Volume I. No. 10.

JANUARY, 1936. FOURPENCE.

URANIA

MOTTO.

Give me the ways of wandering stars to know,
The depth of heaven above and earth below,
Teach me the various labours of the moon,
And whence proceed eclipses of the sun.

Virgil, Georgics.

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URANIA.

Official Organ of the JUNIOR ASTRONOMICAL ASSOCIATION.

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C O N T E N T S .

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Send in your Competition Entries Early - The early bird catches the worm !

EDITORIAL.

94, Dundas Street
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A very happy and prosperous New Year to all our readers! We hope that, during the fresh revolutions round the sun on which we are starting, the number of readers of our little magazine will increase and go on increasing till we are known all over the world, and we hope that our present readers will make it a resolve to send in as many contributions as they can, and to start right away if they have never sent any before.

During this year, we shall, with the help of suggestions and ideas from all our readers, try to make URANIA brighter, better and more interesting each month. This can be done only if you will let us know what you would like to see in the magazine, and what you would like not to see! Any improvements you suggest will be carefully considered, and if possible, put into practice. In particular, please let us know what you think of this issue, in which we have tried to provide a variety of interesting articles.

The Editor.

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GREAT ASTRONOMERS.

No. 10. .....Ptolemy (II).

The fifth book of the “Almagest” contains an account of the construction and use of Ptolemy’s chief astronomical instrument, a combination of graduated circles, known as the astrolabe. Then follows a detailed discussion of the moon’s parallax, and of the distances of the sun and moon.

The sixth book is devoted to eclipses and

the seventh and eighth books contain a catalogue of the stars, and a discussion of precession. The catalogue, which contains 1,028 stars, (three of which are duplicates), is nearly identical with that of Hipparchus.

The last five books deal with the theory of the planets, the most important of Ptolemy's original contributions to astronomy. He adopted the epicycle and deferent which had been used by other early astronomers to explain the retrograde motions of the planets. Ptolemy supposed the centres of the epicycles of Mercury and Venus to be on a bar passing through the sun, and to be between the earth and the sun. The centres of the epicycles of Mars, Jupiter and Saturn were supposed to be farther away than the sun. Mercury and Venus were supposed to revolve in their epicycles in their own periodic times and in the deferent round the earth in a year. The major planets were supposed to revolve in the deferent round the earth in their own periodic times, and in their epicycles once a year.

Ptolemy states that he had no means of estimating numerically the distances of the planets, or even of knowing the order of their distance. He placed Mars, Jupiter and Saturn beyond the sun in that order; and he placed Mercury and Venus between the sun and the moon, Mercury being the nearer to us.

There is much difference of opinion among astronomers as to the merits of Ptolemy; but however they may disagree with his own theories, all are grateful to him for the services he rendered by preserving and developing the great ideas of Hipparchus - ideas which the other astronomers of the time were probably incapable of appreciating and which might easily have been lost to use if they had not been included in the "Almagest".

Historian.

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J. A. A. QUESTION BUREAU.

The Oracle will be pleased to answer any questions about Astronomy, or the J. A. A. on this page every month. Questions should be addressed to the Secretary, and marked "Oracle", as they will then be forwarded direct to him.

What Does the Name "Pleiades" mean?

This name probably comes from the Greek word 'pleiones', meaning many. The stars in the group of this name are supposed in mythology to be the daughters of Atlas.

Are the Hyades and the Haedi the same, or are they separate star-groups?

These groups are entirely distinct, though their names happen to be similar. The Hyades are a group in Taurus, forming a V-shape. The first magnitude star Aldebaran is in this group, but it is not connected with the other stars. The Haedi, or Kids, are three stars, forming a triangle, in Auriga, near the bright star Capella. The name Capella means a "she-goat" and the Haedi are her kids. Both these star groups may be seen at this time of year. (See star-maps).

Which is the Biggest Telescope in the World?

The biggest telescope at present is the 100 inch reflector at the Mount Wilson Observatory, California, where a great deal of work on the Sun is done. A bigger telescope mirror, 200 inches in diameter, is in the process of cooling at the present time.

What is a "Planetary Nebula"?

A planetary nebula is not, strictly speaking, a nebula at all. It is simply a star surrounded by a vast envelope of tenuous gas, which is illuminated by the

star within. This is probably the state in which a nova remains after it has exploded and thrown off its huge atmosphere of gas.

What are meteorites made of?

Meteorites are often made of pure iron - iron such as we never find on earth, a bright, silvery metal. This is frequently combined with nickel, a metal resembling it. Some are made of stone, but nearly always they have veins or particles of iron in them. Then another type of meteorite is the carbonaceous in which carbon compounds are found, closely resembling the organic compounds found on earth.

Is It Possible that Star-light can affect people in any way?

The idea of stars affecting the destiny of people is very old, and is the basis of the old science of astrology. But we presume our correspondent means this question seriously, and the answer is quite probably - yes! The sun's light has an enormous effect on us all, as we know, and the light of stars and those mysterious cosmic rays which reach us from the depths of space, and of whose properties we know so little, may quite as well exercise some effect on the minds and bodies of mandkind.

The Oracle.

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THE RED PLANET.

Though it is not the nearest planet to the earth, Mars is the planet which, at favourable times, can be observed better than any other planet, and it is the planet of which we know most. The orbit of Mars is more eccentric than that of the earth. At its greatest distance from the sun, it is 154,500,000 miles from it; at its perihelion or at least distance, it is 129,500,000 miles

away; and its mean distance is 141,500,000 miles. So the distance between Mars and the Earth varies between 234,000,000 miles and 34,000,000 miles. When Mars is in opposition about the end of August, the opposition is always a favourable one for observation. The planet is then at its nearest. Oppositions in February are better for the naked-eye observer, for Mars is then high in the sky, but for big telescopes it is not so favourable, since the planet is at a distance of about 60,000,000 miles. For our climate, the best times really are October, when the planet is fairly high in the heavens, though it is not so near as in August. When Mars is at its nearest, the southern hemisphere is turned to us, so we know more of this hemisphere than of the northern one.

