

■ 郑锡荣 郑珩 郑肖良 编译 ■

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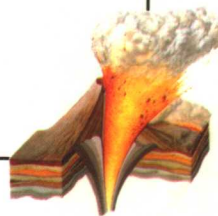
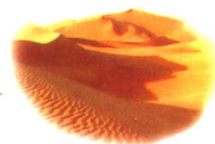
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英汉科学百花园

THE
EARTH
AND
ITS
CHANGING
SURFACE

地球
及其
变化的
表面

山东教育出版社



ENGLISH-CHINESE SCIENCE FLORILEGIA

英 汉 科 学 百 花 园



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地球及其历史

THE EARTH AND ITS HISTORY



the Earth
地球

For many years, scientists have been searching for ways to determine the age of the Earth. In trying to find answers to their many questions, scientists have made several different suggestions about how the Earth was formed and how old it is.

Such suggestions are called hypotheses. After studying a question or problem, a person may state a hypothesis. The person puts together all the facts that he knows about a certain idea. Then he makes a statement that will explain all the facts. Having made a hypothesis, a scientist then tries to test the hypothesis to see if it is true. He may carry out experiments or make certain observations to find out if the

statement he made is true or not true.

Sometimes a scientist will find that his hypothesis does not explain all the facts. Then he must revise the hypothesis to include those facts or he must begin again by stating a new hypothesis. Much of the work of a scientist is concerned with the proving or disproving of hypotheses.

HOW WAS THE EARTH FORMED?

Throughout the years, many people have been interested in learning about the way that the Earth was formed. Scientists tried to find explanations which were based on facts that they knew were true. They then made their hypotheses, which were statements of their explanations.

Once in a while, a hypothesis seemed to be an excellent one when it first was stated. It explained all the facts that were known. Later, however, new facts often were discovered. These facts could not always be explained by the hypothesis. The new facts sometimes were proof that the hypothesis could not be correct.

多少年来,科学家一直在寻找确定地球年龄的方法。在试图为许多问题找出答案的同时,科学家对地球的形成及其年龄提出了几种不同的见解。

这些见解称为假说。在对疑难或问题进行过研究之后,人们可以提出一种假说。他把所知道的有关某种想法的所有事实综合起来,然后作出能解释所有事实的一种陈述。假说既已提出,科学家接着就试图验证该假说是否正确。他可以着手实验或进行某些观察,以确定他的说法是正确的还是错误的。

有时科学家会发现他的假说并不能解释所有的事实。于是他得修订他的假说,使之能解释那些事实,要不然就得另起炉灶,提出新的假说。科学家的大部分工作都同假说的证明或否定有关。

地球是怎样形成的?

