FIRST LESSONS

ABOUT

NATURAL PHILOSOPHY,

FOR

CHILDREN.

PART FIRST.

By Miss MARY A. SWIFT,
PRINCIPAL OF THE LITCHFIELD FEMALE SEMINARY.

HARTFORD.
BELKNAP & HAMERSLEY.
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PREFACE.

At the time this little work was commenced, the author was teaching a few children; and no book on Natural Philosophy suited to their capacity was to be found. It was written for their benefit, and taught to them as it progressed.

The form of question and answer was used in the manuscript, and is retained as the simplest method of teaching children. It has been used in this form in several schools, and the satisfaction expressed by the children has induced the author to allow its publication.

LESSON FIRST.

In what town do you live?

In *

In what county?

In

In what state?

In the state of

Do you live on a continent or on an island?

On a continent.

What is a continent?

A very large portion of land, and larger than any island.

How many continents are there?

There are two continents.

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* Those teachers who make use of this little book, are requested to insert such names in the first lesson as the location of their pupils or schools may require.

What are these two continents called?

The eastern and western continents.

On which of them do you live?

On the western continent.

What is the western continent called?

It is called America.

How is America divided?

It is divided into North and South America.

In which do you live?

I live in North America.

In what country of North America do you live?

In the United States.

In what part of the United States?

In

LESSON SECOND.

In what hemisphere is America?

In the western hemisphere.

Then in what hemisphere do you live?

In the western hemisphere.

What is a hemisphere?

A hemisphere is half a sphere.

What is a sphere?

A sphere is a globe or ball.

Then what is a hemisphere?

It is a half globe, or half a sphere or half a ball.

Is an orange a sphere?

It is, because it is perfectly round like a ball.

If I cut an orange into two equal parts, what would each of those parts be called?

Half an orange, or half a sphere.

Would half of an orange be a hemisphere?

It would, and two halves of an orange would be two hemispheres.

How many hemispheres are there in a sphere?

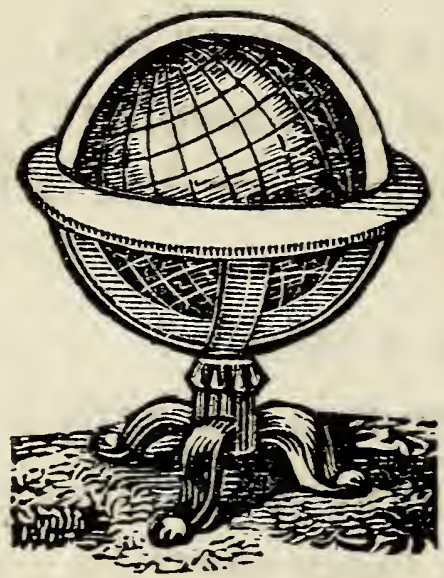
There are two.

Are there no more than two?

No: because two hemispheres make a sphere.

Could I not cut the orange in two, the other way, and make two halves of it?

You could, and these would be hemispheres too.



LESSON THIRD.

If I should make a mark around the middle of an orange without cutting it, would it divide the orange into two hemispheres?

It would; one side of the mark would be one hemisphere, and the other side would be another hemisphere.

What is the shape of the world in which we live?

It is round like a sphere or an orange.

Then how many hemispheres are there?

Two.

What are they called?

Eastern and western hemispheres.

Why are they called eastern and western?

Because the sphere or world is divided by a line that goes from the north pole to the south pole, and that part of the world east of

the line is called the eastern hemisphere, and the part west of the line is called the western hemisphere.

Could I not divide the world into northern and southern hemispheres?

You could.

How could I divide it?

By drawing the line round the other way, and make it go from east to west.

Then what would that part which is north of the line be called?

The northern hemisphere.

And what would the southern part be called?

The southern hemisphere.

In which of them do you live?

I live in the northern hemisphere.

Why do you live in the northern hemisphere?

Because I live north of the line that goes from east to west.

What is that line called?

It is called the equator.

But do you not live in the western hemisphere?

I do.

Why do you say you live in the western hemisphere?

Because I live *west* of the line that goes from the north to the south pole.

And why do you live in the northern hemisphere?

Because I live *north* of the line that goes around the world from east to west.

But are there four hemispheres?

There are only two. If you cut the orange in two, up and down, there will be two hemispheres; but I can cut the same orange in two the other way and make two hemispheres, an upper and lower hemisphere.

LESSON FOURTH.

WHAT is the shape of the world on which we live?

It is round like an orange.

How do you know it is round?

When the Moon was eclipsed, the shadow of the earth upon it was round like a ball.

Did you ever see an eclipse?

What is the shadow of this book like?

Like the book.

What is the shadow of a ball like?

It is like the ball.

Then if the shadow of the Earth on the Moon is round, what is the shape of the Earth?

It must be round.

What is this world called?

The Earth.

What is the Earth?

It is a planet.

What is a planet?

It is a dark body that goes around the Sun, and receives light and heat from the Sun.

Is the Moon a planet also?

It is.

Here is a beautiful hymn about the Earth, which you may learn.

The Earth.

"To our great Creator, our Father in heaven,
We would render our thanks for this home he has given;
His goodness has kept us—his bounty and care
Have crowned with rich blessings each swift-rolling year.
Home, home, sweet, sweet home,
This beautiful planet, the EARTH, is our home.

"And when all our days shall be ended below,
To a far happier world may each one of us go;
To the dear *heavenly* home of our Father above,
Where his children shall ever rejoice in his love.
Home, home, sweet, sweet home,
May this be our home, our glorious home."

LESSON FIFTH.

WHAT do you see when you look up into the sky?

In the day-time I see the sun; and in the evening, I see the moon and stars, when it is not cloudy.

Is the Earth surrounded by stars?

It is.

Can the people on the other side of the world see them?

They can when it is night there.

How do you know they can?

Because the stars are all around the world.

What is this like?

It is like an orange or an apple put into a bowl of water.

Is the water on all sides of the orange?

It is.

Are the stars above us in the day-time?

They are.

How do you know they are?

Some were seen at noon the day the sun was eclipsed.

Can you tell the name of one of them?

Venus was seen then.

Have you ever seen Venus?

I have sometimes seen it just after sunset.

When it is seen at that time what is it called?

It is called the *evening star.*

When is it called the *morning star?*

When it is seen before the sun rises.

How can you tell which star is Venus?

It looks larger than the other stars, and is very bright and beautiful.

Is Venus a planet?

It is.

Are all the stars planets?

They are not. Some stars are called planets, and some are called *fixed stars.*

Do the stars shine in the day-time?

They do.

Why can we not see them then as well as in the evening?

Because the light of the sun is so much brighter than their light is.

Do they do us any good in the day-time?

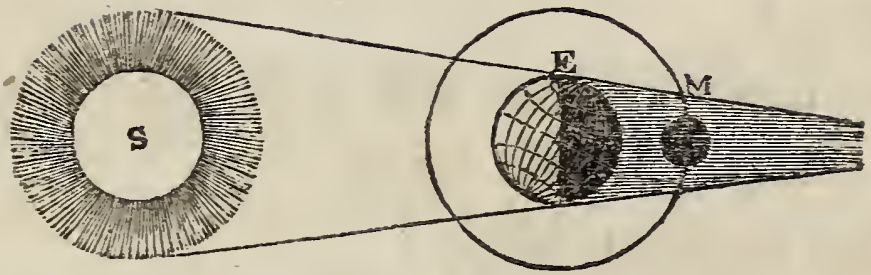
The stars do no more good than a lamp would when the sun shines.

"See, the light is fading
From the western sky;
Day, thou art departing,
Night is drawing nigh.

"Evening winds are breathing
Through the forest green;
Crimson clouds are wreathing
In the sky serene.

