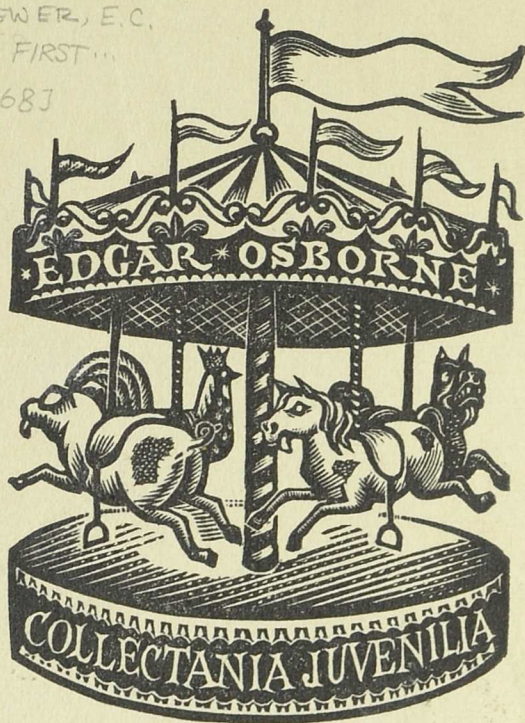




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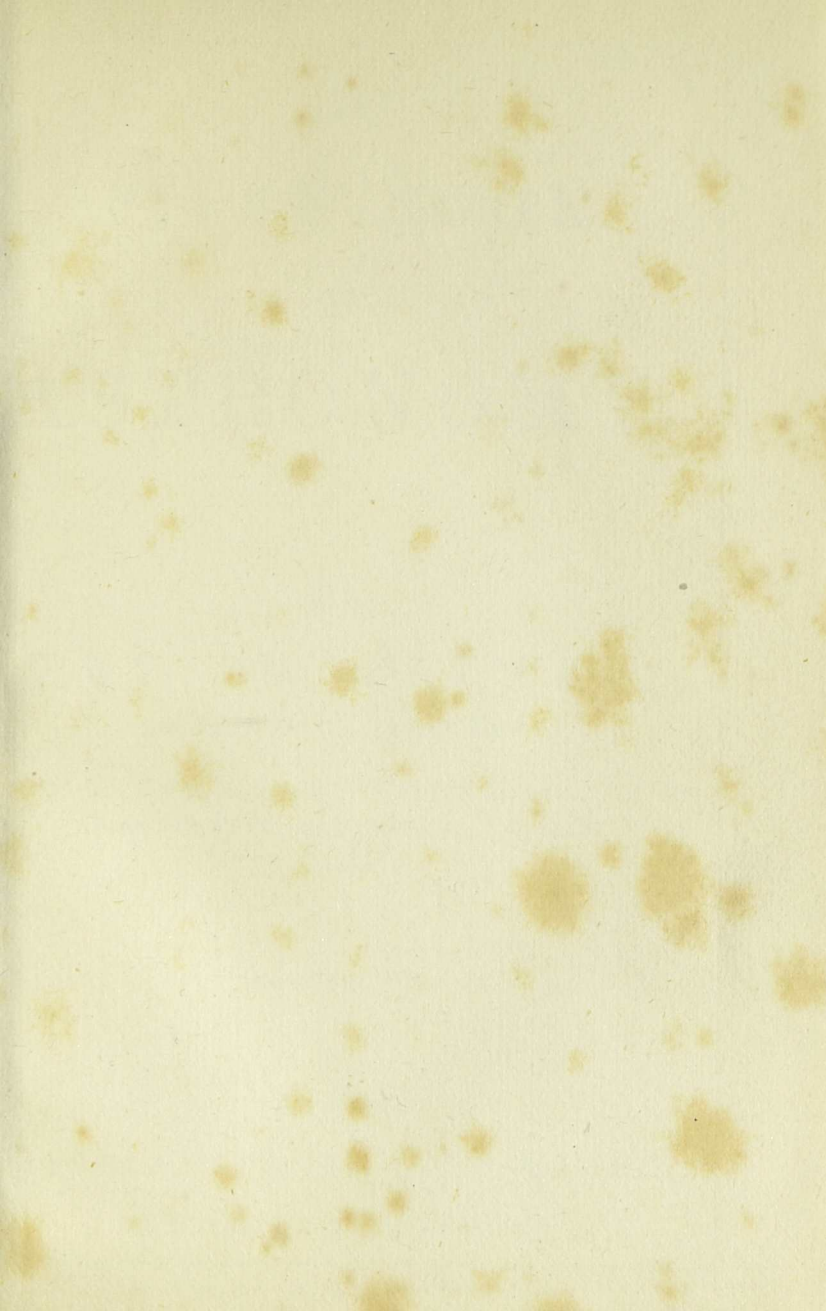


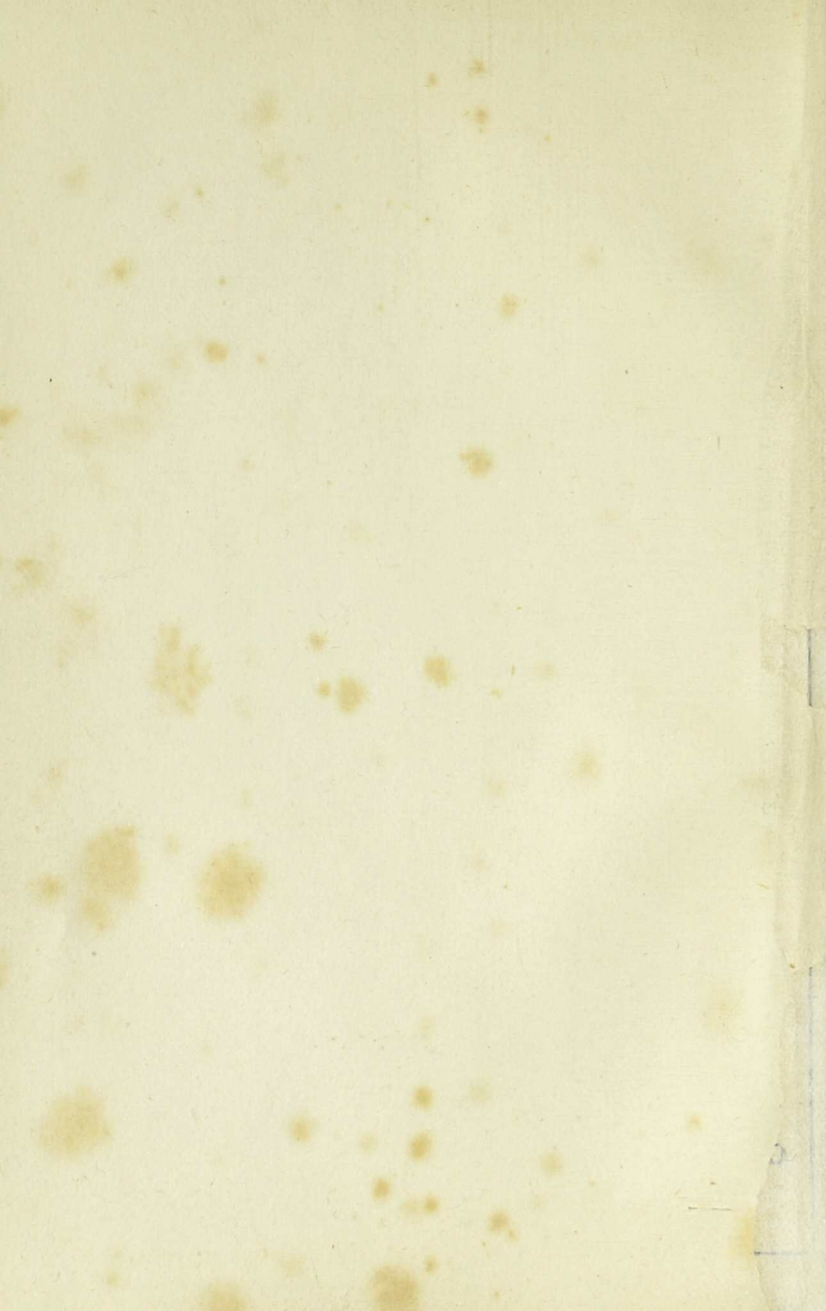
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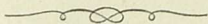




MY
FIRST BOOK
OF
ASTRONOMY.

BY THE
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*Author of "Guide to Science," "Theology in Science," "The
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&c. &c.*



LONDON:
HASSELL, PETER, AND GALPIN,
LA BELLE SAUVAGE YARD, E.C.

LONDON:
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LUDGATE HILL, E.C.

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ASTRONOMY.



INTRODUCTION.

What does Astronomy teach us?

All about the sun, moon, and stars.

What does the word mean?

Star-lore.

What is the word a compound of?

The two Greek words *astron* (star), and *nomos* (law).

What are the stars belonging to our system called?

The solar system.

What is the meaning of solar?

Belonging to the sun.

What does the word come from?

Sol, the Latin for "sun."

Why is our system called the sun-system?

Because the sun may be called the *ruler* of it.

What does the sun of our system govern?

The planets, moon, and comets belonging to it.

THE SUN.

T H E S U N .

(I.) ITS USES.

What does the Bible say God made the sun for?

“To rule the day, and to divide the light from the darkness.”

How does the sun “rule the day?”

It decides how long the day is to be, and whether it is to be fine or wet, hot or cold.

§ *How does the sun “divide the light from the darkness?”*

By being visible or hidden from sight.

When is the sun visible?

When it is in any part of the heaven which we can see.

What is that part of the sky called which seems to meet the earth?

The ho-ri'-zon.

What is the meaning of the word “horizon?”

A boundary.

Why is the horizon so called?

Because it is the boundary beyond which we cannot see.