Since the orbit of Mars is outside that of the earth, the year there is longer than on our world - 687.98 of our days to be exact. The axis of Mars is tilted, just as the earth's is, so that the seasons take place with the same regularity, but they are twice as long as the Earth's. Their precise lengths, which can be very accurately measured, are as follows:

	Northern Hemisphere	S. Hemisphere
Spring	199 days.	147 days.
Summer	183 days.	158 days.
Autumn	147 days.	199 days.
Winter	158 days.	183 days.

The length of the day on Mars can be very accurately determined, since it is possible to see the markings on the surface with great clarity. In 1659, Huyghens concluded that the Martian day was about 24 (twenty-four) hours. Later on, Cassini calculated that it was slightly more - 24 hrs. 40 mins. The modern estimate, made with better instruments, is 24 hrs. 37 mins. 22 secs.

In diameter, Mars is 4,200 miles - about

half of the earth's diameter. The surface of Mars is one-fourth that of the earth, its mass one-tenth, its volume one-seventh and its density therefore only seven-tenths. Gravity at the surface of the planet exerts a less force than at the surface of the earth, as might be expected, so that a body weighing one hundred pounds on earth would weight only thirty-eight pounds on Mars.

The beginning of modern studies of Mars was in 1710, when Miraldi discovered the polar caps, those white patches at the poles of Mars which resemble the ice-caps at our own poles. Later on, in 1777, Herschel, unaware of Miraldi's discoveries, found the polar caps for himself, and studied them with interest. He commented on the similarity between these caps and the terrestrial polar covering. At this period, the coloured areas observed on Mars were divided into three different features. The bluish-green areas were known as "seas", or "maria", as they were called more often; the reddish-ochre areas were "continents"; and the white areas round the poles were, of course, the polar caps.

The first map of Mars was made in 1840, by Beer and Maedler. It was found that the bluish-green parts covered three-eighths of the whole surface, and were found mainly in the southern hemisphere, not far from the equator. This would seem to show that Mars has less water than the earth, whose oceans cover more than three-fourths of its surface.

But a simple test reveals that the bluish-green areas are not really seas at all. If they were water, the reflection of the sun would shine in them as a small, star-like point, travelling round with the rotation of the planet. This would be seen in the earth's oceans if it were to be observed from outer space. No such reflection is ever seen on Mars. Strangely

enough, no one seemed to think of this until 1896, when an American astronomer, Lowell, the builder of an observatory at Flagstaff, Arizon, made the observation on Mars. His results proved conclusively that the bluish-green areas of the planet could not possibly be seas. Another factor which shows the impossibility of this is that the colours of the patches vary between bluish-green and chocolate brown, according to the seasons; also, their boundaries vary considerably.

Some observers now think them to be areas of vegetation. The ochre areas are thought to be deserts, sandy and barren. When it was believed that the ochre parts were continents, in the mid-19th century, an idea arose that the grass and leaves must be red in colour, thus giving a reddish tinge to the whole planet's appearance. This idea is, of course, not considered nowadays. In support of the sandy deserts theory is the fact that occasional small projections have been seen, which are thought to be clouds of sand blown up by the wind.

Another suggestion to account for the red continents is put forward by Dr. Spencer Jones, the Astronomer Royal. This is that the surface is covered with red oxide of iron, caused by oxidation of iron ore by atmospheric oxygen.

It has been found that the surface is very flat, with no high mountains, and no elevations higher than two thousand feet. The barren areas are higher than the bluish-green regions which are believed to be fertile.

Relative to the size of Mars, its snow-caps are much greater than those of the Earth, the maximum diameters being: Southern hemisphere - 3,700 miles; northern hemisphere - 3,111 miles. In 1830, it was first observed that as the snow-caps contracted on the approach of the Martian summer, a blue

belt began to be visible round the cap, sometimes broken up by small bridges of snow. Lowell, in 1894, showed that it contracted along with the cap, and thought that it was probably a belt of water due to the melting of the snow. If this is so, it is probably the only water on the surface of Mars.

The famous canals of Mars were first observed in 1877 by Schiaparelli, working beneath the clear skies of Italy. He thought that they were from 74 to 2,000 miles in breadth. They crossed the red deserts, every canal terminating at both ends either on the edge of a desert, or in another canal, but never stopping abruptly in the middle of a continent. In certain seasons the canals were seen to double almost simultaneously over the whole surface of the planet.

For nine years, no one else saw the network of lines, and Schiaparelli was not believed. Even observers with bigger telescopes failed to observe the markings; but it must be remembered that these observers had not the advantage of the clear sky which Schiaparelli had. Then, in 1880, the great telescope at Nice Observatory showed the canals. In America, Lowell together with Pickering, observed the canals with their powerful forty-inch refractor, and discovered even fainter canals. In 1895, Lowell photographed the canals. He believed that the canals must be the work of intelligent beings. It was Pickering who suggested that it was not the water-ways which we saw but the strips of land on either side of them, fertilised by the water, and bringing forth vegetation. Lowell's reason for believing that the canals were constructed by intelligent beings were three in number:

1) Their geometrical straightness and regularity,
2) The junctions of the canals, where they cross each other are marked by round

dark spots, which Lowell called oases, and which he thought to be the centres where the cities of the Martians would be situated.

3) Their varying visibility; they grew darker as the seasons changed.

