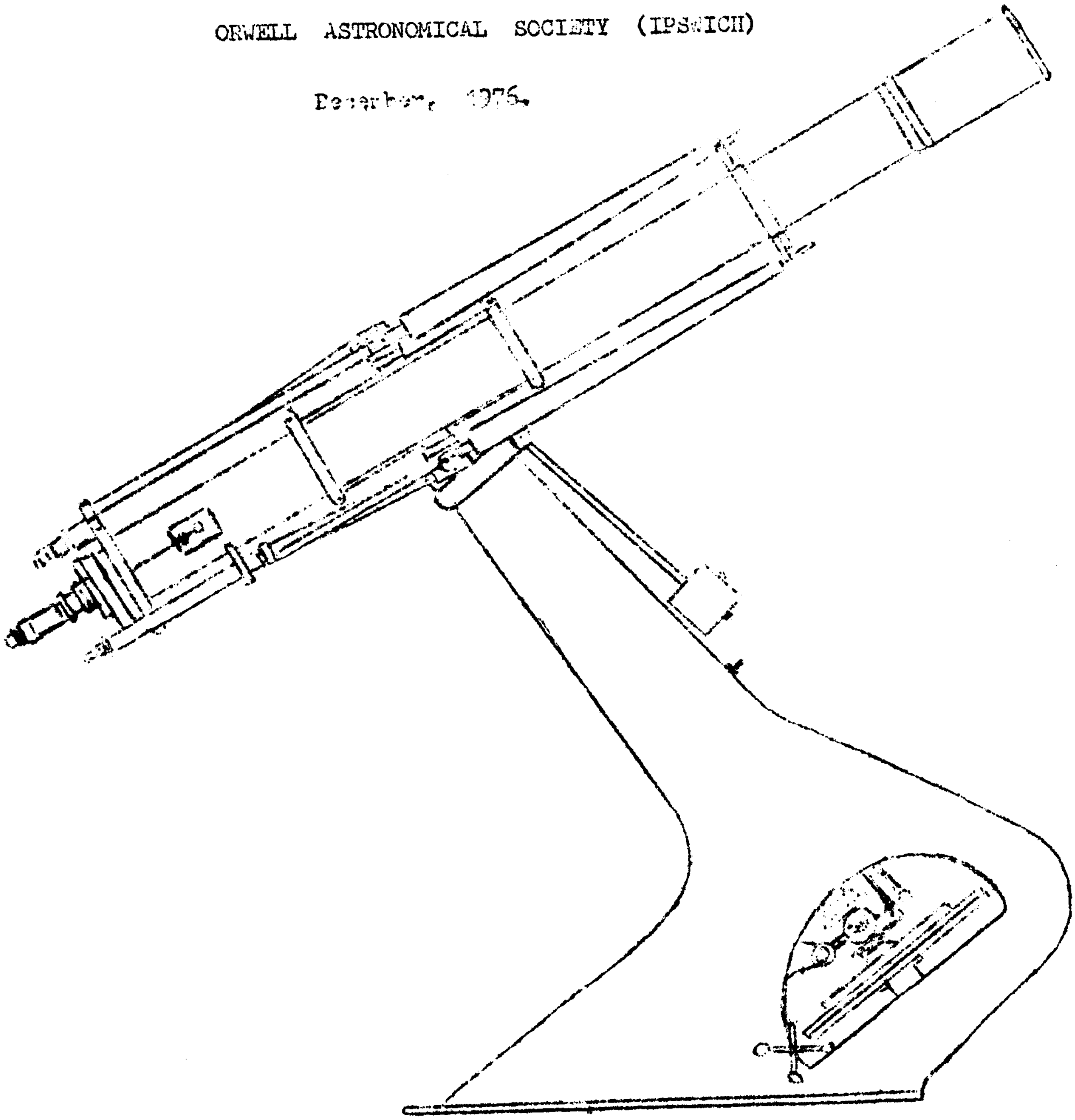
C.A.S.I.

Journal of the

ORWELL ASTRONOMICAL SOCIETY (IPSWICH)

December, 1976.



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<u>ORWELL ASTRONOMICAL SOCIETY (IPSWICH)</u>

[redacted],
Ipswich,
Suffolk
IP4 3NH

December, 1976

Dear Member,

Your annual subscription for 1977 becomes due on January 1st 1977. The following membership subscription rates apply:-

Junior Membership (under 18 years of age or students still in full-time education)	£1
Full Membership	£1.75
Family Membership	£2.50

If you wish to renew your membership for 1977 please send your remittance to the Honorary Treasurer:-

Mrs. R. Markham,
[redacted],
Ipswich,
Suffolk.
IP3 8HB

Yours sincerely,

M.W. STOW

Honorary Secretary.

ORWELL ASTRONOMICAL SOCIETY, IPSWICH

December 1976

Dear Member,

You are warmly invited to the Annual General Meeting of the Orwell Astronomical Society (Ipswich) which will be held on Friday, 7th January 1977 at 8 p.m. The Meeting will take place in the library of Orwell Park School, Nacton.

This is an important event in the Society's calendar and I hope that you will be able to attend.

AGENDA

1. Apologies for absence
2. Minutes of the previous Annual General Meeting and Matters Arising
3. Chairman's Introduction
4. Secretary's Report
5. Treasurer's Report
6. Election of Officers
7. Any other business.