When is the sun hidden from our sight?

When it is below the horizon.

ITS USES.

What determines the length of a day?

The length of time that the sun remains above the horizon.

What determines the length of a night?

The length of time that the sun remains below the horizon.

How long is the longest day?

About sixteen hours and a half.

How long is the shortest day?

About seven hours and three-quarters.

§ In what way does the sun rule the weather?

Chiefly by giving us different seasons.

How many seasons does it give us?

Four.

Name them.

Spring, Summer, Autumn, and Winter.

How does the sun make one season differ from another?

By being more directly over our head at one season than another.

How can you explain this?

By a fowl set before a fire to roast.

Which parts of the fowl feel the greatest heat?

Those which most front the fire, as the breast and back.

Which parts feel the least heat?

Those which turn most away from the fire, as the head and tail.

THE SUN.

How does a roasting fowl resemble our earth?

Our earth turns round before the sun, as a fowl before the fire.

Why does the heat vary at different seasons?

Because the part on which we live is turned more to the sun at one time than at another.

How could the "hang" of a fowl be altered?

By putting the hook of the "jack" through a different part.

For what purpose might this be done?

To cook those parts better which were furthest from the fire.

How is our earth in summer "hung" before the sun?

The part on which we dwell is turned more towards the sun.

How is it "hung" in winter time?

The part on which we dwell is turned more away from the sun.

How is it "hung" in spring and autumn?

Between these two positions.

What does the Bible say God hangs the earth on?

The Psalmist says, "He hangeth the earth upon nothing."

How then is it kept in its position?

By the attraction of the sun.

What is this sort of attraction called?

The attraction of gravity.

What things, besides the sun, have this power?

Every thing that has any weight.

ITS USES.

¶ *What is light?*

Something which acts upon the nerves of the eye.

What is that something?

Probably something in the air.

What is it called?

Light-giving ether.

How does this ether act upon the eye?

It is thrown into a throbbing motion, and jerks against the eye-nerves.

What makes the light-giving ether throb?

Every thing that gives light.

Name some of these things?

The sun, a burning fire, lighted lamps, and many other things.

§ *What makes this notion likely?*

The way sound is produced.

How is sound produced?

By the throbbing of some sounding body.

What does this pulse-beat produce?

A throbbing of the air close by.

How do the pulse-beats of the air convey sounds to us?

By bumping against the ear-drum, they rouse the nerves of hearing.

How do the pulse-beats of ether make the eye see?

By bumping against the eye, they rouse the nerves of sight.

THE SUN.

(II.) WHAT IS THE SUN?

What is the sun?

A globe somewhat like our earth, but larger.

How much larger?

As much as a good sized orange is larger than a pin's point.*

How is the body of the sun surrounded?

By clouds somewhat like our sky.

What surrounds the sun-clouds?

A case of light.

Illustrate this arrangement by a walnut.

The meat of the nut is incased in a shell, and the shell in a green husk.

How will this illustrate our subject?

If the meat of the nut is the sun, the shell would be the clouds round it, and the green husk the "case of light."

* The sun's diameter is a *hundred and eleven* times greater than that of our earth. The proportion may be represented thus:—

- Earth's diameter.
Sun's diameter.

If each of these had a globe round it, the sun's globe would be nearly a *million and a half* times bigger than the earth. Or suppose all the planets, moons, and comets of our whole system rolled together, it would require 500 such systems to make one sun.

HOW FAR THE SUN IS OFF.

What is the "case of light" called?

The sun's photo-sphere.

What is the meaning of photo-sphere?

A sphere or globe of light.

How is it known that the sun is not a body of light?

Because we can sometimes see it through rents in the two envelopes.

How does it look?

Quite black.

What do we call these glimpses of the sun?

Spots in the sun.

Why do we call them so?

Because they appear as spots in that "luminous case," which is, in fact, our sun.

How can these spots be seen?

By a telescope.

(III.) HOW FAR THE SUN IS OFF.

How far off is the sun?

About ninety-five millions of miles, but the distance varies.

If a railway carriage went thirty miles an hour, how long would it take to go that distance?

As many years as there are days in a year.

How many is that?

Three hundred and sixty-five.

How long would 365 years take us back?

To the reign of Henry VII.

THE SUN.

When is the earth nearest to the sun?

In winter time.

When is it furthest off?

In summer time.

How much is the difference?

Only two millions of miles, which is very little in so great a distance.

§ *How fast does light travel?*

Nearly 200 thousand miles in a second.

How long does it take a sun-beam to get to our earth?

About eight minutes and a quarter.

(IV.) THE SUN'S APPARENT MOTION.

Mention some things which "seem" to move though they do not move.

Houses and trees, when we are travelling.

Why is this?

Because their position in regard to ourselves keeps changing.

How do we judge whether a thing is moving?

By the shifting of its position.

When is this a correct way of judging?

Only when we ourselves do not move.

When we are in a railway carriage, how do the houses and trees seem to move?

In the opposite direction to ourselves.

§ *What apparent motion of the sun is similar?*

Its daily journey across the sky.

THE SUN'S REAL MOTIONS.

How does the sun seem to move across the sky?

It seems to begin in the east, to glide over the arch of heaven, and to set in the west.

What gives the sun this seeming motion?

The earth turning on its axis.

In what way does the earth turn on its axis?

From west to east, or the contrary way to the sun's course.

(V.) THE SUN'S REAL MOTIONS.

What real motions has the sun?

It has three.

Name the sun's three motions?

One round its axis, one among the fixed stars, and one onward through space.

How can you illustrate these three movements?

By a wheel, which turns round its axle, shifts from left to right, and moves onward with the cart or carriage.

How long does it take the sun to turn once on its axis?

Twenty-five days.

§ *How is it known that the sun wanders among the fixed stars?*

Because they seem to rise and set, like the sun.

In what length of time does a fixed star return to its place?

In twelve months.

THE SUN.

If a star rises in the east to-day at sun-set, where will it be three months hence?

In the high vault of the heavens.

How will it then shift?

It will get nearer to the sun every night, till it can be no more seen.

When it next appears where will it be?

West of the rising sun.

After that, how will its place shift?

It will get further from the sun every day till it returns again to its place in the east.

§ *What goes with the sun in its onward course?*

Our whole system ; the earth with its moon, and all the other moons and planets.

Who found out this?

Sir William Herschel.

How did he find it out?

He noticed that the stars *behind* the sun seem to get closer and closer ; while those *before* it get wider and wider apart.

When may a similar effect be seen?

When we are going through an avenue of trees.

If we turn round, what shall we see?

The trees seem to get closer and closer the further we go on.

If we look before us, what shall we see?

The trees, which at first seemed to touch each other, seem to get further and further apart.

THE SOLAR SYSTEM.

*As the stars "before" the sun seem to get wider apart,
what does this show?*

That the sun is moving towards them.

In which direction is the sun moving?

From the west towards the east.*

THE SOLAR SYSTEM.

What is the solar system made up of?

Planets, moons, and comets.

How many planets are there in our system?

Eight large ones, and a vast number of small ones.

How many small ones are yet known?

Above eighty.

How many satellites, or moons, have we?

Twenty-one.

How many comets belong to our system?

A large number; every year brings new ones to our knowledge.

¶ *How may the large planets be divided?*

Into two groups, an inner and an outer.

What is meant by the "inner" group of planets?

Those between our earth and the sun.

* For the benefit of parents and teachers, it may be added that the Solar System is moving in the direction of λ Hercules, a point in the heavens whose right ascension is 257° , and north declination 25° .

THE SOLAR SYSTEM.

What are these planets often called?

Inferior planets.

Why are they so called?

From the Latin word *inferior*, which means *lower*.

How many planets are inferior, or nearer to the sun than our earth?

Only two.

Name them.

Mercury and Venus.

§ *What is meant by the "outer" group of planets?*

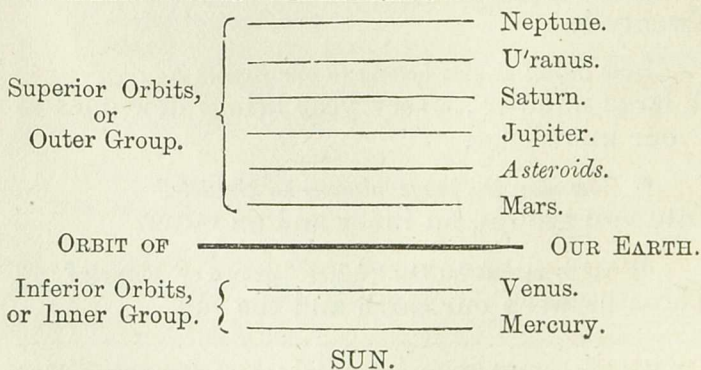
Those planets which are further from the sun than our earth.

How many large planets belong to this group?

Five.

Name them?

Mars, Jupiter, Saturn, U'rānus, and Neptune.



What are these planets often called?

The five superior planets.

THE SOLAR SYSTEM.

Why are they so called?

From the Latin word *superior*, which means *higher*.

¶ *What is the meaning of satellite?*

An attendant.

What is our Earth's "attendant" called?

The Moon.

How many attendants have the two inferior planets?

None at all.

Which planets besides our earth have satellites?

Only the four outer-most ones.

How many moons, or satellites, has Jupiter?

Four.

How many has Saturn?

Eight, and a luminous ring.*

How many have the other two?

U'rānus *six*, and Neptune *two*.†

¶ *How long has the planet Jupiter been known?*

It was known to the Chinese hundreds of years before the birth of Christ.

Who first saw the satellites of Jupiter?

Gal'i-le'o, an Italian.

When did Galileo die?

While Charles I. was King of England.

* This "ring" is, in reality, a series of rings; two of which are luminous.

