

RANGER

Range **5**

Fact

**Exploring
Space**

Joan Macintosh

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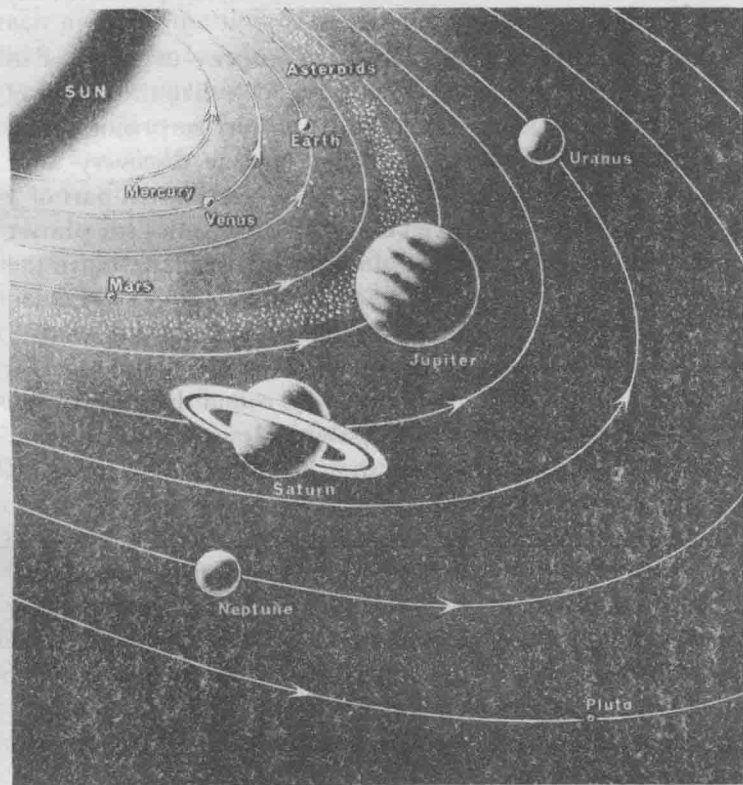
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1. *Our place in space*

The solar system



The people on Earth belong to many different countries. We speak many different languages and have different ideas. We do not look alike and we do not talk alike. But we are all alike in one way. We are all humans born on Earth. We are
5 all Earth-men. All of us live and die on this planet. We have never known any other home.

Men believed for thousands of years that the Earth was the centre of everything. They believed that the sun and the stars moved around us. It was said that the sun was put in the sky
10 to give light and heat to our Earth.

The old ideas of men should not surprise us. Most of us only believe what we see. The Earth looks like the centre of everything from where we stand. It is more surprising that a few great men discovered the truth. One discovery after
15 another proved that our Earth is only a very small part of a great universe. They proved that the Earth is one little **planet** moving round the sun. We do not believe that we are the centre any more.

The truth frightened many people. They did not want to
20 believe it. But in 1540 Copernicus, the great Polish astronomer, found proof that the Earth goes round the sun. At first he did not dare to say this in public. He was afraid that he would be punished for not showing respect to God—the maker of our Earth. So he wrote his discoveries in a book
25 which was printed a few weeks before he died.

It was too late to punish Copernicus after he was dead. Others were not so careful. Galileo, an Italian astronomer, made a great new telescope soon after 1600. With this telescope he proved that Copernicus had been right. Galileo
30 talked bravely about his many discoveries. He wanted everyone to hear him. His punishment was being sent to prison. He stayed there until at last he said in public that he had

alike **human** **believe** **proof** **punish**
respect **punishment**

been wrong. But among his friends he continued to talk
openly about his discoveries. He found out more things about
the universe with his new telescope. He proved that the sky
around us is full of bodies which follow fixed movements. 35

Many people began to believe the new ideas. They saw
that the universe was more wonderful than our old ideas
about the Earth. Some people worried that men might be-
come less important in this huge universe which the astron-
omers were discovering. But men have minds that can
reach out into the universe. With our minds we can learn
about things we cannot see. We can discover how to control
forces outside our Earth. Perhaps we can make our homes in
space as well as on Earth. 40 45

Our knowledge of space has grown since Galileo. What do
we know about the place of our Earth in space?

