TAILPIECE

Advertisements

This space is available free to members for advertisements (preferably, but not necessarily astronomical).

Books and film available

The following books are available from David Le Conte. 10% discount to members.

UK Solar Eclipses from Year 1
by Sheridan Williams
3,000 years of solar eclipses.
Includes details of the 1999 total eclipse.
Price £11.95 less 10% = £10.75

Guide to the 1999 total eclipse of the Sun
by Steve Bell
HM Nautical Almanac Office,
Royal Greenwich Observatory
Details of the 1999 eclipse as it will be seen from the British Isles.
Includes a free *Eclipse99* filter viewer.
Price £5.95 less 10% = £5.35

Members interested in taking photographs of astronomical objects will be interested to know that we are able to offer:

Kodak Ektacolor ProGold 400 film

In a recent article in *Sky and Telescope* this professional film was rated very highly for astrophotographic purposes.

It is normally available only in packs of five. We can offer members 36-exposure 35mm single films at just £4.95 each.

The expiry date of the film is August 1998. It is a colour print, developed with process C-41. Contact David Le Conte.

Web Page

At the time of issue of this newsletter we are in the process of setting up a new home page on the World Wide Web for the Astronomy Section.

The new URL is:

http://dspace.pipex.com/town/estate/vs76/astrosec.htm

The page is currently operating with some basic information about the Section, the Observatory, and recent events. Further news, articles and pictures will be installed on it over the next few weeks, so those of you who have access to the Internet should keep a watch on its development. ☆

Astronomy Section Officers

Section Secretary:	Geoff Falla	724101
Honorary Treasurer:	Peter Langford	720649
Light Pollution Officer:	Ken Staples	54759

The next newsletter will be published early in March. The deadline for publication copy is the 15th February.

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Sagittarius

The Newsletter of the Astronomy Section of La Société Guernesiaise

January/February 1997

Forthcoming events

Into Space
by Dr Patrick Moore
Saturday, 18th January
at 8.00 pm at Beau Sejour

Annual Business Meeting
Tuesday, 21 January
8.00 pm at the Observatory

Imaging
by Daniel Cave
Tuesday, 18th February
8.00 pm at the Observatory

In this issue

The Discovery of Neptune
Comet Hale-Bopp
Observing Programme Summary

Inside

Major articles are in **bold**

Astronomy Section events	Pages 2-3
It all adds up	4
Comet Hale-Bopp	5
Observing Programme Summary	9
The Discovery of Neptune	15
Sunset, sunrise and twilight tims	18
Falkland start	18
Eclipse photo published	18
Section Members	19
Tailpiece	20

Centre inserts

January/February star chart
Moon phase calendar
Sunset, twilight and sunrise times

Annual Business Meeting

The Annual Business Meeting will be held **at 8.00 pm on Tuesday, 21st January.** The agenda is as follows:-

Election of Officers

Treasurer's Report

Projects for 1997:

(a) Equipment

(b) Observing

Public visits to the Observatory

Newsletter – Sponsorship

Any other business

All members are urged to attend this meeting. ☆

Astronomical images

At 8.00 pm on Tuesday, the 18th February, at the Observatory, Daniel Cave will give an illustrated talk on astronomical imaging.

Daniel will discuss a number of techniques that can be used to record images of astronomical objects – from conventional film based methods to CCD and digital image processing. Some new hybrid methods, that take the best from both conventional and digital techniques, will also be discussed, and some of the results will be shown.

With Comet Hale-Bopp fast approaching perihelion, some methods for recording the comet and the detail that is hidden within its nucleus will also be talked about.

Daniel has had considerable success in both astrophotography and CCD imaging, and developed his own processing software, so this promises to be an informative evening. ☆

Patrick Moore - into space

On Saturday, the 18th January Patrick Moore will be presenting an illustrated talk entitled "Into Space" at 8.00 pm at the Bejour Sejour Leidure Centre.

Tickets cost £11.00 or £9.50 from Beau Sejour. Geoff Falla has a few tickets, at £11.00 each. Contact him direct if you want one.

This lecture has been organised by Beau Sejour, not the Astronomy Section, but certainly many Section members will want to attend. Tickets available from Geoff are very limited, so act quickly. You can, of course, contact Beau Sejour direct.

We also have a number of flyers to distribute.

The subject of the talk is the last 40 years of astronomy and space research. It was, of course, 40 years ago, in 1957, that the first artificial earth satellite, Sputnik 1, was launched. Since then, thousands of satellites and spacecraft have been launched, and many of these have been designed specifically to carry out astronomical research. The talk will end with a question and answer session. ☆

Neptune discovered

On the 26th November Frank Dowding recounted the story of the discovery of Neptune in 1846, 150 years ago.

Throughout his talk Frank displayed photographs of the three main characters in the story: Airy, Le Verrier, and Adams. This useful device kept them well in our minds throughout the evening.

Frank's complete talk is being published in Sagittarius. However, a brief synopsis follows.

Frank described how observed perturbation of the orbit of Uranus led to the idea that there might possibly be another planet gravitationally slowing and speeding Uranus up, as one planet passed the other. Given the long periods of revolution of the two planets (84 years and 165 years, respectively), it is indeed a fortunate circumstance that, relatively soon after the discovery of Uranus by William Herschel in 1781 their relative positions were such that these perturbations could be noticed. (Uranus "overtook" Neptune in 1822, an event which would not happen again until 1993!)

Frank related the fascinating story of Adams's calculations, his failure to communicate with Airy, the Astronomer Royal, and Le Verrier's success in getting his calculations acted upon, with the result that he got the credit for the discovery.

An interesting part of Frank's discourse was the background he gave to the times in which these gentlemen lived, as well as details of their individual lives.

Frank graphically demonstrated the formation of an elliptical orbit, using a pre-prepared device, and the effect of one planet's pull upon the other. He also described the part that the enigmatic Bode's Law played.