M.W. STOW
Honorary Secretary.

Nomination Form for Officers and Committee Members of the Orwell Astronomical Society

a) OFFICERS.

I would like to nominate .... as .... of the Orwell Astronomical Society for 1977

Signed ....

Seconded ....

b) COMMITTEE MEMBERS

I would like to nominate ....as a Committee Member of the Orwell Astronomical Society for 1977.

Signed ....

Seconded ....

PLEASE NOTE. Nominees must agree to their nomination

The present Treasurer, Mrs. R. Markham, wishes to resign from the Committee and Mr. K. Dye has also recently resigned.

Please return this form to Mr. M.W. Stow (Hon. Secretary), [redacted], Ipswich, by 20th December, 1976.

What's up? The solar system as seen from Ipswich Dec. 1978 by J.D. Deans

SOLAR SECTION

The Sun starts the month in the constellation of Scorpius, it moves through Ophiuchus and into Saggitarius to start the new year. Sunrise at the beginning of the month will be at 07h40m U.T. and Sunset at 15h50m U.T.

Synodic rotation number 1648	commenced	Nov 7.	2d
" " " 1649	commences	Dec.4.	15d
" " " 1650	"	Dec31.	84d

Heliographic co-ordinates as at 12.00 hrs. U.T.

Dec	3rd	+ 15.3°	+ 0.6°	19.9°
"	8th	+ 13.2°	- 0.1°	314.1°
"	13th	+ 11.1°	- 0.7°	248.2°
"	18th	+ 8.8°	- 1.4°	182.3°
Dec	23rd	+ 6.4°	- 2.0°	116.4°
"	23th	+ 4.0°	- 2.6°	50.6°
Jan	2nd	+ 1.6°	- 3.2°	344.7°

MERCURY will reach greatest eastern elongation (20°) on the 20th at 10hU.T and will be setting about 1h20m after the Sun on the 20th. The planet will be at about magnitude - 0.2. Moon near Mercury on the 22nd.

VENUS now a brilliant object in the south west at mag - 4.8 lies at 45° east of the Sun showing a slightly gibbous phase and at a distance of 0.89 A.U. will show a disc diameter of 18.9 arc seconds. The Moon will be near Venus on the 24th.

EARTH on the 21st at 18h U.T. the winter solstice occurs giving the shortest daylight and longest darkness. If you were above the arctic circle you would not see the Sun rise on that day.

MARS has just passed conjunction last month on the 25th, it now lies at 8° western elongation, magnitude + 1.6 and is not well placed for observation.

JUPITER rising very early now and crosses themeridian at about 21h 30m U.T. by the latter part of the month. The Moon will be near Jupiter on the evening of the 4th.

SATURN rises in the east at 20hrs. U.T. mid month at magnitude + 0.3 it is on the border of the constellations of Cancer and Leo. The Moon will be near Saturn on the 11th.

LUNAR SECTION

Phases of lunation 667/668

Full moon	Dec.	6th	18h. 15m	U.T.
Last quarter	"	14th	10h. 14m	U.T.
New Moon	"	21st	02h. 08m	U.T.
First Quarter	"	28th	07h. 48m	U.T.

Occultations

Dec	1st	ZC	146	D	mag	4.4	22h 18.2m.	U.T.
"	2nd	"	252	D	"	7.4	17h 09.3m	"
"	2nd	"	264	D	"	7.0	20h 13.0m	"
"	2nd	"	272	D	"	5.9	23h 02.0m	"
"	3rd	"	284	D	"	7.4	1h 14.1m	"
"	12th	"	1397	R	"	5.5	1h 04.4m	"
"	25th	"	3281	D	"	7.5	18h 42.3m	"
"	30th	"	340	D	"	7.1	1[illegible] 55.3m	"

From the beginning of the New Year I shall be relinquishing my status as Editor of the monthly journal. Mark Howe (Assistant Editor) will be taking over the Editorship. Mark has made several very good contributions to the journal over the year. These kind of contributions are invaluable and I hope that many more people will help by sending Mark some articles, I hope to be able to do some in the New Year myself. My thanks must also go to David Barnard director of the meteor section for looking after the meteor section of the journal and to all the other people who have sent me articles for inclusion in the journal. Finally I would like to mention that without the painstaking efforts made by our Chairman who looks after the printing, collating and distribution there would be no journal.

I am sure that we all wishevery success to Mark with the editorship.

T H E   S P A C E   S H U T T L E

by S. Harvey

MISSION PROFILE

Recently, as some of you know, the first Shuttle was rolled out of the Palmdale facility in California. "Enterprise" as the first Shuttle was named (by Gerald Ford), after the Enterprise on the T.V. series Star Trekis a third of the height of a Saturn 5, yet it represents a new stage in Space Techniques, Rocketry and Technology.

