Volume I. DECEMBER.
No. Nine. 1 9 3 5 .

URANIA

M O T T O .

Give me thw 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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Volume One. DECEMBER

Number Nine. 1935.

URANIA.

Official Organ of the JUNIOR ASTRONOMICAL ASSOCIATION.

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C O N T E N T S .

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A New Year Resolution! Resolve to become a first Magnitude Member this year and start well by taking your 7th Magnitude Examination now!

EDITORIAL

94, Dundas Street
GLASGOW C.1.

This month, we are sorry to say, there, has been a s1ight falling off in the number of contributions. We hope that this is only temporary, and that next month more articles will come pouring in.

In response to a letter from one of our members, we have decided to try to bring out the magazine at the end of the month previous to the date on the magazine. That is to say, the January, 1936, issue will appear at the end of December, if possible. We hope this new arrangement will meet with the approval of our readers.

A few members expressed approval of the idea of a Meteor Circle, but the response was not very great, so we have decided not to start just yet. One member said that if we could publish some articles on this subject, it would be very helpful for those who are interested, but who do not know very much about it. We may be able to do so quite soon.

We are pleased to hear from many of our readers how helpful our star maps are proving themselves. You will see that now the maps have no printed, matter on their backs, so that it is possible to remove them from tho magazine, if this is found more convenient. The maps could be mounted on stiffer paper, and this could make them easier to handle.

The Exchange Bureau, which has lapsed for some time, has been revived in this

issue, and we hope that many more readers will take advantage of it, for it has not been very much used in the past.

The secretary wishes to announce that back numbers of URANIA are still obtainable and will be sent on payment of the usual price and postage. Any members who would like a specimen copy of the magazine to show to prospective new members can have one free of charge on application to the Secretary.

The Editor.

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GREAT ASTRONOMERS

No.9. ..... Ptolemy (I).

The last great name in Greek astronomy is that of Claudius Ptolemaeus, better known as Ptolemy. The dates of his birth and death are unknown: all that is certain being that he conducted his observations in Alexandria in the 2nd century A.D.

His doctrines are incorporated in his greatest treatise, known as the "Almagest", which is the source from which the greater part of our knowledge of Greek astronomy is derived.

Several other minor astronomical and astrological treatises are attributed to him, some of which are probably not genuine, and he was also the author of an important work on geography, and possibly of a treatise on Optics, which is, however, not certainly authentic, and may be of Arabian origin. The "Optics" discusses among other topics, the refraction or bending of light in the

atmosphere of the earth.

The "Almagest" is avowedly based largely on the work of earlier astronomers, and in particular of that of Hipparchus, for whom Ptolemy always expresses the greatest admiration and respect.

The "Almagest" consists of 13 books. The first two deal with the simpler observed facts, such as the daily motion of the celestial sphere, and the general motions of the sun, moon, and planets, and also with a number of topics connected with the celestial sphere and its motions, such as the length of the day and the times of the rising and setting of the stars in different zones of the earth. But the most interesting part of these books deals with what are called the postulates of Ptolemy's astronomy.

The first of these is that the earth is spherical. Ptolemy discusses and rejects various alternative views, and gives several of the usual arguments for a spherical form. The other postulates which he enunciates, and for which he argues are, that the heavens are spherical and revolve like a sphere, that the earth is in the centre of the heavens, and is merely a point in comparison with the distances of the fixed stars, and that it has no motion. He supposed that the moon, sun, and stars revolved in circles about the earth. Beyond the latter, and beyond the fire and water which is supported was the ether. The zones of the heavens were in and beyond the ether, each zone a transparent spherical shell. Each shell or sphere had its own heavenly body, which while revolving

with it, moved round the earth.

The third book deals with the length of the year, and the theory of the sun.

The fourth book treats of the length of the month, and the theory of the moon.

Historian.

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J. A. A. QUESTION BUREAU

The Oracle will be pleased to answer any questions on 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 directly to him.

Which is the Correct Spelling - Fomalhaut, or Formalhaut?

The correst spelling of this name if Fomalhaut : it means "Mouth of the Fish". The star of this name is Alpha Piscis Australis.

How Far from Us are the following Stars - Sirius, Vega, Capella, Aldebaran, and Betelgeuse?

The distances of these stars are: Sirius - 8.6 light-years: Vega - 26 light-years: Capella - 52 light-years: Aldebaran - 57 light-years; and Beteleuse - 200 light-years.

What is "Berenice's Hair"?

Coma Berenices, or the Hair of Berenice, is a small star-group, to be found in Virgo, between Bootes and Leo, and just underneath Canes Venatici. It is not very conspicuous, but there is an interesting

story connected with it. The legend is that Berenice, a queen of Egypt, vowed her hair to a temple if her husband returned home safely from the wars. When her hair was placed in the temple, it was stolen, whereupon the court astronomer declared that the tresses had been placed in the heavens. In support of this he pointed to the shimmering group in the sky. While is is not bright, this constellation gives an interesting field for binoculars.

Is it true that Uranus had been Observed before Herschel Discovered it?