"See the stars appearing,
All around so bright;
Emblems, ever cheering,
Of eternal light."

LESSON SIXTH.



What caused the Moon to be eclipsed?

The Earth on which we live came between the Sun and Moon.

Could we not see the Moon?

We could see it, but it did not shine on us.

Why did it not shine; is it not a bright object?

It is not; it is dark like the earth.

Then what makes it shine?

The sun shining upon it makes it look light.

Can you explain how the Sun can make the Moon shine by shining upon it?

If I take the candle out of the room in the

evening, and leave the room perfectly dark, the looking-glass looks as dark as the other things in the room.

How will it be if you bring back the light into the room?

The looking-glass will look lighter than the other things. It will shine.

What makes it shine?

It throws the light of the candle back into the room.

When the looking-glass throws back the light that shines upon it, what do we say the looking-glass does?

We say the looking-glass *reflects* the light.

Then when the Sun shines on the Moon, what makes the Moon shine?

The Moon throws back, or *reflects* the light of the Sun; and this is what makes the Moon shine.

We do not see the Sun in the evening; and how can it shine on the Moon when we cannot see it?

If I place the candle in another room, so that it can shine upon the looking-glass when the door is open, I can see the looking-glass shine from every part of the room, though I do not stand where I can see the candle.

Now can you tell why we can see the Moon shine when we cannot see the Sun?

The world turns over every day, and when we are turned away from the Sun, the Sun can shine on the Moon, and we see the Moon shining when we cannot see the Sun.

Does the Sun shine on half of the Moon at the same time?

It does on that half which is toward the Sun.

When do we see all of that part of the Moon on which the Sun shines?

When the Moon is round, and the whole of it seems to shine.

What is the Moon then called?

It is called the *full Moon.*

Why do we not always see the *full Moon?*

Because sometimes a part of its bright side is turned away from us.

What is the *full* Moon?

We call the Moon a *full Moon*, when the whole of the bright part is towards us.

When is it called *new Moon?*

When in the evening we see but a little of that part on which the Sun shines, we call it the *new Moon.*

Is the Moon made new then every month?

It is not.

When was it made?

When God created the Earth.

How do you know?

The Bible tells us about it in the first chapter of Genesis.

Who made the Moon?

God made the Moon, and the Earth; and he made all things.

The Moon.

"Come, little children, all tell me
What high up in the sky you see,

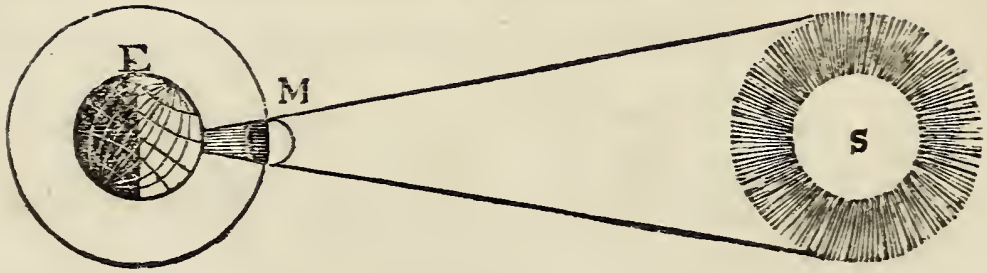
That shines so bright on you and me?
'T is, O 't is the Moon.

"Tell me, child, when you 're asleep,
And all around you quiet keep,
What does through your curtains peep?
'T is, O 't is the Moon.

"What shines when all is lone and still,
Except the little running rill
That turns the wheel of yonder mill?
'T is, O 't is the Moon.

"Sweetly singing in the vale,
To whom, pray, does the nightingale
Tell her little lonely tale?
'T is, O 't is the Moon."

LESSON SEVENTH.



WHAT caused the eclipse of the Sun?

The Moon moved between the Earth and the Sun, and hid a part of the Sun from us.

Why did it not hide all of the Sun?

Because the Sun is very much larger than the Moon.

How did the Sun look when it was eclipsed?

It looked as if there was a dark round spot upon it.

What makes the *day* and the *night?*

The light of the Sun makes the day, and when the Sun does not shine it is dark, and we call it night.

But does not the Sun shine all the time?

It does, but we do not see it all the time.

Why do we not see it?

The Earth turns over every day, and one part of the time the Sun shines on one part of the world, and we call it *day;* and when we are turned from the Sun, it does not shine on us, and it is dark, and we call it *night.*

When we are turned from the Sun, on which part of the Earth does the Sun shine?

On the opposite side of the Earth, and then it is day there, but it is night on the side where we are.

Does the Sun *rise* and *set* every day?

It appears to, but it does not. We cannot see the Sun move at all.

Then why does it appear to rise every morning, and set every evening?

It is because the Earth turns over every day, and sometimes we are turned towards the Sun, and sometimes we are turning away from it.

Can you explain why the Earth seems to stand still, and the Sun seems to move?

When I am riding very rapidly in a carriage, the houses, fences, and trees seem to be going swiftly past me, while the carriage seems to stand still. So the Earth moves round so rapidly that the Sun seems to be going round the Earth, while the Earth seems to stand still.

Which way does the Sun appear to move?

From east to west.

What makes it appear to move from east to west?

The Earth turning from west to east.

Which way are we turning in the morning?

Towards the Sun.

And which way are we turning at night?

Away from the Sun.

If the earth did not turn over at all, how would the Sun appear to us?

It would appear to stand still.

Would there be any night then?

There would be none to us, if we were turned towards the Sun.

How would it be to people on the other side of the Earth, away from the Sun?

It would always be night.

Did people ever think the Earth stood still, and the Sun, Moon and stars moved around it?

Those who lived a great many years ago thought so.

The Sun.

"What is it looks so very bright,
And quick dispels the dusky night,
Shedding around a cheerful light?
It is the glorious Sun.

"What is it that appears at dawn,
And dries the dewy mists of morn,
And ripens all the fruits and corn?
It is the glorious Sun.

"What gives the fragrance to the flower,
And paints the rainbow on the shower,
An emblem of almighty power?
It is the glorious Sun."

LESSON EIGHTH.

How often does the Earth turn over?

Once in twenty-four hours.

How can you tell?

Because from sunrise yesterday, till sunrise to-day, there were twenty-four hours; and from yesterday noon till noon to-day, there were twenty-four hours; and from sunset last night till sunset to-night, there are twenty-four hours.

What is a day?

Twenty-four hours.

How many days are there in a week?

Seven.

How many weeks are there in a year?

Fifty-two.

How many months are there in a year?

Twelve.

How many days are there in a year?

Three hundred and sixty-five.

What months are called Spring?

March, April, and May.

What months are called Summer months?

June, July, and August.

Which are the months of Autumn?

September, October, and November.

And which are the Winter months?

December, January, and February.

Which is the first month in the year?

January.

Which day is called New-Year's Day?

The first day of January.

What makes the year?

The Earth going round the Sun once.

Then how often does the Earth go around the Sun?

Once in a year.

And how often does it turn over?

Every day.

What is turning over called?

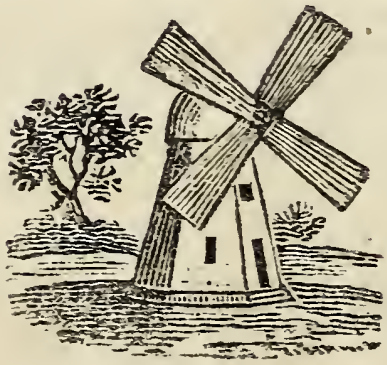
Revolution.

Then how many *revolutions* has the Earth?

It has two revolutions.

What are they?

One is its turning over every day, and the other its going round the Sun once a year.



LESSON NINTH.

Is the Sun useful to us?