The canals were thought to carry water from the melting polar caps through the deserts, so that vegetation might be grown. The inhabitants of Mars could dwell in the oases, whence they could tend their vegetation along the banks of the canals.

The canals were not fully believed in even yet; and, indeed, there were many astronomers who, even today, treat them very lightly. Most declare them to be an optical illusion, and experiments have been tried out to prove this. In 1892, Maunders experimented with a class of boys at Greenwich Hospital School.

He pinned up a drawing of Mars in which several rows of dots were drawn. Many of the boys drew straight lines where the lines of dots were. Thus it was thought that the canals of Mars were merely small markings on the surface which were mistaken for lines.

Some years later, Flammarion tried this experiment with a class of French boys, of whom not one drew lines. The optical illusion theory is thus at a deadlock. Astronomers who have made a study of Mars nearly all agree that the canals exist, and it is only those who have not studied the planet carefully who believe the canals do not really exist - a significant point.

The question of the temperature and atmosphere of Mars is an important one in considering whether it may be inhabited by intelligent life, or by any life at all.

Mathematicians declare that the temperature must be below freezing point, according to Mars' distance from the sun. Observers, however, think that the temperature must be above zero Fahrenheit. When the polar snows

are melting, the temperature must be about 32 degrees Fahrenheit at least. Lowell estimated that the mean climatic temperature must be about 48 degrees Fahrenheit. In 1924, Lowell observed Mars with a radiometer attached to the forty-inch reflector, and concluded that the equatorial region is much warmer than the polar, that the afternoon temperature is higher than the morning, and that of the blue-green areas higher than that of the deserts. The temperature varied between 46 and 63 degrees Fahrenheit. At Mount Wilson Observatory it was found that the noonday temperature was 45 degrees Fahrenheit. These measurements were confirmed in 1926.

The atmosphere of Mars is decidedly thinner than that of the earth - probably thinner by half than the air on top of the Himalayas. The Martian atmosphere is generally free from clouds, but occasionally whole areas at the poles are surrounded and covered with mist. The most conspicuous clouds are found along the terminator, at sunrise and sunset on the planet. Cloudy nights seem to be the rule on Mars. The clear skies in the daytime will let in a great deal of heat, and the cloudy atmosphere, 120 miles in depth, will keep in the heat at night. So the climate might be rendered quite tolerable, even for us, and this brings the possibility of beings on Mars not very different from ourselves.

It is quite probably that most of the gases of our atmosphere are present in Mars! Gases must have a certain velocity in order to escape from the pull of a planet, but hydrogen is the only gas able to escape in this way from Mars; it can escape also from the earth. It was thought some time ago that oxygen existed in Mars' atmosphere to the about of 15% of that in the earth's; and water vapour to the amount of 5%.

About 18 months ago, however, Dr. Adams

failed to find water vapour or oxygen in a greater proportion than one-thousandth of the earth's. Dr. Spencer Jones suggests that the oxygen may be all converted into ozone by the action of the sun's ultra-violet rays.

On our own earth, we have a region which seems to resemble Mars very much in its condition. In the Tundras, the temperature is always very low, but the sun shines constantly. This region contains abundant life, both animal and vegetable. Thus it becomes more and more possible that Mars is indeed fit for life. We can almost imagine being like ourselves, struggling for life on their dying planet, adapting every possible means to obtain the life-giving water which is so necessary to their existence. Perhaps their civilizations is better than ours, their learning greater. What must be their feelings when they think that, not so far in the future, all the knowledge they have gained, and the communities they have built up, must perish and vanish into nothing!

M. Eadie.

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THIS MONTH'S QUOTATION.

Hymn to Diana.

Queen and Huntress, chaste and fair,
Now the sun is laid to sleep,
Seated in thy silver chair,
State in wonted manner keep;
Hesperus entreats thy light
Goddess excellently bright.

Earth, let not thy envious shade
Dare itself to interpose;
Cynthia's shining orb was made
Heaven to clear when day did close!
Bless us then with wished sight,
Goddess excellently bright.

Lay thy bow of pearl apart,
And thy crystal-shining quiver;
Give unto the flying hart
Space to breathe, how short soever:
Thou that mak'st a day of night-
Goddess excellently bright.

Ben Jonson.

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NOTICE: The Quotations Editor will be glad of quotations, poems, etc., on astronomical subjects. These may be of any length. Please sent to address on front page.

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COMPETITION PAGE.

This month, as the January, 1936 issue of Urania is followed so closely on the previous issue, we did not receive any articles, and so it has been decided to award only one prize. Will members please note that this competition is really continuous, that is, that articles may be sent in at any time. Those arriving by the twentieth of the month are included in the competition for that month; those arriving later are put into the next month's. The subjects suggested last month may be used at any time.

Prize-Winner This Month.

Nan M. Silver - "The Old Astronomer and the Moon".

Highly Commended.

Jean C. Harris - "Monarch of the Skies" (Poem).

Astronomical Notebooks:

The second competition for these is now running, and closes on March 31st, 1936. For further particulars, see October, 1935 URANIA, or write to the Editor. All entries will be returned.

Next Month's Competition will be on the lines of those of previous months. Closing date - January 20th, 1936. All entries should be sent to the Editor. Articles may be of any length; poems are also accepted.

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BALLAD OF THE BEARS.

Beneath the skies of ancient Rome
There dwelt long, long ago
A huntress fair, with golden hair,
Her name was Callisto.

Fair Callisto, she had a son,
A brave and manly boy,
She called him Arcas, and in him
She had much pride and joy.

But one fine day this happy pair,
When sporting in the wood,
Were spied by Jupiter, the king
of Gods, so great and good.

Hs smiled on them, and loved them well
But soon his queen perceived
That kindly smile, and in a while
I fear Juno was peeved.