Uranus had been observed several times before it was found to be a planet. Many observers had taken it for a star, but more careful notes would have shown its motion. One astronomer was found to have recorded an observation of Uranus on a paper bag which had once contained hair-powder! It was only by his care and methods that Herschel was enabled to discover the new planet.

How Many Stars are there in the Milky Way?

The Milky Way is a system to which our own belongs, and in it there are one hundred thousand million stars. This is the average size of a "star-city", and there are about two million of them in the heavens.

The Oracle.

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VENUS IN DISGUISE!

Most young astronomers must think that Venus, whether she adorns the evening skies

or shines, as she does at present, in the early morning, is a most conspicuous object not to be mistaken for anything other than a planet. But mistakes are often made about this bright body.

In the year 1910, an amateur astronomer, who had been searching without success for Halley's comet, was out walking, when he came upon a group of people on a bridge, gazing earnestly into the western heavens. He asked what they were looking at, and one man told him it was the comet. The amateur astronomer was eager to look, but judge of his surprise and disappointment when the men pointed to Venus!

Venus has also been taken on occasion for an eclipse of the moon, and for a shower of meteors. Sometimes, too, people have thought her to be a new star, and frantic telegraphing of observatories has resulted in humiliation for the "discoverer" !

Nan M. Silver.

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A CHRISTMAS QUOTATION.

Brightest and best of the sons of the
morning
Dawn on our darkness, and lend us thine aid;
Star of the East, the horizon adorning,
Gide where our Infant Redeemer is laid.

Reginald Heber.

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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 send to address on front page.

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THE ORIGIN OF THE MOON

The moon is the biggest satellite in proportion to the size of its primary in the whole solar system. Even Jupiter's big moons do not attain the same relative size. Surely then, the moon's origin must be somewhat different from the origin of other satellites?

It in thought that the satellites may have been small condensations in the gas torn from the sun at the birth of the planets, which have been captured end forced into subjection by their bigger brothers. Perhaps they were even at one time planetoids: and indeed, it has been suspected that Jupiter, not so very long ago, adopted a planetoid and added it to his family.

But the moon would make at rather big planetoid, and, for that matter, so would many others of the satellites of the solar system. It is not likely that the earth managed to catch a satellite about one-quarter of its own diameter. Many astronomers think that the moon was actually produced by a splitting of the earth. Just like a binary star, the rapidly rotating earth became first slightlY elongated, then pear-shaped, and finally a portion of it broke off and became the moon. From that day the moon has steadily retreated from the earth, but some day she will begin to come back, and if she comes near enough, the earth may be adorned by a ring like that of Saturn! It has been suggested that the place from which the moon broke away is now the huge Pacific Ocean. J.H.L.

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COMPETITION PAGE.

Owing to the fewness of entries this month, we have decided to award only one prize.

First Prize.

Jane H. Laurence - "Star-dust".

Highly Commended.

"Aldebaran" - "A View of Saturn"..

Next month we hope there will be more entries. We have thought that perhaps lack of a subject had deterred members, and this month it has been decided to suggest a few subjects which we hope will proved interesting. Members who would prefer to choose their own subjects are not bound to use these suggestions; they are merely for the help of those who cannot think of anything suitable.

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A Few Ideas For Articles.

1. "The Wonders of Orion".
2. "The Stars of Winter".
3. "Star-lore of the Ancients" (of any nation).
4. "The Planet Jupiter".

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Articles may be of any length. For this month's competition they should arrive by 20th December, 1935. Articles arriving after this date will be entered for next month's competion. All entries should be sent to:

M. Eadie, 94 Dundas Street: Glasgow, C.1.

Poems are also accepted.

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RESULTS OF ASTRONOMICAL NOTEBOOKS COMPETITION.

First Prize (Celestial Globe):

Christine Willett, Gloucester. Christine sent a beautifully neat book, containing careful records of her own observations, notes from books, newspaper clippings, and diagrams. This notebook was well-kept as well as interesting, and will be a useful and valuable volume in the future.

Second Prize (Map of the Moon):

Nan M. Silver, Aberdeenshire. Nan's book was kept in several chapters, under headings of "The Sun", "The Planets", "The Stars", etc., and was written up in beautiful English. A great deal of interesting material was collected, and many of the notes Were written in the form of articles.

Third Prize (Pocket Planisphere):

Jean C. Harris, Gloucester. Jean's notebook was neat1y typed in a loose-leaf book, and its contents were very interesting and varied, with the addition of a list of books read and criticisms on them at the end.

Consolation prizes of books were awarded to two readers: one, who assumes the pen-name of "Aldebarah"; and another to Jane H. Laurence, who sent an interesting book with e beautifully stencilled cover. All notebooks have been returned.

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SECOND ASTRONOMICAL NOTEBOOKS COMPETITION.

This competition is run on the same

lines as the first. Closing date:- 31st. March, 1936. Fuller particulars may be obtained from the Editor on application.

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J. A. A. EXCHANGE BUREAU.

If any members have books, star-maps, etc., which they wish to exchange, temporarily or permanently, we shall be pleased to publish advertisements of these on this page, and to do our best to arrange matters.

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Grand Serial. Chapter IX.