多年来,许多人一直热衷于弄清地球的形成过程。科学家试图寻找以已知无误的事实为依据的各种解释。然后他们提出自己的假说,也就是对他们的解释作出表述。

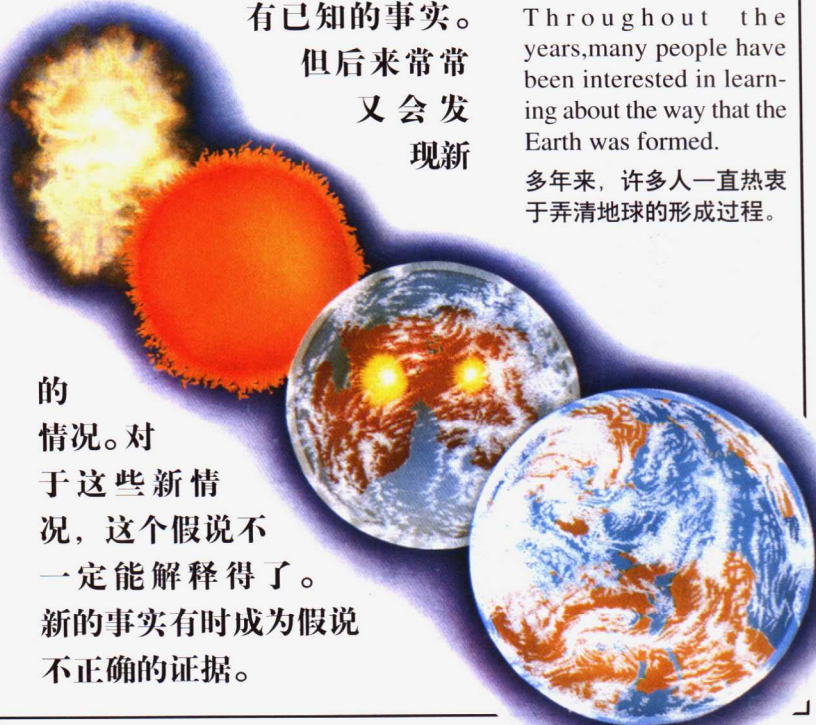
偶尔有这种情况:假说刚提出时似乎完美无缺。它能解释所

有已知的事实。
但后来常常
又会发现新

的情况。对于这些新情况,这个假说不一定能解释得了。新的事实有时成为假说不正确的证据。

Throughout the years, many people have been interested in learning about the way that the Earth was formed.

多年来,许多人一直热衷于弄清地球的形成过程。



In the study of science, you need to remember that new discoveries continually are being made. These new discoveries may change

some ideas which now are thought to be true. New discoveries also may help to prove that some of these ideas really are correct.

WHAT ARE SOME HYPOTHESES ABOUT THE ORIGIN OF

THE EARTH?

One of the first hypotheses to be developed about the origin of the Earth was stated by Pierre Simon Laplace, a French astronomer who

lived from 1749 to 1827. It was Laplace's hypothesis that the Earth developed from a great rotating body of hot gases in space. According to Laplace, these gases cooled and the Earth and other bodies were formed.

This hypothesis was believed for many years. Then some new discoveries were made which showed that Laplace's hypothesis could not be correct.

About 1900, another hypoth-

esis was stated by two United States scientists, Thomas Chamberlin and Forest Moulton. They suggested that the Earth developed out of material from the Sun. This material could have been removed by a star which passed close enough to the Sun to attract some of the material away. The Earth and other bodies were thought to have been formed from this material.

Similar to the Chamberlin-Moulton hypothesis is the idea that a collision of the Sun with another star caused material to break away from the Sun.

Later information showed that the material would have spread out before cooling. If this happened, then the hypothesis could not be correct.

About 40 years ago, Carl von Weizsäcker, a German astronomer, developed a new hypothesis. This hypothesis has been improved by other scientists and is accepted today. Some of its ideas are based on parts of earlier hypotheses, including Laplace's.

Weizsäcker's hypothesis was stated after studies were made of how stars may be formed from clouds of dust and gas. As the "dust cloud" forms into a more compact mass, it becomes hotter and hotter. A nuclear reaction then begins, creating a star. Some other parts of the cloud do not become part of the reaction, but continue as whirling dust and gases.



As the "dust cloud" forms into a more compact mass, it becomes hotter and hotter. A nuclear reaction then begins, creating a star.



当“尘云”形成更致密的物质时，它变得越来越炽热。于是开始了核反应，创造出恒星。

在学习科学知识时,要记住新的发现总是层出不穷的。这些新发现可能会使现在认为是正确无误的一些观念发生改变。新的发现也可能有助于证明某些概念的确是正确无误的。关于地球起源的假说有哪些?

有关地球起源的第一个假说是皮埃尔·西蒙·拉普拉斯(1749 - 1827, 法国天文学家)提出的。拉普拉斯假说认为地球是从宇宙空间里大团旋转着的炽热气体发展而来的。按照拉普拉斯的意见,这些气体冷却后形成了地球和其他天体。

有许多年人们都对此假说深信不疑。后来有了一些新的发现,表明拉普拉斯假说不可能是正确的。

1900年前后,美国科学家托马斯·张伯伦和福莱斯特·莫尔顿提出了另一种假说。他们认为地球起源于来自太阳的物质。这些物质有可能是被就近掠过太阳的一颗恒星从太阳里吸引出来的。地球和其他天体有可能是这些物质形成的。