The success of the French led to a big row between the French and the English, with Airy caught up in a hurricane of English indignation. Le Verrier and Adams, however, kept their distance from this argument. Frank pointed out that they were not observational astronomers, but were essentially mathematicians. They eventually met, at a gathering at John Herschel's house. ☆

Supper and quiz evening

The Christmas supper and quiz evening, held on the 10th December was, as usual, most enjoyable. With a fine spread before us, we attempted to answer the questions posed by Debbie Quertier.

The two teams were: (a) Lawrence Guilbert, Gareth Coleman, Daniel Cave and David Le Conte, and (b) Geoff Falla, Kevin O'Donovan, Roger Chandler and Peter Langford. Michael Marshall gave sideline support.

Team (b) pipped team (a) by just two points: 67 to 65. The individual winner was Roger with 30 points, followed by Daniel with 28 points.

As usual, we all learned a considerable amount, largely because of Debbie's thoughtful and challenging questions. ☆

A selection of Debbie's questions will appear subsequent issues of Sagittarius.

Visits to Observatory

A troop of ten Ranger Guides visited the Observatory on Wednesday, the 13th November.

Members are reminded that we are always happy to have organised groups of visitors.

We already have a Women's Institute group visit arranged for March. ☆

1997 Programme

The Programme for 1997 is included with this issue of Sagittarius. As usual, it is a varied programme, including several talks and other events of interest, including this year a number of observing events. ☆

It all adds up

"Why", I was asked, "do we use 10 as the basis of our number system?"

The obvious answer, and, I believe, the correct one, is because we have ten digits (fingers and toes), so it must have seemed a pretty sound basis for a number system. Simply use your fingers and, when large numbers are involved, use your toes.

Our present system originates in India, and is Hindu-Arabic. The Egyptians also used a system based on 10. Of course, not everybody has used 10. The Romans based their system on 5. The Roman numeral for 5 is V, which we believe represents the open hand with the thumb extended. The symbol for 10, X, is thought to be two fives, one on top of the other: V/Λ

In Ancient Babylon the system was based on 60, and we still see elements of this in our modern day system, eg 60 seconds in one minute, etc.

Early humans probably used a tallying system, cutting notches into sticks, collecting and monitoring pebbles or knots tied in a cord.

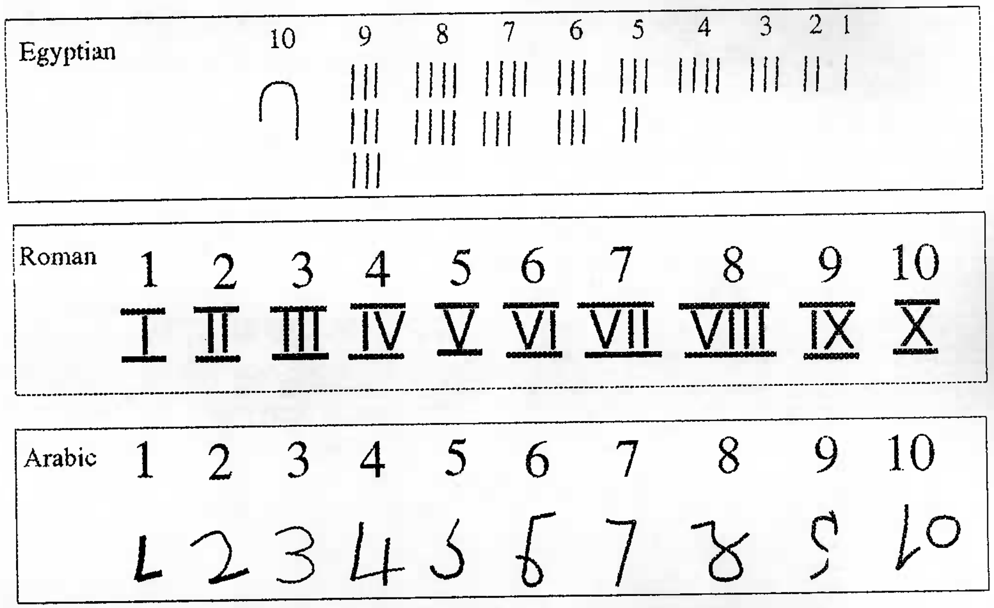
Below are some examples of different number systems.

Thank goodness we decided to follow the Hindu-Arabic system – would somebody please remind the BBC. ✫

David Williams

Ref: *Penguin Book of the Physical World*, 1976

1	一	6	六
2	二	7	七
3	三	8	八
4	四	9	九
5	五	10	十



Comet Hale-Bopp

The following table gives the daily positions of Comet Hale-Bopp over the next four months, calculated with a computer program which I have developed from the Cambridge programs by Duffett-Smith, using recent orbital elements by Brian Marsden. Magnitude estimates are interpolated from published data. The data is grouped by week, starting with Sunday.

SD = Comet-Sun distance in au.
ED = Comet-Earth distance in au
RA = Right Ascension in hours and mins.
Dec = Declination in degrees and mins.
El = Elongation from Sun in degrees.
Mag = Magnitude

The best time to see the comet is a balance between the several parameters listed. Its intrinsic brightness and tail length depend largely on the Comet-Sun distance, but its brightness as seen from Earth is also affected by the Comet-Earth distance. It is closest to the Earth on the 22nd March, and closest to the Sun (perihelion) on 1 April.

The magnitude figures listed are estimates of what is expected. The visibility of the comet is also, of course, dependent upon its position, especially its altitude above the horizon after evening twilight and before morning twilight, and some indication is given by the elongation figures. Our latitude also has to be taken into account. And, of course, moonlight will adversely affect observations of it.

The outcome of all these considerations is that the best time to see the comet will be late March/early April, and we will be holding public evenings at the Observatory in early April.

A month-by month prediction of visibility follows.