Her anger rose by leaps and bounds,
Until, one gloomy day,
Juno conceived a plan to drive
Poor Callisto away.

She waved her wand, and wove a spell
And Callisto became
A savage and fearsome grisly bear,
It really was a shame.

Poor Callisto, she ran away,
Her friends she dared not face,
For fear that she would then become
A victim of the chase.

She hid within the gloomy wood,
And lived upon wild roots,
For several years she thrived on these
Eked out with summer fruits.

Meanwhile, her son, Arcas the Bold,
Grew up to be a man.
He was so fleet, no man nor beast
Could best him when he ran.

One day when hunting in the wood,
He chanced a bear to meet.
'Twas Callisto, and though she fled,
Arcas, he was too fleet.

He raised his bow, took careful aim,
The arrow swiftly sped,
And ere he knew what he had done,
Fair Callisto lay dead.

His bitter tears then fell so fast
That Jupiter was sad,
He waved his hand, and all at once,
A bear, became the lad.

The god then raised the bear and cub
Into the starry skies.
Bright groups of stars the two were made,
By Jupiter the Wise.

And still we see them shining there,
They greet us every night,
The Greater and the Lesser Bears,
A truly wondrous sight.

Jean C. Harris.

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OBJECTS FOR SMALL TELESCOPES
No.7. The Sun and his Spots.

Now is the best time in the year to study our sun. He is conveniently low down in the heavens. About Christmastime he is

at his nearest to us, but the difference between his distance then and his distance when he is at his furthest is not enough to make any difference worth mentioning in the size of his disk. We in the Northern Hemisphere may well be thankful that the cold of our winter-time is at any rate mitigated just a little by our being then at our nearest to the Sun.

He is, as we all know, the father of a family of nine. Once, there were ten, but one - between Mars and Jupiter - came to grief. Five of the family are small and four are big. The Earth is the biggest of the five small ones.

The grandchildren number at least 26. (One of them - the Moon - we all know well.) How old the Sun is no one really knows, but he is certainly well past the prime of life - as one would expect a grandfather with so many grand-children to be. In the language of Astronomy, he is in the “second yellow stage”. Shall we say he is already “in the sear and yellow leaf”?

To look directly at the Sun through a telescope you screw over the eyepiece a cap with a very dark glass. (The glass must be very dark indeed, or else you might ruin your sight). But a better way of seeing him is to hold a piece of white paper a few inches in front of the naked eyepiece and look at his image on the paper.

My own plan is as follows:- I first put on the dark-glass cap, find the Sun and get the focus right. Then I take off the cap and let the Sun’s image fall on a sheet of white paper pinned on a blackboard.

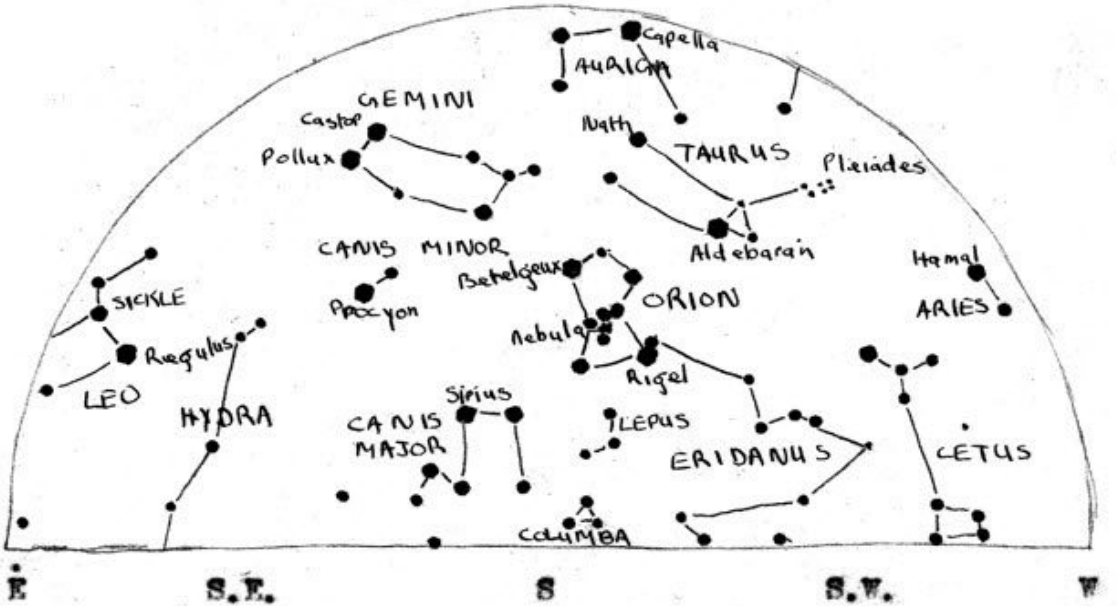
I ought add that the white paper must be screened from the direct sunlight by a good-sized piece of card or brown paper fixed round the eye-piece tube of the telescope. By increasing the distance between the eyepiece and the paper you, of course, increase the size (and diminish

the brightness) of the image. With my own beloved instrument I can get a beautifully bright image well over a foot in diameter, showing the sun-spots with admirable clearness.

What you see of the Sun (except during a total eclipse) is really only his core, the Photosphere. Only when he is totally eclipsed can you see the red ball round this, the Chromosphere (though it is two or three thousand and or more miles thick) with its flame-like Prominences, and the lovely pearly-white halo or Corona round the whole.

But there is endless enjoyment in watching the Sun-spots from day to day, and noting which way they go and how long they last. You will observe that a spot takes a little less than a fortnight to cross the Sun's disk. From this you will infer that the Sun turns round on his axis in rather less than a month. (Actually, his period of rotation is 25 days at his Equator, but longer nearer his Poles). Knowing the size of the Sun, you will easily credit the fact that many a spot is so big that it could take a dozen or more Earths to cover it.