ADVENTURES IN SPACE.

by Marion F. Eadie.

(Conclusion).

On through the forest the carriage pelted, and soon the 'Eros' was left behind. Then the tree-city was before them, and Rex and Hazel were being led to huts in the trees, furnished with every decoration the little people could devise to honour their guests. Both were very tired, and fell asleep quickly; but the last thought of each adventurer was - could there be hope after all that they might return to the earth?

Kan became king of the little people next day. The ceremony was very simple. The chief of each tribe swore allegiance to the new ruler presented gifts, and performed a dance round the king. Rex and Hazel, as the deliverers of the people, had seats of honour, high seats, up in the trees, from which they discovered they could look out over the

forest, and see their space-ship in the distance. Neither said a word to the other but both were busy with schemes. The little people were settled now under a wise ruler, who would make them great now that their enemies were gone. It would be fitting if the leaders who had come so mysteriously to their aid couId vanish now, back into spnce.

Days passed, and still Rex and Hazel felt afraid even to discuss leaving the little satellite of Jupiter on which they had landed. Kan was busy at work on his new kingdom, often coming to them for advice, which they gave as well me they could. Then one day, the king came to them in great sorrow.

"My dreams have told me of your intended going", he said mournfully, in the simple language of his people, which the adventurers had come to know quite well. "We shall miss you, but we know that you cannot remain alweys with this unworthy people; and must return to the great bright place whence you came".

Hazel and Rex skilfully concealed their amazement, and asked Kan more about his dreams.

"I dreamed," said Kan, "that in the time when the Great Star shone above the Tree, the two mighty ones departed in their chariot, flying up into the sky, and all my people mourned".

As soon as Kan had gone, Rex turned to Hazel in surprise.

"What do you tbink?" he asked. "Is it a gentle hint to us to be moving on?"

"Of course not!" cried Hazel. "Kan has always been friendly, and he would

not do such a thing. I think he really had a dream, and perhaps if we set out when he says he dreamed, we'll arrive home safely."

"It's not very likely, I'm afraid", said Rex. "Besides, what did he mean when he spoke about the Great Star, and all that?"

"I know about that," answered Hazel, and she went to the door of the tree-hut. "Look at the sun. Seen from this distant planet, it looks much smaller than it used to look on earth. The little people call it the Great Star".

"So when the sun is above some tree, we set out?"? reflected Rex. "But which tree?"

"I think I know that too," replied Hazel. In this rare atmosphere, as we've both noticed, we can see some of the stars in daylight. There is one constellation which these people call the Tree. There it is, near the sun".

Rex looked, and in the dark violet sky, he was able to make out some bright stars in the direction of Hazel's pointing finger.

"I know that constellation!" he exclaimed in surprise. "It's Orion!"

"That's right", Hazel agreed. "Here it is known as the "Tree". When the sun is above Orion, we leave this world, and set out into space".

That day they visited the "Eros", and saw that everthing was in working order. There was plenty of oxygen, but as they had left the lights on when they quitted the space-ship, the batteries had run down. While searching around Rex dis-

covered the camera, which they had completely forgotten, and resolved not to leave till he had secured some photographs of the little people and their world. He decided not to let them see the camera, in case they should be afraid, but snapped them when they were quite unsuspicious.

Time passed quickly in the fitting out of the space-ship, collecting provisions, specimens of the craftmanship of the people, and snapshots of them and their homes. Daily the adventurers watched the sun as it neared Orion. It had been very near to the constellation when they had first looked, and slow as the sun's motion among the stars was, they were able to see it.

At last the time came when Kan visited the adventurers in their respective huts, clad in sombre brown, the colour of mourning among his people. He had come, he said, with his subjects to bid farewell to the leaders who had helped them in the fight for freedom. He knew that this was the day they intended to go, and wished to see their departure. Rex and Hazel were ready. They were carried in litters to the 'Eros', the last time they would travel thus. Each carried a helmet, the part of their suits which they had not required. Slowly and mournfully the procession wound its way through the forest, till the great round globe of the space-ship lay before them. There the departing travellers climbed from their litters, and stood watching while Kan's people danced the farewell dance, and

chanted a sorrowful hymn. Then the king spoke, telling his people in sad tones how the leaders had come down from the stars to help them against their oppressors, and how they must now leave them. When he had finished, a wail went up from the assembled people, and Hazel, who knew the language better then her brother, said a few words, promising that their favour would always remain with the people, and that they would prosper under their new king. Then she warned Kan to lead his people away to some distance from the ship, for she knew that it would not be safe for them to remain near. The little people withdrew, and the adventurers amid a solemn hush, climbed into the 'Eros'. Rex set off the apparatus which provided them with oxygen, and the other which absorbed carbon dioxide and other waste products. They saw to the food supplies, the water, everything. Then Hazel slammed and secured the door of the ship, while Rex laid his hand on the controlling switch. Through the window they could see the little people congregated at a distance gazing wide-eyed. Hazel suddenly felt afraid.