It is very useful.

In what way is it useful?

It gives us light, so that we can see, and it makes us warm.

In what other way is it useful?

It warms the Earth and makes the plants grow.

What gives the flowers their beautiful colors?

The *light* of the Sun.

What ripens the grain and fruit?

The *heat* of the Sun.

Can you tell one color from another in the dark?

I cannot.

Is every thing black in the dark?

It is.

How do you know?

If I go into a room that is perfectly dark, I cannot distinguish one color from another.

Suppose I let in a little light?

The colors begin to be seen very faintly.

If I make it quite light how will they appear?

The colors will be very distinct.

When the room is perfectly dark, how do you know there are no colors in it, though you cannot see them?

If it is light that makes colors, then where there is no light, there can be no colors.

Then the Sun gives you pleasure, does it not?

It does. This world would be a very dismal place without the Sun.

Does the light produce many colors?

It does very many indeed.

Are some colors made by putting other colors together?

They are: yellow and blue when mixed to-

gether make green; and blue mixed with red makes purple.

Can you tell what makes the light?

It comes from the Sun.

Has a ray of light ever been separated?

It has been separated into different colors.

Into how many colors has a ray of light been separated?

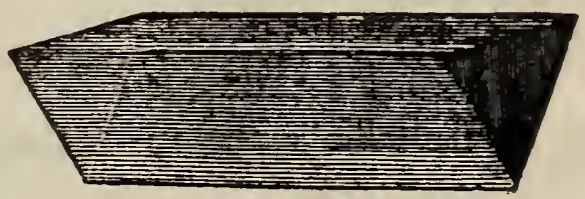
Seven, like the colors of the rainbow.

What were those colors?

Violet, indigo, blue, green, yellow, orange, and red.

How were they separated?

By a prism.



What is a prism?

A prism is a three-sided piece of glass.

On the opposite page is a *prism* with a *ray*

of light passing through it, and separating it into seven colors,—and also a *rainbow.*

What makes the rainbow?

The Sun shining through the drops of water while they are falling makes the rainbow.

How do the drops of water help to make the rainbow?

Each drop of water is like a little prism, and separates the light of the Sun when the Sun shines through the drop.

Can a rainbow be seen when there is no water falling?

It cannot.

Do you ever see a rainbow when it rains, unless the Sun shines bright?

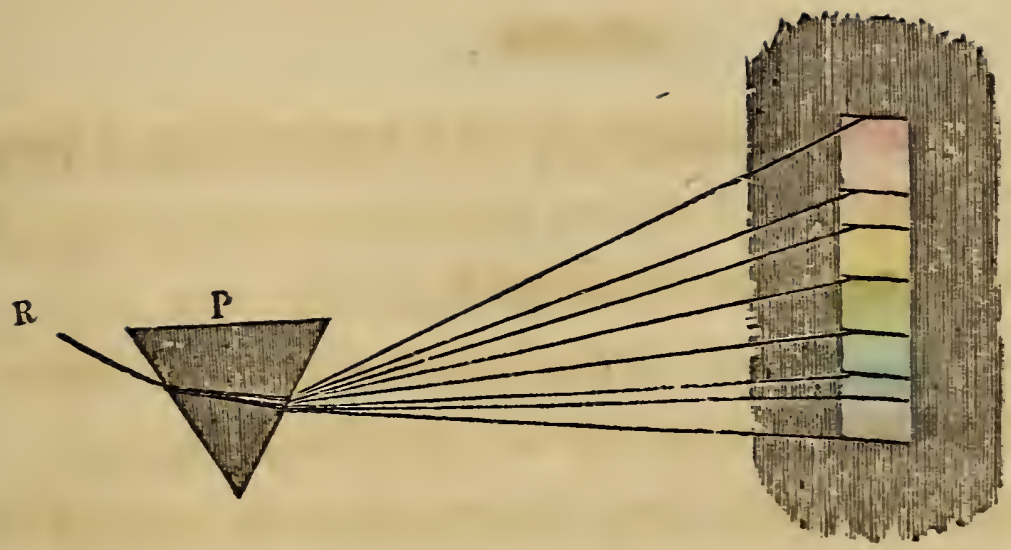
I do not.

Then what two things are necessary to make a rainbow?

A bright *sunshine* and a *shower.*

Why is the rainbow so beautiful?

It has beautiful bright colors, a splendid arch,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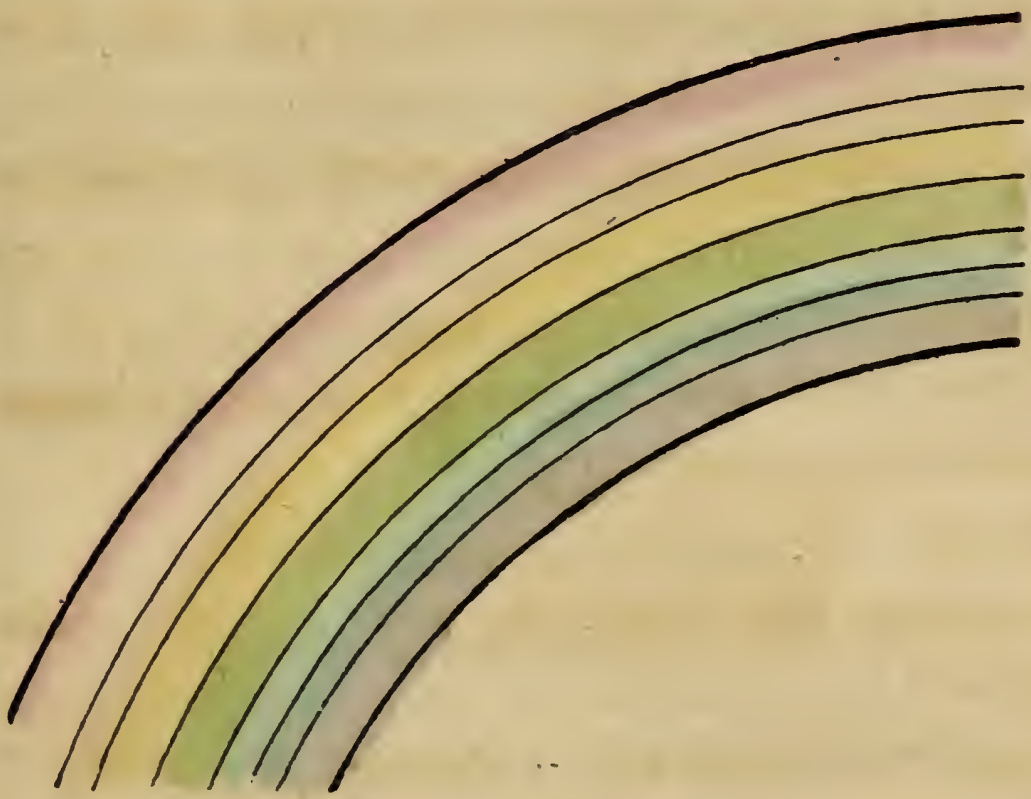


and when we see it, we remember the promise which God made to Noah, that he would not drown the world again.

Why does the *rainbow* make you think of that promise?

Because God said that the bow in the cloud should be a sign that he would never drown the world again.

Then when we see the rainbow, is it not as if God was speaking that promise to us?

It is; and it should make us very happy, and grateful to our heavenly Father for such kindness to us, whenever we look at the rainbow in the cloud.

The Rainbow.

Emblem of happiness!
Where is thy dwelling-place?
Where dost thou wander, and why art thou here?
Dost thou exultingly
Spread thy broad canopy,
Calming the spirits of mortals that fear?

Whence is thy origin?
Is it from forests green,
Where nature doth smile in the beauty of Spring?
No: my glories I borrow not
From mountain or cooling grot—
From a hand far more worthy my lustre I bring.