We know that we are a planet moving among other
planets round the sun. At present we know of nine planets
moving round the sun. This family of the sun and its planets
is called the **solar system**. 50

The sun controls the regular movement of all the planets
moving round it in the solar system. It controls the planets
moving at different speeds along different paths or **orbits**.
An orbit is the path of a planet round the sun—or the path
of any body in space around another body. 55

The sun gives each planet all the heat and light it receives.
The sun is, in fact, a star big enough to hold over a million
Earths. A star is a body of burning gas travelling in space.
But our familiar sun is not the greatest star. It only looks big
because it is the nearest star. Many stars are bigger. The sun
is only one star amongst 100,000 million (one hundred
thousand million) other stars in our **galaxy**. 60

A galaxy is a great family of stars moving through space

among movement worry huge control
gas space familiar million

65 together. Try to think of 100,000 million stars. It is impos-
sible. With the strongest telescope we can only see a few stars
in our galaxy. We cannot count them exactly. But our instru-
ments tell us that they are there.

Our own galaxy is so huge that we cannot see all of it. But
70 our galaxy is not the end of things. We know by radio tele-
scope that there are 100,000 million other galaxies. In fact
we know that there are many more that cannot be seen at all
by any of our instruments. Many galaxies are much bigger
than ours.

75 All these galaxies move in the universe. We do not know
how far the universe reaches or where it ends or whether it
has an end. Many astronomers believe that it is endless.
Endless? Our minds are not big enough for that idea.

Men prefer to think of distances which they can measure.
80 But our Earth measurements are too small to measure the
distance between stars. We cannot measure the distance of
space in miles. It would be as stupid as measuring the distance
from London to Tokyo in inches! So now we have a new
measurement called a **light-year**. This is used to measure
85 distance in space.

A light-year is the distance that light travels in one year.
Light travels 186,000 (one hundred and eighty-six thousand)
miles in one second. So it travels six million million miles in
one year. That is the measurement of one light-year.

90 Here is an example showing that it is more easy to measure
space in light-years than in miles.

The nearest star in our galaxy is 24,000,000,000,000 miles
away—or four light-years. A space-ship travelling at twenty-
five thousand miles an hour will have been travelling for
95 120,000 years when it arrives there!

It is difficult to think easily about these distances and these

impossible **endless** (-less) **stupid** **prefer**
measurement (-ment) **example**

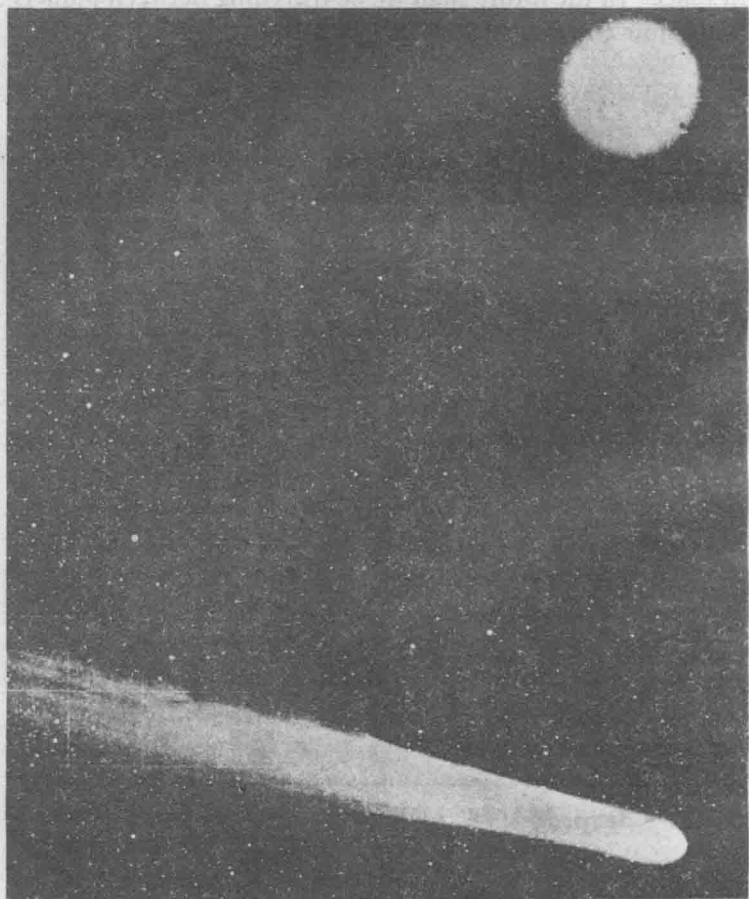
figures. The whole history of man has not been long enough for one journey to the nearest star. The place of our Earth in the universe is less than one tiny piece of sand in the Sahara Desert. Humans need courage to look at that huge universe without despair. 100