January Low in the east in the morning sky. Little interference from the Moon. Rises about 3.30 am by the end of the month. Second magnitude. Short tail up and to the left of the head of the comet.

February Rises about 3.00 am in the north-east, moving to altitude 15° in the east before sunrise. . Its tail will be lengthening and pointing upwards. By the end of the month it will be rising at about 1.15 am. It will also become visible in the early evening, very low in the north-west, setting at about 7.45 pm. First magnitude. The Moon will affect observations in the late part of the month.

March The comet should really start living up to the hype this month. The Moon will interfere in the third week, when the comet is closest to the Sun, but there should, nevertheless, be good opportunities for observation. By the middle of the month it will be visible all night, moving from low in the north-west, across the north part of the sky, to low in the north-east. At the end of the month the comet should have a magnitude of -1½, and an early evening altitude of 30° in the north-west. It should by then have a long tail.

April The first half of the month affords good opportunities for observation, with no interference from the Moon. Its altitude will be decreasing, and by the middle of the month it will be at an altitude of 25° in the north-west, setting shortly after midnight. The Moon will then start interfering with observation, and the comet's altitude will decrease as it moves rapidly southwards.

The excitement will then fade as the comet moves out of sight within the next couple of weeks. ✫

David Le Conte

Comet Hale-Bopp - Positional data

JANUARY

Date	SD au	ED au	RA h m	Dec ° '	El °	Mag
01	1.8	2.6	18 42	+04 48	28	2.5
02	1.7	2.5	18 44	+05 03	28	2.4
03	1.7	2.5	18 45	+05 18	28	2.4
04	1.7	2.5	18 47	+05 33	28	2.3
05	1.7	2.5	18 48	+05 48	29	2.3
06	1.7	2.5	18 50	+06 04	29	2.2
07	1.7	2.5	18 52	+06 20	29	2.2
08	1.7	2.5	18 53	+06 37	29	2.2
09	1.7	2.4	18 55	+06 54	30	2.1
10	1.6	2.4	18 56	+07 11	30	2.1
11	1.6	2.4	18 59	+07 29	30	2.0
12	1.6	2.4	19 00	+07 47	31	2.0
13	1.6	2.4	19 02	+08 05	31	1.9
14	1.6	2.3	19 03	+08 24	31	1.9
15	1.6	2.3	19 05	+08 44	32	1.8
16	1.6	2.3	19 07	+09 03	32	1.8
17	1.6	2.3	19 09	+09 24	32	1.7
18	1.5	2.3	19 11	+09 44	33	1.7
19	1.5	2.3	19 13	+10 06	33	1.6
20	1.5	2.2	19 14	+10 27	33	1.5
21	1.5	2.2	19 16	+10 49	34	1.5
22	1.5	2.2	19 18	+11 12	34	1.4
23	1.5	2.2	19 20	+11 35	34	1.4
24	1.5	2.2	19 22	+11 59	35	1.3
25	1.5	2.1	19 25	+12 23	35	1.3
26	1.4	2.1	19 27	+12 48	36	1.2
27	1.4	2.1	19 29	+13 13	36	1.2
28	1.4	2.1	19 31	+13 39	36	1.1
29	1.4	2.1	19 33	+14 06	37	1.1
30	1.4	2.0	19 36	+14 33	37	1.0
31	1.4	2.0	19 38	+15 01	38	1.0

FEBRUARY

Date	SD au	ED au	RA h m	Dec ° '	El °	Mag
01	1.4	2.0	19 40	+15 29	38	0.9
02	1.4	2.0	19 43	+15 58	38	0.8
03	1.3	2.0	19 45	+16 [illegible]8	39	0.8
04	1.3	1.9	19 48	+16 58	39	0.7
05	1.3	1.9	19 51	+17 29	39	0.7
06	1.3	1.9	19 53	+18 01	40	0.6
07	1.3	1.9	19 56	+18 33	40	0.5
08	1.3	1.9	19 59	+19 06	40	0.5
09	1.3	1.8	20 02	+19 40	41	0.4
10	1.3	1.8	20 05	+20 15	41	0.4
11	1.3	1.8	20 08	+20 50	42	0.3
12	1.2	1.8	20 11	+21 26	42	0.3
13	1.2	1.8	20 14	+22 03	42	0.2
14	1.2	1.8	20 17	+22 40	42	0.1
15	1.2	1.7	20 20	+23 18	43	0.0
16	1.2	1.7	20 24	+23 57	43	-0.1
17	1.2	1.7	20 28	+24 37	43	-0.1
18	1.2	1.7	20 32	+25 17	44	-0.2
19	1.2	1.7	20 35	+25 58	44	-0.2
20	1.2	1.6	20 39	+26 39	44	-0.3
21	1.1	1.6	20 43	+27 22	44	-0.4
22	1.1	1.6	20 48	+28 04	45	-0.4
23	1.1	1.6	20 52	+28 48	45	-0.5
24	1.1	1.6	20 56	+29 31	45	-0.6
25	1.1	1.6	21 01	+30 16	45	-0.6
26	1.1	1.5	21 06	+31 01	45	-0.7
27	1.1	1.5	21 11	+31 46	45	-0.7
28	1.1	1.5	21 16	+32 31	46	-0.8