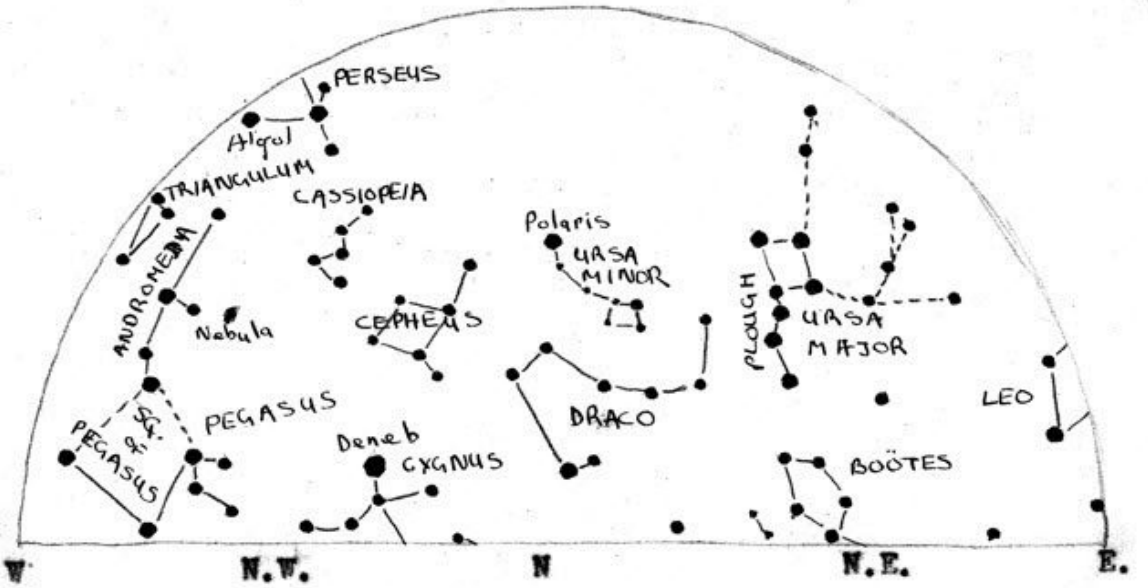
When my friends ask me what the sun-spots are, I always say quite simply: "No one really knows. They look like dark holes, but it doesn't follow that this is what they are. Articles appear in the papers from time to time about their effect on the weather. It is a fact that the maximum of Sun-spot activity occurs every eleven years (approximately). Now, as we all know, in dicotyledonous trees, a fresh ring of wood is added every year. Some time ago, an American professor, after carefully examining a great many of tree-trunks, claimed to have found out that, [missing] every eleventh ring was thicker than the others - in other words, that every eleventh



This map is correct for January 5th at 11 p.m., and for four minutes earlier each succeeding night. To find these stars, face due south and look up.

1 2 3 4 5

Magnitudes



This map is correct for January 5th at 11 p.m., and for four minutes earlier each succeeding night. To find these stars, face due north and look up.

1 2 3 4 5

Magnitudes

year was one when weather conditions (a minimum of warmth and wet) were specially favourable to plant growth. Jeans has recently told us that the height of the water in Lake Victoria in Africa is at its greatest every eleven years. It appears too that certain wireless phenomena vary in proportion to the amount of Sun-spot activity.

I close with a quotation from today's "Times" (Dec. 2nd); "There are many other examples in nature of phenomena that follow the waxing and waning of the sunspots which by some are considered to be the actual cause, but it may quite be rational to regard the spots, and the other periodic happenings, whatever they may be, as equal and parallel manifestations of some great change".

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The next article under the heading "Objects for Small Telescopes" will be the first of a second series. The articles in this series will, as a rule, be shorter than the above and its six predecessors.
Next month; "The Great Nebula in Orion".

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AN ASTRONOMICAL DIARY.

January - 1936.

The Moon's Phases:

First Quarter	1d. 15h. 15m.
Full Moon	8d. 18h. 15m.
Last Quarter	16d. 19h. 41m.
New Moon	24d. 7h. 18m.
First Quarter	30d. 23h. 36m.

On the fourth of January, the earth is at perihelion, or least distance from the sun; its distance then is 91,341,000 miles from the sun. During the nights of the

second to the fourth, the shower of meteors known as the Quadrantids may be seen. On the 29th, the Coronids will appear.

A total eclipse of the moon, visible at Greenwich, will take place on the 8th of the month. The moon enters the penumbra at about 3 p.m., enters the umbra about an hour and a quarter later, and is totally eclipsed one hour and a half after entering the umbra. Totality ends at twenty minutes past six, and the moon leaves the umbra about eight o'clock, and the penumbra at one minute after nine p.m. The exact figures are tabulated below.

During this month, Mercury is visible as an evening star, reaching its greatest eastern elongation on the sixteenth of the month, when it is nineteen degrees east of the sun. On the 31st of January, Mercury passes inferior conjunction; that is, we have the earth, Mercury, and the sun in a line, with Mercury in the middle.

The moon is at apogee (furthest from the earth) on the fourteenth of the month, and at perigee (nearest to the earth) on the twenty-sixth of the month.

Planets visible this month: In addition to Mercury, Venus may be seen as a morning star, and may be seen low down in the east from about 6 a.m. or earlier. It passes Jupiter on the evening of the fifteenth. Magnitude of Venus -3.6.

Jupiter is a morning star, rising two or three hours before the sun. It is on the left of Venus at the beginning of the month and directly below that planet by about the degree on the fifteenth. Magnitude of Jupiter: -1.4.