† This is not quite certain. Mr. Lassell, of Liverpool, discovered one satellite of Neptune in 1846, and *thinks* he saw a second in 1850. Prof. Bond, of the United States, is almost sure of this second satellite.

THE SOLAR SYSTEM.

What is the planet Jupiter noted for?

His streaks or belts.

How many belts has Jupiter?

The number varies, but seldom more than three can be seen at one time.

Which other planet has belts, like Jupiter?

Saturn, but his belts are smaller.

§ For what is Saturn chiefly noted?

A double ring, which moves round him like a river of light.

What use does the ring serve?

It helps to give light to the planet, and perhaps heat.

§ Who first saw the planet Uranus?

Sir William Herschel, in the reign of George III.

What did he call it?

The "Georgium Sidus" (*George Star*), in honour of King George.

§ Who first found out the planet Neptune?

Mr. (now Dr.) Adams, of Cambridge.

How did he find it out without seeing it?

He noticed a disturbance in the motion of Uranus, and said it must be caused by a planet not yet known.

When was this?

In the year 1845.

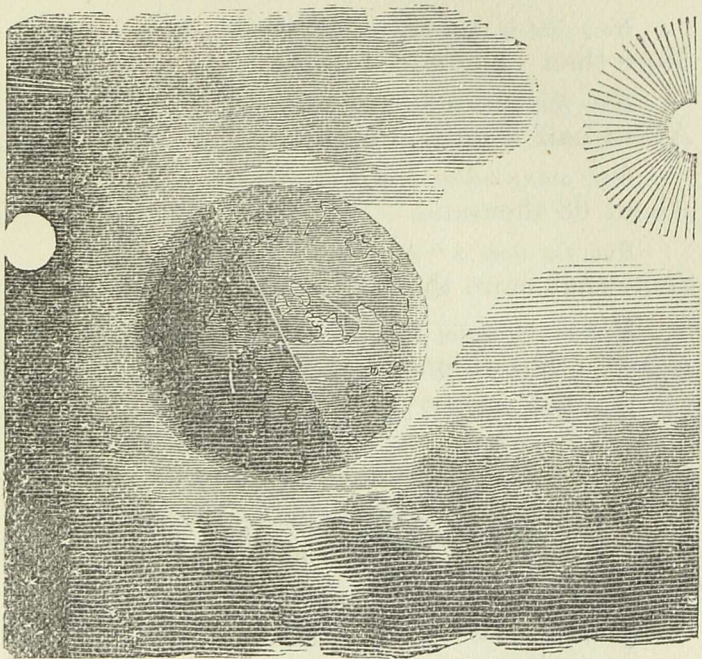
What Frenchman noticed the same thing?

Le Verrier, who said where the planet should be looked for (1846).

SPEED OF THE EARTH.

THE EARTH.

(i.) ITS MOTIONS.



What is the planet called on which we live?
The Earth.

What is the meaning of the word planet?
A wanderer.

Why is our earth called a wanderer?
Because it wanders round and round the sun.

THE EARTH.

¶ *How long does it take to go once round the sun?*

A year, or 365 days.

How fast does it go?

About nineteen miles in a second.

How fast is that per minute?

More than 11 hundred miles.

How fast does a railway train go?

About half a mile in a minute.

How many miles does the earth go per hour?

About 68 thousand.

How far does a "fast train" go in an hour?

Somewhat more than 30 miles.

How many miles does the earth go in a year?

Nearly 600 millions.

How long would it take a railway train to go the same distance?

More than two-thousand two-hundred years.

What makes the earth roll round the sun?

The attraction of the sun acting on the onward motion of the earth.

If there were nothing to attract it, how would the earth move?

In a straight line, through space.

§ *What is the path of the earth round the sun called?*

The earth's orbit.

What is the meaning of the word orbit?

It is a Latin word, and means *track* or *path*.

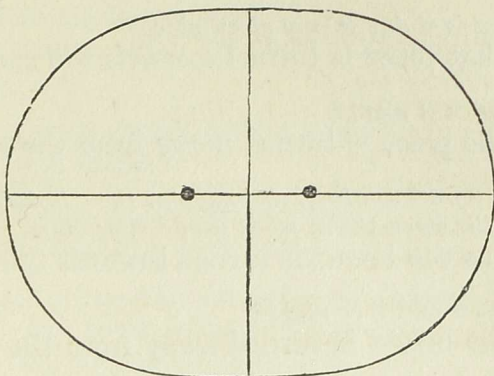
If the orbit were marked, what would be its shape?

A circle somewhat flattened.

ITS MOTIONS.

What is a flattened circle called?

An el-lipse.



The sun is not in the centre—that is, the point where the two lines cut each other—but where one of the dots is. These dots are the *foci* of the ellipse.

¶ *What other motion has the earth?*

One round its own axis, like the sun.

How long does it take to turn on its axis?

One day, or 24 hours.*

§ *What does the journey of the earth round the sun bring about?*

The changes of the seasons.

* The earth has two motions—one round its axis and one round the sun. Suppose the table to be the sun, and Nelly to be the earth. If Nelly will waltz round the table, she will move like our earth, turning round and round in the waltz step, and going round the table at the same time.

THE EARTH.

What does the whirling of the earth round its axis produce?

Day and night.

When is it day to any given place?

When that place is turned *towards* the sun.

When is it night?

When the place is turned *away* from the sun.

Take a fowl roasting, and suppose the "breast" to be the given place, when would it be day?

So long as the breast is turned towards the fire.

When would it be night?

When the breast is turned away from the fire.

(II.) THE CLOCK OF A MAP.

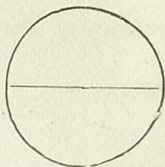
What is a drawing of the earth called?

A map of the world.

What is the line called which cuts it in halves from east to west?

The equator.

EQUATOR.



EQUATOR.

How is the equator divided?

Into 360 parts, called degrees.

THE CLOCK OF A MAP.

How are these parts shown on a map?

By lines running through it from the top to the bottom.

§ *How are degrees divided?*

Into minutes and seconds, as we divide an hour.

How many seconds make a minute?

60, in both cases.

How many minutes make a degree?

60, as 60 minutes make an hour.

§ *As the sun-shine goes all round the earth every day, how many degrees does it go over?*

360 in the twenty-four hours.

How many in half a day, or twelve hours?

180, which is half 360.

How many in a quarter of a day, or six hours?

90, which is a quarter of 360.

How many in an hour?

15, the twenty-fourth part of 360.

If the equator is marked into hours, how must it be divided?

Into parts equal to fifteen degrees.

What do we call the lines which run through a map from the top to the bottom?

Meridians, or noon-day lines.

When these lines are fifteen degrees apart, what may they be called?

Hour-circles.

THE EARTH.

Why so?

Because any one of them is just an hour off the one next to it.

If the sun is over any given line of the map, what time of the day is it to all places on that line?

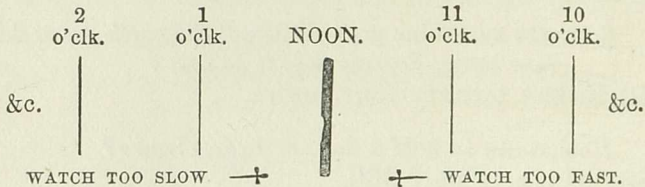
Noon-day.

What o'clock is it to the line on the right of it?

Eleven o'clock, or one hour before noon-day.

What o'clock is it to the line on the left of it?

One o'clock, or one hour past noon-day.



If the sun is one hour in getting over fifteen degrees, how long is it getting over one degree?

4 minutes.*

If my watch is London time, how would it be at Brussels (four degrees east)?

It would be a minute too fast.

How would it be at Glasgow (four degrees west)?

A minute too slow.

How must we alter a watch if we go east?

We must put it back.

How must we alter it if we go west?

Put on four minutes for each degree.

* And, of course, it goes one second of space in *four* seconds of time.

SHAPE OF THE EARTH.

(III.) THE SHAPE OF THE EARTH.

What shape is the earth?

Round, like an orange.

§ *Give me a proof of the earth being round?*

Men have often sailed round it.

§ *Give me another proof?*

The earth's shadow is always circular.

When may the earth's shadow be seen?

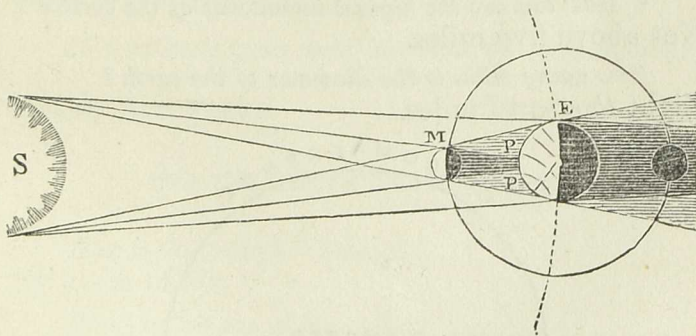
In an eclipse of the moon.

Where may it be seen?

On the face of the full moon.

What causes an eclipse of the moon?

The earth being between the sun and the moon.



Here S is the sun, E the earth, little m the moon eclipsed by being in the earth's shadow.

How can you eclipse a candle?

By holding up my hand between it and my eyes.

Which in this case represents the earth?

The hand held up. The candle is the sun, and my eyes the moon.

THE EARTH.

§ *What is a third proof of the earth being round?*

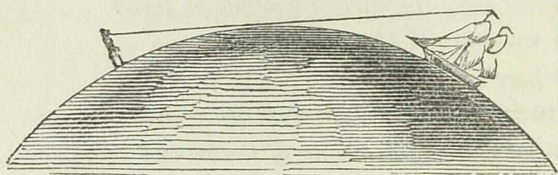
The way a ship dis-appears at sea.