Are there other creatures living somewhere who can also see the edge of the universe in which we live? Do other creatures in our galaxy also look at the stars and think about them? Do they have minds like ours? Can we ever meet them in space? In the future shall we be travelling between planets as we now travel between cities? 105

tiny despair

2. *The Earth's family*

Halley's comet and the planet Venus



Our own solar system is very small among the galaxies of space. Our distance from the other planets is almost neighbourly. Visits to our own planet-family cannot be impossible. But even in the solar system distances are huge. Let us consider whether visits to other members of the family will ever be possible. 5

Of course we can never visit the sun. The sun, like all the stars, is made of burning gases. Everything which goes too near must melt in its heat. But it is not really the sun's fire that warms and lights the solar system. We know now that **atomic energy** is coming out of the sun all the time. This is what warms and heats our world. The sun is like a huge atomic bomb exploding in space. We are lucky that there is enough gas in the sun to explode for millions of years. So there is no danger that the sun will soon disappear. 10 15

What about the other planets? Can we ever visit them? Shall we be travelling between planets as we now travel between countries? Or will that be impossible? 20

You will see from the plan on page 1 that our nearest neighbours are Venus and Mars. Further away are Mercury and Jupiter. The furthest planets are Saturn, Uranus, Neptune and Pluto. Pluto was only discovered in 1930. It is so far from the sun that it is probably in complete darkness. Its journey round the sun lasts 248 (two hundred and forty-eight) years. 25

These are the only planets that we have yet discovered. But there may be others hidden in space or near the sun. Astronomers often discover new bodies in space. But finding one planet is like finding one bird amongst millions of birds. 30

Can we ever visit the planets we know?

When we examine the other planets we find that most of them are very uncomfortable places for humans. We used to

melt **explode** **million** **forty**

think, for example, that there could be life upon Venus. It is the brightest planet in the sky—brighter than anything except the sun and the moon. But we know now that Venus is much too hot for human life. It is so hot that perhaps we shall never be able to visit the planet.

Most of the other planets probably don't contain any life. Jupiter and Saturn are very far from the sun and they are as dark and as cold as death. Mercury is too hot by day and too cold by night. It has no water and no air that men could breathe.

Mars is one planet where there may be life. We know more about Mars than about any other planet. But astronomers are still guessing about many things. For example, we think that on Mars there may be changes of weather during the year. Our own weather changes from winter to summer. Perhaps it is the same on Mars. In Mars' mid-summer we can see brown places on the planet. In mid-winter these places are white. So some scientists believe that plants grow on Mars during mid-summer and change colour in the winter. They do not say that there are green fields on Mars. But perhaps there is some kind of life.

Mars has very little water. Perhaps it has none. But astronomers can see strange narrow lines upon the planet. These lines are sometimes called 'canals', like the narrow waterways made by men on Earth. Some people believed, in fact, that these were real canals for carrying water from one part of Mars to another. So, these people said, there must be life on the planet—creatures with minds like ours. Most astronomers are sure that this is not true. They do not think that creatures like us can live on Mars. But many scientists do accept the idea that simple plants may grow on Mars.

during **mid-** (mid-summer, mid-winter) **accept**

There are strong forces holding all the planets around the sun. It is not by accident that we follow our fixed paths or orbits. This is controlled by several things. The strongest force controlling us is called **gravity**. This is a force pulling everything on or around a star or planet towards its centre. The gravity of the sun is the strongest gravity in our solar system. It holds the planets in their paths, so they do not wander away into space.