Mars is visible in the early evening sky in the constellation Capricornus and Aquarius. It passes a degree north of Saturn in the evening of the twenty-fifth,

Saturn is in the constellation Aquarius, and may be seen in the west, but sets in mid-evening. Magnitude of Saturn: +1.2.

At the beginning of January, the sun is in Capricornus, but passes into the sign Aquarius about the end of the third week. During the month the mornings increase by 25 minutes; the afternoons by 45 minutes.

The stars visible during January are shown on the charts in the middle pages.

STILBON.

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CONSTELLATIONS VISIBLE THIS MONTH.

January 20th - 10 p.m.
Directly Overhead:— Auriga.

N - S. Draco, Polaris, *Orion, Canis Major.
E - W. Leo, Lynx, *Perseus, Pisces.
NE—SW. Bootes, Ursa Major, *Taurus, Eridanus.
SW-NW. Hydra, Gemini, *Cassiopeia, Cygnus.

(The asterisk placed in the line denotes the point overhead, the zenith).

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THE ECLIPSE OF THE MOON.

The Moon enters the penumbra -	8d.	15h.	17m.
The Moon enters the umbra - -	8	16	28
Total Eclipse begin - - - - -	8	17	58
Total Eclipse ends - - - - - -	8	18	21
The Moon leaves the umbra - -	8	19	51
The Moon leaves the penumbra -	8	21	1

The first contact of the moon's disc with the umbra will take place at a point 75 degrees from the North point measured towards the east, the last at 310 degrees.

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THE OLD ASTRONOMER & THE MOON.

The Old Astronomer had been giving a lecture at the local school - one of a series on “Modern Science”. As I was leaving after the lecture, I met him just emerging from the school.

“Good-evening", he greeted me. "I am going out to the observatory to-night, so we may as well walk out together”.

I was delighted at the prospect, for the Old Astronomer is always interesting.

"It it a great pity the weather is so bad", he remarked, as we set out, “I have been taking a series of photographs of the moon for my new book, but I have had no chance recently".

"A book!” I exclaimed. "How interesting. Is it all about the moon?"

"Oh no," replied the astronomer, "The book is on general astronomy - for beginners. There are a great many such books on the market, but I flatter myself that this ie going to be slightly different".

"The moon must be a fascinating study", I suggested, “It would be splendid if we could pay a visit to our satellite”.

°We may be able to do so at no far distant date", smiled my friend. "But, just to amuse ourselves, suppose we imagine we could do so now. First of all we must make preparations. We must wrap up warmly in furs and woollen garments, and take some cylinders of oxygen with us, as well as the apparatus to breathe it with. Do you know why?"

"There is no air on the moon, of course", I answered, "And so we couldn't breathe. Then since there is no air to keep in the sun’s heat during the night, it would become very cold".

“Very good", went on the Old Astronomer. "Now, we close our eyes, take a deer breath

- and we're there! The first thing we notice is the utter silence, intense darkness, and bitter cold. We are shivering even in our warm furs. Then we look around. High on either tide of us towers an immense wall of rock, reaching away up into the sky, We are at the bottom of a lunar crevasse. As we crane our necks to gaze up to the top of the walls, we see along the top of one a bright streak of light, with a sharp dividing line between the dark and the light. The sun is rising, and is beginning to light up the valley. It must be fairly high up in the sky when it begins to shine here, for we are sunk away beneath the moon's surface. Yet we see no soft blue sky above - only the black velvet of space with the stars glowing in it. Other things we notice are the sharpness with which the markings on the illuminated part of the cliff are defined and the crisp clear shadows, and the fact that, to all appearances, we have suddenly gone deaf, for no matter how loud we yell we cannot make each other hear. All these things are due to one thing, the absence of air. There is no atmosphere to break up white light and give us the blue sky; to soften the shadows by bending the light; and to convey the sound waves between us. Deep down in a crevasse as we are, however, there may be a very little air. But this is not nearly enough to support our life, and it is probably in the form of a liquid. When we solidify gases, we require a pressure of several terrestrial atmospheres as well as cold, so the air will not likely be solid, but merely liquid. So if we wonder why our feet are so cold, we may look down and find that we are standing in a puddle of air!"

I laughed at this quaint idea and then asked: "What actually is the temperature of the moon at night?"

“That is the next thing we shall find out”, replied the old Astronomer. "We have brought an ordinary Fahrenheit thermometer with us. Now we bring it out, and look at it. But it will not help us much. The mercury has shrunk away down, beyond the scale, and is frozen solid in the bulb! Astronomers on earth have found out the temperature, however. It is 250 degrees below zero Fahrenheit. No wonder we have to stamp about to keep warm. But when we do this, a strange thing happens. When we take a jump, we go flying away up in the air. If we try to leap from one point to another, we completely overstep the mark, and take quite an creditable long jump”.

"1 can explain that!” I cried in excitement. “The moon is very much smaller and lighter than the earth, so that things on the moon weigh only one-sixth what they would on earth. If we were on the moon, we would weigh so much less that the least effort would enable us to spring about".

“Good! I see you would not be entirely puzzled on the moon", smiled the astronomer. “Since we find ourselves so active, let's try to get out of this crevasse, and see what is above. Perhaps we find an easy way to climb, but, anyway, here we are - gazing round on the surface of the moon! We are on a broad, flat plain, rough, rocky, and broken. The rocks are all hard and jagged, for there are no streams, rain nor winds to wear them smooth. For the same reason we find no dust and no soft soil. But, look out! Lucky we dodged in time! A great meteor has just whizzed past our heads - or, rather, it has fallen with tremendous speed, but in absolute silence. There is no air to intercept it, turn it

by friction into glowing vapour, and prevent its giving us a knock on the head. Dozens of these stray stones from space are falling on every side, and we must be careful they do not strike us, for they possess great energy. If we really were on the moon, we would find it impossible to avoid the falling meteors, but since we are only imaginary visitors, we can say that they miss us every time. As we have our minds free from anxiety on this account, we may now proceed to look over the plain. It is completely flat, except for a range of mountains in the distance.