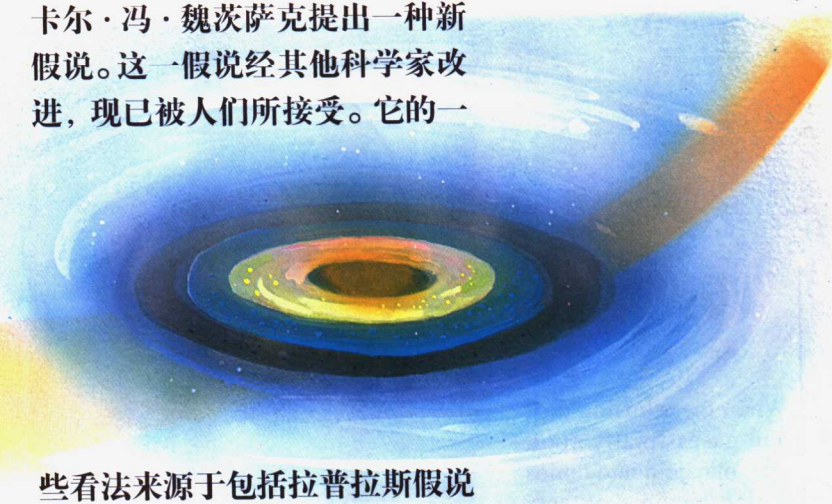
还有一种意见同张伯伦-莫尔顿的假说很类似,认为是因为太阳同另一颗恒星相撞而使一些物质从太阳中分裂出来。

后来的研究表明,这样的一些物质在冷却之前会扩展开来。如果确会这样,那么这个假说就不可能是正确的。

约40年前,德国天文学家卡尔·冯·魏茨萨克提出一种新假说。这一假说经其他科学家改进,现已被人们所接受。它的一

些看法来源于包括拉普拉斯假说在内的早期假说的某些合理部分。

魏茨萨克假说是在研究了恒星可能形成于尘气云后提出的。当“尘云”形成更致密的物质时,它变得越来越炽热。于是开始了核反应,创造出恒星。尘云的其他部分未参与核反应,继续以旋涡尘气云形式而存在。

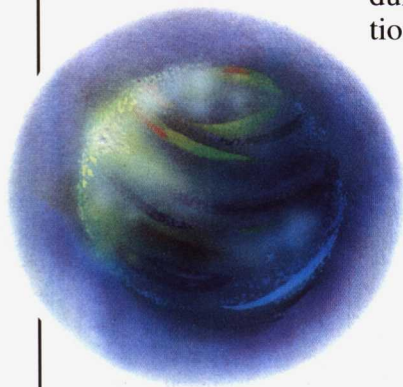


The Earth developed out of material from the Sun. 地球起源于来自太阳的物质。

When the whirling dust and gases finally cool, they may join into lumps which become objects such as the Earth. Such a process could have taken place to form the Earth.

HOW DID THE EAREH CHANGE AS IT FORMED?

Some scientists believe that the Earth may have been very hot during the early part of its formation. If the Earth was hot, the gases



When the whirling dust and gases finally cool, they may join into lumps which become objects such as the Earth.

当旋涡尘气云最终冷却时，可能会聚成团，成为地球之类的天体。



that made up most of the material of the young Earth probably began to cool very quickly. Scientists think that the cooling gases changed into a liquid to form a ball-shaped mass.

The outer part of the liquid mass cooled more quickly than the inner part. Such a cooling caused a crust to form on the surface of the young Earth, while the part under the crust remained as a liquid.

Over a long period of time,

heavier materials within the mass settled toward the center. Some scientists believe that there is a liquid nickel-iron core at the center of the Earth which may have been formed in much the same way.

As the materials beneath the crust became cooler, they may have contracted to occupy less space. This action may have caused parts of the crust to begin cracking. Wrinkles and folds were created.

The wrinkling and folding which took place on the surface of the young Earth was one of the actions that helped to form mountains.