How does a ship at sea disappear?

The thick hull first, then the broad sails, and last of all, the thin mast-tops.

Why is this?

Because it is the swell or curve of the earth that hides the ship from sight.

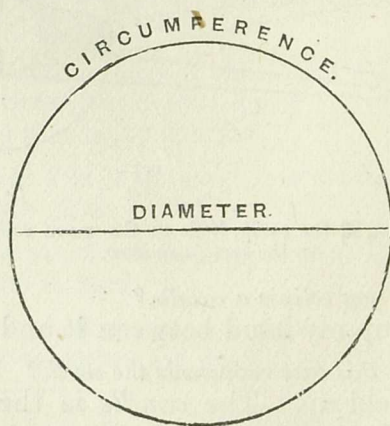


¶ *How tall are the highest mountains of the earth?*

Not above five miles.

How many miles is the diameter of the earth?

Eight thousand miles.



THE EARTH'S ATMOSPHERE.

What is meant by the diameter of the earth?

A line from outside to outside, right through its centre.

How may the difference between 5 and 8,000 be shown?

If two of Cassell's great Family Bibles represent 8,000 miles, one single leaf would equal five miles.*

How far would the mountains of the earth interfere with its round-ness?

Far less than the roughness of its skin prevents an orange from being considered round.

If it is 8,000 miles "through" the earth, how many miles is it "round" the earth?

Twenty-five thousand miles.

If a railway train went 30 miles an hour, how long would it be going 25,000 miles?

Nearly five weeks.

(IV.) THE EARTH'S ATMOSPHERE.

How is the "earth" incased?

By a sea of air.

What is this sea of air called?

The atmosphere.

How thick, compared with the earth, is this envelope?

About the same as the down of a peach is, compared to the peach itself.

* Cassell's great Family Bible contains about 1,600 pages, and two would contain 1,600 leaves. Now, 5 to 8,000 is the same proportion as 1 to 1,600.

THE EARTH.

§ *What is the atmosphere composed of?*

Different gases.

What gas makes up the chief part?

Ni'tro-gen.

What gas is the next chief ingredient?

Ox'ygen.

What other gases are there in the air, but in much smaller quantities?

Vapours and carbonic acid.

Where does the carbonic acid gas come from?

The breath and perspiration of animals, the reek of dunghills, fires, lamps, and so on.

In what form are these several gases in the air?

In very small particles, called atoms.

How small are these particles or atoms?

Finer than sand, finer than the finest flour, too fine, indeed, for the eye to see them.

How are they mixed together?

They float about the vast mass quite freely.

§ *What are the uses of the atmosphere?*

Its uses are almost number-less.

Tell me one of them.

It is what we breathe, and without which we could not live.

Tell me another use.

It enables us to hear sounds. If there were no air, we could not hear each other speak.

Tell me a third use of the atmosphere.

It causes light to spread over the earth.

SIZE OF THE MOON.

Tell me a fourth use of it.

It enables us to smell sweet perfumes and other odours.

Tell me a fifth use.

As wind, it blows ships over the sea, moves mill-sails, dries linen, and so on.

Tell me a sixth use.

It carries off bad vapours, and keeps the earth in a healthy state.

Tell me another use which it serves.

It sups up water from the earth and seas to form into clouds.

Tell me an eighth use.

It buoys up the clouds.

N.B.—It is thought that the earth's atmosphere is more than forty miles thick.

THE MOON.

(I.) ITS SIZE AND SHAPE.

What is the moon?

The earth's satellite, or attendant.

Why is it called the earth's attendant?

Because it follows the earth all round its orbit.

§ *What shape is the moon?*

A solid ball, like our earth.

§ *Which is the larger of the two?*

The earth.

THE MOON.

How many miles is it through the moon?

About two thousand; or a quarter as much as through the earth.

How many miles is it round the moon?

Between six and seven thousand.

Viewed from the moon, how large would the earth appear?

About thirteen times as large as the moon seems to us.

How many moons would our earth cut up into?

Nearly fifty.

(II.) MOTIONS OF THE MOON.

How many motions has the moon?

Four.

Name three of them.

One round its axis, one round the earth, and one round the sun.

What is the fourth?

An onward motion through the fixed stars.*

* These four motions can be explained thus. Suppose this house were a ship sailing on the sea. Let Harry walk slowly round the room, and Nelly keep waltzing round Harry as he does so. Then Nelly would have four motions at once:

1. By waltzing she turns round and round herself.
2. She also waltzes round her brother Harry.
3. As Harry keeps walking round the room, Nelly gets round also.
4. As the ship sails onward, both Harry and Nelly are carried onward with the ship.

MOTIONS OF THE MOON.

¶ *How long is the moon turning once on its axis?*
A lunar month, or four weeks.

How is a day divided on our earth?
Into two parts, day-time and night.

How long does each last?
About twelve hours, more or less.

How long is one day and one night in the moon?
Each is two of our weeks.

How many days make a month in the moon?
One; and thirteen days make a year.

§ *How can we know this?*
By looking at the moon.

Tell me in what way.
Every moon of the year at the same period is almost exactly alike.

What does this prove?
That every moon of the year at the same period turns the same face towards the earth.

If the moon turned faster or slower on its axis, what difference would it make?
The part seen at any given period would vary.

How do we know it does not vary?
Chiefly by observing the "spots" of the moon.

What do we find respecting these spots?
That they are always exactly in the same place, and of the same shape at any given hour.

If we only see one side of the moon, what do we know of the other?
Nothing at all, as it is never turned towards us.

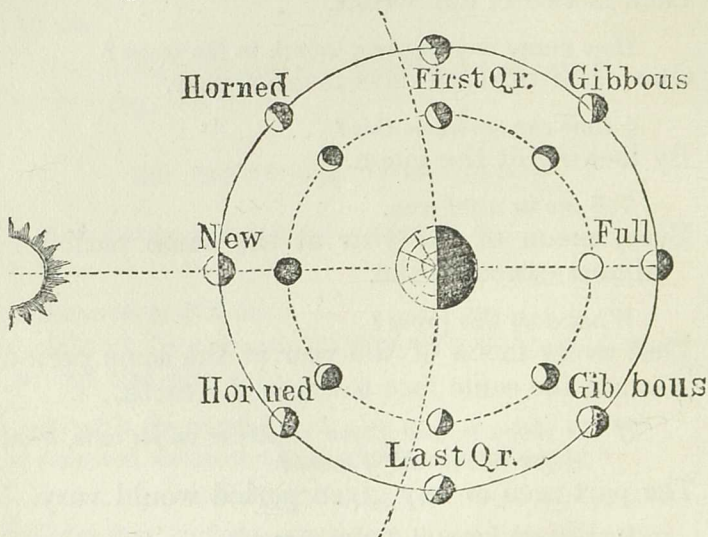
THE MOON.

¶ *How long is the moon going once round the earth?*
About a month, or four weeks.

What is its path round the earth called?
Its orbit.

What effect is produced by this wandering round the earth?

The moon changes from new to full, and full to new again.



Here the word "new" shows where the moon is at the time referred to, and it will be seen that the dark half is turned towards our earth.

When is the moon new?

When it is between the sun and the earth.

Why is it then dark?

Because the bright part is turned away from our earth.

MOTIONS OF THE MOON.

When is it full moon?

When the earth is between the sun and moon.

Why is it then full moon?

Because the part we see is the part on which the sun shines.

When is the moon crescent or horned?

When it is less than half.

If more than half, what is it called?

Gibbous.*

Why is the moon crescent or gibbous?

Because only a part of its bright side is turned towards the earth.

¶ *How long is the moon rolling round the sun?*

A year.

How does this motion differ from the other two?

The other two are independent, but this is not.

Why is not the moon's circuit independent?

Because it is carried by the earth, on which it always attends.

What effect on its appearance has this yearly circuit?

It produces what we call the Harvest and Hunters' Moon.

§ *When is the harvest moon?*

The first full moon after the middle of August.

When is the hunters' moon?

The next full moon to the harvest moon.

What is remarkable about these two moons?

They rise earlier and are larger than any other moons of the whole year.

* Gibbous. The *g* in this word is hard, as in *give*.

THE MOON.

What is the usual difference of the moon's rising?
It rises about fifty minutes later every day.

What is the difference in the harvest moon?
For about a week it rises only twenty minutes later one night than another.

When does the full harvest moon rise?
Immediately after sun-set.

Why is this moon larger than any other?
Because it is more in a line with the sun and earth than in any other month of the year.

How are they in other months?
Sometimes the earth is a little above, and sometimes a little below, the direct line.

Why are they more in a line during the harvest moon?
Because the sun is in "Virgo," the full moon in "Pisces," and the earth on a level between them.*

* See this table. Suppose the sun began in December from the middle of the floor, climbed up the left-hand wall, across the ceiling, down the right hand wall, and ended his yearly journey next December where he began.

Carry your eye now from the top of the table to the left-hand wall, and pick out the spot which is on the same level. That spot we will call *Pisces*.

The spot opposite, on the right-hand wall, we will call *Virgo*.

Now, when the sun is at the spot we call *Virgo*, the earth is where the top of the table is, and the moon is at the spot we call *Pisces*. They are all in a direct line with each other, and this happens at the full of the moon only once a year.

At all other full moons, the sun is either higher or lower than the table level.

N.B.—In spring, of course, the same thing happens when the sun and moon change sides, but then the moon is *new*, and we cannot see it

LIGHT OF THE MOON.

What effect is produced by the sun and moon being on the same level with the earth?

The sun shines full upon the moon, and we see more of the bright part than in any other month.

(III.) LIGHT OF THE MOON.

What does the Bible say God made the moon for?

To give light upon the earth by night.

What makes the moon bright?

The light of the sun reflected from it.