The Shuttle is composed of the Orbiter, an External tank that contains the ascent propellant to be used by the Orbiters main engines, and Solid Rocket Boosters. The Orbiters and SRB's are reusable, whereas the External Tank is expended on each trip. The Space Shuttle mission begins with the installation of the mission cargo whic is placed into the Orbiter. The SRB's and the Orbiters main engines fire simult[illegible]eously at lift-off. The SRB's are jettisoned soon after lift off and fall by parachute into the sea, as well as the large External tank which is also jettisoned shortly before making orbit. The Orbiter manouvering system (OMS) is used to attain the desired orbit and to make any desired orbital manoeuvers that may be necessary such as manoeuvering near to faulty satellites in need of repair. As soon as the Payload doors are open the Crew begin their Payload operations. When the orbital operations ar finished, the crew start to make de-orbit manouevers and re-entry into the atmosphere is made at a hight angle of attack and when the Orbiter reaches a low altitude it glides in much like a conventional aeroplane does. NA.S.A. aims to have a peak turnaround time of two weeks.

The nominal design duration of the first flight is 7 days, but the time in orbit can be lengthened by adding the necessary consumables.

THE VEHICLE

The current Orbiter is designed to carry a crew of 7 into orbit (the current baseline is 4) which includes Scientific & Technical personnel & Payload specialists. (The rest of the vehicle - the SRB's & ET are used to boost the Orbiter into orbit). During the time that the Orbiter is in Orbit, it is powered by its own Rocket-motors by fuel in the rear of the Orbiter. During atmosp[illegible]ric flight the Orbiter is controlled and stabilised by the aerodynamic surfaces on the wings and by a vertical stabiliser (Vertical tail wing).

If nece[illegible]ry the Orbiter can be up in orbit within 24 hours of notification if it is already on standby status. If another Orbiter is disabled, then another Orbiter can accommodate 10 astronauts maximum, thus the crew of a disabled Orbiter could be rescued by a rescue mission Orbiter.

The SRB's are jettisoned from the Orbiter/External T[illegible]ight of 27 nautical miles (50 km) and they descend on parachutes and drop into the sea approximately 150 nautical miles from the launch site. They are then recovered, touched up and are then ready for re-use. After the SRB's have been jettisoned and the Orbiter is heading on the right ascent path, the External tank is jettisoned, falling in either the Indian or the South Pacific Ocean depending on the position of the launch site. The Orbiter then continues in orbit.

T H E   S H U T T L E - D A T A

LENGTH
System 56m
Orbiter 37m

HEIGHT
System 23m
Orbiter 17m

WINGSPAN
Orbiter 24m

WEIGHT
Gross lift-off
2,000,000Kgs
Orbiter on landing
85,000kgs.

THRUST
Solid Rocket Boosters (2)
11,8000,000N each

Orbiter Main Engines
2,100,000N each

Cargo Bay
DIMENSIONS
18m Long
5M in diamter
Accommodations
Unmanned Spacecraft
To fully equipped laboratory

....cont'd....

TIME	DETAILS
Sparation of SRB's	Ht 50kms Velocity 5,170 km/hr

ORBIT INSERTION & COMMENCEMENT at 215 Kms VELOCITY 28,300km/hr

ORBITAL OPERATIONS Ht 185 to 1,100 kms DURATION up to 30 days
ATMOSPHERIC RE-ENTRY Ht 140kms VELOCITY 28,100kms/hr

L ANDING Restricted to plus or minus 2,000kms VELOCITY 346kms/hr (from entry path)

METEOR NOTES by David Barnard, Director Meteor Section.

Bad weather has dismissed the last four watches so lets keep our fingers crossed for December.

There are two chief showers this month:

1. GEMINIDS, one of the finest showers of the year, rich in fireballs. Max. on Dec. 14th at 03hrs U.T. Z.H.R. = 58, Radiant R.A. 0728 Dec. +32, transit 0205 U.T. The Moon rises at midnight and is 22 days old, There will be a METEOR WATCH to observe this shower on [illegible] Sat 11th December at 9p.m. Meet at the usual place outside the Golf Hotel, Foxhall Road, Ipswich at 9p.m. irrespective of weather conditions.

2. URSIDS. This is another excellant shower, the B.A.A. quotes ' Very favourable indeed and badley needs observation' This shower is associated with comet Tuttle (1939). Max on Dec. 22nd, normal limits Dec 17th to 24th, Z.H.R. = 5, Radiant 1428hrs U.T. Dec 22, Transit 0825. The radiant is circumpolar and the Moon does not interfere with this shower as it is only one day old.

There will be a meteor watch to observe this shower on Wednesday 22nd December which is the night of the maximum. For this count meet outside the Golf Hotel as usual at 8.30p.m.

These meteor watches are open to anybody who would like to come along and the more people we have the better itis. All you have to bring is yourself, a chair to sit on and some warm clothing. Even if you only come for an hour or so please come.

OUR MONTHLY JOURNAL.

If you have any items of astronomical interest or any comment about our Journal or Society or you have a report you would like to put in our Journal please contact either Mr. J. Deans or Mr. M. Howe. Remember this is your Journal and anything which you think of astronomical interest which you think might interest other members of the Society please send it to the Editor. Dont leave it to other members, send something NOW.

THIS SPACE TO LET

could you have filled it?

OBSERVATORY CLOCK:

The Observatory a ..onomical clock which was denated to ..r Society by Mr. N.C.C. Barrell has now been installed in the Club Room in the Observatory. You are requested NOT TO TOUCH IT even if it has stopped!! This clock has been hand built by Mr. Barrell and took about 5000 hours to design, build and calibrate so please leave it alone. You may however, take the top lid off the clock case and look down into the workings, but be very careful not to upset the clock.