"The mountains not dimmed and softened by distance„ nor have they the bluish tinge we see on earth. They are clearly etched against the the lunar Apennines, with Mount Huyghens, the highest peak, 19,000 feet high. We have been inside one of the cracks in the moon's surface which can be seen near the Apennines through a telescope. Away on the other side of us from the mountain range is a huge crater or ring mountain, Archimedes, invisible from where we stand. This should be more interesting to us than the Apennines so we'll go in its direction, bounding along at a fine speed!

"We can look up at the sky as we go, and see the sun, brilliant and dazzling, shining in a black sky, We have smoked glasses with us, and we put them on to see the sun better. To our surprise we can actually distinguish around the sun's limb the leaping prominences, which we should never be able to see on earth - a beautiful and amazing sight! I don't think we should see the corona, even in the atmosphere's absence, for the sun's brightness would swamp it; but it would very likely be visible at sunrise and sunset, when the brilliant body of the sun was below the

horizon. There is another beautiful heavenly body in the sky - the earth, only a small crescent of it shining, yet that crescent is enormous compared with the moon we people of earth see in the sky. The whole circle of this bright body is lit up, however, by faint moonlight".

"The stars would be visible too?" I remarked, as he paused.

"Oh yes, but not just by the sun, of course", continued the Old Astronomer. "We'd certainly see the old constellations, though. But suppose we now imagine that time has passed on, the sun in the sky has been approaching the earth, and an interesting phenomenon is about to occur. The sun seems to creep forward, and now it begins to vanish behind the earth, which is now completely dark, except for moonlight. We see the huge shadow of the earth sweeping towards us across the desolate surface of the moon. Gradually the black earth covers the sun, blotting out its light, and a fearful cold ensues. On the sunlit surface, we have had to endure terrible heat - about 200 degrees Fahrenheit, but now the temperature falls, almost abruptly, by about 350 degrees. The earth has blotted out the sun, but it does not fit over the sun, but expands beyond it, hiding the prominences, and most of the corona. Round the earth appears a hazy ring of light. This it, the atmosphere, which is lit up by the sun's light. Because of this light, we do not find ourselves in complete darkness, but in a ghostly twilight, with a rich gloom over everything. This total solar eclipse takes very long to complete itself, but at last the sun re-appears, and soon the shadow of the earth has passed away, and the sun is beaming as brilliantly as ever. The cold has also gone, and we are once more gasping in the heat, which makes the

rocks so hot that it is impossible to touch them. The thermometer, in which the mercury has thawed, registers two hundred degrees - only twelve degrees less than the boiling point of water. Yet, if we had brought any water with us, it would be boiling merrily away. It would boil at a much a lower temperature than two hundred degrees on the moon. This is nimply because there it no atmospheric pressure. On earth, the higher we ascend a mountain, the less atmosphere there is above us, therefore the less the pressure becomes and the lower the temperature at which water will boil. So we see that the oceans of the moon, if there ever were any, have boiled away and escaped as vapour into space".

"This has been so interesting", I said, observing that we had reached the little lane where we must part company.

"I'm sorry we did not manage to reach Archimedes, but perhaps we might some other time; or go to other worlds instead".

"Quite probably we might", agreed my old friend, "I should be very pleased to conduct your tour of discovery. But don't forget to come up some clear evening, and I'll show you the places we have just visited, in the telescope, and also the photographs I have been taking".

I promised to do so, and with cordial "Good-nights", we parted. When the moon came out later that night, I gazed at her bright face with renewed interest, and thought of the marvellous journey which, in imagination, I had taken to her bleak surface.

Nan M. Silver.

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ELEMENTARY LESSONS - No.8.

This month we shall discuss some of the movements of the earth, and their apparent effects an the heavenly bodies. Two of these movements we knew already - the rotation round an axis, which takes place in twenty-three hours, fifty-six minutes, four seconds; and the revolution round the sun, which takes place in 365.25 days. There is another movement of the earth's axis, known as precession, which is very interesting, though rather hard to understand. In the northern heavens, the bright star Alphae Ursa Minoris is only about one degree away from the pole of the heavens, and so it is known aa the Pole Star. This star marked the pole for the last generation, and will do so for many years to come. But it was not always the pole star. Three thousand yeere ago, the star Alpha of the Dragon marked the pole; twelve thousand years hence, the pole star will be Vega, the bright star in the Lyre. In short, it has been discovered that the pole is describing a circle in the heavens, with its centre the pole of the ecliptic, the movement being completed in 25,867 years. This shows that the axis of rotation of the earth is itself changing in position, since the pole of the heavens is the projection of the earth's pole. The character of this rotation of the axis may be illustrated by a common toy, the peg-top. When the top le spinning, it is rotating rapidly about an axis, and at the same time the axis is moving slowly so that it describes a cone. The earth is rotating just like a vast peg-top. If the top were not spinning, and yet were leaning over at the angle adopted by it in accomplishing the rotation of its axis, it would fall; but, since it is rotating about the axis,

gravitation can do no more than cause the axis itself to rotate.

If the earth were subject to no exterior interference, its axis of rotation would remain constantly parallel to itself. There is, however, a body disturbing the earth, or rather, there are two bodies, the sun and the moon. How can they produce this precessional motion?

If the earth were a perfect sphere, there would be no possibility of the sun nor the moon producing any motion in the axis, as can be mathematically proved. But the earth, as everyone knows, is not a perfect sphere; it is slightly flattened at the poles. The attracting bodies are able to grasp this protuberance by their attraction, and force the axis to change its direction.