How do you know that the moon does not shine by its own light?

Because more of it is bright some times than at others.

If it shone by its own light, what would be the case?

It would always be full, like the sun.

§ I have seen the moon, when nearly new, look a pale white; why is this?

Because it rises before sun-set, and the light of our earth is thrown upon it.

How far is the moon off?

About 240 thousand miles.

How can you recollect this distance?

It is about ten times the circle of our earth.

If a railway train went 30 miles an hour, how long would it take to go 240,000 miles?

Nearly a year.

THE MOON.

§ *How long is a ray of light coming from the moon to our earth?*

About two seconds.

How long is two seconds?

While we can clap our hands twice, or count two.

§ *In what respects does moon-light differ from sun-light?*

It is less bright, far less heating, and has peculiar chemical effects.

Prove that moon-light has a little heat.

When gathered into a focus on a thermometer the mercury rises a little.

What strange chemical effects have moon-light?

Plants grow faster in moon-light, meat putrifies faster, and persons exposed to it suffer in health.

(IV.) CHARACTER OF THE MOON.

What is the moon itself like?

A desolate rocky country, with no rivers or seas, grass or trees, birds, or other living thing.

Why is it so desolate?

Because it has no air and no water.

How is it known that the moon has no air?

Because the edges of its mountains and caverns are hard lines.

CHARACTER OF THE MOON.

How would it be if there were an atmosphere there?
The lines would be softened, and both the glare and shadow would be toned down.

How else can we tell that the moon has no atmosphere?
When the moon glides before a star, the star does not vanish in a mist, but is either hidden entirely or not at all.

If there were an atmosphere, what would be the case?
The star would grow dim before it was hidden.

How is it known that there are no clouds?
If there were, we should be able to see them through a strong telescope.

How do we know that there is no grass there?
Because there is neither air nor water.

How do we know there is no living creature there?
Because they could not breathe without air.

How do we know there are no fish there?
Because there is no water.

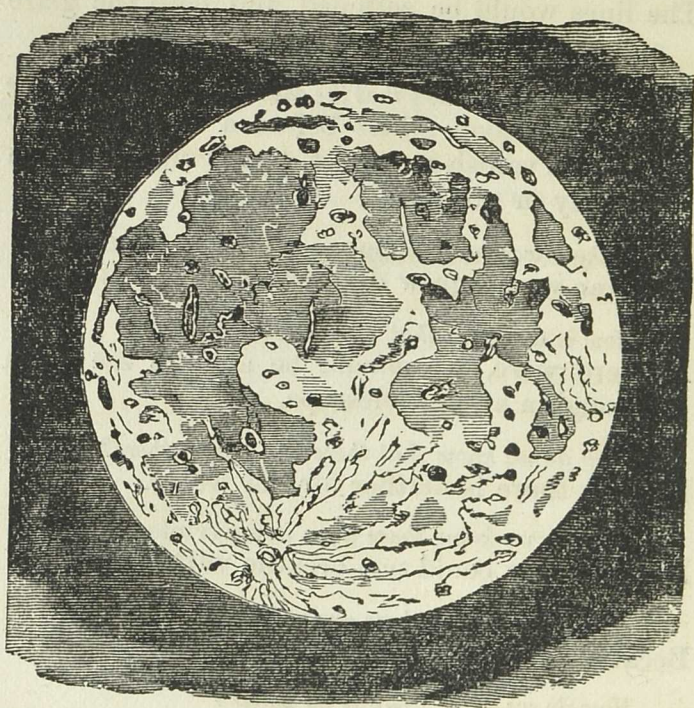
How do we know there is no water?
Because there are no clouds to restore what the sun would sup up.

What does it seem likely the moon really is?
Either a world which has died out, or one not yet finished.

N. B.—The moon is in a somewhat similar state to that which geologists say our earth was before any living thing grew or moved upon it, when its surface was granite or some other similar rock, and volcanic disturbances marked its surface with the most frightful irregularities.

THE MOON.

(V.) MAP OF THE MOON.



How do the spots of the moon differ?

Some are very bright, some dusky, and others grey.

What are the bright spots?

Mountain peaks.

What are the dusky spots?

Pits or caverns.

What are the grey spots?

Plains or dry seas.

MOUNTAINS OF THE MOON.

(Lunar Mountains.)

¶ *What sort of mountains are there in the moon?*

Three sorts.

Name them.

Single mountains, mountain chains, and ring-fences.

§ *How high are the single peaks?*

The highest are about five miles.

What is the finest peak called?

Pico (*Pee-ko.*)*

Why is it so called?

From a sugar-loaf hill, very much like it, in the Mauritius.

Where is the lunar Pico?

Near the south pole of the moon, and close by the crater named Plato.

§ *From what are the mountain chains named?*

Similar groups in our own earth.

To what height do these mountains rise?

About the same as those of Europe.

What did the ancients call these plains?

Lunar seas.

What do they look like on a map of the moon?

Ocean beds, or the beds of inland seas.

How is it known that they are not seas?

Because there is no water in the moon.

* You may easily remember this name by a pun. The finest peak is *Peak-O* (Pico).

THE MOON.

How else can it be proved that they are not seas?
Their surface is broken with hills, valleys, and deep pits.

Name the most celebrated of these mountain chains?
The Apennines (*Ap'-en-nines*).

Why is the chain so called?
From the mountain chain of the same name in Italy.

How long are the Italian Apennines?
About 800 miles.

How long are the lunar Apennines?
About 600 miles.

How far is 600 miles?
As far as from Brighton to the top of Scotland.

§ What are the ring-fences of the moon?
Mountain walls enclosing a circular space.

What sort of space is thus enclosed?
Sometimes a space of only a few hundred feet, and sometimes one of 100 miles across.

What is in some cases seen in the centre?
A sugar-loaf mountain, standing all alone in the midst of the plain.

What are these rings?
Lunar craters.

What is a crater?
The mouth of a volcano, or burning mountain.

Why are these "rings" called craters?
Because they are the craters of volcanoes no longer in action.

MOUNTAINS OF THE MOON.

What are exhausted volcanoes called?

Extinct volcanoes.

How are these rings or craters disposed?

Sometimes singly, and in other places crowded together like the cells of a honey-comb.

How deep are they?

Some are four or five miles in depth.

How many have been discovered?

Above a hundred.

How are they named?

After astronomers or other eminent men.

Name one or two of the most celebrated.

Pla'to, Kepler, Ty'cho, Coper'nicus, and so on.

§ *Where is the crater called "Plato"?*

A few degrees above the south pole of the moon.

§ *Where is the crater called "Kepler"?*

Nearly midway between the middle and the eastern rim of the moon.

What is the character of the region lying between Kepler and Plato?

It is remarkable for its great volcanic disturbance.

How is the surface round Kepler distinguished?

By its extraordinary brilliancy.

§ *Where is the crater called Coper'nicus?*

To the west of Kepler. This is one of the finest craters in the moon.

N. B.—PLATO, a Grecian philosopher; KEPLER, a German astronomer; TYCHO (Ty'ko), a Danish astronomer; and COPERNICUS, a Prussian astronomer.

THE MOON.

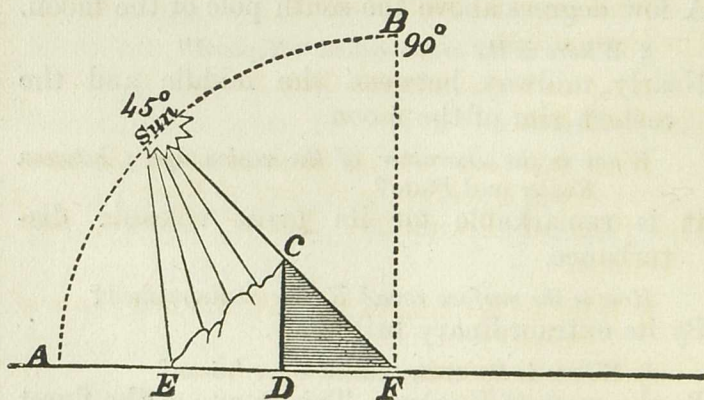
§ Where is the crater called Tycho?

About as far from the *north* pole of the moon as Plato is from the south.

What is remarkable about this crater?

It looks like a piece of starred glass, with cracks all round it.

How to Measure the Height of a Lunar Mountain.— Perhaps it may be asked, how can a person measure the height of a lunar mountain, seeing the moon is so many thousand miles off? I will tell you one way. You have seen a hill. When the sun is low, the shadow of the hill is cast along the ground, and gets longer and longer as the sun is lower. Now there is a time when the shadow is exactly equal to the height of the mountain, and that time is when the sun is exactly half-way between the horizon and its highest point. If, therefore, we measure the shadow of a lunar mountain at such a moment, we know exactly the height of the mountain itself.



MOUNTAIN SHADOW.

Here the sun is half-way between A and B. CD is the height of the mountain. DF is the length of the shadow. And $CD = DF$.

N.B.—If the angle is *less*, the shadow is longer. If the angle is *greater*, the shadow is shorter.

SEAS OF THE MOON.

(Lunar Seas.)

How are the plains or dry seas of the moon called?
Oceans, seas, and lakes.

What are the notches cut in the coast-line called?
Gulfs and bays.

What are the level tracts of the moon called?
Plains and marshes.

Looking at a map of the New World, what lunar ocean would correspond to the Atlantic?
The Ocean of Storms.

What lunar sea would correspond to our North Pacific?
The Tranquil Sea.

What sea to the South Pacific?
The Serene Sea.

What sea to the Antarctic Ocean?
The Cold Sea.

What four seas belt the moon at about the same degree of latitude as the Gulf of Mexico?
The Seas of Fecundity, Nectar, Clouds, and Damps.