"Rex!" she cried. "I don't want to go! We can't leave the people. And - what does space hold for us? At least we're on firm ground here; but out there - - - "

"I'm afraid, too, Hazel," confessed Rex, "But we must go. If we didn't, we'd regret it for ever. We must take the chance."

Quietly and firmly he depressed the controlling switch.

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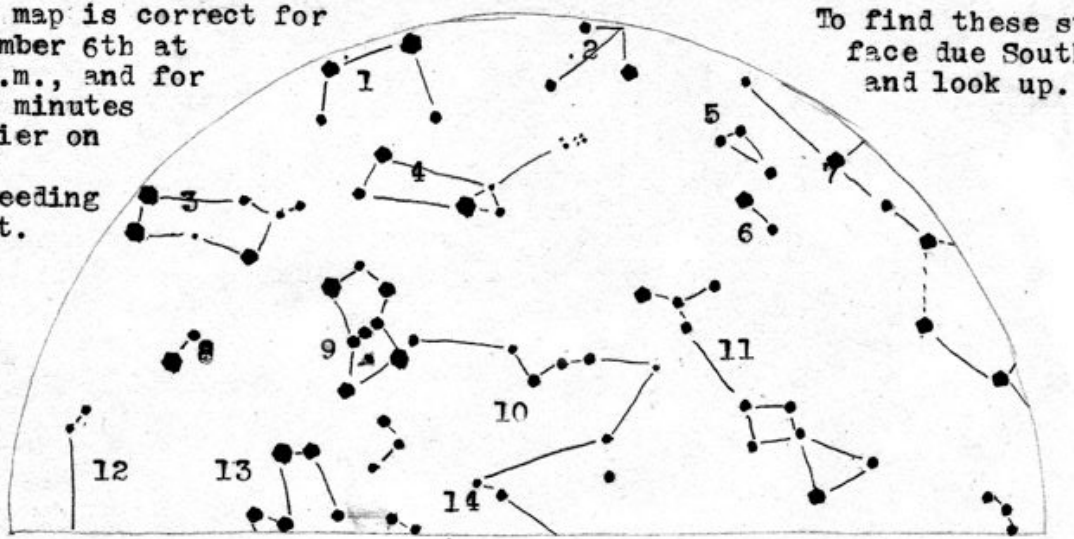
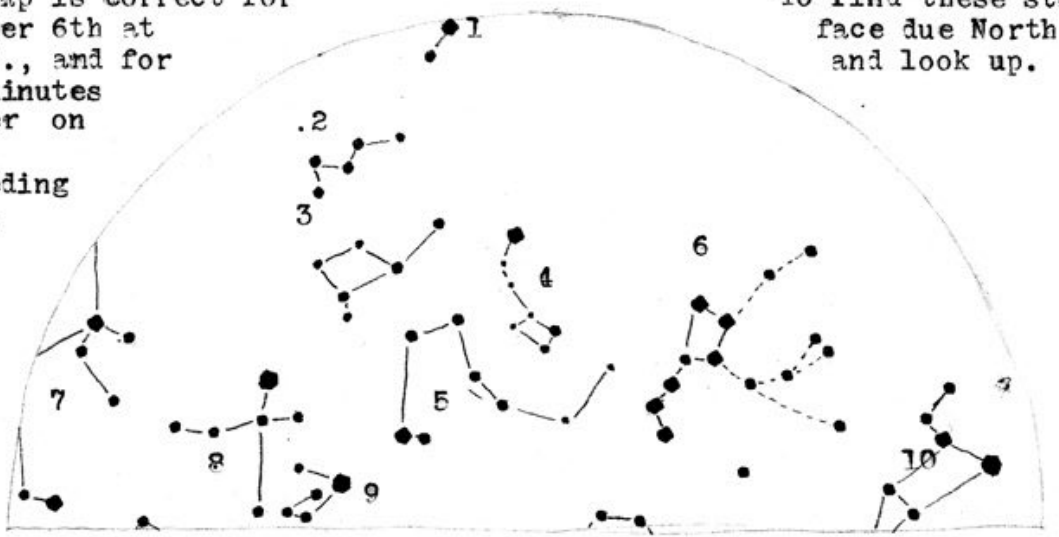


1. Auriga.
2. Perseus.
3. Gemini.
4. Taurus.
5. Triangulum.
6. Aries.
7. Andromeda.
8. Canis Minor.
9. Orion.
10. Eridanus.
11. Cetus.
12. Hydra.
13. Canis Major.
14. Columba.

Magnitudes. 1 2 3 4 5

This map is correct for December 6th at 11 p.m., and for four minutes earlier on each succeeding night.

To find these stars face due North and look up.



1. Perseus.
2. Cassiopeia.
3. Cepheus.
4. Ursa Minor.
5. Draco.
6. Ursa Major.
7. Pegasus.
8. Cygnus.
9. Lyra.
10. Leo.

Magnitudes 1 2 3 4 5

They felt limp and light-headed when they recovered from the shock of departure. Rex went to the window, but it was turned away from the satellite of Jupiter on which they had been living. Only the sun blazed in a black sky, brilliant with stars. Once more they saw the streaming corona, the creeping red prominences round the sun's rim, but the brilliance was too much for them to look long. Hard as they stared, there was as yet no sign of the earth beside the sun. Somehow they both felt too tired to worry, and a strange confidence had come over them. It was as though the journey had been planned for them so that no obstacle should come in their way. The 'Eros' progressed unscathed through the belt of the Planetoids, passed Mars at a good distance, and rushed on towards the earth, which was now visible near the sun. Rex and Hazel marvelled at the ease with which the journey was accomplished.