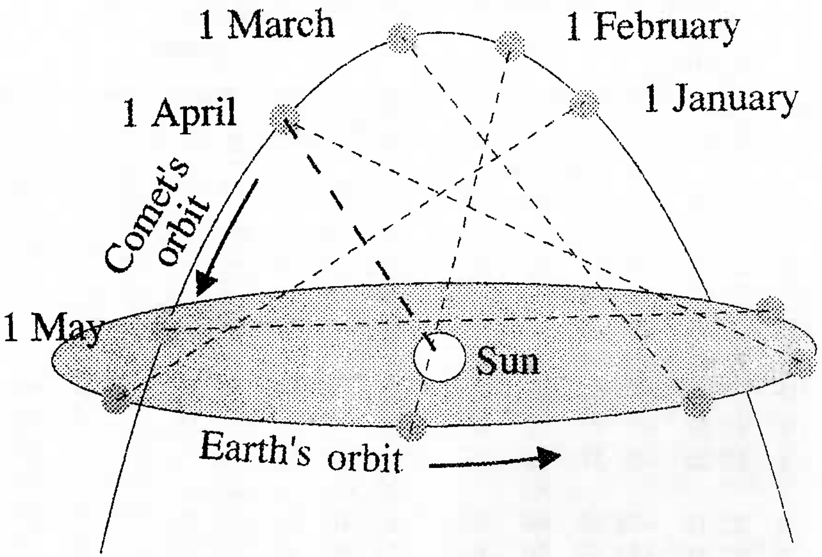
Comet Hale-Bopp - Positional data

MARCH

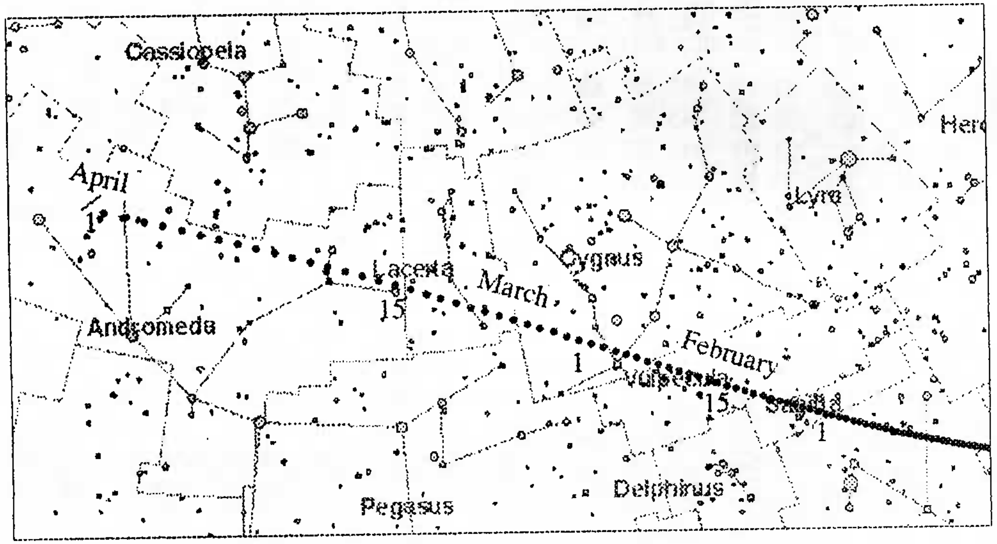
Date	SD au	ED au	RA h m	Dec ° '	El °	Mag
01	1.1	1.5	21 22	+33 16	46	-0.8
02	1.1	1.5	21 27	+34 02	46	-0.9
03	1.1	1.5	21 33	+34 48	46	-1.0
04	1.0	1.4	21 39	+35 33	46	-1.0
05	1.0	1.4	21 46	+36 18	46	-1.1
06	1.0	1.4	21 52	+37 03	46	-1.1
07	1.0	1.4	21 59	+37 47	46	-1.2
08	1.0	1.4	22 06	+38 31	46	-1.2
09	1.0	1.4	22 13	+39 13	46	-1.3
10	1.0	1.4	22 21	+39 54	46	-1.3
11	1.0	1.4	22 28	+40 34	46	-1.4
12	1.0	1.4	22 36	+41 13	46	-1.4
13	1.0	1.4	22 45	+41 50	46	-1.5
14	1.0	1.3	22 53	+42 25	46	-1.5
15	1.0	1.3	23 02	+42 58	46	-1.5
16	1.0	1.3	23 11	+43 29	46	-1.5
17	1.0	1.3	23 20	+43 57	46	-1.6
18	0.9	1.3	23 30	+44 22	46	-1.6
19	0.9	1.3	23 39	+44 44	45	-1.6
20	0.9	1.3	23 49	+45 03	45	-1.6
21	0.9	1.3	23 59	+45 19	45	-1.7
22	0.9	1.3	00 09	+45 32	45	-1.7
23	0.9	1.3	00 19	+45 41	45	-1.7
24	0.9	1.3	00 29	+45 47	45	-1.7
25	0.9	1.3	00 39	+45 49	44	-1.7
26	0.9	1.3	00 49	+45 48	44	-1.8
27	0.9	1.3	00 59	+45 44	44	-1.8
28	0.9	1.3	01 09	+45 36	44	-1.8
29	0.9	1.3	01 19	+45 24	43	-1.8
30	0.9	1.3	01 29	+45 10	43	-1.7
31	0.9	1.3	01 38	+44 52	43	-1.7

APRIL

Date	SD au	ED au	RA h m	Dec ° '	El °	Mag
01	0.9	1.4	01 47	+44 32	43	-1.7
02	0.9	1.4	01 56	+44 09	42	-1.7
03	0.9	1.4	02 05	+43 44	42	-1.7
04	0.9	1.4	02 13	+43 16	42	-1.7
05	0.9	1.4	02 22	+42 47	41	-1.6
06	0.9	1.4	02 30	+42 15	41	-1.6
07	0.9	1.4	02 38	+41 42	41	-1.6
08	0.9	1.4	02 46	+41 07	40	-1.6
09	0.9	1.4	02 53	+40 31	40	-1.6
10	0.9	1.4	03 00	+39 54	40	-1.6
11	0.9	1.5	03 07	+39 16	39	-1.5
12	0.9	1.5	03 13	+38 37	39	-1.5
13	0.9	1.5	03 19	+37 57	39	-1.5
14	0.9	1.5	03 25	+37 17	38	-1.4
15	0.9	1.5	03 31	+36 37	38	-1.4
16	1.0	1.5	03 37	+35 56	38	-1.4
17	1.0	1.5	03 42	+35 15	37	-1.3
18	1.0	1.6	03 47	+34 34	37	-1.3
19	1.0	1.6	03 52	+33 53	36	-1.2
20	1.0	1.6	03 57	+33 12	36	-1.2
21	1.0	1.6	04 02	+32 31	36	-1.1
22	1.0	1.6	04 06	+31 50	35	-1.0
23	1.0	1.6	04 11	+31 10	35	-1.0
24	1.0	1.7	04 15	+30 29	35	-0.9
25	1.0	1.7	04 19	+29 50	34	-0.8
26	1.0	1.7	04 23	+29 10	34	-0.8
27	1.0	1.7	04 27	+28 31	33	-0.7
28	1.0	1.7	04 30	+27 52	33	-0.7
29	1.0	1.7	04 34	+27 14	33	-0.6
30	1.0	1.8	04 37	+26 36	32	-0.6