Our thanks again go to Mr. N.C.C. Barrell for this magnificant clock which we will make a plate up to put on the case showing that the clock was donated to us by Mr. Barrell.

WEDNESDAY/THURSDAY EVENINGS at the Observatory.

You will note from the December programme at the back of this month's Journal that Mr. Cheesman (Wednesday evenings) and Mr. Bearcroft (Thursday evenings) have changed their nights at the Observatory. This is because of heavy committments by Mr. R.M. Cheesman during December abd normal nights will be resummed in January.

A.G.M.

The A.G.M. of our Society takes place on Friday 7th January starting at 8p.p.m. in the Library of Orwell Park School.

COMMITTEE MEMBERS:

New committee members will be ellected at the A.G.M. The only two members who cannot stand again for re-election are: Mrs. R.A. Markham as she will be going away to University during 1977, and Mr. Kevin Dye who has moved away with his Bank to Clare will be unable to stand again on the Committee.

If you have any nominations for Committee Members to represent your Society for 1977 please fill in the enclosed form which is at the front of this month's Journal.

SUBSCRI TIONS FOR 1977.

All subscriptions become due on 1st January 1977 and should be sent to

Mrs. R. Markham,

[redacted],

IPSWICH

who will still be acting as Hon. Treasurer until a new treasurer is elected at the A.G.M.

LECTURES:

Our next lecture at The Friends Mecting House, Fonnereau Road, Ipswich is on Friday 10th December and is being given by Mr. G. Curtis, B.S.c. This lecture is entiled 'The Galaxy' and starts at 8p.m. Please come along and please put the poster at the back of this Journal in a place were it can be seen to advertise this event.

THE GEOLOGY OF THE SOLAR SYSTEM.

This article by Mr. R. Markham, B.Sc. is completed in this month's Journal and there are three sheets (making a total of four sheets with the one in last month's Journal).

DOUBLE STAR NOTES. by Mr. David Bearcroft, Esq.

We have had a magnificent season so far and have observed many of our old favourites (Vera Lynn), and observed many new doubles to add to our already impressive list of stars logged with the mighty 10". We have yet to observe stars below the horizon but we have seen from our lofty perch (transit room roof) wall to wall (90% of arc) lightning, and a very eerie it was too!

We discovered a new specis of five legged spider (spiderus telescopus) who had woven a web inside the telescope and had died of STARvation waiting for the flies tocome in through the round window at the end! This was our most important discovery to date.

We are blessed with clear, sparkling, trouble-free viewing (apart from when it rains) and we would welcome any serious double star observers to atten Roy's, Nigel's or Michaels nights (if they want to get on).

As yet we have discovered no new novas and a suspected variable was due to one of our overkeen helpers moving the dome! We are trying to devise a system for all weather viewing by painting stars on the inside of the dome and using the wrong end of the telescope. ... continued on next sheet

DOUBEE STARS NOTES continued (or pass to next report by Charles Radley)

As I was saying before you had to turn to this sheet (that is if you have not passed on the Charly's report), by this meathod there is no excuse for not knowing the constellations as they will be labelled. We feel that this will be a great help to those who do not know their way around the sky as they will be able to follow the arrors if the Indians don't get them first.

That's all for the time being,

Yours (known to his friends as Friend)

Mr. David Bearcroft, Esq.

FIREBALLS GALORE! by our London Correspondant, Charles Radley.

On the afternoon of August 23rd Nigel Gage rand me up andput me onto one of his workmates who had seen a fireball. I casually noted the details to send up to the B.A.A., but I expected nothing to come of it. Oh little faith! In that day's 'Evening Star' there was actually another report of the sighting - 21hrs 09m .UT., the times matched - BINGO! I knew I had a good one.

At once I rand Bob Malster and asked him to put an appeal in the next E.A.D.T., which he duly did. The appeal resulted in sex sightings by about ten people. I send a report up to Keith Hindley, B.A.A. Meteor Section Director.

Recently he sent me an interesting letter (parts reprinted below) which is why I am writing this article. Although addressed to me it really applies to all the above mentioned (plus others) and I would like to take this opportunity of thanking you all.

As I am not always available please send future fireball sightings to David Barnard [redacted], Ipswich, Telephone Ipswich [redacted] as he is the Society's Meteor and Fireball Section Director.

Copy of letter received from Keith Hindley to Charles Radley:

'This is just a short note about the 1976 August 22 fireball. Many thanks again for doing so much work which was certainly appreciated. We got one or two other sightings, but it was certainly not widely observed.

I am delighted to report, however, that we wrote at onee to Dr. Zdenek Cepleche, the leader of the European Network system and he has just written to report that the fireball was photographed by two members of the European Network - stations 55: Marienberg and station 59: Nurburg. These are the most north-westerly two stations of the European Netwerk.

The fireball began at about 80km height some 70km NW of Dusseldorf and ended at about 50km height about 25km WSW of Dusseldorf. The start height is a photographic one (i.e. when the fireball had become bright up to about mag. -7. Visually (i.e. when the fireball had brightened up above +6 or +4) the start height would have been over 100km.

It is interesting to note that the fully corrected end bearings from Ipswich of all our reports (allowing for conversion from magnetic to true bearings) is 101.6 plus or minus 6.9 degrees. The true bearing of the photographic end-point above is actually 103 degrees - a pretty good agreement under the circumstances and showing that the survey method is a good one.