"It's absolutely miraculous!" Hazel said to Rex. "Kan's dream seemed to be a real prophecy. I shouldn't be surprised if we arrived back at Professor Randolph's."

"We couldn't have managed better though we had spent years planning our course and calculating when to set out," agreed Rex. "I'm quite confident we shall not miss the earth, but as to which spot we shall land on I won't vouchsafe an opinion."

As the earth drew nearer, the window of the ship turned away from the planet, but this brought the man-hole also on the diametrically opposite side of the 'Eros' from the earth, a very fortunate circumstance. Now the adventurers could not tell how near the earth was drawing, except by the increase in weight they felt. The sensation of falling increased, till

suddenly they struck the atmosphere. Frightful, suffocating heat assailed them, and the metal of the globe seemed to be melting, so great was the friction of their passage through the air. Then the crash came.

The 'Eros' landed in the garden of a young and enthusiastic American Astronomer, much to his own delight. He thought it was a huge meteor. When some hours later, having allowed the arrival to cool, he went out and gazed into the pit the 'Eros' had made, he could scarcely believe his eyes. When the man-hole opened, and the adventurers emerged, he was almost as dazed as they, and it was not until they climbed out of their suits and spoke English, that he would believe they were not visitors from Mars. Rex and Hazel told their amazing story, showed the things they had brought with them from the distant world, and succeeded in convincing their host. Before nightfall, all three were on their way to England.

Professor Randolph had escaped with his life from the midst of the forces let loose at the departure of the 'Eros', but everyone though the shock of the explosion had unhinged his mind. No one ever believed that the space-ship could possibly leave the earth; it was thought that an explosion had occurred, in which Hazel and Rex had lost their lives. Now that the adventurers had turned up, the public still refused to be convinced. Some people declared that Rex, Hazel, the Professor, and even the young American were all mad. Others were willing to believe that the 'Eros' had been blown across the Atlantic by the explosion. But the opinion of most was that the whole thing was a clever hoax - a newspaper stunt, with all the photographs and other proofs faked.

Only the four who had taken part in the adventure believed, and realized that at last man had conquered gravitation. After a time, the whole affair was forgotten by the pulbic, though a few scientific societies were interested.

But whenever Rex or Hazel looked through Professor Randolph's big telescope at the mighty planet Jupiter, they watched with special interest one tiny spec which glittered beside the great body, sometimes passing across the disc. There, on that satellite, Kan and his people still lived and worked. Hazel wondered often if they would ever repay the visit.

THE END.

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OBJECTS FOR SMALL TELESCOPES.

No. 6. Taurus and his Clusters.

With the exception of Orion, the most interesting to me of all the constellations is Taurus. It is now well-placed for observation, and will remain so throughout the winter. It contains Aldebaran one of the three or four reddish first magnitude stars; a very easy double-star, Theta Tauri; and two glorious "Open" Clusters, the Hyades, and the Pleiades,(These two clusters are called "open" in contrast to the globular clusters such as the famous one in Hercules.) We know that each of these two famous groups is a real cluster, and not just a number of stars that from our terrestrial point of view happen to be close together, because each group has been ascertained to be moving as a whole in a certain direction. (Aldebaran itself, though one of the stars in the "V" that we call the Hyades, is not really one of the cluster; it is not moving along with the rest, but in quite another direction.)

The Pleiades-cluster is the first celestial object I ever looked at through field glasses. I shall never forget what a revelation it was. What had been little more than a misty patch of light was suddenly turned into a blaze of stars - half-a-dozen or so of bright ones and a number of lesser lights. (The name "Pleiades" probably comes from the Greek pleiones, many.) No wonder the group has attracted the attention of star-gazers from earliest times. One recalls the question in the Book of Job: "Canst thou bind the cluster of the Pleiades?" (R.V.) The Greek poet Hesiod, referring to the period when the sun is in the constellation Taurus, says of the Pleiades:

"There is a time when forty days they lie
And forty nights concealed from human eye."

For viewing the Hyades and the Pleiades, the Junior Astronomer will find a good pair of field-glasses perhaps even more useful than a telescope. The advantage of the former is the larger extent of their field of view.

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Another lovely open cluster is in Perseus, near Cassiopeia. It is made up of two round patches just touching each other, and so looks something like the figure eight (8).

I am looking forward after Christmas to seeing the open cluster Praeseps, in the Crab. Praeseps means a "sheep-fold". What a pretty name for a star cluster! I suppose the stars are the sheep.

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Next article in this series : "The Sun and his Spots".

AN ASTRONOMICAL DIARY.

December - 1935

First Quarter.. . . . . 2nd December.

Full Moon.. . . . . 10th December.
Last Quarter. . . . . 17th December.
New Moon. . . . . 25th December.