Some of the rocks in the Earth are radioactive. Radioactive rocks give off heat energy. Heat from radioactive rocks keeps some of the materials within the Earth in a liquid state.

Many scientists believe that the outer surface of the Earth cooled more quickly than the inner part. This could help to explain why the outer surface of the Earth is hard, while the inner core may be liquid.

During the history of the Earth, there seem to have been periods when great areas of the surface were rising and sinking. During one of these periods, there was a land connection between the continents of Asia and North America. There also is evidence that much of North America has been covered by water.

当漩涡生气云最终冷却时，可能会聚成团，成为地球之类的天体。这种过程可能发生过，从而形成了地球。

地球形成时发生过什么变化？

有些科学家认为地球在其形成早期可能异常炽热。如果地球那时是炽热的，那么，占构成年轻地球的物质一大部分的那些气体可能会开始非常迅速地冷却。科学家认为冷却的气体变成液态，形成球状团块。

液态团块的外部比内部冷却得快。这种冷却过程使得年轻地球表面形成地壳，而地壳底下的部分仍保持液态。

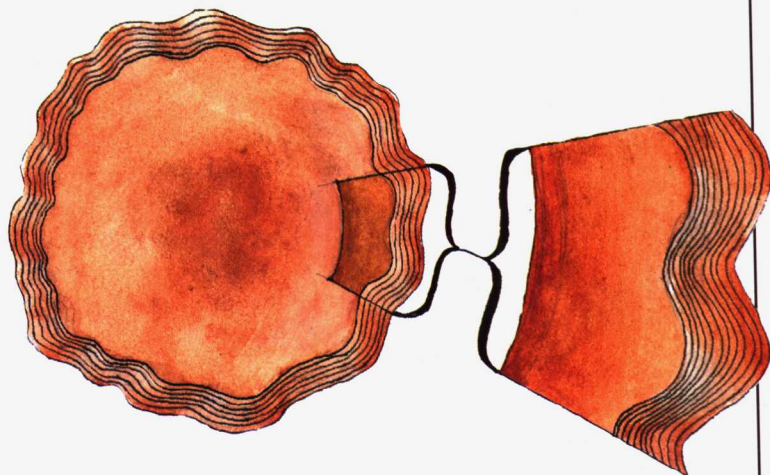
经过很长一段时间，团块里的较重物质向中心沉淀。一些科学家认为地球的中心存在一个液态的镍-铁地心，其形成的过程同上述的非常相似。

当地壳下边的物质冷却时，它们会因收缩而占据较小的空间。这一过程会使地壳的一些部分开裂，于是形成褶皱和起伏。

年轻地球表面发生的褶皱

和起伏是导致山峦形成的因素之一。

地球上的一些岩石具有放射性。放射性岩石能发出热能。



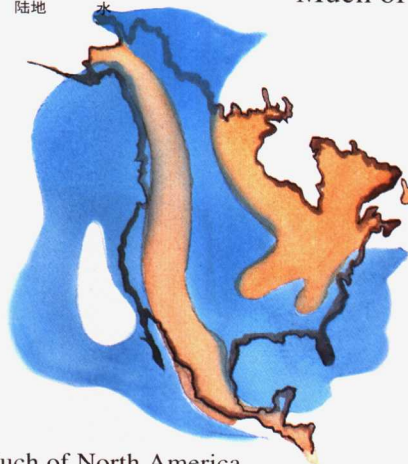
放射性岩石发出的热量使地球内部的某些物质保持液态。

许多科学家认为地球外表面的冷却要比内部来得快。这有助于解释为什么地球外表面很坚硬，而内部的地心却可能是液态的。

在地球的历史上，似乎在某一时期里地表曾发生过大范围的抬升和沉降。在此期间，亚洲和北美洲曾有陆地连接。还有证据表明，北美洲的大部分曾被水所覆盖。

As the materials beneath the crust became cooler, they may have contracted to occupy less space. This action may have caused parts of the crust to begin cracking. Wrinkles and folds were created.

当地壳下边的物质冷却时，它们会因收缩而占据较小的空间。这一过程会使地壳的一些部分开裂，于是形成褶皱和起伏。



Much of North America has been covered with shallow inland seas.