§ *What sea lies between the Cold Sea and Ocean of Storms?*
The Sea of Showers.

How is the Sea of Showers bounded on the north-west?
By the Apennines (*Ap'-en-nines*).

How is it bounded on the south?
By the Alps and the crater called Plato.

THE MOON.

§ *What range of hills separates the Sea of Showers from the Ocean of Storms?*

The Carpathians.

What mountains lie to the west of the Sea of Damps and Ocean of Storms?

The U'ral mountains.

What mountain chain runs down the east coast of the Serene Sea?

That called the Hæmus.

What mountain chain runs down the west coast of the Serene Sea?

That called the Taurus.

Which are the higher, the lunar or earth mountains?

Lunar mountains are much the higher.

§ *Name the chief lakes of the moon.*

The Lake of Death and the Lake of Dreams.

§ *Name the chief marshes.*

Dream Marsh, Putrid Marsh, and Cloud Marsh.

(VI.) TIDES.

How does the moon affect the earth?

It causes the sea to ebb and flow

What is an ebb and flow of the sea called?

A tide.

How does the moon produce a tide?

By its attraction.

TIDES.

Why has the moon this power of attraction?
Because it is a solid body.

What is meant by a solid body?
A body that has weight.

Tell me something that has no weight.
The light-giving ether.

Tell me something else.
The agent called electricity.

§ *What is a flood-tide?*
The tide of full water.

What is the tide of low water called?
The ebb, or ebb-tide.

How many ebbs and floods are there in a day?
Two of each.

Why is the tide always shifting?
Because the part opposite the moon is always changing.

Why is this?
Because the earth is for ever moving on its axis.

When has a sea-coast its first flood-tide?
When it is opposite the moon.

When is this?
When the moon is only a half moon.

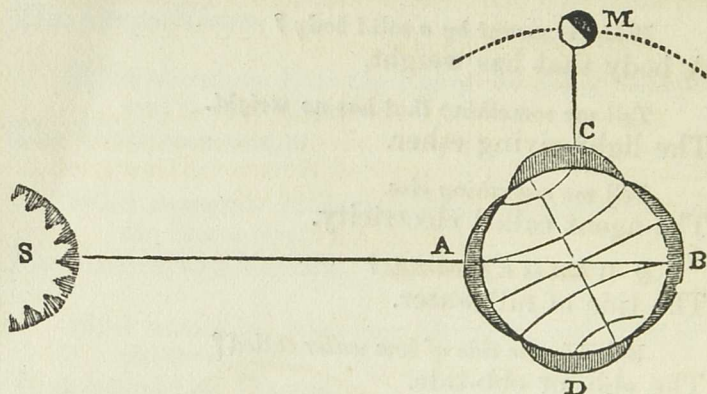
What are these small tides called?
Neap-tides.

Why are they so called?
From a Saxon verb, which means "to dwarf"
or make small (*knipan*).

THE MOON.

When has it its second tide?

When it is furthest away from the moon.



Let M be the moon, C the part of the earth which faces the moon, D the part which is farthest from the moon. When any sea-coast is come to C, it will have a flood-tide, and another when it has turned to D.

What is the cause of the first flood-tide (C)?

The *strong* attraction of the moon, which draws the water upwards towards itself.

What is the cause of the second flood-tide (D)?

The *weak* attraction of the moon, which is not sufficient to hold the waters up.

How can a weak attraction produce a flood?

The waters sag for want of being braced up by greater attraction.

§ *How often are the tides less than usual?*

Twice a month, at the time of half-moon.

Why are the half-moon tides smaller than usual?

Because the swell of water is then divided into four great waves instead of two.

TIDES.

Why is this?

Because two obey the moon, and two the sun.

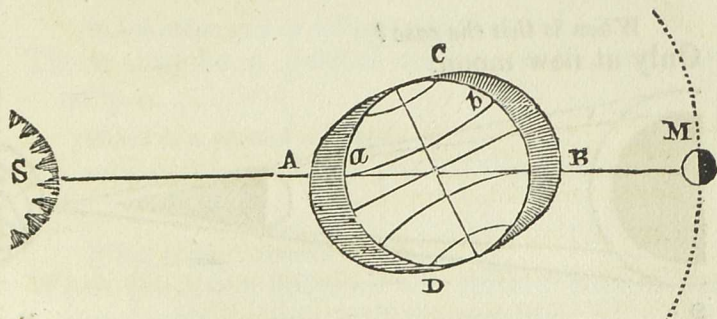
Which attraction is the greater?

That of the moon.

See Fig. (p. 46). It will be seen that the tides C and D owe their flood to the influence of the moon; but those of A and B to the influence of the sun. The attraction of the moon is opposed to that of the sun.

§ When are the tides fullest?

At new and full moon.



Here we see only two swells, A and B; the other two are drawn into these two great ones.

What are these tides called?

Spring-tides; because they spring or "well up" more than usual.

Why are the tides largest at full and new moon?

Because then the sun and moon act together.

As this is the case, how many swells are there?

Only two instead of four.

What becomes of the two caused by the sun?

They are added to the two caused by the moon.

ECLIPSES.

ECLIPSES.

What is an eclipse of the sun or moon?

A hiding of them, either wholly or in part, from our sight.

§ *What hides the sun from our sight?*

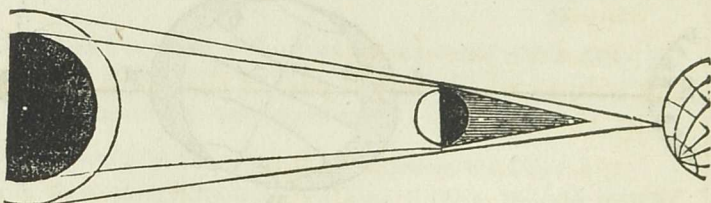
The moon does so sometimes.

When does the moon hide the sun from our sight?

When it comes in a line between the earth and the sun.

When is this the case?

Only at new moon.



S

E

Here M, the smaller object, hides S, the larger one. Similarly, a halfpenny held close to one eye, while the other is shut, will hide or eclipse the window.

Why does not every new moon eclipse the sun?

Because it does not always come in a line between the earth and the sun.

How does it come?

Sometimes *above* the line and sometimes *below* it.

Sun * Moon ● ○ Earth

or thus,—

Sun * ○ Earth
Moon ●

SOLAR ECLIPSES.

How much is the sun's diameter larger than the moon's?

About 400 times.

How can the moon, which is so much smaller, hide the sun from our sight?

Because it is 400 times nearer to us.

When is there a "total" eclipse of the sun?

Only when the *centre* of the moon is in a straight line with the centre both of the sun and earth.

What other sort of eclipses can there be?

There may be a *partial* eclipse or an *annular* eclipse.

What is a partial eclipse?

An eclipse where only a *part* of the sun is hidden by the moon.*

What is an "annular" eclipse.

When the moon hides all the middle part of the sun, leaving a *ring* of light outside.

The Fig. (p. 48) represents an annular eclipse of the sun (S).

When does this sort of eclipse happen?

Only when the earth is in that part of her orbit which is nearest the sun.

When is that?

In spring and autumn.

* The diameter of the sun is supposed to be divided into twelve equal parts, called digits (*fingers*), or *units*. If half the sun is eclipsed, we say *six digits* are eclipsed; if three-quarters, we say *nine digits* are eclipsed; if only one quarter, we say *three digits* are eclipsed, and so on.

ECLIPSES.

§ *What hides the moon from our sight?*
The shadow of the earth falling on it.

When does this happen?
Only at full moon.

Why is there not an eclipse at every full moon?
Because the sun, earth, and moon at the time are not always in the same line.

Sun *.....○ Earth ● Moon

or thus,—

Sun *.....○ Earth ● Moon

§ *How long may a total eclipse of the sun last?*
Not above three or four minutes.

How long may a total eclipse of the moon last?
An hour and three-quarters.

Why may an eclipse of the moon last longer than an eclipse of the sun?
Because the earth is much larger than the moon, and its shadow is larger also.

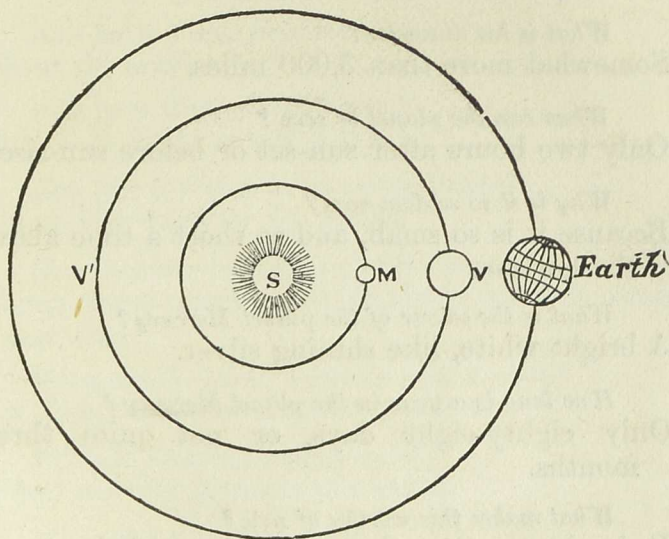
How many eclipses are there in a year?
Always two, and sometimes as many as seven.

What is the ordinary number?
Two of the sun and two of the moon.

If there are only two eclipses in the year, what will they be?
They will both be eclipses of the sun.

THE PLANETS.

(I.) THE INFERIOR PLANETS.



Name the two inferior planets.

Mercury and Venus.

Why are they sometimes called interior?

Because their orbits round the sun are *within* the earth's orbit.

§ Which of these two planets is nearest the sun?

Mercury.

THE PLANETS.

How far is Mercury from the sun?

37 millions of miles.

What is the size of the planet Mercury?