During this month Saturn is still visible, but he is very near the horizon, and not easy to observe. In the mornings, Venus will be found to have drawn very close to the sun, and she will be completely invisible.

The sun reaches the winter solstice on December 22nd, when it passes from Sagittarius into the sign Capricornus. After this the days begin to lengthen. At the solstice the sun rises and sets in the south-east and north-west. During the month the mornings increase by 23 minutes, and the afternoons increase by 5 minutes.

The stars visible this month are shown on the charts in the middle pages.

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CONSTELLATIONS VISIBLE THIS MONTH.

December 21st - 10 p.m.

Directly Overhead:- Perseus.

N - S. Hercules, Draco, Polaris *Taurus, Eridanus.
E - W. Leo, Gemini, Auriga, *Andromeda, Pegasus.
NE-SW Ursa Major, Lynx, *Aries, Cetus.
SE-NW Canis Major, Orion, Taurus, *Cassiopeia Cepheus, Cygnus.

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

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NEW MOON.

What varied fancies can the Moon inspire!
She is a vestal maid, a frozen fire,
A silver shield defying Phoebus' dart -
High heaven's emblem of the virgin heart;
Her tilt crescent seems to some to be

A galley lone that sails a star-isled sea,
A scimitar, a feather soft and light,
A sickle reaping the far fields of night;
And lately, one bright evening clear and cold,
While still the sky was mingled blue and gold,
She seemed - that tiny curve so pearly-pale,
A trimming from Diana's finger-nail.

W. K. H.

From the "Glasgow Herald", May, 1934.

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ELEMENTARY LESSONS - No. 7.
The Sun. (Continued).

Before continuing with our study of the sun we must first learn a few facts about spectroscopy.

When the sun shines after the rain, we often see an arc of many colours in the heavens opposite the sun. This is, of course, the rainbow, and we all know its colours in their order - red, orange, yellow, green, blue, indigo and violet. If we take a right triangular glass prism, and let a beam of sunlight pass through it, we see a band of colours exactly the same as the rainbow. So we conclude that white light is really a mixture of all these colours, and that the effect of the prism and of the raindrops in the air, in the case of the rainbow, is to break up the white light into its component colours. The spectrum of sunlight is what we call a continuous spectrum, that is, it contains every colour. But when we examine the light of the vapour of any substance, say, sodium, a constituent of common salt, we find not a continuous spectrum, but a bright yellow line. In the same way, potassium gives a violet line, and strontium, which is used in making fireworks, a line in the red. These things show us two laws in connection with spectroscopy; firstly, that an incan-

descent solid, or liquid, gives a continuous spectrum; secondly, that an incandescent gas gives a bright-line spectrum, the lines being peculiar to that gas.

Now, if we examine the spectrum of the sun in more detail, we find that the band of colour is crossed at right angles to its length by numbers of fine, black lines. These are called Fraunhofer lines, from their discoverer. Further examination reveals that these dark lines correspond in many cases to bright lines we have observed to be given by incandescent gases. So that these lines may be produced, the elements must be present in the sun. Thus we have a way of telling what the sun is made of. But why are these lines black instead of bright? They are, of course, not really black, but their darkness is accentuated by contrast to the bright background. The lines are produced by the light of the sun passing through an atmosphere, cooler than the body of the sun, and containing the elements whose characteristic "trade marks" appear as lines in the solar spectrum. The elements in the atmosphere absorb some of the light from the sun's white light; but they absorb only light of the same kind as they would give out. It is the elements in the solar atmosphere that the spectroscope tells us of; of the sun's interior it says nothing.

The spectroscope can also tell us how fast the sun is rotating, with much more exactness than an observation of sunspots could. When a body is moving towards us, the waves of light coming from it follow quickly on each other, and become crushed up, as it were, so that they come at shorter intervals. In the spectrum of such a body, all the absorption lines would appear to be shifted to the violet end of the spectrum, since violet waves of light have the shortest wave-lengths, and the wave-lengths of light coming from the body would all to be seem shortened. The opposite

would happen if a body were moving away from us, the lines being shifted to the red end. If we apply the spectroscope to the opposite limbs of the sun, we find that one is moving away from us and the other moving towards us. The amount of shift of the lines, which can be measured by comparing with the spectra of elements taken on earth, shows the rate at which the sun is rotating. This is known as the Doppler Effect. It can also show us the motion of stars in the line of sight, and the movements of binary stars.

When the light from the sun is passed through a slit which lies in the line of a radius of the sun, certain short bright lines become visible which lie exactly in the prolongation of the corresponding dark lines in the solar spectrm. These bright lines are due to prominences, and are mainly those of hydrogen, helium, and calcium. The prominences themselves may even be seen, and, not merely their spectra. If one of the brightest of the lines is brought into the middle of the field of the telescope and the slit of the spectroscope is opened wide, an image of the prominence in red is seen. This makes it possible to study the shapes of these interesting objects without waiting for a total solar eclipse. It has not yet been found possible to study the corona in the same way, for its light is too faint.