The orbit of Comet Hale-Bopp is highly inclined to the ecliptic, at an angle of 89°. The diagram shows the relative positions of the Comet and the Earth, and the Comet's position at perihelion.



The path of Comet Hale-Bopp from 1 February to 1 April 1997

Observing programme summary

To conclude the series of Observing Programme Charts and Notes, I have completed a summary of all the objects under the headings of Constellations and Object Types, with references to each of the six Chart Sections and coordinates covering the sky from Polaris to minus 30 degrees declination.

It is hoped that the Observing Programme offers an easy to follow, practical Guide, which will be available at the Observatory.

Geoff Falla

The first part of the summary, by constellation, appears below.

SUMMARY – LIST OF OBJECTS BY CONSTELLATION

Constellation	Object	Type	Binocular object: OO	Coordinates RA h m	Dec degs	Section
ANDROMEDA	M 31	Spiral galaxy	OO	00 43	+ 41.3	5
	M 32	Elliptical galaxy		00 43	+ 40.9	5
	NGC 7662	Planetary nebula		23 26	+ 42.6	6
	Gamma γ	Double star (*Almach*)		02 04	+ 42.3	6
	NGC 891	Spiral galaxy		02 23	+ 42.3	6
	59	Double star		02 11	+ 39.0	6
	NGC 752	Open cluster	OO	01 58	+ 37.7	6
AQUARIUS	M 72	Globular cluster		20 54	-12 05	4
	M 2	Globular cluster	OO	21 34	- 00.8	5
	NGC 7009	Planetary nebula (*The Saturn Nebula*)		21 04	- 11.4	5
	NGC 7293	Planetary nebula (*The Helix Nebula*)		22 30	- 20.8	5
	Zeta ζ	Double star		22 29	00.0	5
ARIES	Gamma γ	Double star		01 54	+ 19.3	6
	NGC 772	Spiral galaxy		01 59	+ 19.0	6
AURIGA	M 36	Open cluster	OO	05 36	+ 34.1	1
	M 37	Open cluster	OO	05 52	+ 32.5	1
	M 38	Open cluster	OO	05 29	+ 35.8	1
BOÖTES	Mu μ	Triple star		15 24	+ 37.4	3
	Epsilon ε	Double star		14 45	+ 27.1	3

Constellation	Object	Type	Coordinates RA h m, Dec degs	Section
		Binocular object: OO		
CANCER	M 44	Open cluster OO (*Præsepe or Beehive*)	08 40 + 20.0	1
	M 67	Open cluster OO	08 50 + 11.8	1
CANES VENATICI	Alpha α	Double star (*Cor Caroli*)	12 56 + 38.3	2
	M94	Galaxy	12 51 + 41.0	2
	M 51	Galaxy (*The Whirlpool*)	13 28 + 47.5	3
	M 3	Globular cluster OO	13 40 + 28.6	3
CANIS MAJOR	M 41	Open cluster OO	06 47 - 20.7	1
CASSIOPEIA	Eta η	Double star (*Achird*)	00 49 + 57.8	5
	NGC 281	Diffuse nebula	00 53 + 56.6	5
	NGC 7789	Open cluster	23 57 + 56.5	5
	M 52	Open cluster OO	23 24 + 61.6	5
	M 103	Open cluster	01 33 + 60.7	6
	NGC 457	Open cluster OO	01 19 + 58.3	6
	Iota ι	Triple star	02 29 + 67.4	6
CEPHEUS	Beta β	Double star	21 29 + 70.6	5
	Delta δ	Double star	22 29 + 58.4	5
	Mu μ	Variable star (*Herschel's Garnet Star*)	22 44 + 58.8	5
	NGC 188	Open cluster	00 44 + 85.3	5
CETUS	M 77	Spiral galaxy	02 43 00.0	6
	Omicron o	Variable star (*Mira*)	02 19 - 03.0	6
COMA BERENICES	M 64	Galaxy (*The Black Eye Galaxy*)	12 57 + 21.7	2
	24	Double star	12 35 + 18.4	2
	M 53	Globular cluster OO	13 11 + 18.4	3
CORONA BOREALIS	Zeta ζ	Double star	15 39 + 36.6	3