北美的大部分就曾经被浅的内陆海所覆盖。

Some regions that now are under the sea once have been dry land. Other areas that today are dry land have been under water. Much of North America has been covered with shallow inland seas.

During the periods when areas were covered with water, bits of material fell to the bottoms of the shallow seas. Layers of these tiny particles were built up very slowly.

The layers hardened, through many years, into layers of rocks.

In tens of millions of years, these areas again became dry land. Wind and running water uncovered many of these rocks. It is known that deep layers of

rock have been formed in this manner.

WHAT ARE SOME FACTS ABOUT THE EARTH TODAY?

When you look at the surface of the Earth, you cannot get a true picture of the shape of the Earth. When you look out over an ocean or over a large field, you see a flat Earth. When you look out over hills and valleys, you see a rough, uneven Earth.

Views of the Earth can give you information about some of the features of the Earth, but they do not tell you very much about the Earth as a whole. The Earth may be flat in some places and uneven in other places. However, the Earth as a whole is shaped somewhat like a round ball. Such a shape is called a sphere. If you could see the Earth from some place in space, the Earth would appear as shown in the following picture.

Scientists have found that the Earth does not have the shape of a perfect sphere. By using instruments, scientists have discovered that the Earth is slightly flattened at the poles. The distance through the center of the Earth is about 40 kilometers less from pole to pole than the distance through the center of the Earth from points on the equator.



views of the Earth 地球风光

现今位于海底的某些地区曾一度是干燥的陆地。而今天是干燥陆地的其他一些地区则曾经位于水底下。北美的大部分就曾经被浅的内陆海所覆盖。

在一些地区被水覆盖的时期里,点点滴滴的物质不断落到浅海海底上。这些小颗粒层堆积得异常缓慢。

经过许多年代,小颗粒层硬化成为岩层。

千万年来,这些地区重又变为干燥的陆地。风和流水使许多岩石裸露出来。现已知道,有些厚岩层就是这样形成的。

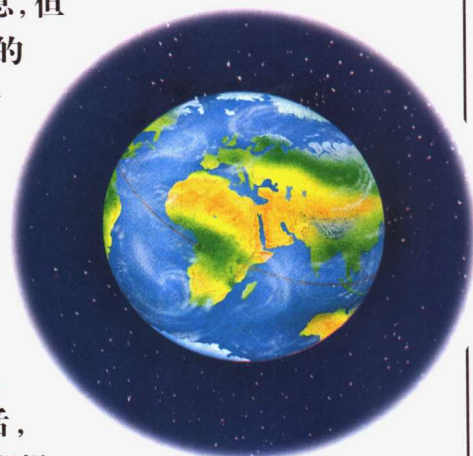
地球现状如何?

当你望着地球表面时,你看不出地球形状的庐山真面目。当你眺望海面或是大片田野时,你看到的是平坦的地球。当你放眼

小丘或山谷时,你看到的地球粗糙而不平坦。

地球的风光能为你提供有关地球特征的一些信息,但却不能给你一个地球的整体概念。地球上一些地方可能很平坦,而另一些地方则很崎岖。不过,从整体上看,地球却很像一个圆球。这种形状称为球体。如果你能从太空某处看地球的话,地球的外形就像图示那样。

科学家发现地球的外形并非精确的球体。通过仪器,科学家发现地球两极方向略为扁平。通过地心的极与极间的距离要比赤道上通过地心的两点距离约短40千米。



If you could see the Earth from some place in space, the Earth would appear as shown in the following picture.

如果你能从太空某处看地球的话,地球的外形就像图示那样。



Although 40 kilometers may seem like a great distance to you, it is only a small amount when compared to the size of the Earth. The thickness of the Earth is about 12,800 kilometers. So, in proportion, the Earth is at least as round as an ordinary basketball.

Scientists believe that the Earth is made of layers. The outer layer is called the crust. The thickness of the crust varies from a few kilometers below the ocean floor to about 40 kilometers beneath the continental land mass.