Dr. Cepleche wishes me to thank you for the field work, which he found particually usefull. To get back to the August fireball the meteor was of peak absolute magnitude -10 to -11 and did not lead to a meteorite fall. It was probable carbonaceous in nature and completely disintegrated during its flight.

So many thanks for the good work - I hope you have a much meatier fireball event to get your teeth into soon.

signed Keith Hindley.

Tranquillitatis). Their origin, meteoric or volcanic, is still uncertain, and also the nature of their infilling (lava or ejecta). The Maria consist of a granular regolith (thin deposits of pulverised rock debris) overlying what is probably volcanic lava, but which may possibly be sheets of ejecta. There are unflooded basins (lacking mare material) on the far side.

Three main types of surface material have been returned by Apollo missions, (a) fine powdery material or 'soil', (b) crystalline igneous rocks, (c) breccias (fragmented rock). Moon rocks are unlike common meteoric materials.

The lunar regolith or 'soil' consists of minute rock fragments, mineral fragments, glass fragments and glass spheres, all very fine in size. It has been formed over a long period of time by meteor and micrometeorite impacts which have broken up and melted the surface rock. Large rocks are scattered around in the soil and on the surface; they are common around the rims of recently formed craters. The 'soil' extends down for a few metres.

Basalt, a crystalline rock, originally molten lava material (by analogy with properties of igneous rocks on earth) is found in the maria; maria basalts are composed of feldspar, pyroxene, ilmenite (iron titanium oxide), and smaller quantities of olivine.

The Moon is poorer in volatile elements such as sodium, potassium and phosphorus, but richer in refactory (high melting point) elements such as titanium and uranium; the latter are not concentrated as on Earth because of lack of volatiles.

There is some breccia on the maria, produced by meteoric impact breaking up rock and welding together the fragments (shock metamorphism) by compression or with molten material produced.

The 'highlands' of the Moon are formed mainly of breccia (rocks consisting of broken fragments of pre-existing rocks welded together by impacts); the highlands are cratered by numerous impacts. They are richer in aluminium (and therefore lighter) than the mare basalts. They are mostly composed of (once molten, now crystalline) anorthositic gabbro; anorthositic rocks are the most abundant lunar rock, with their great quantities of the plagioclase feldspar $CaAl_2Si_2O_8$. Some are composed of basalt (known as KREEP basalt), rich in potassium (K), rare earth elements (REE) and phosphorus (P), formed by remelting.

Much work on lunar stratigraphy has been carried out by mapping by the United States Geological Survey; combined with radioactive dating the broad outline of lunar history is now known. Relative ages are established by normal stratigraphic principles of cross-cutting relationships and superpostion.

The mountain terrain is the oldest part of the Moon, formed in Pre-Maria time. The highland breccias, the oldest-known moon rocks, are approximately 4,000 million years old, formed at the time of the very high rate of cratering which produced the cratered highlands seen today. The anorthositic gabbro and KREEP basalt now forming the breccias would have originally crystallised at a time prior to its breaking up (brecciation).

The maria (basins) seem to have been formed about the time of the intense bombardment, and between 3,900 million and 3,200 million years ago these basins were filled by basaltic lavas, forming the Maria rocks; the oldest rocks known on Earth were formed when the lunar basins were being infilled.

A much lower crater density shows that the rate of cratering was very much less during the formation of these plains.

The last 3,200 million years of Moon history (Postmaria time) show a low intensity bombardment (occasional craters) and meteoric weathering of the surface. Measure of changes produced by cosmic rays on rocks gives a guide to the ages of post-mare craters. Copernicus is about 850 million years old, Camelot crater about 90 million years old, and South Ray crater about 2 million years old. Ages of other craters can be estimated, based on the freshness of appearance with those of dated craters.

Age relationships between craters are clear where one crater overlaps another directly. Otherwise, age relationships are determined by relative degrees of degradation (whether features are fresh and sharp, or worn), as the steady bombardment by small impacts breaks down origihal structures. However, secondary ('splash') impacts can accomplish the same thing, and thus in some cases the degree of degredation of an older crater depends on its closeness to another large fresh crater. The ejecta from the most recent impact basins has blanketed much of the earlier surface.

No areas of solid rock have been found on the Moon, all sampled rocks have been separate rocks strewn around the surface and usually partly embedded in the dusty soil. This means that the crystalline rocks did not form where they were found. The basalts are usually interpreted as pieces of lava flow derived from melting of part of the lunar crust; it has also been suggested that melting was made in the course of impact, and that the blocks have been flung to their present positions by impact events. Another suggestion is that the surface rocks are purely the result of 'infall' (accumulation by 'meteorites'), rather than of melting on the Moon; Moon rocks are unlike 'modern' meteoric material, but not necessarily, it is suggested, different from the material the Moon was originally formed from.

Stratification on the Moon has been observed, but it is not yet known whether it is due to lava flows or simply to the compaction of the powdery dust.

The origin (impact or/and volcanic) of the craters on the Moon is uncertain, but evidence, though not conclusive, suggests that many (large ray craters, e.g. Copernicus) are of impact origin. These are circular structures with (when fresh) radiating swarms of small craters and ejecta deposits; the small (secondary) craters are generally thought to have been formed by missiles ejected from the primary crater during excavation. The bright ray systems have been interpreted as "splash" features. Terrace features inside some craters may be due to slumped blocks.