Constellation	Object	Type	Coordinates RA h m, Dec degs	Section
		Binocular object: OO		
CYGNUS	Beta β	Double star (*Albireo*)	19 31 + 28.0	4
	NGC 6826	Planetary nebula (*The Blinking*)	19 45 + 50.5	4
	M 29	Open cluster	20 24 + 38.5	4
	61	Double star	21 06 + 38.8	5
	M 39	Open cluster OO	21 32 + 48.4	5
	Mu μ	Double star	21 44 + 28.8	5
DELPHINUS	Gamma γ	Double star	20 47 + 16.1	4
DRACO	Eta η	Double star	16 24 + 61.5	3
	NGC 5907	Elliptical galaxy	15 15 + 56.5	3
	NGC 6543	Planetary nebula	17 59 + 66.6	4
ERIDANUS	32	Double star	03 53 - 03.0	6
	Omicron2 o^2	Triple star	04 15 - 07.7	6
	NGC 1535	Planetary nebula	04 14 - 12.7	6
GEMINI	M 35	Open cluster mm	06 09 + 24.3	1
	Castor	Double star	07 35 + 31.9	1
	NGC 2392	Planetary nebula	07 29 + 20.9	1
HERCULES	M 13	Globular cluster OO	16 40 + 36.5	3
	NGC 6210	Planetary nebula	16 45 + 23.8	3
	Alpha α	Double star (*Rasalgethi*)	17 15 + 14.4	4
	M 92	Globular cluster OO	17 17 + 43.3	4
LEO	M 65	Galaxy	11 19 + 13.0	2
	M 66	Galaxy	11 20 + 13.0	2
	M 95	Galaxy	10 44 + 11.7	2
	M 96	Galaxy	10 47 + 11.8	2
	Gamma γ	Double star (*Algieba*)	10 20 + 19.9	2
	NGC 2903	Galaxy	09 32 + 21.5	2
	Iota ι	Double star	11 24 + 10.5	2
	54	Double star	10 56 + 24.8	2
	90	Double star	11 32 + 17.0	2

Constellation	Object	Type	Coordinates	Section
		Binocular object: ○○	R A h m / Dec degs	
LEPUS	M 79	Globular cluster	05 25 - 24.5	1
LIBRA	Alpha α	Double star	14 51 - 16.0	3
LYRA	M 57	Planetary nebula *(The Ring)*	18 54 + 33.0	4
	Epsilon ε	Quadruple star (Double-double)	18 44 + 39.7	4
	Beta β	Double star	18 50 + 33.3	4
MONOCEROS	Beta β	Triple star	06 29 - 07.0	1
	M 50	Open cluster ○○	07 03 - 08.3	1
	NGC 2244	Open cluster and nebula *(Rosette Nebula)*	06 03 + 04.9	1
OPHIUCUS	M 12	Globular cluster ○○	16 45 - 01.9	3
	M 10	Globular cluster ○○	16 55 - 04.0	3
ORION	M 42 & M 43	Diffuse nebula ○○ *(The Orion Nebula)* & multiple star group *(The Trapezium)*	05 35 - 05.5	1
	Beta β	Double star *(Rigel)*	05 14 - 08.2	1
	Sigma σ	Multiple star group	05 39 - 02.4	1
	Lambda λ	Double star	05 35 + 09.9	1
	Delta δ	Double star *(Mintaka)*	05 32 - 00.3	1
	Zeta ζ	Double star *(Alnitak)*	05 41 - 02.0	1
PEGASUS	M 15	Globular cluster ○○	21 30 + 12.2	5
	Xi ξ	Double star	22 47 + 12.3	5
	NGC 7331	Spiral galaxy	22 37 + 34.4	5

Constellation	Object	Type	Coordinates	Section
		Binocular object: ○○	R A h m / Dec deg	
PERSEUS	NGC 869	Open cluster ○○	02 19 + 57.1	6
	NGC 884	Open cluster *(The Sword Handle double cluster)*	02 22 + 57.1	6
	NGC 1528	Open cluster ○○	04 15 + 51.2	6
	NGC 1245	Open cluster ○○	03 15 + 47.2	6
	Beta β	Variable star *(Algol)* ○○	03 08 + 40.9	6
	M 34	Open cluster ○○	02 42 + 42.8	6
SAGITTARIUS	M 8	Diffuse nebula and cluster *(Lagoon Nebula)* ○○	18 04 - 24.4	4
	M 24	Open cluster ○○	18 18 - 18.4	4
	M 17	Diffuse nebula and cluster (*Omega* or *Horseshoe Nebula*) ○○	18 21 - 16.2	4
	M 22	Globular cluster ○○	18 36 - 23.9	4
	M 23	Open cluster ○○	17 57 - 19.0	4
SCORPIUS	M 4	Globular cluster ○○	16 21 - 26.4	3
	Beta β	Double star	16 05 - 19.8	3
	M 80	Globular cluster ○○	16 14 - 22.9	3
SCUTUM	M 11	Open cluster ○○ *(The Wild Duck Cluster)*	18 51 - 06.3	4
SERPENS	M 5	Globular cluster ○○	15 16 + 02.3	3
	Beta β	Double star	15 46 + 15.4	3
	Theta θ	Double star	18 56 + 04.2	4
	M 16	Diffuse nebula and cluster *(The Eagle Nebula)*	18 19 - 13.8	4

Constellation	Object	Type	Coordinates		Section
		Binocular object: ○○	RA h m	Dec degs	
TAURUS	M 1	Nebula/supernova remnant (*The Crab Nebula*)	05 35	+ 22.0	1
	M 45	Open cluster ○○ (*The Pleiades*)	03 47	+ 24.1	6
	Chi χ	Double star	04 23	+ 25.6	6
	NGC 1647	Open cluster	04 46	+ 19.1	6
TRIANGULUM	M 33	Spiral galaxy	01 34	+ 30.7	6
URSA MAJOR	M 81	Galaxy	09 56	+ 69.0	2
	M 82	Galaxy	09 56	+ 69.7	2
	M 97	Planetary nebula (*The Owl Nebula*)	11 15	+ 55.0	2
	M 108	Galaxy	11 12	+ 55.7	2
	M 109	Galaxy	11 58	+ 53.4	2
	Zeta ζ	Visible double ○○ (*Mizar and Alcor*) and double star (*Mizar*)	13 23	+ 54.9	3
	M 101	Galaxy (*The Pinwheel Galaxy*)	14 03	+ 54.4	3
VIRGO	M 104	Galaxy (*The Sombrero Galaxy*)	12 40	- 11.6	2
	Gamma γ	Double star (*Porrima*)	12 42	- 01.5	2
	M 87	Elliptical galaxy	12 31	+ 12.4	2
	Theta θ	Triple star	13 10	- 05.5	3
VULPECULA	M 27	Planetary nebula (*The Dumbbell*)	19 57	+ 22.6	4

The Discovery of Neptune

by Frank Dowding

The subject of this article is how the planet Neptune was discovered.