From whence dost thou come then?
From a cavern or woody glen,
Where the dark waters dash o'er the rocks so sublime?
No: not from a dismal den,
Not from a gloomy glen—
I came from the hand of a power most Divine.

Thou smile of thy Maker's face!
The *cloud* is *thy* dwelling-place,
The dark cloud that threatens a deluge of rain;
But encircling the lowering brow,
On trembling man smiling now,
Bid'st peace and tranquillity ever remain.

LESSON TENTH.

CAN you think of any other way in which the Sun is useful to us?

I can; it would not *rain* if the Sun did not shine.

Why would it not?

The Sun warms the water in the brooks, and rivers, and seas, and makes it rise into the air.

What is this like?

It is like the steam or vapor that comes from the tea-kettle, when the fire heats the water in it.

What becomes of the water that rises up into the air?

The little particles of water-like vapor make the Clouds that we see in the air.

What becomes of the Clouds?

When there is much water in them, they become heavy and fall down.

What do we call them when they fall?

We call the water Rain.

What is Snow?

Snow is frozen vapor.

What is Hail?

Hail is frozen drops of water.

Why is hail heavier than snow?

Frozen drops of water are heavier than very small particles of water are when they are frozen.

You said the water rose out of rivers when the Sun warmed them; can you tell how rivers are formed?

When it rains, some of the water sinks into the ground.

Where does it go when it has sunk into the Earth?

The drops trickle through the earth, and meet other drops that are trickling through the earth, and these run together and form a little stream under ground.

What becomes of the little stream?

It runs along under ground, till it comes to other little streams, and they run together and make a larger stream.

And where does it go?

When it comes to a bed of *clay* it stops.

Why does *clay* stop its course?

Because water cannot run through clay.

When the water has filled up the basin made by the clay, and continues to rise, what becomes of it?

It bursts out at the top of the ground.

What is it called when it bursts out of the ground?

It is called a *spring* of water.

When the water runs along from the spring, what does it make?

A little brook.

Where does the brook run?

It runs along till it meets other little brooks, and they run together and make a larger one,

and it grows larger and larger, till it becomes a great river.

And where does the river go?

It runs to the great ocean.

The Water.

"What is it that glitters so clear and serene,
And dances delightful in billows so white;
Ships sailing over the surface are seen?
'T is Water that glitters so shining and bright.

"Sea-weeds are winding in cavities wet;
Near them, so shining, the pearl-oysters sleep.
Fair shells of yellow, and amber, and jet,
Mingling with coral, grow bright in the deep.

"Now it comes roaring along from the hill,
Sparkling and dashing in foam down the steep;
Then in the valley, it roars through the mill,
Winding and whirling in many a sweep.

"Clouds, blown about in the chilly blue skies,
Stores of invisible water contain;
White in the snow-flake, in winter it flies,
Mild in the summer, in dew-drops and rain.

"When the sunbeams on falling drops shine,
God bends the rainbow to brighten the shower;
Brilliant in colors, this beautiful sign
Tells us the water shall drown us no more."

LESSON ELEVENTH.

WHAT do we breathe?

We breathe the air.

Where is the air?

It is above us, and all around us?

By what other name is the air called?

It is called the atmosphere.

Is the air or atmosphere dry?

It is far from being dry.

How do you know it is not dry?

The vapor is rising from the rivers and seas, and from the moist earth, all the time; and this vapor fills the air we breathe.

Why do we not see these watery particles in pleasant weather?

Because they are so very small.

When does the air or atmosphere contain most moisture, in cloudy or in fair weather?

In fair weather.

How do you know it does?

Because when the Sun shines brightest, it warms the water in the rivers most, and there are a greater number of particles of water rising into the air.

Why does not the air appear as moist in fine weather, as it does in cloudy weather?

Because the particles of water in the air are so very small.

But when the Sun sets, it stops warming the water on the earth and in the rivers, and what becomes of the vapor in the air then?

Some of it rises high into the air and forms clouds, and some of it falls to the earth, and we see it on the leaves and grass.

What do we call it, when it is on the leaves and grass?

We call it dew.

On a fine winter morning, we see little particles in the air like ice: can you tell what they are?

They are the little particles of vapor frozen by the cold.

Now can you tell what frost is?

Frost is frozen dew.

When does it freeze?

While it is falling to the earth.

The Frost.

"The Frost looked forth one clear cold night,
And he said, 'Now I shall be out of sight,
So through the valley and over the height,
In silence, I 'll take my way.
I will not go on like that blustering train,
The wind and the snow, the hail and the rain,
Who make so much bustle and noise in vain,
But I 'll be as busy as they.'

"So he went to the mountain and powdered its crest,
He climed up the trees, and their boughs he dressed
With diamonds and pearls; and over the breast
Of the quivering lake he spread
A coat of mail, that it need not fear
The downward point of many a spear,
That he hung on its margin far and near,
Where a rock might rear its head.

"He went to the windows of those who slept,
And over each pane like a fairy crept;
Wherever he breathed, wherever he stepped,
By the light of the Moon were seen
Most beautiful things. There were flowers and trees,
There were bevies of birds, and swarms of bees,
There were cities, thrones, temples, and towers, and these
All pictured in silver sheen.

"But one thing he did that was hardly fair,—
He went to the cupboard, and finding there
That all had forgotten for him to prepare,
'Now, just to set them a thinking,
I'll bite this basket of fruit,' said he,
'This bloated pitcher I'll burst in three,
And this glass of water they've left for me
Shall "tchick" to tell them I'm drinking.'"

LESSON TWELFTH.

You have told of several ways in which the Sun is useful to us; can you think of any other good it does?

O! yes: the *wind* would never blow if there were no Sun.

Why would it not?

The Sun heats the air, and when air is hot it rises higher and higher till it becomes cold again.

What makes warm air rise?

When the air becomes warm, it is lighter, and because warm air is lighter than cold air, it rises.

When it rises, what fills the place the hot air leaves?

The cold air that is around it rushes into the place, as fast as the hot air rises.

While the hot air is rising and the cold air rushing in, what do we say?

We say the wind blows.

Then what is wind?

Wind is moving air.

When the Sun shines very hot, how does the air rise?

It rises very fast indeed.

Then what does the cold air do?

It rushes in very rapidly all around the place.

And what do we say then?

How very hard the wind blows!

Does the wind always blow hardest in the hottest days in summer?

It does not. Sometimes, in very hot weather, we have no wind at all.

Why is there no wind?

The wind blows only when one part of the atmosphere is heated more than the rest; and when all parts are equally hot, there is no cold air to come in.

But why is there so much more wind in winter than in summer?

The air at the Equator is always hot; and when it rises, the cold air from the north, in winter, rushes toward the Equator, more rapidly than in summer.

What makes the north-west wind so cold?

It is the cold air coming from the cold country far away north-west of us, where it is always colder than it is here.

What makes the chilly north-east wind?

The north-east wind is the air coming from the cold Atlantic ocean north-east of us; and it blows the clouds or the vapor from the ocean with it.

What makes the south wind so much warmer than the other winds?

The south wind is the warm air coming from warm countries south of us.

If you were in South America, in the United Provinces, what wind would be the coldest?

The south wind.

Why would it be the coldest?

Because it comes from the cold ocean, near the cold south pole.

Which wind would be the warmest?

The north wind.

Why would the north winds be warmest?

Because they come from hot countries near the Equator.

Where is the hottest place on the earth?

It is hottest where the Equator is.

Why is it hottest there?

The Sun always shines straight down on the Equator, and it does not on any other part of the world.

The Wind.

"Whence does the wind come, and where does he go?
He rides o'er the water, and over the snow;
Through wood and valley, and o'er rocky height,
He moans in the morning and bellows at night.