The shares taken by the two disturbing bodies, the sun and the moon, in producing the precessional motion, are not in the proportions one might expect. The sun is enormously bigger than the moon, and has a much greater pull; but the moon is nearer - it has the advantage of being “on the spot", and in bringing about the motion we are discussing, the nearness is the greater factor. It may be said that one-third of the precessional movement is due to the sun and two-thirds to the moon.

It is simpler to consider the effects of the two bodies separately, and so we shall begin with the sun. As the earth travels on its annual path round the sun, its axis points to a spot in the heavens 23½ degrees from the pole of the ecliptic. The action of the sun is to cause the pole of the earth to revolve in a circle round the pole of the ecliptic. For this purpose we may regard the pole of the ecliptic as fixed.

The moon's action is much more com-

plicated. The precessional effect of the moon is to cause the pole of the earth's axis to revolve round the pole of the moon's orbit. This is the same action as the sun produces, for, of course, the pole of the ecliptic is the pole of the sun's apparent orbit, as seen from the earth. Thus it would seem that the movement of the earth's axis would, have to include two motions, one about the pole of the ecliptic, and one about the pole of the moon's orbit, which is five degrees distant from the first point. We should imagine since the moon has been shown to control the precessional motion more than the sun, that the movement would conform more to the rotation round the pole of the plane of the moon's orbit than to rotation round the pole of the ecliptic.

But the moon has another movement which simplifies this greatly. The pole of the moon's orbit is revolving round the pole of the ecliptic, at a distance of five degrees, in a period of eighteen & two-third years. Since the period of the moon's plane is quite small compared with the time of the precessional movement - one fourteen hundredth - we may take the mean position of the pole, and this is the pole of the ecliptic.

Thus we see that the effect of the sun and moon is the same, to cause the earth's axis to describe a circle round the pole of the ecliptic. If we examine the track of the earth’s axis minutely, we shall find it is not a perfect circle but exhibits undulations. This twisting in and out of the mean circle is due to the revolutions of the pole of the moon's orbit, and the period of the undulations is the name as the period of revolution of this pole. This delicate phenomenon in known as "nutation”, and was discovered by Bradley, in 1747.

This month there will be no questions, as the subject does not usually appear in Promotion Paper A, but it is one which should be understood, even though it may seem very complicated.

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LAST MONTH'S QUESTIONS.

Since the December and January magazines are appearing at such short intervals, we have not received many answers to last month's paper, and those received have not yet been corrected. They will be returned together with any papers arriving during next month. Please remember that it is not too late to begin studying the "Elementary Lessons". The first lesson appeared in the June 1935 number. Members wishing to obtain back numbers in order to begin the lessons„ should write to the Secretary, who will try to send then. No extra charge is made for this.

Any questions on the lessons or on the Promotion Papers should be sent to M. Eadie, 94 Dundas Street, Glasgow, C.1. A leaflet telling what should be known for thr different Papers may be obtained from the Secretary.

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A View of Saturn.

It was a cloudy, uncertain evening, and I was in despair, for I had been invited to go and view Saturn that night through a friend's telescope. As the darkness closed in I watched the heavens eagerly, and at last the moon came out. She was very clear and bright, and I was quite sure the evening was going to be a success after all.

When I arrived at my friend's, the clouds had begun to disperse, and the moon beamed brilliantly in the deep blue vault of heaven, lighting up the soft rolling clouds to a blue-white glory. Saturn had not appeared, so the telescope was first turned on the moon. She was not at a good phase for observation, being only a few hours from the full, but I had a splendid view of the crater Tycho, with its mysterious rays.

At last, the planet broke through the clouds, and the telescope was at once swung towards it. Wildly excited, I gazed on the beautiful ringed orb for the first time.

Brilliantly, in the middle of the field, shone the small flattened disc, creamy-white in colour, surrounded by the wonderful rings. Just beyond the extremity of the rings on one side shone a steady beaming point. It was Saturn's satellite, Titan, the only one then visible. With a higher power of eye-piece, I was able to make out a faint marking on the disc, and the shadow of the rings was sharp and clear across the planet's body. The rings I could see only as one, for the divisions were not visible.

Facts kept buzzing round my head - Saturn is 75,000 miles in diameter; 886,000,000 miles from the sun; takes twenty-nine and a half years to go round the sun. But somehow, they seemed quite incredible in face of that tiny, serene globe in the far depths of the heavens.

"Aldebaran".

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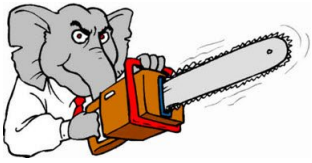
A NEW YEAR RESOLUTION: become a 1st. magnitude J.A.A. member this year. Begin NOW by taking Paper A for the 7th. magnitude examination.



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This almost facsimile edition was created as both surviving copies had suffered serious fading of pages 1 to 16. Scanning the pages to create image files was followed by adjustment of contrast and levels. This process created copies of unfaded pages which could be processed with an optical character recognition program to recover the text. Some of the earlier pages could be OCR'd but most had to be retyped.

In one copy, page 10 was printed at an angle, causing the end of the last line to disappeared off the page. Four stray scraps of paper(?) left voids with straight edges on page 15 and a few words were lost. Fortunately, the other copy contained the complete text.

The program used for the OCR work is called OmniPage. Curiously, it created pages of utter garbage as well as pages requiring just minor tweaking. In the case of some of the recovered faded pages, the program was loading them **side-ways** into its processing area. And, in the case of unfaded page 30, OmniPage chose to load it **upside-down!**

Will computers ever take over from human beings? Not if they keep on doing stoopid things of this magnitude and indulge in boneheadedness on a truly industrial scale.