Beneath the crust is the mantle, which is a layer of solid rock almost 3,000 kilometers in thickness. Beneath the mantle, at the center of the Earth, is the core, which is thought to be liquid rock. From the outer edge of the core to the center of the Earth is a distance of slightly more than 3,200 kilometers.

You probably have never been more than a few meters beneath the surface of the Earth. If you have gone into a cellar, you may have noticed that the temperature was lower than on the surface. However, if you had gone down more

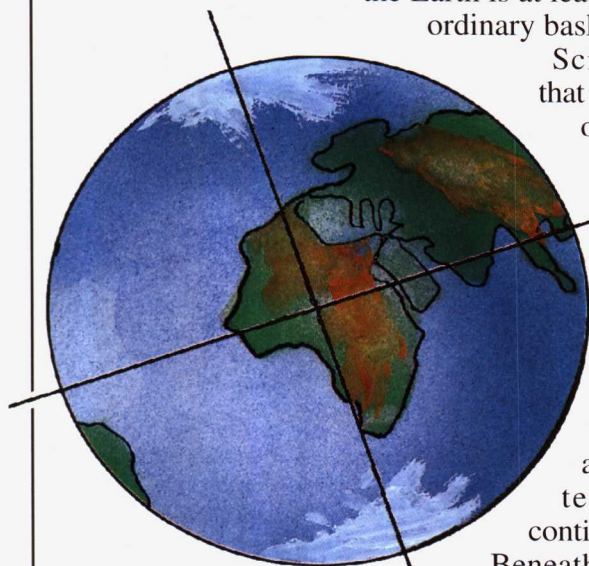
than 20 meters below the surface of the Earth, you would have noticed a different effect. At depths greater than 20 meters, temperatures rise. In fact, at the bottom of a deep oil well, the temperature may be above the boiling point of water.

It is known that the temperature increases as it is measured at deeper and deeper places within the Earth. Scientists cannot measure temperatures at very great depths because it is so difficult to drill into the Earth. From the information that they have been able to gather, however, they know that temperatures within the Earth are very high. As scientists learn more about the temperatures of the Earth, they will be able to test hypotheses about the origin of the Earth.

You probably are quite familiar with many other facts about the Earth, such as its rotation, its orbit around the Sun, and its climates. You will learn much more information as you continue to study the Earth.

WHAT CAN BE LEARNED FROM A STUDY OF ROCKS?

Your age can be found by looking at records which give the date of your birth. Finding out the age of the Earth is not that easy. Scientists have tried to determine the age of the Earth in many ways. One of these ways is to study the materials of the Earth.



Scientists have found that the Earth does not have the shape of a perfect sphere.

科学家发现地球的外形并非精确的球体。

你可能会觉得 40 千米是一个很长的距离,但同地球的大小比起来,它只是一个很小的数目。地球的直径大约是 12,800 千米。因此,从比例上看,地球至少同普通篮球一样圆。

科学家认为地球是一层层构成的。外面的一层是地壳。地壳的厚度从海底下的几千米到大陆团块下边的约 40 千米不等。地壳下边是地幔,这是一层厚达 3,000 千米的固态岩层。地幔下边的地球中央部分是地心,一般认为它是液态的岩石。从地心外沿到地球中心的距离略大于 3,200 千米。

你可能从未到过地表以下几米深处。你如果进过地窖,你可能会注意到那里的温度比地面要低一些。不过,要是你进入地面以下 20 米处的话,你将注意到迥异的结果。在深度超过 20 米处,温度上升了。事实上,在深油井底部,温度可能上升至水的沸点以上。

众所周知,越往地球内部深处测量,温度越高。科学家无法测得极深处的温度,因为朝地球钻进是很困难的。不过,从能搜

集到的资料看,科学家知道地球内部的温度是非常之高的。科学家在进一步了解了地球的温度之后,就能对地球起源的假说进行验证。

你可能对同地球有关的其他许多情况(诸如它的自转,它的绕日轨道以及它的气候等等)已很熟悉。在你对地球继续进行研究之后,你将学到更多的知识。

通过对岩石的研究能知道些什么?