There is some evidence of volcanic activity on the Moon. Some irregular-shaped domes appear to be volcanic domes. Possible lava outpourings may have come from vents in the maria, but molten rocks may have been generated by impact. Flow patterns of material on the maria are usually interpreted as volcanic lava, but may be flows of other material (?regolith).

The major linear features of tectonic origin ('internal upheavals') so characteristic of Earth's surface are absent on the Moon; there are no signs of contortions in any of the ring shaped structures on this very ancient surface. There are some smaller linear features, such as the Straight Wall Fault, about 75 km. long, in the Mare Nubium. Some sinuous rilles may be collapsed 'lava tubes' (formed by lava river flowing beneath consolidated crust of lava).

'Moonquakes' originate at a very great depth (most of those on Earth originate at shallow depths, less than 60 km.). Seismic signals show that the immediate subsurface structure to be different to that of Earth, and interpretation of bedrock as volcanic lava must take this into account.

The Moon has a negligible general magnetic field; any local crustal magnetic fields may be residual.

MERCURY.

Mercury is about two-fifths of the diameter of Earth. It has a density comparable with that of the Earth, suggesting a large metallic core; there is a magnetic field, possibly residual from an earlier phase of mercurian history. The outside of the planet is similar to that of the Moon, with a cratered surface and comparable sequence of events. There is no atmosphere.
Temperature at the surface rises to over 400 °C.

Most of our knowledge of Mercury comes from Mariner fly-by spacecraft observations; more than half of the total surface has still to be seen.

Two broad types of terrain have been seen-

(a) densely cratered terrain with large craters, resembling the highlands of the Moon.
(b) relatively poorly cratered plains, similar to the lunar maria, and possibly composed of volcanic material; they overlie the cratered surface.

The highlands of Mercury are similar in appearance to the lunar highlands, with close-packed large basins and craters with superposed smaller craters. The craters are probably impact craters, based on criteria used in connection with the Moon. There are differences between fresh craters on Mercury and those on the Moon. Material ejected from primary impact craters covers a less extensive area than on the Moon, and secondary impact craters are much closer to primary craters; ejecta is not thrown so far because of the greater gravity.

The plains are relatively smooth areas, younger than most of the heavily cratered terrain. They are probably of volcanic (lava) origin rather than sheets of ejecta (as the plains material is not associated solely with large craters).

The Caloris Basin, 1,300 km. in diameter, is probably an impact basin, comparable to the Imbrium Basin on the Moon. It is surrounded by a rim of mountains and the floor is filled with smooth Plains material; the floor shows a fracture pattern of ridges and cracks, implying post-emplacement movement of plains material in response to stresses.

If the craters of Mercury are 3 or 4 thousand million years old, their shapes show that there has been no crustal plate movement as on Earth. Lack of surface erosion rules out any atmosphere in the past. Subsurface temperatures in equatorial regions are above the freezing point of water, but no evidence of chemical weathering conceivably associated with occasional release of subsurface water has so far been observed.

It appears that the present surface of Mercury, like that of the Moon, was formed early in its history and has changed little since then.

VENUS.

Venus is about the same size and density as the Earth, and it is possible that the internal structure is similar; if so, the apparent absence of a magnetic field might be explained because Venus rotates very slowly.

Venus has an atmosphere, primarily carbon dioxide, with a surface pressure about ninety times that at the surface of the Earth. The surface temperature is over 450 °C, the clouds seeming to 'trap' sunlight to maintain this temperature.

No surface features have been viewed from space because of the cloudy atmosphere. However, radar-reflectivity mapping distinguishes terrain as rough or smooth, and as high or low. Generally, Venus appears to be much flatter than the Moon, Mercury, Mars and Earth. Surface features ("mountains") are often large in extent but with a small range of heights and depths, there are few features more than a mile high. A few large circular craterlike forms are known: one large 'crater' just north of Venus' equator, is about 100 miles in diameter but only about one quarter of a mile high at the rim, while its interior does not appear to be much below the level of the surrounding terrain. Meteoric and volcanic origins have been suggested. Apparent scarcity of small craters, if of meteoric origin, can be attributed to the planet having an atmosphere.

Parts of the surface of Venus have been photographed by 'Venera' landing spacecraft. At one site there were numerous tabular angular boulders, ranging in size from about one foot to over three feet across; the angular boulders are little eroded, indicating fairly recent breakage, -'Venus-quakes' have been suggested as responsible for shaping the blocks. At the other site, the landscape looked appreciably older, a plain with smoother rock outcrops. The composition of the surface is unknown, but observations of radioactivity indicates presence of uranium, thorium and potassium, pointng to igneous rocks.

Reactions at the surface may include the action of wind, heat and rain.

Observed motions of the atmosphere have been interpreted as high-speed winds extending over large areas, but winds at the surface seem to be very gentle.

The high temperatures at the surface may possibly liberate gases from rocks, and may also deform low melting-point materials; information is not yet available on these points.

It is thought that the Venusian clouds possibly contain sulphuric acid; any rain may therefore consist of hot acid, and the action of such a corrosive fluid may be responsible for the shallowness of surface features on the planet. Again, information is not yet available.