It is the smallest of the eight large planets, being only thrice as large as the moon.

What is his diameter?

Somewhat more than 3,000 miles.

When can the planet be seen?

Only two hours after sun-set or before sun-rise.

Why is it so seldom seen?

Because it is so small, and so short a time above the horizon.

What is the colour of the planet Mercury?

A bright white, like shining silver.

How long is a year in the planet Mercury?

Only eighty-eight days, or not quite three months.

What makes this worthy of note?

It is shorter than the year of any of the great planets.

How long is a day in the planet Mercury?

The same as with us—namely, twenty-four hours.

What would things weigh in the planet Mercury?

Only half as much as they do with us.

Which is the hotter planet, Mercury or the Earth?

Both the heat and light of Mercury are seven times greater than with us.

PLANET VENUS.

§ *What planet rolls between Mercury and our earth?*
Venus, the brightest of all the planets.

Why is Venus the brightest of all the planets?
Because it is nearer the earth than Mercury,
and nearer the sun than any exterior planet.

How far is Venus from the sun?
About 68 millions of miles.

How large is the planet Venus?
Almost as large as our earth.*

How long is a year in the planet Venus?
About 224 days, or 32 weeks.

How long is a day in the planet Venus?
About three-quarters of an hour shorter than
our own.

When can the planet Venus be seen at night?
For about three hours after sun-set.

When is Venus an evening star?
When moving towards our earth.

When is it a morning star?
When moving away from our earth.

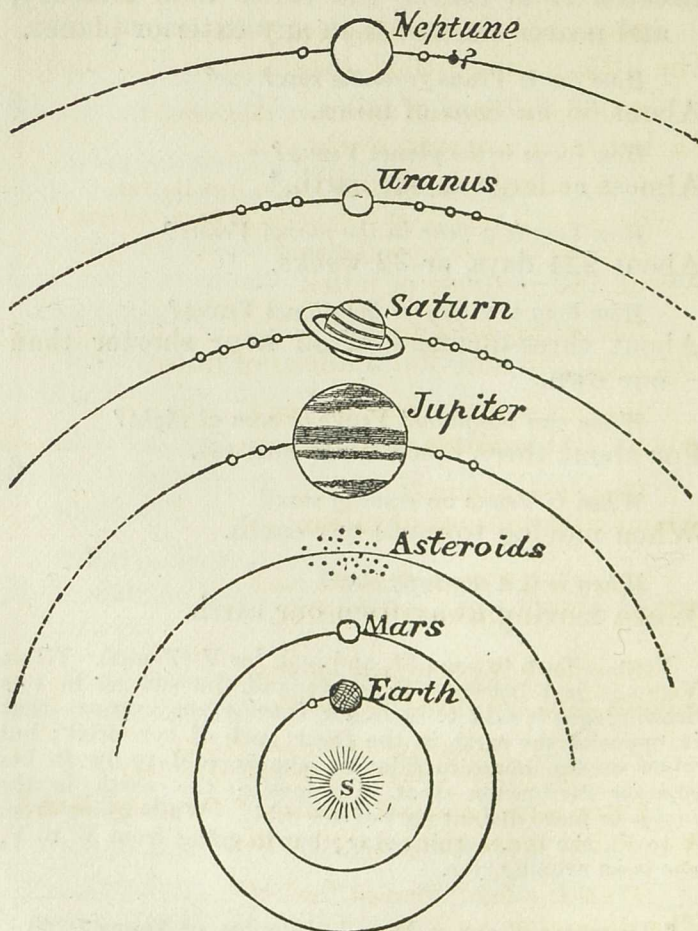
NOTE.—Turn to page 51, and look for V (Venus). When Venus is just between the earth and the sun, as in this drawing, she is said to be in her *inferior conjunction*—that is, opposite the earth in the *lower part* of her orbit; but when on the opposite side (V'), she is said to be in her *superior conjunction*—that is, opposite the earth in the *higher or more distant part* of her orbit. While going from V to V', she is a morning star; but in going from V' to V, she is an evening star.

* Diameter of our earth is 7,916 miles, of Venus 7,700.

THE PLANETS.

(II.) THE SUPERIOR PLANETS.

What are the superior planets sometimes called?
The "exterior."



SUPERIOR PLANETS.

Why are they called exterior planets?

Because their orbits are outside the earth's orbit.

Name the five superior planets.

Mars, Jupiter, Saturn, U'rānus, and Neptune.

What comes between Mars and Jupiter?

The little planets called Asteroids (*As'-te-roids*).

How many Asteroids have been discovered?

81, but more are seen every year.

(1) *Distance of the Superior Planets from the Sun.*

(The Earth is about 95 millions of miles from the Sun.)

How far is Mars from the sun?

About 142 *millions* of miles.

How far are the Asteroids?

Between 200 and 300 *millions* of miles.

How far is Jupiter from the sun?

About 490 *millions* of miles.

How far is Saturn?

About 900 *millions* of miles.

How far is Uranus from the sun?

About 1,800 *millions* of miles.

How far is Neptune from the sun?

About 2,800 *millions* of miles.

(2) *Diameters of the Superior Planets.*

(The Earth's diameter is about 8,000 miles.)

§ *How many miles is it "through" the planet Mars?*

Somewhat more than 4,000 miles.

What is a line "through" called?

The diameter.

PLANETS.

Which is the largest of the planets?

Jupiter, which is the brightest also, except Venus.

How much is Jupiter larger than our Earth?

About 1,400 times; but bulk for bulk, it is much lighter.

What is the diameter of Jupiter?

More than eleven times that of our earth.

Which is the next largest planet?

Saturn and Neptune next.

What is the diameter of Saturn?

Nearly ten times that of our earth.

What is the diameter of Neptune?

Nearly six times that of our earth.

What is the diameter of Uranus?

Nearly five times that of our earth.

If an "express" had started from our earth to the planets at the birth of Christ, and gone 33 miles an hour without stopping, it would still have more than 4,300 years to travel before it reached Saturn, and 7,800 years more before it arrived at Neptune. Such a train would take—

1,712	years	to	reach	Jupiter
3,113		"		Saturn
6,226		"		Uranus
9,685		"		Neptune

∴ Diameters in miles: Jupiter, 90,750; Saturn, 77,230; Neptune, 41,500; and Uranus, 35,000.

SUPERIOR PLANETS.

(3) *Length of the Day in the Superior Planets.*

§ *What causes a day?*

The turning of a planet on its axis.

How many hours is a day in Mars?

About half an hour longer than one of our days.

How long is a day in Jupiter?

Not quite ten hours.

How long is a day in Saturn?

About ten hours and a *quarter*.

What is the length of a day in Uranus?

About an hour less than in Saturn.

What is the length of a day in Neptune?

It is not yet known.

(4) *Length of the Year in the Superior Planets.*

§ *What causes a year?*

The journey of a planet round the sun.

How long is a year in Mars?

Almost equal to two of ours (687 days).

How long is a year in the Asteroids?

From three to five of our years.

How long is one of Jupiter's years?

Nearly twelve of ours.

How long is one of Saturn's years?

About twenty-nine and a *half* of ours.

PLANETS.

How long is a year in Uranus?

About eighty-four of our years.

How long is a year in Neptune?

Nearly 165 of our years.

§ *If a cart-load of "soil" could be taken from Saturn, how heavy would it be found?*

No heavier than the same quantity of cork.

How heavy would that of Uranus or Neptune be?

About the same weight as deal and elm.

How heavy would that of Jupiter be?

Somewhat heavier than water.

(5) *Light and Heat of the Superior Planets.*

§ *How great are the light and heat of Jupiter?*

Some twenty-five times less than what we enjoy.

How great are they in Saturn?

Some eighty times less than what we enjoy.

How great in Uranus?

Nearly 400 times less than what we enjoy.

How great are they in Neptune?

Not half as much as in the planet Uranus.

How light would Jupiter be at mid-day?

Darker than our midnight.

How light would the other three planets be?

So dark, that eyes like ours would not be able to see at all, even at mid-day.

SUPERIOR PLANETS.

How hot would be the hottest day in Jupiter?

Colder than the coldest day at the North Pole.

How hot would it be in the other three planets?

Colder than any degree of cold we know of.

§ *What is the colour of the planet Mars?*

Red, like the flame of a fire.

What kind of atmosphere surrounds it?

A thick, heavy air.

What advantage is this thick atmosphere?

It makes the planet more warm and light.

What is the colour of Saturn?

A pale yellow.

(6) *Are the Planets inhabited?*

If these planets are inhabited, what sort of people must dwell in them?

Creatures wholly unlike ourselves, or any animals we know about.

What power must they possess?

They must see in the dark, and be able to bear cold which would kill us in a minute.

How else must they differ from ourselves?

Their muscular system must be wholly peculiar.

Why so?

Because a body like our own would be so heavy, it would be unable to stir either hand or foot.

What kind of plants must grow there?

None like ours could live there a single hour.

COMETS.

COMETS.

What are comets?

Wandering "stars" which move round the sun, but differ widely from the planets.

How do planets move round the sun?

From west to east.

How do comets move?

Some one way, and some another.

What shape is the orbit of the planets?

Nearly circular, the sun being in the middle.

In what sort of an orbit do comets move?

In a long oval, like a "large-hand" O.

Where is the sun's place in these orbits?

Not in the middle, but towards one end.*

§ *What is the meaning of the word "comet?"*

A hairy star (Latin, *coma*, "hair").

Why are comets called hairy stars?

Because they have generally a haze like hair.

Of what three parts are comets often composed?

The kernel, head, and tail.

What is the kernel of a comet called?

Its nu'-cle-us.

What is the head of a comet?

A cloudy light all round the kernel.

* At one of the *foci*.

CELEBRATED COMETS.