"O'er us he 's bending the leaves on the tree;
But how he can bend them, no mortal can see;
He heaps up the water in billows so high,
They near reach the clouds which he rolls through the sky.

"Suddenly stopping in some cunning nook,
He rings a sharp larum,—but if you should look,
Nothing remains when he quits his resort,
But a heap of dry leaves he has gathered in sport.

"Let him howl o'er us; he 'll do us no harm,
For round a good fire we 're social and warm;
Cheerful we 'll read, till the evening is past,
All guarded and safe from the wind's chilling blast.

"Then we 'll to bed go, and when we are there,
He will do as he pleases, and what shall we care?
He may knock at the door, but we 'll not let him in;
If he drive at the window, we 'll laugh at his din."

LESSON THIRTEENTH.

When you have been by the sea-side, you have felt the wind blow in the morning and evening, regularly; do you know what these winds are called?

People always call them *sea-breezes.*

Can you tell what sea-breezes are?

They are the cool air coming from the sea, at evening; and the cool air going from the land, in the morning.

When the wind blows from a hot desert, like the desert of Sahara, would the wind be cool or hot?

It would be very hot indeed.

Do you know what these desert winds are called?

Simoon or Samiel.

What is a Hurricane?

A hurricane is a most violent wind, that often does great injury by blowing down trees and houses.

Now can you tell what good the wind does?

It makes us very cool and comfortable in the summer.

Does it do any more good that you know of?

It blows off bad air from places where there is dreadful sickness.

What is one of the greatest uses of the wind?

It blows the ships over the sea from one country to another, so that the people can go from one country to another.

Does it ever injure these ships?

It does. Sometimes the wind blows up the waves as high as mountains, and they break over the ship; and then it tosses the poor ship furiously against the rocks, and dashes it into pieces, and the miserable people in it are all drowned.

Who contrived this wonderful plan to purify

the air, and to help people to go from one country to another across the great ocean?

God, our heavenly Father, was the great Contriver.

How should we feel, when we see the wonderful things God has contrived?

We should admire, and love, and adore him.

Can you repeat what the Psalmist said about the works of the Lord, in the one hundred and seventh Psalm?

Verse 23. They that go down to the sea in ships, that do business in great waters;

These see the works of the Lord, and his wonders in the deep.

For he commandeth and raiseth the stormy wind, which lifteth up the waves thereof.

They mount up to heaven, they go down again to the depths; their soul is melted because of trouble.

They reel to and fro, and stagger like a drunken man, and are at their wit's end.

Then they cry unto the Lord, and he bringeth them out of their distresses.

He maketh the storm a calm, so that the waves thereof are still.

Then they are glad because they be quiet, so he bringeth them into their desired haven.

O that men would praise the Lord for his goodness, and for his wonderful works to the children of men!

LESSON FOURTEENTH.

You have now proved that the Sun is very useful to us; can you repeat some of the ways in which it is useful?

It gives light and heat.

And what good does the *light* of the Sun do us?

It makes all the beautiful colors, and helps us to see them.

And what good does the *heat* of the Sun do us?

It warms the earth, and makes the plants grow; and it warms the air, and makes the wind blow; and it warms the water in the rivers and seas, and makes it rise into the air and form clouds.

What good do the clouds do us?

They fall in rain and water the earth, and make the springs, and brooks, and rivers.

If there were no Sun, would there be any rain or dew?

There would not.

Would there be any brooks and rivers?

Only for a short time.

Why would there not be rivers and brooks?

The springs would soon be dry, and the brooks would run into the rivers, and the rivers into the ocean, and there they would always remain.

Then what would happen to the earth?

The plants and grain would wither and die, and the people would soon die of hunger and thirst.

Who made the glorious Sun to be useful to us?

Our Father in heaven; and surely we ought to thank him, for giving the useful and glorious Sun to us.

Did God make the Earth, and Moon, and stars also?

He did. He has made our evenings very

beautiful, by setting the Moon and stars in the blue sky.

Has God made any thing which we cannot see?

He has made very many things that we cannot see.

Can you tell me of any thing God has made that you cannot see?

He has made a great many other worlds that I cannot see.

Why can you not see them?

Because they are so far above us in the sky.

Then how do you know there are any such worlds, if you have not seen them?

Other people have seen them.

How could they see them?

Through glasses made on purpose.

What are such glasses called?

They are called telescopes.

Can you mention the names of any stars that we see in the sky?

We can see Jupiter, Venus, and Mars, almost every pleasant evening.

And what other stars can be seen through a telescope?

Mercury, Saturn, and Herschel.

Are these stars planets like the Earth?

They are, and they are so much like the Earth in many things, that it is thought people live on them.

Hymn.

"The spacious firmament on high,
With all the blue ethereal sky,
And spangled heavens, a shining frame,
Their great Original proclaim.
Th' unwearied Sun, from day to day,
Does his Creator's power display,
And publishes to every land
The work of an Almighty hand.

"Soon as the evening shades prevail,
The Moon takes up the wondrous tale,
And nightly, to the listening Earth,
Repeats the story of her birth;

Whilst all the stars that round her burn,
And all the planets in their turn,
Confirm the tidings as they roll,
And spread the truth from pole to pole.

"What though in solemn silence all
Move round this dark terrestrial ball!
What though nor *real* voice nor *sound*
Amid their radiant orbs be found!
In *reason's* ear they all rejoice,
And utter forth a glorious voice,
Forever singing, as they shine,
'The hand that made us is divine.'"

LESSON FIFTEENTH.

How many planets are there moving round the Sun?

Seven.

What are their names?

Mercury, Venus, Earth, Mars, Jupiter, Saturn, and Herschel.

Which planet is nearest the Sun?

Mercury.

How long is Mercury in going round the Sun?

Eighty-seven days.

Then how long is Mercury's *year?*

Only eighty-seven days.

Which planet is next nearest the Sun?

Venus, the beautiful *evening star.*

How often does Venus go around the Sun?

Once in two hundred and forty-four days and seventeen hours.

Then how long is Venus' *year?*

Venus' year is two hundred and forty-four days and seventeen hours.

Which planet is next nearest the Sun?

The Earth, and it has a beautiful Moon.

Is it the planet on which we live?

It is; the planet Earth is *our* world.

How long is the Earth in going round the Sun?

Three hundred and sixty-five days, five hours, and forty-nine minutes.

Then how long is the Earth's *year*?

The Earth's year is three hundred and sixty-five days, five hours, and forty-nine minutes.

What planet is next to the Earth?

Mars.

How does Mars look?

Mars looks very red and fiery.

How long are the years of Mars?

They are six hundred and eighty-seven days.

What planet comes next to Mars?

Jupiter, a very large and beautiful star.