It is obvious that there is a great deal of speculation in any discussion about Venus; present and future work should greatly increase our knowledge. Any information about the geological history of Venus will be of great interest, - conditions on the planet may have been very different in the past.

TORO.

Away from the main asteroid belt, the Apollo asteroids cross the orbit of Earth. The spectral characteristics of the Apollo asteroid known as Toro show it to match closely with L-type chondrite meteorite; could the latter possibly be parts of Toro? Many meteorites may be collisional fragments of asteroids.

MARS.

(This was written before the landing of the 1976 'Viking' spacecraft).

Mars is about half the diameter of Earth. It has a density of just under 4, and therefore its interior cannot be like that of Earth. There is a tenuous atmosphere (surface pressure less than 2/100 the pressure at the surface of the Earth) rich in carbon dioxide. There is no liquid water (because of low pressure, and very cold conditions), and no magnetic field.

Mariner spacecraft have shown that the southern hemisphere of the planet consists of densely cratered highlands, indicating an ancient age. The northern hemishere is low, smooth and sparsely cratered (resembling the Moon maria or plains), indicating youthful age. There is evidence of geological activity, with volcanism, tectonism, and possibly fluvial processes. Thus Mars has both lunar and terrestrial analogues.

Near the equator are several gigantic mounds with craters on top, similar in appearance to terrestrial shield volcanoes; the largest, Olympus Mons, is over twice as large as the largest shield volcano on Earth. The summit features appear to be calderas (collapsed features once lava vents), and there are long thin lava-like flows and channels on the flanks. The flanks of these volcanic mountains are almost free of impact craters, implying comparative youth. Old volcanic features are also known.

The plains show many lobed scarps, resembling volcanic flow fronts, and indicating possibly basaltic composition. Some areas have more craters than others, implying different periods of lava flooding.

The Valles Marineris complex is a great equatorial rift (fault) valley extending for 5,000 km., in places 75 km. wide and 6 km. deep; there are diagonal subsidiary valleys, possibly of complex origin, including fracturing, landslides, wind, and perhaps running water. There is evidence of fault blocks elsewhere, as in the Tharsis plateau area.

No linear chain mountains (evidence of horizontal cr ustal plate motions) have been identified.

Wind plays an important part in erosion and deposition of materail on Mars. Scouring by wind may have faceted hills, and possibly etched the irregularly shaped closed depressions in the south-polar region. Craters have been modified and eroded by the scouring action of winds, bright 'rays' of ejecta are removed, and craters with dust-streak 'tails' also give evidence of wind action. Wind-lain sand-dune fields have also been photographed. Windblown dust is no doubt responsible for the seasona l changes of light and dark coloured material. The light-scattering properties of the surface of Mars are similar to those of the iron oxides limonite and goethite.

At the present time Mars has small permanent ice-caps, apparently chiefly of water ice, with seasonal ice-caps of carbon dioxide ice.

Laminated terrain in the polar regions consists of numerous layers (each about 100 m. thick) of sedimentary appearance, perhaps a mixture of dust and ice. The 'cliff and bench' topography suggests varying resistance to erosion.

There is evidence of fluvial processes on Mars, with valleys which may have been formed by running water at the surface.

There are meandering valleys, with highly sinuous courses, but of particular interest are the channels with many tributaries, which seem able to have been formed only by rainfall, as the water needs to originate over a large area. Some valleys show braided terrain (networks of small channels) on their floors, another indication of fluvial action.

Some channels are degraded and densely cratered, others appear 'fresh' (with very few craters), implying widely differing ages.

"Chaotic terrain" (great masses of broken and tilted rocks) gives the impression of subsidence, perhaps due to the melting of subsurface ground ice.

The evidence of water action on Mars where there can be no liquid water at the present day (because of 'glacial' conditions), implies the possibility of major climatic variations during Martian history. The duration of warmer climate and water erosion was short, as erosion has not destroyed pre-existing cratered surfaces.

There are several large multi-ringed impact craters on Mars; in the southern highlands, Hellas is nearly twice the size of the Imbrium basin on the Moon.

The lack of free water and lack of atmospheric protection from radiation are not insuperable problems when considering the possibility of 'life' on Mars. It may well be worth looking for Martian fossils.

Martian history may be briefly summarised as follows-

1). Formation of craters and basins of the cratered highlands.
2). Formation of fault scarps and graben; breakup of northern 'crust'.
3). Formation of 'volcanic lava plains'.
4). Formation of major volcanic shields.

PHOBOS.

Phobos, the larger satellite of Mars, is a cratered (impact-eroded) rocky chunk.

ASTEROIDS.

Asteroids are minute in size, have no significant gravitational field and so can have no atmosphere. Many of them have been spectrophotometrically examined, and compared with the spectra of powdered minerals. The commonest (80%) asteroid surface material resembles that of carbonaceous chondrites; about 10% have a surface resembling laboratory spectra of 'stony iron' meteorites. Surfaces similar to nickel-iron have also been found.

Could the Asteroids have once all been part of one or more bodies which had segregated into a heavy metallic core with lighter material outside.

IO & EUROPA.

With densities over 3, these two 'Galilean' satellites of Jupiter seem to be bodies of the type found in the inner solar system. Some surface features are known.