Nowadays, in good spectroscopes, the glass prism is replaced by what are known as diffraction gratings. These are metal plates, engraved with fine lines, thousands to the inch, which break up the light just as effectively as the older methods.

The sun has been at the centre of its system for countless thousands of centuries. It has seen the evolution of the planets, and of intelligent life on one planet at least. Every day it pours forth tremendous energy, of which the earth intercepts only a tiny fraction. Despite this, the tiny fraction, if used to

full advantage, would probably supply all the power we need for all the work done on earth. How is this gigantic, this prodical output of power maintained? The power must be maintained either from outside or from inside. If from outside, we know of only two possible sources - starlight, and meteorites. We can measure the amount of starlight and star heat reaching the earth, and find out how much would reach a body having a surface as big as the sun's. This source does not begin to account for the sun's output of heat and light. Meteorites falling on the sun must bring a good deal of energy, and they must fall in much greater quantities than they do on the earth, both because the sun has a larger surface and because its gravitational pull is greater. But the energy they give is not nearly enough to keep up the sun. To do this, the number of meteorites in the vicinity would be so great that Mercury would be noticeably perturbed by them.

It is useless to think the the sun may be burning. Thought it were made of pure coal burning in an atmosphere of pure oxygen, the resultant energy would not be nearly enough to maintain the sun through the long period during which the earth has existed. The suggestion that contractions of the sun would give off sufficient energy, according to the law that a mass of gas contracting becomes hotter, has also been proved inadequate. The only theory which seems to account for the sun's enormous output of power, and for the long period over which it has been continued, suggests that the sun is actually turning its matter into energy. We know that the terrestrial element radium has the power of exploding spontaneously, giving off energy. Probably at the immense temperatures of the sun's interior other elements, which are not radio-active on earth, may become so. The energy

released by this means is tremendous, and would be enough to support the sun for uncountable ages.

QUESTIONS.

1. Describe the appearance of the sun during a total solar eclipse.

2. State the diameter of the sun, and its volume and mass as compared with those of the earth.

3. How does the sun's surface appear in a telescope?

4. What are sunspots thought to be, and in what zones of the sun are they seen?

5. Name some of the substances, found in the sun's atmosphere, and explain briefly how the spectroscope tells us of their presence.

6. Describe various theories explaining how the sun's power is maintained, and say which is most probable.

Answers to this paper should be sent to M. Eadie, 94, Dundas St,, Glasgow, C.1. Names and addresses should be put on papers, as they are corrected and returned by post. Any questions on the lessons should be sent to the same address. Questions about Astronomy or the J. A. A. should be sent to the "Oracle", c/o the Secretary, at the address on the title page.

READERS' QUESTIONS.

"Spice"; The Elementary Lessons began in the June, 1935, edition of URANIA. I am sorry I cannot send you copies of the lessons, but if you apply to the Secretary, she will probably be able to send you the required

back numbers. I shall be quite pleased to correct the papers if you send them in.

N. M. S. (Scotland); A lesson on the stars will shortly be appearing in this series, but it will not be very advanced, as the Lessons are for beginners A good book for you to study in this connection would Sir James Jeans' "The Stars in Their Courses".

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STAR - DUST.

When we talk of star-dust, it makes us think, perhaps, of the powdery trail of the Milky Way, and for that reason astronomers used to say this term was too poetical for such a prosaic, unromantic (!) subject as astronomy. But now they are beginning to find out that there really is such a thing as star-dust, and that it exists in quite large quantities in space.

It is quite possible for us to see this star-dust if we turn a telescope on the constellation of Orion, which is now visible in the night skies. With the naked eye, we can see a hazy patch in Orion's sword, just below the belt. The telescope shows this to be a huge expanse of misty light, with many contortions and parent folds. It is the famous Orion Nebula. The nebula is made up of glowing gases, stray atoms, and particles of dust, all giving forth light and energy. The breadth of this mass is 100 light years - that is, light would take one hundred years, travelling at the rate of 186,000 miles per second, to pass from end to end of the nebula. Despite this enormous size, we find that the object cannot have a very great mass - astronomically speaking - for it has no appreciable effect on neighbouring stars, as a body with a large mass and therefore great gravitational pull would have. It has been calculated that the density of the Orion

nebula is less than 10 to the power -20 - that is, one 100,000,000,000,000,000,000th - that of water. This is a state of tenuity which we can scarcely imagine.

How do these nebulae shine? Some think it is their own light, others that it is by the reflected light of stars contained within the nebula. In some nebulae, it is obvious that the source of illumination is a bright star inside the gaseous envelope - that these objects are probably stars which have exploded, and have thrown off an atmosphere of gas and small particles of matter. Such nebulae are rather small in size, but in some of the huge nebulae we know of, it is palpably impossible for any star or stars to be the source of the light; these nebulae are very likely incandescent, and shine by their own light. In the case of nebulae shining by the light of a star, it has been suggested that the light is not exactly reflected, but causes the particles of gas to become fluorscent. This means that the gas absorbs the light, and is excited to activity by the energy, so that it produces light of its own, often of a different colour. This phenomenon can be observed in our laboratories on earth, when certain substances, acted on by ultraviolet light, which our eyes cannot see, give off ether radiations of a colour which we can see.