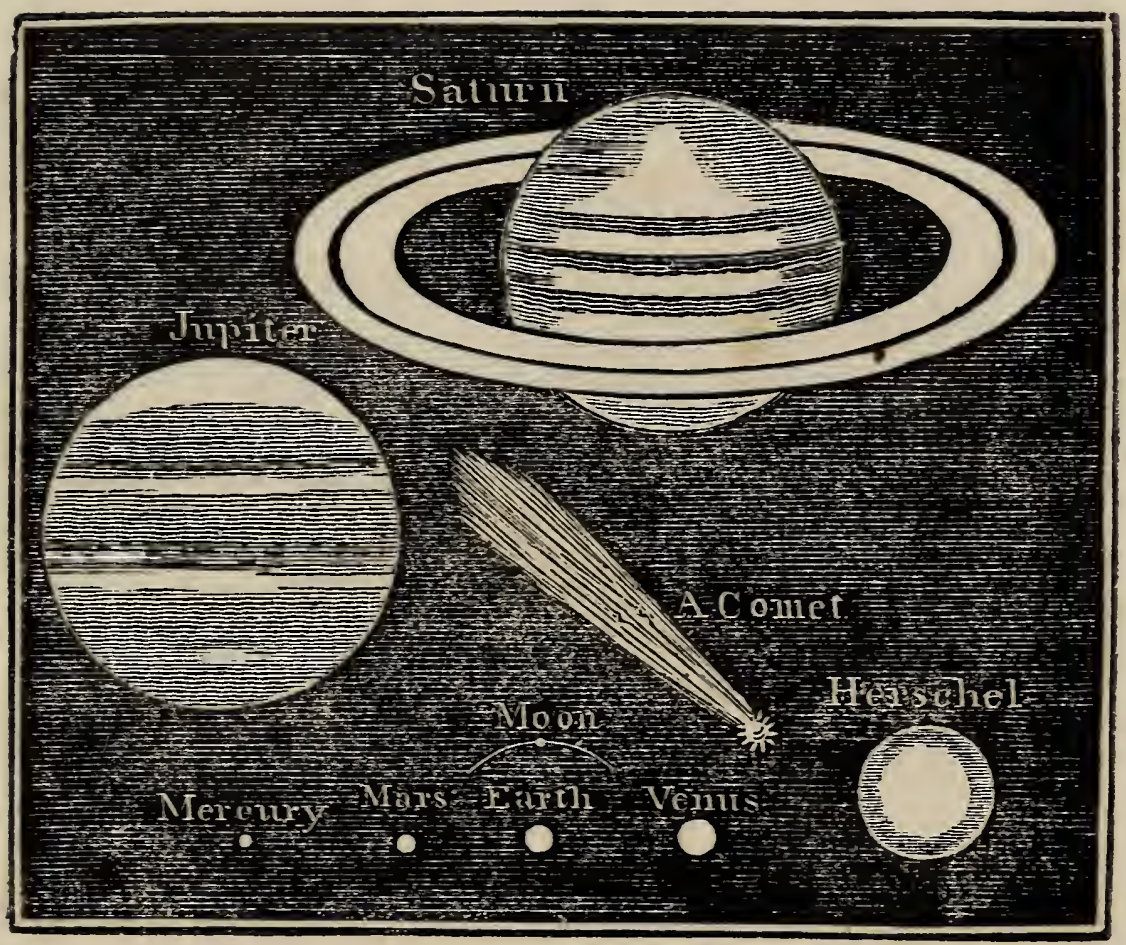
Has Jupiter any moon?

Jupiter has *four* moons.

Do you not think her evenings are very delightful with *four moons*?

How long is Jupiter's *year*?

Nearly *twelve* of *our* years, and the days are only *ten hours* long.


Saturn
Jupiter
A Comet
Herschel
Moon
Mercury
Mars
Earth
Venus

What planet is next to Jupiter?

Saturn.

Can you say any thing interesting about Saturn?

Saturn has a broad ring set edgewise around it, and this ring *shines* like the Moon.

What makes it shine?

The Sun shines on one side of the ring almost *fifteen years*, and then on the other side as long.

Then how many *days* does Saturn have in *thirty years?*

Only *one* day and *one* night.

How long is Saturn's day?

Saturn's day is almost *fifteen years* long.

How long is Saturn's night?

It is almost *fifteen years* long.

Has Saturn any moon?

Saturn has seven *moons*, and its evenings must be very bright and pleasant.

How long is Saturn in going round the Sun?

Nearly *thirty* of *our years.*

Which planet is last and farthest from the Sun?

The planet Herschel.

Can you tell why it is called Herschel?

Because Doctor Herschel first saw it through his great telescope.

How long is Herschel's year?

Herschel's year is *eighty-four* of our years.

How many *moons* has Herschel?

Herschel has *six* moons.

Which is the *smallest* planet?

Mercury is the smallest planet.

Which is the *largest?*

Jupiter is the largest planet; it is twelve hundred times larger than the Earth.

Which planets are smaller than the Earth?

Mercury and Mars.

Which planet is about as large as the Earth?

Venus.

Which planets are larger than the Earth?

Jupiter, Saturn, and Herschel.

LESSON SIXTEENTH.

HAVE any other planets been seen, besides those seven which you have mentioned?

There are *four small* planets very near each other, between Mars and Jupiter.

What are they called?

They are called Asteroids, or the *little stars*.

Are not *moons* planets?

They are *small* planets.

By what names are the *large* planets distinguished from the *moons?*

The large planets are called Primary Planets.

What are the moons called?

The moons are called Secondary Planets.

Why are the large planets called primary planets?

Because they move round the Sun.

Why are the moons called *secondary* planets?

Because they move round the *primary* planets.

Is the Earth a primary or secondary planet?

The Earth is a *primary* planet.

Why is it a primary planet?

Because it moves round the Sun.

Is our Moon a primary or secondary planet?

The Moon is a *secondary* planet.

Why is the Moon a secondary planet?

Because it moves round a primary planet.

What primary planet does our Moon move around?

It moves around the Earth.

Do the moons keep moving around their planets, while the planets are going around the Sun?

They do; and in this way the moons have two motions.

What are these two motions?

One is their motion around their planets, and the other is their motion with their planets, around the Sun.

What are the Fixed Stars?

The Fixed Stars are those stars which appear to be fixed in one place, and are not known to move.

How can we tell the fixed stars from the planets?

The fixed stars shine with a *twinkling* light, and the planets do not.

What are the fixed stars supposed to be?

They are supposed to be suns, like our Sun.

Why do they look so small?

Because they are so very far above us in the sky.

Can all the stars be seen with telescopes?

It is supposed that only a few of them can be seen, even with telescopes.

Why can they not be seen with telescopes?

Many of them are too far off to be seen even with telescopes.

Can we tell how many stars there are?

We cannot; for there may be thousands, and

millions, and millions of stars, too far off to be seen by us.

What are Comets ?

They are planets.

Do they look like other planets ?

They do not. They appear to have a long flaming trail on one side.

Do they move around the Sun regularly like the other planets ?

They do not; they sometimes come very near the Sun, and then they go a great distance from it.

Can you tell what the Milky Way is ?

It *looks* like a very light place in the sky in the evening, a little like a long white cloud.

What is it supposed to be ?

It is thought to be a great many millions of *fixed stars* near each other.

Is it not delightful to look at the Milky Way, and think how many suns and worlds may be so near together ?

It is; and when we think about that wonderful Hand that made them all, and put them in their places, it is much more delightful to look at them.

Is it not very proper to call such a great, and powerful, and wise Being, "ALMIGHTY GOD?"

It is; for none but an Almighty God could do such mighty works.

Hymn.

"The Lord our God is *full* of might,
The winds obey his will;
He speaks, and in his heavenly height
The glorious Sun stands still.

"Rebel, ye waves, and o'er the land
With threatening aspect roar;
The Lord uplifts his awful hand,
And chains you to the shore.

"Ye winds of night! your force combine;
Without his high behest,
Ye shall not in the mountain pine
Disturb the sparrow's nest."

LESSON SEVENTEENTH.

WHAT causes the water to rise into the air and form clouds ?

The Sun warms the water and makes it rise.

What makes the beautiful Rainbow ?

The Sun shining through the falling drops of water.

But does not God make the clouds and the rainbow ?

He does ; but he makes use of one thing to make another.

In what way ?

He makes the clouds, but he uses the Sun to warm the water first.

Then what does God make use of to form clouds ?

He uses the heat of the Sun, and the water.

When God uses one or two things to make another thing, what do we say he does ?

We say that God uses *means*.

Then what *means* does God employ to make clouds ?

The heat of the Sun and water.

In making the rainbow, what does God use ?

He uses the light of the Sun and the drops of water.