Neptune is 2,800 million miles from the Sun – 30 times further from the Sun than we are. It takes 165 of our years to complete one circle around the Sun, so if we took that long our winters and summers would be 41 years long! It is so far from the Sun that its surface temperature is minus 162°C.

Neptune is four times the size of the Earth, but completes one day in just 16 hours. It is quite unlike the Earth in that its surface is just gas: hydrogen, helium and methane. Methane gives it the blue colour.

It is quite unlike the Earth also because if you could fly a spaceship and try to land, you would just sink into the gas for a long way. It would become thicker until you would be immersed in liquid. The liquid would become thicker until eventually you would find a rocky core, probably about the same size as the Earth, but no one knows for sure.

Neptune has two moons. Triton is the largest, which appears to have liquid nitrogen under the surface, as it gushes out occasionally. Nereid, the smaller satellite, has not been seen at close range. In Greek mythology, Nereid is Neptune's wife, and Triton is their son.

So, how was Neptune discovered? There are three main players in the story:

John Couch Adams, English

George Biddel Airy, English (and the Astronomer Royal at the time)

Urbain Jean Le Verrier, a Frenchman

There was one thing that each of these men had in common: they were all brilliant mathematicians.

There were actually two things they had in common, because each had assistance, while they were young, to obtain a good education. You see, it was not as straightforward in the first half of the 19th century to have an education. For one thing, it was not compulsory. In fact, in 1818 the Government set up a Commission to establish the percentage of children attending school, and found that only a quarter was having any form of education. It did not become compulsory until 1870, 24 years after Neptune was discovered.

The Government only gave money to a handful of schools: private schools, like Rugby and Marlborough. After all, many businessmen were denied child labour if children went to school. Village teachers were often unpaid. Oxford and Cambridge were the only universities, and Oxford would only accept Anglicans. Cambridge accepted non-Anglicans, but would not give them a degree.

London started a university in 1828, and did not require their students to be of a religious nature, but it was looked upon by Oxford and Cambridge to be an ungodly institution. But this was followed later by Durham.

The years we are looking at are the first half of the 19th century, 1801 - 1850. Neptune was discovered in 1846, and each of these men were born between 1801 and 1819.

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Both France and England shared the same kind of transport system. England had the first train in 1825, but before then it was walking, horse-back, or stage-coach. But the roads were no more than tracks, and muddy tracks in the rain. The London Times, in 1828, declared a new record when a passenger took only 4½ days to be taken from Manchester to London.

Around 1830, when our oldest man, George Airy, was 22 years old, the Government appointed a contractor to start constructing proper roads. These were not tarmac, but hard-core was used, and the roads were raised to improve drainage, but this took a long time to achieve.

In 1815 the Napoleonic Wars ended. In 1829 Robert Peel founded the Police Force, and drunkenness became to be regarded as a disgrace, rather than a natural thing. Lighting in the home was supplied by candles or oil lamps. Chloroform, the first anæsthetic, was not used until 1847, one year after Neptune was discovered.

In 1825 the Stockton to Darlington railway was built. In 1830 the Liverpool to Manchester railway was started. To indicate perhaps the different style of reporting in those days, an incident happened at the inauguration of the Liverpool to Manchester line. A man named Huchisson was killed as the train arrived at the station, by a door which had swung open. The Prime Minister of the day, the Duke of Wellington, was heard to remark that he knew Huchisson, and he had always been clumsy. The London times declared that on that day there were only four trains running in England, and anyone who got himself killed by one must have been extremely careless!

Cross-channel shipping was by sail. The first paddle steamer was in 1840, but was considered unreliable, and anyway the engine took up too much passenger room.

But the letter post was very much established. It was reliable, and, although it could not travel faster than the transport system, it was always given priority. By 1840, newspapers were being delivered throughout the country, and letters and scientific journals took only a few days to travel from one major city in one county to that of another.

It was a changing world for our mathematicians, from walking on muddy tracks when they were young, to seeing a network of railways by the mid-1840s.

Let me tell you something of the three people.

John Couch Adams was born in 1819 at Laneast. His father, Thomas Adams, and his mother Tabatha ran Lidcot Farm, seven miles from Launston in Cornwall. His father was a tenant farmer and a Weslyan. They were a respectable family of modest means.

Adams's cousin was Headmistress of a private school in Devonport. Adams attended the Laneast School, and by the age of 8 he was the first pupil to excel in calligraphy, Greek and mathematics. In fact, at the age of 8 he knew as much as his teachers. He stayed at the school until he was 12, during which time he developed an interest in astronomy.

He inscribed a sundial on the window sill, and observed solar altitudes with an instrument he had made himself. At 12 he attended his cousin's academy at Devonport, when he distinguished in the classics. But, using the school library, ➠

he taught himself astronomy and mathematics, becoming fluent in conic sections, integrated calculus, and the theory of numbers.

His cousin helped his parents to pay for him to go to Cambridge, where he attended St John's College. Each year for four years he held the highest honour for Greek, and in the last year obtained the highest pass for mathematics. In 1843 he graduated as senior wrangler, and accepted a teaching post at the University.

Urbain Jean Le Verrier was born on the 11th March 1811, eight years earlier than Adams. His family was from Normandy, but moved to Paris when he was at an early age. His father was an estate manager, and could see that his son was getting on exceptionally well at school. In fact, his father sold his house to live in a more modest building, so that he could afford for Urbain to attend the Paris Polytechnic, the French University.