Io is about the same size as Earth's moon, and has a tenuous atmosphere. It seems to be a reddish-brown colour, with darker reddish polar caps. Both sulphur and sodium-rich evaporite salts have been suggested to account for the colour.

Europa is slightly smaller than the Moon, and has what appear to be snowy-looking polar caps, accordind to some accounts.

GANYMEDE & CALLISTO.

The other two Galilean satellites of Jupiter are not dense enough to be rock bodies, but may eventually yield useful information on such subjects as the erosion of impact craters on icy surfaces. It has been suggested that darker regions may represent rocky material in ice matrix.

Ganymede is larger than the planet Mercury; it has definite dark and light surface areas and may have a thin atmosphere. Pioneer 10 photography showed surface resolution of c. 400 km.

Callisto is about the same size as Mercury, and darker than Ganymede.

TITAN.

Titan, the largest satellite of Saturn, is about the same size as Mercury. Titan is not dense enough to be a rock body, but a hydrogen and methane atmoshere, deeper than that of Mars, makes it of particular interest. It has been suggested that sunlight may be absorbed, this energy heating part of the atmosphere and possibly leading to the formation of complex organic molecules.

IKEYA-SEKI.

The comet Ikeya-Seki passed within $\frac{1}{2}$ million km. of the Sun in 1965, and heating from the Sun was enough to vaporise some of the stony matter in tha head, spectral analysis providing evidence of sodium, calcium, iron, nickel, chromium and other metallic elements.

COMPARATIVE DATING.

Absolute (radioactive) dates are known only from the Earth and Moon.

Comparative dating of events may be possible if reasons are extra-planetary, and if those external conditions (e.g. impacting objects) are from a common source and not of local origin.

Extrapolation of knowledge of age of Moon rocks and cratered surfaces allows estimation of ages for many surface features of Mercury and Mars.

Palaeoclimatology of Earth and Mars may be affected if passing through dust clouds in space at the same time, perhaps giving rise to 'Ice Ages'.

SOME FURTHER READING.

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R. A. D. Markham.

ADDENDUM :'VIKING' AT MARS, 1976.

Both landing sites show rock boulders everywhere. Sand-dunes are present at site 1; the rocks at site 2 show vesicles similar to those of volcanic rocks on Earth.

The search for life is so far (end of September 1976) inconclusive; 'soil' material is very 'active', but the processes are unknown. Material from under rock (sheltered from ultra-violet radiation) is being analysed. Future missions may need to 'look' in cracks in rocks rather than at loose material.

Photographs from orbit show the volcanoes and valleys in greater detail than previous missions. The North Polar Cap is water ice, not carbon dioxide.

The satellites Phobos and Diemos are both heavily cratered; Phobos shows lineation features.

ORWELL ASTRONOMICAL SOCIETY (IPSWICH)

Programme for

DECEMBER, 1976

<u>At Orwell Park Observatory, Nacton, Nr. Ipswich.</u>

MONDAYS from 7.30p.m. General Observations Section.
Director Mr. N. Gage, [redacted], Felixstowe, 'Phone Felixstowe [redacted]
and Mr. S. Flory, [redacted], Ipswich, 'Phone Ipswich [redacted]

6th December
13th "
20th "
23rd "
30th "

* WEDNESDAYS from 8p.m. Double Stars Section
Director Mr. D. Bearcroft, [redacted], Ipswich 'Phone Ipswich [redacted]

1st December
15th "
29th "

* THURSDAYS from 7.p.m. Solar, Lunar & Planetary Section.
Director Mr. R.M. Cheesman, [redacted], Ipswich

2nd December
9th "
16th "
30th "

FRIDAYS from 7.30p.m. Nebula and Faint Object Section
Directors Mr. R. Hazelwood, [redacted], Ipswich 'Phone [redacted]
and Mr. R. Gooding, [redacted], Ipswich

3rd December
17th "

* Please note that Mr. R.M. Cheesman and Mr. D. Bearcroft have changed their nights at the Observatory for December only

<u>LECTURES.</u>
At the Friends Meeting House, Fonnereau Road, Ipswich.

A warm welcome to all - ADMISSION FREE. - Refreshments available.

Friday 10th December, 1976 at 8p.m. a lecture entitled

'THE GALAXY' given by Mr. G. CURTIS, B.Sc.

METEOR SECTION. Director Mr. D. Barnard, [redacted], Ipswich
'Phone Ipswich [redacted]

THERE WILL BE TWO METEOR WATCHES THIS MONTH:

1. GEMINIDS. ~~Wednesday~~ SAT 11th December. Meet outside the Golf Hotel, Foxhall Road Ipswich at 9p.m.

2. URSIDS: Wednesday 22nd December. Meet outside the Golf Hotel at 8.30p.m.

REMEMBER TO COME ALONG and wrap up warm!

O.A.S.I.

Orwell Astronomical Society (Ipswich)

presents

a lecture entitled

THE GALAXY

by

Mr. G. CURTIS, B.Sc.

on

FRIDAY 10th. DECEMBER 1976

at 8p.m.

at

The Friends Meeting House
Fonnereau Road, Ipswich

REFRESHMENTS

ADMISSION FREE

Secretary: Mr. M. Stow,
13 Ladywood Road,
Ipswich.