Then what *means* does God employ in making the rainbow ?

The light of the Sun and the drops of water.

Can you tell what means God employs to keep the planets in their places, and in making them move around the Sun, without coming against each other ?

God has given the Sun the power of drawing the planets to itself.

Then what prevents them from being drawn to the Sun ?

God has given the planets also the power of flying away from the Sun.

What prevents them from flying quite away from the Sun ?

The Sun's power of drawing them to itself.

Can you tell what this power of drawing the planets to the Sun is called?

It is called Centripetal force.

What is the meaning of *centripetal?*

Seeking the centre.

And what does *force* mean?

Power or ability to move.

Then what does *centripetal force* mean?

The power of moving *to* the centre.

What is the centre to which the planets are drawn?

The Sun.

What do you mean by the *centre* of a body?

The *middle point* of a body is its centre.

What is the centre of a circle?

A point in the middle of a circle is the centre of the circle.

When the Sun draws the planets to itself, what is it said to do?

We say the Sun *attracts* the planets.

What is meant by Attraction?

Drawing any thing.

What is that power called that makes the planets fly from the centre?

It is called Centrifugal Force.

What is the meaning of *centrifugal?*

Flying from the centre.

Then what is meant by *centrifugal force?*

The power of flying *from* the centre.

If the Sun draws or attracts the Earth to itself, and the Earth at the same time seems to try to fly from the Sun, how would the Earth move?

It would move round the Sun, because it could not go *to* the sun, nor go *away* from it, but would continue to move all the time.

Can you explain it?

If I take an apple, and tie a string to its stem, and then take hold of the other end of the string and whirl the apple round, it will show how the Earth moves round the Sun.

Which represents the Earth?

The apple.

And which represents the Sun?

My hand.

What does the string represent?

It represents the drawing or *attraction* of the Sun.

If you let go of the string, what will become of the apple?

It will fly off in a straight line.

What prevents the apple from flying off while you are whirling it?

My hand holds it by the string, just as the Sun keeps the Earth from flying off.

Why does not the apple fall to your hand while you are whirling it?

The power that makes it fly off, like the centrifugal force, keeps it from falling.

LESSON EIGHTEENTH.

While you were whirling your apple, when it flew off how far did it go in a straight line?

But a little way before it fell to the ground.

What made it fall?

The Earth, as well as the Sun, has the power of drawing or attracting bodies to itself—and it attracted the apple.

When the Earth attracts bodies, what is its attraction called?

The Attraction of Gravitation.

What is meant by *attraction of gravitation?*

The power which large bodies have of drawing smaller bodies to themselves.

Do *all* large bodies attract smaller ones?

They do.

Then if I let go of this book, why does it fall to the floor, instead of falling to the table?

The Earth is so much larger than the table, that the attraction of the Earth is much greater than that of the table.

When I throw a ball into the air, why does it not stay there?

Because the Earth attracts it to itself.

When an apple is broken from the stem, what makes it fall to the ground?

The *attraction* of the Earth.

And what is this *attraction* of the Earth called?

The *attraction of gravitation.*

Then what makes the apple fall to the ground?

The *attraction of gravitation.*

Who found out what makes an apple and every thing else fall to the Earth?

Sir Isaac Newton.

Where did he live?

In England.

How came he to find it out?

When he lived in London, there was a terrible disease, called the Plague, raging in the city,

and very many people died of it. He went out of the city to escape the plague. One day he was sitting in an orchard, and he saw an *apple fall* from the tree. He then tried to think what *made* it fall. After studying and thinking hard, he at last found out that *great* bodies *attract small* ones. The Earth is larger than any thing on it, and of course it ATTRACTS every thing to *itself.* This is what made the apple fall. Afterwards, he found that the Sun was larger than the Earth or the planets, and of course it draws or ATTRACTS them all; and this is what makes the planets move round the Sun.

LESSON NINETEENTH.

Did you not say that the Earth attracted every thing that is upon it to itself?

I did.

Why then do we not see the trees and houses fall down to the ground?

Because God has given the little particles of matter the power of sticking together.

What is this power called?

Attraction of Cohesion.

What does *cohesion* mean?

Sticking together.

Then what is meant by *attraction of cohesion?*

The power which *little particles* have of *sticking together.*

And what is the *attraction of gravitation?*

The power which the Earth has of drawing bodies to itself.

To the particles of wood attract each other?

They do, all of them.

Do the particles of stones attract each other?

They do.

Do the particles of leaves and grass attract each other?

They do; and so do the particles of fruit.

Do the particles of *all* bodies attract each other?

They do; but the particles of some bodies do not attract each other as *strongly* as the particles of some other bodies do.

Can you mention some bodies, whose particles do not attract each other as *strongly* as the particles of some other bodies do?

The particles of *fruit* do not attract each other as strongly as the particles of *wood;* and the particles of *wood* do not attract each other as strongly as the particles of *iron* and *stone* do.

How can you find out what bodies have the *greatest* cohesive attraction?

By trying to break them or pull them apart.

Which has the *strongest cohesive attraction*, cotton or sponge?

The sponge.

How do you know it has?

I have to pull harder to tear the sponge, than I do to pull apart the cotton.

Which has the *strongest cohesive attraction*, chalk or marble?

The marble.

How do you know that the marble has the *strongest* cohesive attraction?

Because I can easily crumble the chalk, but I cannot break the marble.

Which has the *strongest cohesive attraction*, this paper or wood?

Wood has stronger *cohesive* attraction than paper.

How do you know it has?

I can tear the paper very easily; but I should have to try very hard to break a board or a stick of wood.

Why do you have to try harder to break the wood, than to tear the paper?

Because the *particles* of wood *stick closer* together than the particles of paper do; the *particles* of wood have *greater cohesive attraction* than the particles of paper have.

Can water be made into a table or chair?

It cannot unless it is frozen.

Why can it not?

It would all run away on the ground, because the *particles* of water *attract* each other only a *very little* indeed.

Do they attract each other *at all?*

They do.

How do you know that they do?

When I dip my finger into water, a drop will stay on the end of my finger.

What makes it stay?

The little *particles* of water *attract* each other, and my finger *attracts* them too.

Cannot water in some way be made to stand up like wood or stone?

It can be made to stand like wood or stone when it is frozen, just as well as wood can.

Can you mention any thing that has been made of frozen water?

Catharine, the empress of Russia, had an *ice palace* built for her. It was built of ice instead of wood. Instead of nailing the pieces together, the workmen dashed water on to the places where the pieces were put together. And the water froze them together very hard and strong. When the palace was finished, they made the furniture of ice. Ice chairs and ice tables; ice fire-places and ice sofas; and a beautiful ice throne. Then they colored some water green, and some red, and a great many other colors, and froze it, and made beautiful wreaths of flowers around the icy rooms. All was ice within and without the palace. In the evening, when they made fires in their icy fire-places, and lighted the candles in their

icy candlesticks; when they hung their icy lamps from the icy walls, and the bright light shone around on the icy furniture and icy flowers, it was a brilliant scene. The ice was clear and sparkling like precious stones; and the palace looked as if it were made of millions of costly diamonds. So we see that water *can* be made into any form, *when the particles attract each other strongly.*

But where was the beautiful ice palace when summer came?

The poet Cowper thus beautifully describes it:

"No forest fell
When thou wouldst build; but thou didst hew the floods,
And make thy marble of the glassy wave.
Silently as a dream the fabric rose;
No sound of hammer or of saw was there;
Ice upon ice, the well-adjusted parts
Were soon together joined.
Lamps gracefully disposed, and of all hues,
Illumined every side; a watery light
Gleamed through the clear transparency
Convivial table and commodious seat,
Sofa and couch, and high-built throne were there.
'T was once a stream, and soon would glide
Into a stream again. *Great princes* have *great play-things.*'

LESSON TWENTIETH.