He excelled in mathematics, and graduated at age 22. During his time at the Polytechnic, like Adams, his interest was in astronomy. He had made an in-depth study of celestial mechanics and the stability of the solar system.

At age 26 he married the daughter of his former maths teacher, and gave private lessons to support himself and his wife. In 1837 he obtained the post as Repetiteur de Chimie at the Polytechnic, and at age 28 he was formally asked to present his knowledge of celestial mechanics to the French Academy of Science.

George Biddel Airy was born in Northumberland, on the 27th July 1801. He was the eldest of four children. His father, William Airy, was a farmer and excise man, and his mother, Anne Airy, was the daughter of a well-off farmer.

At 10 years of age George Airy attended the Byatt Walker School at Colchester. He was not a favourite with other school mates, but he impressed them by making and designing pea-shooters. He learned arithmetic, slide rule and double-entry book-keeping.

In fact, George Airy was a young snob. He came to know his uncle, Arthur Biddel, a highly respected farmer from Ipswich, and asked that he might live with him rather than his own family. As it happened, his father lost his job with the Excise Department, so he did not object.

Between the ages of 13 and 18 George Airy met many people like Tom Clarkson, the abolitionist, and Charles Musgrove, a Fellow of Trinity College, Cambridge. It was Charles Musgrove that was able to help Airy enter Cambridge in 1819.

He graduated in 1823 as a senior wrangler. He did not get on with the tutors, but did extremely well in mathematics. On leaving Cambridge he gave private lessons in accountancy. He was married in 1829.

George Airy was interested in astronomy, but it was the data collected, and the exact recording of it which interested him. Throughout his life, even at Cambridge, he never threw anything away. Notes for tradesmen, cheque stubs, bills and receipts: everything was stored for immediate access.

He was not a scientist; he was an organiser, and was well known for it. ☆

Frank Dowding

To be continued.

The second part of this article will appear in the next issue of Sagittarius.

Sunset, sunrise and twilight times

Over the past year I have been providing as an insert a two-month calendar showing the Moon's phases for each night at 9.00 pm. I have now added sunset, sunrise and twilight times on the back of the calendar. Because of space limitations I can only provide them for every two days, rather than daily.

Each line refers to a night, whose evening date is given in the first column. The second column gives the sunset time. The third, fourth and fifth columns give the end of civil, nautical, and astronomical twilights. The next three columns give the morning twilight times (in time order, so starting with astronomical twilight), and the last column shows the sunrise time.

Note that the morning times are for the morning of the date **after** the date given in column one. So, for example, on the 1st january the Sun sets at 16:21, and rises at 08:06 the following day. The idea is that each line represents a single night, so you can glance along the line and see just what is happening that night, from sunset to sunrise.

All times are in UT (GMT), so one hour will have to be added when BST is in force.

The time listings were prepared by a new computer program which I have written especially for this purpose. It is based on algorithms which I have used in other programs. The times have been thoroughly checked against the US Naval Observatory's definitive program *Mica*, and are accurate to two minutes.

Three twilight systems are used: civil, nautical and astronomical. These are defined in terms of the angle of depression of the Sun below the horizon: 6°, 12° and 18°, respectively. For general purposes, you will probably find that you can observe from the end of evening nautical twilight to the beginning of morning nautical twilight.

Please let me know if you find these listings of use. I would be interested in any suggested enhancements.

While the bi-monthly listings will be provided in each issue of the newsletter, the complete set of daily data for the whole year is already posted at the Observatory. The lunar phase calendar is also posted for the year.

Finally, the sunset, sunrise and twilight times are accurate enough to be used for any year. ☆

David Le Conte

Falklands stars

Once again, we have provided star charts and descriptions of binocular objects for the annual expedition to the Falklands, led by ornithologist Tim Earl. ☆

Eclipse photo published

The January issue of *Astronomy Now* includes a photograph of the October 12th solar eclipse taken by David Le Conte with the Observatory's 11-inch Celestron telescope. ☆

Section members

Although many Astronomy Section members know others who are members of the Section, we thought that it would useful to make available a complete list, so here it is. Thanks to Peter Langford for providing it. The list is complete as at the end of 1996. There are 47 members, probably the highest number the Section has ever had.

Members should receive a subscription reminder with this issue of Sagittarius. The rate remains unchanged at £5.00 (£3.00 for students and OAPs). Some members have already paid their 1997 subscription. Don't forget that you must also be a member of La Société Guernesiaise.

The newsletter is sent to all paid-up members. Copies are also sent to Guernsey secondary schools.

Mrs Felicity Belfield
Mr Daniel Cave
Mr Roger Chandler
Mr James Cheetham
Mr Gareth Coleman
Mr Iain Daish
Mrs Jane Darlow
Mr Louis Dekker
Mr Geoff Denton
Mr Graham Domaille
Mr Steve Dorrity
Mr Frank Dowding
Rev John Elliston
Mr Geoff Falla
Dr David Falla, FRAS
Mr John Ferguson
Mrs Hayley Froome
Mr Paul Gavey
Mrs A Gill
Mr Lawrence Guilbert
Mr Sean Harvey
Mrs Margaret Helyer
Mr Rex Huddle
Mr Mark Humphrys
Mr Steven Jefferys
Mr Nigel Kennedy
Mr Peter Langford
Mr David Le Conte FRAS
Mr Michael Marshall
Mr Michael Maunder FRAS
Mr Frank Money
Mr Alan Nel
Mr E Nial
Miss V Nial
Mr Kevin O'Donovan
Mr Bert Ozanne
Dr Lawrence Pilkington
Mrs Debbie Quertier
Mrs Carolyne Rebstein
Mrs Ann Robilliard
Mr Gerald Robilliard
Mr Alan Robinson
Mr Antony Saunders
Mr Ken Staples
Dr Stephen Sweet
Mr John Taylor
Mr Doug Walton
Mr David Williams ☆