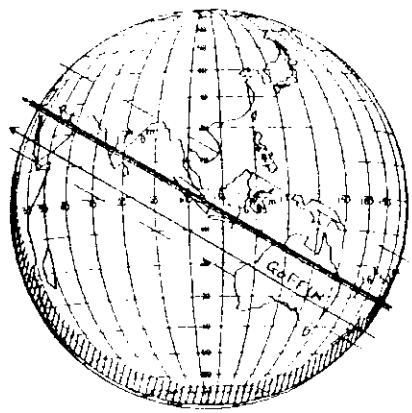
SAO 76216 by Anneliese 93 Feb 25



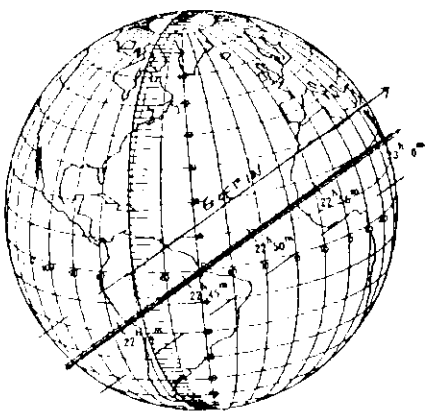
Anonymous by Juno 93 Feb 26, 4^h



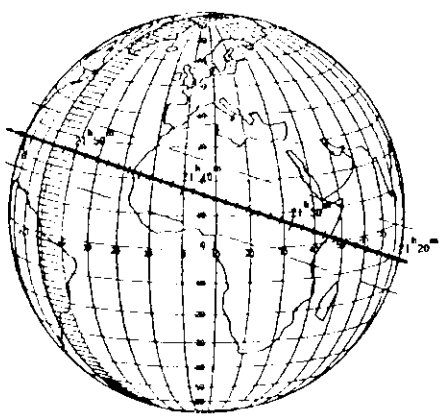
Anonymous by Juno 93 Feb 26, 5^h



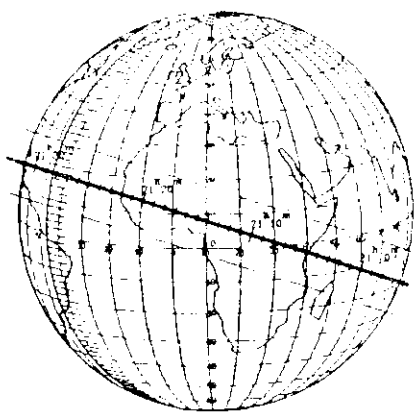
SAO 137736 by Io 93 Mar 2



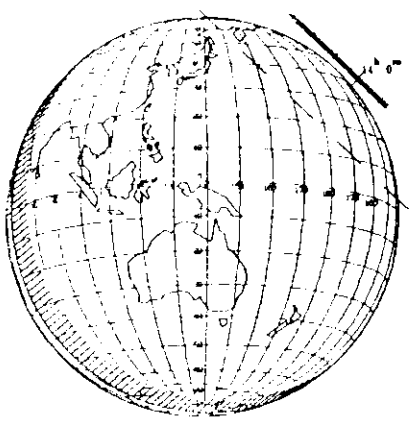
A1752275 by Melpomene 93 Mar 12



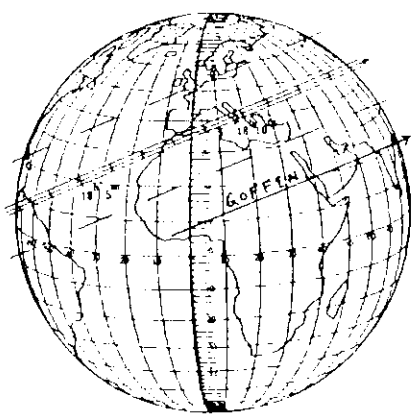
SAO 98690A by Peraga 93 Mar 15



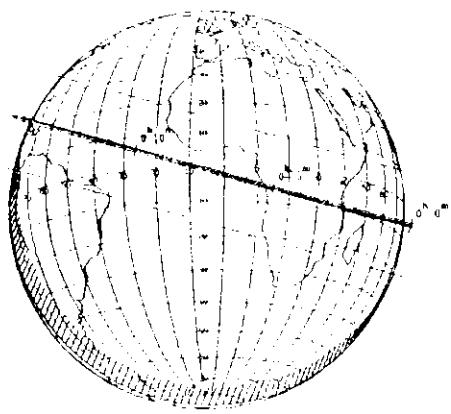
SAO 98690B by Peraga 93 Mar 15



SAO 156367 by Iduna 93 Mar 18



SAO 95879 by Juno 93 Mar 22



SAO 156969 by Lumen 93 Mar 24

IOTA

The International Occultation Timing Association was established to encourage and facilitate the observation of occultations and eclipses. It provides predictions for grazing occultations of stars by the Moon and predictions for occultations of stars by asteroids and planets, information on observing equipment and techniques, and reports to the members of observations made. IOTA is a tax-exempt organization under section 509(a)(2) of the (USA) Internal Revenue Code, and is incorporated in the state of Texas.

The **ON** is the IOTA newsletter and is published approximately four times a year. It is also available separately to non-members.