Seen in a telescope, nebulae often resemble writhing coils of smoke, things which seem about to melt and disperse. They have often been observed carefully so that any change in their form might be noticed. It is thought that in some cases movements have taken place, but this is uncertain in all but one case. This is Hubble's Variable Nebula, which has been photographed at intervals, and shows distinct differences of outline at different times.

Coming back to Orion, let us turn our telescope to another interesting object,

which is to be found just under the top star of the belt. This a bright streamer of nebulosity, but about the middle of it, silhouetted against the brilliance, is a black patch, very much resembling a horse's head. From this the nebula is known as the Horses' Head Nebula. In the southern hemisphere there is a similar object, in Centaurus. It is called the Coal-sack, and is just like a hole in the heavens. A third appearance of this type is the Trifid Nebula in Sagittarius, a beautiful nebula divided into three parts by black rifts. Formerly, it was thought that the appearances, especially the Coal-sack, really were holes by which we could see through the clustering stars of our galaxy into the space beyond. Now we believe that the dark patches are clouds of star-dust, coming between us and the stars or bright nebulosity beyond, and blotting out the light. Dark nebulae are composed of very small particles, slightly bigger than atoms; in fact, just about large enough to blot out light waves. There are not many dark nebulae that we can see, but there may be a large number that we cannot see, for they are onlv visible against a background or stars, or of glowing nebulosity. Of bright nebulae there are only about 1,000.

The spectra of bright nebulae are nearly always found to show two lines which have long been a mystery. They correspond to no earthly element that we could discover, and so they were thought to be due to a substance which was named "nebulium". It is now known that there is really no such substance, but that the lines are produced by common terrestrial elements, oxygen and nitrogen. The reason for their producing such unfamiliar lines, as those which came to be known as N1 and N2 lies in the fact that nebulae always have a very low density. TO understand this phenomenon properly, we must remember that atoms of matter are made up of electrons

revolving round a central nucleus, just like the planets revolving round the sun. But unlike the planets, electrons have the power of jumping from orbit to orbit. When an electron jumps to an orbit nearer the nucleus, it emits energy, which we may see as light. In a gas at normal atmospheric pressure, the atoms are always jostling each other, and the result of this is that, in some mysterious way, the electrons are restricted to certain orbits, and cannot jump to any other than these prescribed orbits. Thus they give out light of a certain colour, giving a line in the spectrum characteristic of the element they make up. In the extremely tenuous stuff of the nebula, the atoms do not jostle so much, and the electrons are able to jump into different orbits; the light they give out when they do this is very different from that which we know. So the familiar light of oxygen and nitrogen is quite different when we see it in a distant nebula.

When certain stars in Orion were being observed with the spectroscope, it was found that their spectra contained the lines H and K, produced by ca1cium, lines which were usually found in nebulae. It was thought that this was a star surrounded by a gaseous envelope. As time passed, it was found that the star's proper motion did not correspond with that of the envelope - the star was leaving its atmosphere behind! It was now decided that the lines in the spectra were due to some nebulous matter between the star and us. In fact, all space is filled with tenuous nebulosity, of a density of 10 to the power -24 - that is, one 1,000,000,000,000,000,000,000,000th that of water. This is so very tenuous that space might be said to be very nearly empty - certainly we can never hope to produce a vacuum so great. The lines H and K which are due to this all-pervading star-dust are seen only in the spectra of very distant stars, whose light has travelled

for a long way through the nebula.

The fact that space is not entirely empty, however thinly it may be filled, will tend to change many of our ideas on astronomy. The medium might not retard the motion of planets to any noticeable extent, but it could quite possibly retard such flimsy things as comets. Then the shifting of lines towards the red end of the spectrum observed in the distant "spiral nebulae" or star-cities, may not be due to the fact that they are receding from us, as is thought, but to the fact that their light has travelled for a long way through the star-dust, which would tend to make their light appear redder.

Jane H. Laurence.

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CORRESPONDENCE SECTION.

Do you want a pen-friend? If so, please send all detail of age, etc., of the correspondent required, and we will dO our very best to arrange things to your mutual satisfaction.

Particulars of pen-friends will be published on this page from time to time, and if you see a suitable friend, please write at once.

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THE PRESIDENT AND EDITOR OF URANIA AND THE SECRETARY OF THE JUNIOR ASTRONOMICAL ASSOCIATION HAVE PLEASURE IN WISHING ALL MEMBERS, AND EVERYONE WHO READS THIS MAGAZINE, A VERY HAPPY CHRISTMAS AND THE BEST OF FORTUNE IN 1936.

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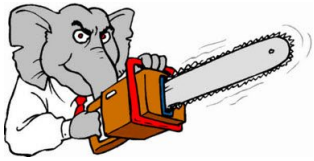

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Two copies of this edition of URANIA survive; both with the whole of the printed interior faded significantly.

Scanning the pages to create image files was followed by adjustment of contrast and levels to facilitate processing with an optical character recognition program to recover the text, which was then used to create this almost-facsimile.