But planets are not the only bodies which move around in the solar system. There are other bodies travelling with us. Some of these move round the planets in fixed orbits. The reason is that planets have their own gravity. This controls smaller bodies and keeps them circling round the nearest planet. These bodies are called **satellites** or moons.

Jupiter, the biggest planet, is very grand. It has twelve moons travelling round it. Saturn has nine moons. Some of these moons are as big as the smaller planets like Mercury and Mars.

Of course the moon which is familiar to us is our own moon, travelling with the Earth. We only have one moon, but it is very important to us. It deserves a special chapter because it is our closest companion in space.

As well as the sun and its planets and the planets' satellites there are other bodies moving in the solar system. There are, for example, asteroids, comets and meteors.

Asteroids are pieces of rock which travel round the sun like planets. Perhaps they are pieces of a planet that fell apart in space.

The comets are easy to recognise. They have a great tail of fire burning behind them as they rush across the sky. When a comet appears it can sometimes be watched crossing the sky for days or weeks. The bigger comets are very grand and

grand chapter

20 bright. All the astronomers keep watch on a comet as soon as
it appears. At last it disappears and it may not be seen again
for many years. But astronomers know when each comet will
100 be travelling again across the sky. The movements of the
comets are as fixed as the movements of the planets. This
makes it easy to find them.

Halley's Comet, for example, appears every seventy-six
years. Its last appearance was in 1910, so it will be coming
105 again in 1986.

People used to believe that the appearance of a comet
warned us of some terrible coming event. Halley's Comet in
1066 warned the English that their enemies were going to
attack them. Now that we know more about comets they do
110 not frighten us. In fact when Halley's Comet comes again we
shall be sending men into space to examine it more closely.

Meteors are pieces of mineral travelling in the solar system.
There are countless meteors in the solar system, and millions
of them are pulled towards Earth by the Earth's gravity.
115 When they reach the ground most meteors have become tiny
pieces of sand or dust. They have been burned away as they
fall. A few are big enough to make a hole when they hit the
ground. In America there is a hole nearly a mile wide. It
was made by a meteor which fell a thousand years ago. It is
120 lucky that most meteors burn up before reaching Earth.
Our lives would always be in danger if meteors fell like rocks.

When meteors fall to Earth at night they sometimes burn
brightly in the sky. They shoot across the sky on their way
down. So they are sometimes called shooting stars, although
125 they are not really stars. We can often see them in a clear
sky, falling in bright pieces.

appearance **warn** **now that** **countless (less)**
ago **America**

3. *Our own planet*

The Earth from 100,000 miles away in space



Men travelling in space have described the beautiful appearance of our own planet. They have a good view from there of blue seas, high mountains, green land and brown land, gold fields and silver rivers. All these can be seen through a veil of cloud.

Other planets are covered by dry ranges of hills without life or colour. The great empty mountains of the moon are very beautiful. But we have not yet found anything in space as lovely as the Earth. Because it is familiar we do not value our own planet. But in many ways we are lucky that the Earth is our home.

For example, we are lucky that Earth's gravity is comfortable for human life. All planets are alike in having gravity. But the strength of gravity is not the same on all of them.

What is the effect of this gravity? Its force is so familiar that we hardly think about it. Every time we lift a foot we are pulling against gravity. Gravity pulls the foot back to earth as we step forward. Gravity brings a ball back to us when we throw it in the air. It is the fault of gravity when we drop something and it is broken.

Gravity is so strong on some planets that it would be very difficult to move our feet or lift a ball. It is so weak on other planets that we should float off the ground.

Our own Earth's gravity is not too strong and not too weak. We can move freely. It is easy to lift things and put them down safely. Our gravity does another important thing. It holds the **atmosphere** (the air) like a veil around the Earth. Without gravity our air would disappear into space. But we could not live without the oxygen contained in this precious atmosphere. Our whole lives are lived within it. Sometimes we leave the safety of oxygen when we swim underwater or climb high mountains or fly in space. But we cannot live

gold veil lifeless (-less) effect float
freely (-ly)