你的年龄可以从你的出生记录查出。确定地球的年龄可就没有那么容易了。科学家曾经试图用好些种方法确定地球的年龄。方法之一是对地球的各种物质进行研究。

Scientists believe that the Earth is made of layers.

科学家认为地球是一层层构成的。



In some places, the crust of the Earth contains layers of rock. Studying the layers of rock is one method that scientists have used to estimate the age of the Earth.

Scientists who study the Earth and its history are called geologists. Geologists think that some kinds of rocks and some layers of rocks are older than other kinds and other layers. They can estimate the age of rocks from a study of the layers of rocks.

Rock formations often are formed in layers under water. Geologists sometimes can determine the age of a rock formation by looking at layers within the rock. If different kinds of layers were formed at different seasons of a year, the geologists can tell how many layers were formed in a year. Then they can tell how old the rock is.

In the Grand Canyon, geologists have found layers of rock that were formed many hundreds

of millions of years ago. Geologists try to learn how old the Earth is by tracing back the ages of very old rocks such as these.

Another way of finding the age of the Earth is by studying the changes that are taking place today. Changes still are going on in certain kinds of rocks called radioactive rocks. Radioactive rocks are rocks that give off energy.

Radioactive rocks not only give off energy, but they also change at a steady rate. By studying how much change has taken place in a rock, scientists can determine the age of the rock.

Some rocks contain a material called uranium. Uranium is a silvery-white metal which gives off energy. As this energy is given off, the uranium changes to lead. The rate at which uranium changes to lead is always the same. As time goes on, the amount of uranium in a rock is decreased, and the amount of lead in the rock is increased.

A long time is required for uranium to change to lead. It takes $4\frac{1}{2}$ billion years for one-half of the uranium in a rock to change to lead. In another $4\frac{1}{2}$ billion years, half of the remaining uranium changes to lead. Every $4\frac{1}{2}$ billion years, half of the remaining uranium changes to lead.



AT FIRST

起初



AFTER $4\frac{1}{2}$
BILLION YEARS
45亿年以后



AFTER 9
BILLION YEARS
90亿年以后

As time goes on, the amount of uranium in a rock is decreased, and the amount of lead in the rock is increased.

随着时间的流逝，岩石里的铀含量减少，而铅的含量却增加了。

在某些地方,地壳含有多层岩石。对岩层进行研究是科学家用来估计地球年龄的一种方法。

研究地球及其历史的科学家称为地质学家。地质学家认为某些种岩石和某些岩层比其他的岩石和岩层更为古老。他们能通过研究岩层来估计岩石的年龄。

岩石地层经常在水下层叠而形成。地质学家有时能通过考察岩石内部的层次来确定岩层的年龄。如果一年四季形成不同的层次,地质学家就能知道一年形成了多少层次。于是他们就能说出岩石有多古老。

在大峡谷里,地质学家发现过若干亿年前形成的岩层。地质学家就是通过对诸如此类的极古老的岩石年龄的推算来掌握地球年龄的。

测定地球年龄的另一种方法是对今天正在发生的一些变化进行研究。某些放射性岩石至今仍在持续发生变化。放射性岩石是能释放出能量的那些岩石。

放射性岩石不但会放出能量,还会以稳定的速率发生变化。只要研究一块岩石里发生过多少变化,科学家就能确定岩石

的年龄。

有些岩石含有一种叫做铀的物质。铀是一种银白色金属,会释放出能量。在能量放出以后,铀就变成了铅。铀变为铅的速率总是一定的。随着时间的流逝,岩石里的铀含量减少,而铅的含量却增加了。

铀变成铅需要很长的时间。岩石中所含铀的一半变成铅需要45亿年时间。又要再花45亿年时间,剩下的铀的一半才会变成铅。也就是说,每过45亿年,余下的铀的一半会变成铅。

In the Grand Canyon, geologists have found layers of rock that were formed many hundreds of millions of years ago. 在大峡谷里,地质学家发现过若干亿年前形成的岩层。