WHICH, then, has the *strongest* cohesive attraction—water or ice?

The *ice.*

Which has the *strongest* cohesive attraction—water or molasses?

Molasses.

Do the particles of all liquids attract each other *equally?*

They do not; the particles of some liquids attract each other more *strongly* than the particles of other liquids do.

How do you know that the molasses has the *strongest* cohesive attraction?

Because I cannot move my finger through it quite as easily as I can through water.

Which has the strongest cohesive attraction—*cold* butter or *melted* butter?

The *cold* butter.

How do you know it has the strongest cohesive attraction?

Cold butter is *hard*, and melted butter is *soft*, and runs like oil.

Why is *cold* butter harder than *warm* butter?

Because *heat separates* the particles from each other, and *destroys* their *cohesive attraction.*

Which has the *strongest* cohesive attraction—water or steam?

Water has stronger cohesive attraction than steam or vapor has.

Why has it?

Because the *heat* has separated the water of steam into very small particles.

What does *heat* do to *cohesive* attraction?

It partly destroys it.

Which has the strongest cohesive attraction—ice or water?

Ice.

Why has ice stronger cohesive attraction than water?

Because *heat* has partly *destroyed* the cohesive attraction of ice, by melting it, and turning it into water.

Can we destroy the cohesive attraction of lead?

We can by *heating* it.

How will you know that its cohesive attraction is destroyed?

By pouring it as I do water.

Can you make its cohesive attraction return to it again?

I can by cooling it.

LESSON TWENTY-FIRST.

You have been speaking of the particles of bodies; can you tell what *bodies* are?

All the things that we see are *bodies.*

Is the Earth a body?

It is a large body.

Are rocks and trees bodies?

They are; and animals are bodies, and we are bodies.

By what other names are *bodies* called?

Matter.

Then is every thing that we see, Matter?

It is, and it is called Material.

What properties belong to all bodies?

Impenetrability, extension, figure, divisibility, inertia and attraction.

What do you mean by *properties* of bodies?

Some things which belong to all bodies, so that there can be no body without them.

What is the first *property* which you say all bodies possess?

Impenetrability.

If you stick a pin through a paper, is the paper where the pin is?

It is not; the paper is crowded away to make room for the pin.

Why could not the pin and paper be in the same place?

Because the pin and paper are both *impenetrable;* so that the paper cannot be where the pin is, and the pin cannot be where the paper is.

If you drive a nail into wood, is the wood where the nail is?

It is not; for the wood is crowded away to make room for the nail.

Why could not the wood and nail be in the same place?

Because both the wood and the nail possess *impenetrability.*

If you put a spoon into a glass of water, is the water in the same place where the spoon is?

It is not; the water flows over the spoon, to make a place for the spoon.

Why are not the water and the spoon in the same place?

Because they both possess *impenetrability*, so that where one of them is, the other cannot be at the same time.

If you put an empty vial into water, will the water fill it while it is full of air?

It will not; the air comes out in little bubbles first, and the water runs in as fast as the air comes out.

Why cannot the water and the air be in the vial at the same time?

Because the air and the water have *impenetrability*.

Then what do you mean by *impenetrability*?

IMPENETRABILITY IS THAT PROPERTY WHICH ALL BODIES HAVE OF OCCUPYING A CERTAIN PLACE, SO THAT WHERE ONE BODY IS ANOTHER CANNOT BE.

LESSON TWENTY-SECOND.

WHAT is another *property* which all bodies have?

Extension.

How far does this book extend?

About five inches one way, and four inches the other way.

What do you mean by the *extension* of this book?

I mean the *length* and *breadth* of the place which this book occupies.

Does it not extend another way?

It does; it is about half an inch in thickness.

Then what is the *extension* of a book?

Its length and breadth and thickness.

What is the extension of a house?

Its *length* and *breadth* and *height.*

What is the shape of a ball?

It is round.

Then what is the figure of a ball?

Its *figure* is round.

What do you mean by the *figure* of any thing?

I mean its shape or form.

What is the *figure* or shape of a book?

The *figure* of some books is a square.

What is the shape or figure of the Earth?

Its figure is round like the shape of a ball.

Do *all* bodies have a shape or form?

They do.

And what is the *shape* or *form* of a body called?

It is called the *figure* of a body.

Then what is another *property* of all bodies?

Figure.

Can you cut this apple?

I can with a knife.

Can you cut one of the pieces again?

I can.

And can you cut one of these little pieces again?

I can; and I can keep doing so, till it is cut into very small pieces.

Can a rock be split in two?

It can.

Can one of its parts be split in two?

It can; and it could be split again and again, until it becomes as fine as sand.

Could a grain of sand be split in two?

It could; and these parts of a grain of sand could be split again and again, as long as they could be seen, if there was any thing to split them with.

What is splitting called?

It is called *dividing*.

Then what is another *property* of all bodies?

Divisibility.

What do you mean by divisibility?

The *property* which bodies have of being *split in two* or *divided*.

Could a house be divided?

It could; and a table could be divided, and a

book could be divided. *Every thing* could be *divided.*

Will an apple move of itself?

It will not; it could not stir from its place, unless somebody moves it.

Will any body move of itself?

It will not unless it is alive.

Will not the hands of a watch move, if no one moves or touches it?

They would not move if the watchmaker had not made the little wheels, and the spring, and set them in motion by winding it up with a key; and it will not go then but a little while, before it must be set in motion again.

Then does a watch move *of itself?*

It does not.

Will any thing move of *itself?*

It will not.

Then what is another *property* which all bodies have?

All bodies that are not alive, have the *property of not being able to move or stir of themselves.*

Do you know what this property is called ?

It is called Inertia.

What is the other *property* which all bodies have ?

It is Attraction.

What do you mean by Attraction ?

The power which the particles of matter have of drawing or attracting each other, and the power which the Earth has of drawing or attracting all bodies to itself.

What makes bodies *heavy?*

The Earth draws or *attracts* them, while we lift them; and we say, they are *heavy.*

Why are *some* bodies *heavier* than *others?*

The more matter there is in a body, the *stronger* does the Earth *attract* it.

LESSON TWENTY-THIRD.

Now you have been studying something of Natural Philosophy; can you tell what you mean by Natural Philosophy?

Natural Philosophy explains the reasons of things, and tells us about the properties of bodies.

Is Philosophy a useful study?

It is a very useful, and a very pleasant study too.

What good does it do children to learn it?

It explains so many things that we did not know before, that we think it a very useful study.

What have *you* learned in this book, that you did not know before?

I have learned how very useful the Sun is, and how the *wind* and *rain* are produced.

What have you learned about the *planets* and *stars?*

I have learned that the Earth and the other planets go round the Sun; and that the *stars are great worlds and suns.*

Can you mention any other things that you have learned?

I have learned the reason why things *fall* to the ground, instead of going up into the sky.

Who found out what made things fall to the ground, and what made the planets go round the Sun?

Sir Isaac Newton.

What great astronomer first saw the planet Herschel?

Doctor Herschel.

Who made all things?

The Bible says, "Thou, Lord, in the beginning, hast laid the foundation of the Earth, and the heavens are the works of thy hands;" and the more we learn about his wonderful works, the more shall we admire his power and goodness.

Do you expect to see all the glorious works of God before you die?

Oh no. I can see only a very few of them; and no person has ever seen them all.

But can you feel satisfied with seeing so few of his many wonderful works?

I think if I should live a thousand years, and be looking at them all the time, I never should feel satisfied; I should still wish to see more and more of them.

Then what can you do, to know more of God?

I can give myself away to Him, and love and obey Him; and then when I die, He will take me to His glorious home, and "I shall be satisfied when I awake with his likeness."

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