What is the tail of a comet ?

A cloudy light similar to the head.

Where is the tail or train of a comet placed ?

Sometimes before the comet and sometimes behind it.

When is it behind the comet ?

When the comet is going towards the sun.

When is it before the comet ?

When the comet is going away from the sun.

What are comets with heads and no tails called ?

Bearded comets.

When have comets beards and no tails ?

When they are opposite the sun, and have the earth between.

Have all comets either beards or tails ?

No ; hundreds of them have neither.

What are the head and tail of comets supposed to be ?

Gas or vapour produced by the great heat of the sun.

How is it known they are gas or vapour ?

Because stars may be seen through them as well as through a common window.

Celebrated Comets.

§ *Name the four comets whose return is well known ?*

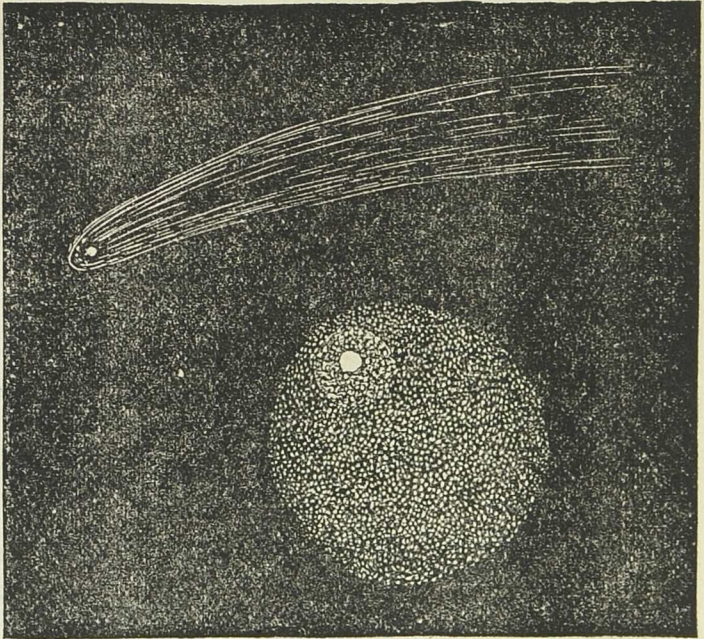
Halley's, Enckë's, Gambart's, and Faye's.

How often does Halley's comet return ?

Every seventy-six years.

COMETS.

How often does Encké's comet return?
Every three years and a quarter.



ENCKE'S COMET.

THE COMET OF 1811.

The upper one is Encké's comet, with a tail. The lower one is the comet of 1811, with a beard.

How often does Gambart's comet return?
Every six years and three-quarters.

How often does Faye's comet return?
Every seven years and a half.

CELEBRATED COMETS.

§ *Name the most famous comets of the present century.*

Those of 1811, 1843, and 1858.

How long will it be before the comet of 1811 returns?

About 3,000 years.

For what was the comet of 1843 remarkable.

The great length of its tail.

When will it return again?

Probably not for 400 years.

What is the comet of 1858 called?

Dona'ti's comet.

Why is it so called?

From Dona'ti, an Italian, who first saw it.

For what was Donati's comet remarkable?

Its great splendour and nearness.

§ *What influence have comets on the air?*

None that we know of.

What is very generally thought to be their influence?

It is thought that it is hotter when they approach the earth, and colder when they go away.

What is generally said about the great comet years?

That the vines bore better grapes than usual in those years.

What is the wine made from those grapes called?

Comet wine, which is considered very excellent.

What wine especially is called "Comet Wine?"

That made in the year 1811.

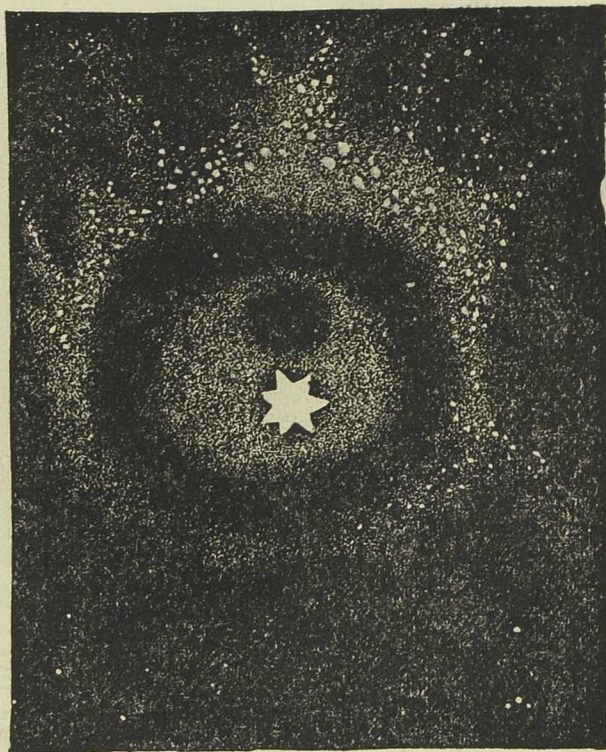
N.B.—In 1846 there was a very remarkable comet, which separated into two distinct parts. The two parts moved on together for a time, and then diverged. This is called Biela's Comet, from a Bohemian of that name.



DONATI'S COMET.

NEBULÆ.

NEBULÆ.



NEBULA DISCOVERED BY LORD ROSSE.

(In the constellation Gemini.)

What are Nebulæ?

Indistinct patches of light in the heaven.

What are these patches known to be?

Clusters of stars so far off that their light is seen very feebly indeed.

NEBULÆ.

¶ *What is meant by the Milky Way?*

A luminous band, which stretches across the sky from north to south.



PART OF THE MILKY WAY.

Why is it called the Milky Way?

Because it looks white, like milk spilt in the starry heavens.

What causes this white milky appearance?

Hosts of stars, so far off, that their blended light seems like a belt of white milk.

CONSTELLATIONS.

CONSTELLATIONS.

♈ Aries, *the Ram*.
♉ Taurus, *the Bull*.
♊ Gemini, *the Twins*.
♋ Cancer, *the Crab*.
♌ Leo, *the Lion*.
♍ Virgo, *the Virgin*.

♎ Libra, *the Balance*.
♏ Scorpio, *the Scorpion*.
♐ Sagittarius, *the Archer*.
♑ Capricornus, *the Goat*.
♒ Aquarius, *the Water-bearer*.
♓ Pisces, *the Fishes*.

What is a constellation?

A group of stars.

By what names are the groups called?

By fancy names.

Which are the most remarkable?

The twelve signs of the Zodiac.

What names are given to these groups?

Fancy names, descriptive of the season, or sun's apparent motion.

§ *Name the three spring signs.*

A'-ri-es (*the Ram*), Taurus (*the Bull*), Gem'-i-ni (*the Twins*).

When does the sun enter Aries?

The third week of March.

Why is it so called?

Because it is the time when rams used to be allowed to run wild with the sheep.

When does the sun enter Taurus?

The 20th of April.

Why is the sign so called?

Because the bulls go to pasture at this season of the year.

CONSTELLATIONS.

When does the sun enter Gemini?

The third week of May.

Why is the sign so called?

Because it is the great mating season, when birds lay their eggs, &c.

Name the three summer signs.

Cancer (*the Crab*), Leo (*the Lion*), Virgo (*the Virgin*).

When does the sun enter Cancer?

The third week of June.

Why is the sign so called?

Because the sun having reached its furthest point north, goes *back* (like a crab).

When does the sun enter Leo?

The third week of July.

Why is this sign so called?

Because the heat rages like a lion.

When does the sun enter Virgo?

The third week of August.

What does Virgo represent?

The virgin "Plenty," with a basket of corn and fruit.

§ *Name the three autumn signs.*

Libra (*the Balance*), Scorpio (*the Scorpion*), Sagitta'rius (*the Archer*).

When does the sun enter Libra?

The third week in September.

CONSTELLATIONS.

Why is the sign so called?

Because the day and night are just equal, or exactly balance each other.

When does the sun enter Scorpio?

The third week of October.

Why is this sign so called?

Because it is the most unhealthy season of the whole year.

When does the sun enter Sagittarius?

The third week in November.

Why is the sign so called?

Because it is the shooting season.

§ *Name the three winter signs.*

Ca'-pri-cor'-nus (*the Goat*), Aqua'rius (*the Water-bearer*), and Pisces (*the Fishes*).

When does the sun enter Capricornus?

The third week of December.

Why is this sign so called?

Because it is a time of snow, and goats delight in snow.

When does the sun enter Aquarius?

The 20th of January.

Why is this sign so called?

Because it is the wettest season of the year.

When does the sun enter Pisces?

The 18th of February.

CONSTELLATIONS.

Why is this sign so called?

Because it is the time when fishermen loose their boats from winter quarters, and go to fish again.

How long does each sign continue?

For thirty days.

Repeat the verses given below, which tell the order of the twelve signs.

NORTHERN SIGNS.

The *vernal* signs the RAM begins,
Then comes the BULL, and then the TWINS ;

The CRAB in *June*, then LEO shines,
And VIRGO ends the northern signs.

SOUTHERN SIGNS.

The BALANCE brings *autumnal* fruits,
Then SCORPIO stings, the ARCHER shoots ;

Then comes the GOAT with *wintry* blast,
AQUARIUS next, the FISHES last.

DOUBLE AND MULTIPLE STARS.

We have not said much about the fixed stars, as we thought it better to keep chiefly to our own system in a book so elementary as this. We add this note to say that many stars are evidently *double*, and some are groups of three or more—in which case they are called *multiple* stars. It seems that one of the number is a centre round which the rest of the group revolves. Each double and each multiple star looks like only one single star to the naked eye, but the telescope shows what I have stated to be true.

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