The officers of IOTA are:

President	David W. Dunham
Executive Vice President	Paul Maley
Executive Secretary	Rocky Harper
Secretary-Treasurer	Craig and Terri McManus
VP for Grazing Occultation Services	Joe Senne
VP for Planetary Occ'n Services	Joseph Carroll
VP for Lunar Occultation Services	Walter Morgan
ON Editor	Joan Kirby Dunham
IOTA/European Section President	Hans-Joachim Bode
IOTA/ES Secretary	Eberhard Bredner
IOTA/ES Treasurer	Alfons Gabel
IOTA/ES Research & Development	Wolfgang Beisker
IOTA/ES Public Relations	Eberhard Riedel

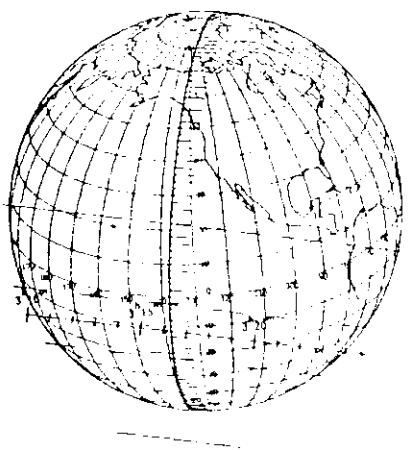
Addresses, membership and subscription rates, and information on where to write for predictions are found on the front page.

The Dunhams maintain the occultation information line at 301-474-4945. Messages may also be left at that number. When updates become available for asteroidal occultations in the central U.S.A., the information can also be obtained from either 708-259-2376 (Chicago) or 713-488-6871 (Houston).

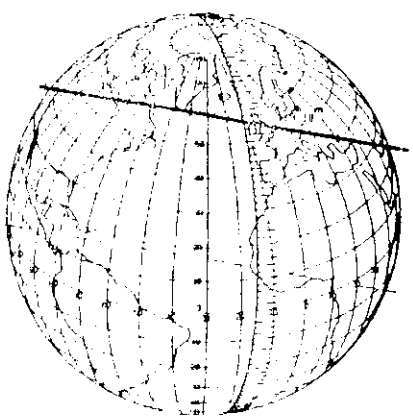
Observers from Europe and the British isles should join IOTA/ES, sending DM 40.-- to the account IOTA/ES; Bartold-Knaust Strasse 8; 3000 Hannover 91; Postgiro Hannover 555 829 - 303; bank-code-number (Bankleitzahl) 250 100 30. Full membership in IOTA/ES includes the supplement for European observers (total and grazing occultations) and minor planet occultation data, including last-minute predictions, when available.

The addresses for IOTA/ES are:

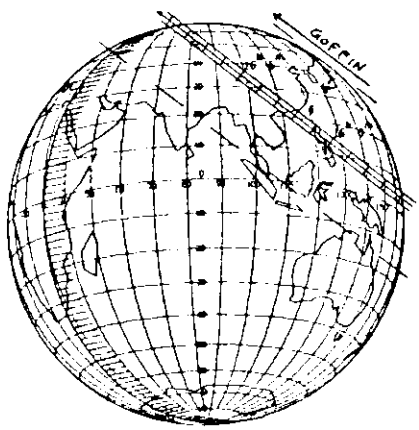
Eberhard Bredner	Hans-Joachim Bode
Ginsterweg 14	Bartold-Knaust-Str. 8
D-W-4730 Ahlen 4 (Dolberg)	D-W-3000 Hannover 91
Germany	Germany
Telephones (49- for Germany, or 0- within Germany)	
2388-3658	-511-424696
Fax 2381 36770	-511-233112



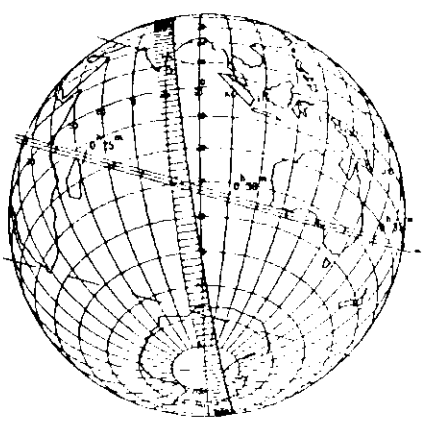
SAO 79187 by Mars 93 Mar 27



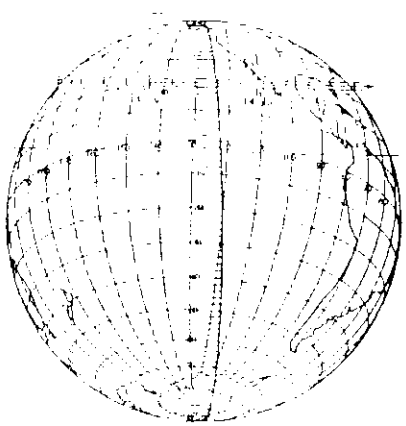
Anonymous by P/Sm Wm-1 Mar 27



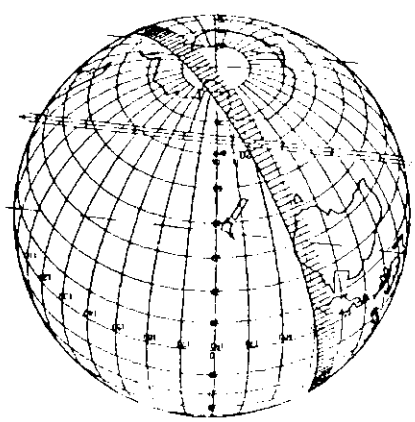
SAO 155934 by Interamnia Apr 1



SAO 211153 by Hektor 93 Apr 2



C23 14467 by Themis Apr 2



SAO 230574 by Euphrosyne 93 Apr 6