郑锡荣 宋杰 刘润东 编译

英 ENGLISH-CHINESE SCIENCE FLORILEGIA 汉 英汉科学百花园

EXPLORING THE UNIVERSE

探索宇宙

山东教育出版社

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说　明

本书在编译过程中，参考了《简易英语科技丛书》、《少年儿童知识文库》、《阶梯新世纪百科全书》，*Science Encyclopedia*, *General Science*, *Physical Science in the Modern World* 等书刊和资料，在此表示衷心的感谢。我们恳请出版者同我们联系，以便作出妥善处理。

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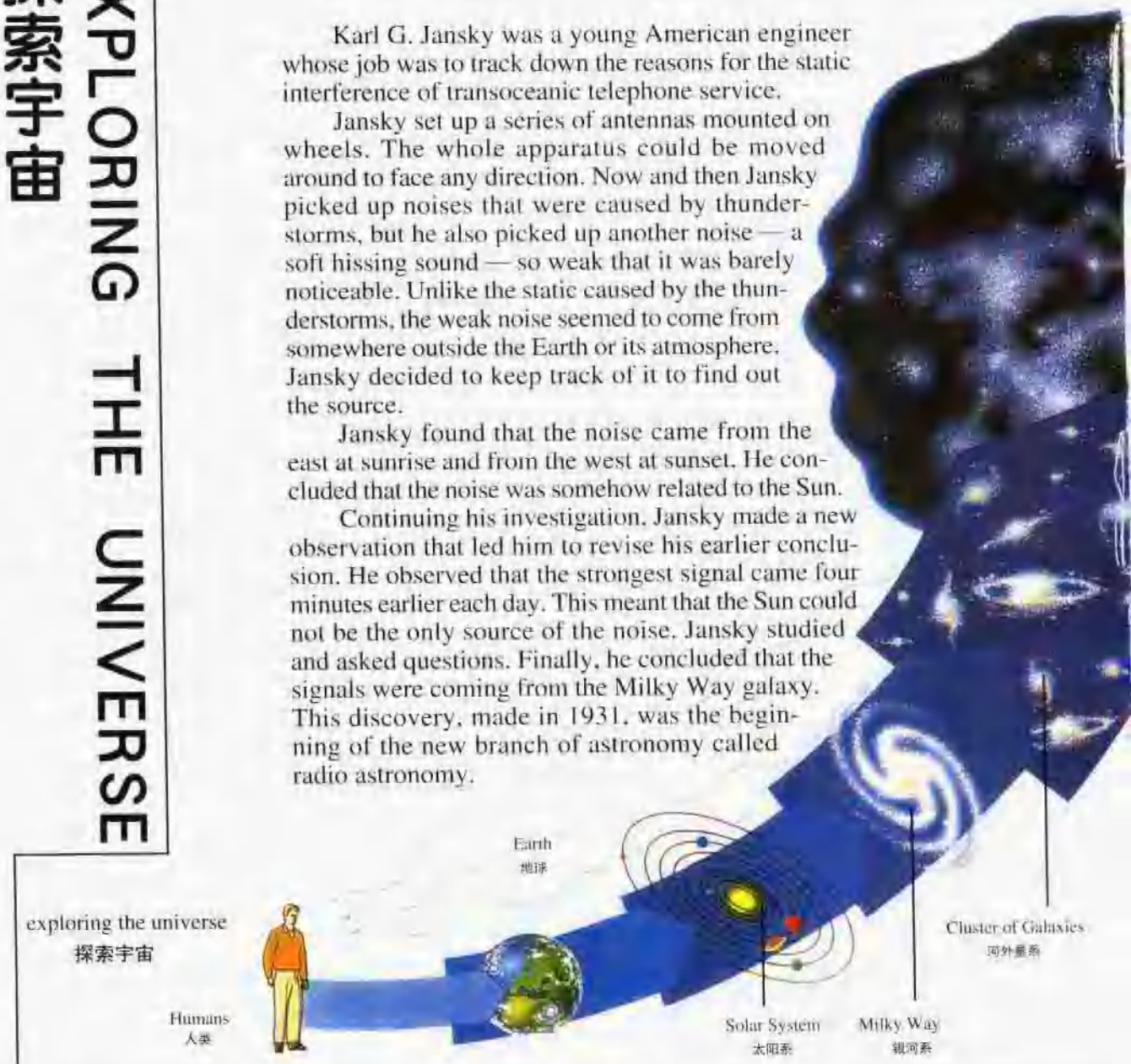
EXPLORING THE UNIVERSE
探索宇宙

Karl G. Jansky was a young American engineer whose job was to track down the reasons for the static interference of transoceanic telephone service.

Jansky set up a series of antennas mounted on wheels. The whole apparatus could be moved around to face any direction. Now and then Jansky picked up noises that were caused by thunderstorms, but he also picked up another noise — a soft hissing sound — so weak that it was barely noticeable. Unlike the static caused by the thunderstorms, the weak noise seemed to come from somewhere outside the Earth or its atmosphere. Jansky decided to keep track of it to find out the source.

Jansky found that the noise came from the east at sunrise and from the west at sunset. He concluded that the noise was somehow related to the Sun.

Continuing his investigation, Jansky made a new observation that led him to revise his earlier conclusion. He observed that the strongest signal came four minutes earlier each day. This meant that the Sun could not be the only source of the noise. Jansky studied and asked questions. Finally, he concluded that the signals were coming from the Milky Way galaxy. This discovery, made in 1931, was the beginning of the new branch of astronomy called radio astronomy.



卡尔·G·扬斯基是一位年轻的美国工程师，他负责追查越洋电话线路静电干扰的起因。

扬斯基建立起一系列装有轮子的天线。整套设备可自由移动，以对准任何方向。扬斯基不时探测到雷暴雨引起的噪声，同时也探测到另一种噪声——一种很弱的嘶嘶声，弱到仅仅勉强能注意到。这种微弱的噪声不像是雷暴雨引起的静电，它似乎来自地球以外某处或是地球的大气层。扬斯基决定追查到底，以弄清它的来源。

扬斯基发现噪声于日出时来自东方，于日落时则来自西方。他于是得出结论，认为噪声同太阳有某种联系。

在继续研究的过程中，扬斯基进行的一项新观测使他得以对自己以前的结论进行了修正。他发现，最强的信号每天提前4分钟到来。这表明太阳并不是唯一的噪声源。扬斯基不断研究并提出问题。最终他得出结论，认为信号来自银河系。于1931年取得的这一发现，标志着叫做射电天文学的天文学新分支的开端。

Jansky set up a series of antennas mounted on wheels.

扬斯基建立起一系列装有轮子的天线。

HOW IS THE UNIVERSE STUDIED?

What is in the universe surrounding the solar system? The solar system, as you know, is made up of the Sun, its nine planets, and other bodies that revolve around the sun. The solar system, however, is only a tiny part of a much larger system that is made up of gases, dust, and 100 billion or more stars. You know this huge system as the Milky Way galaxy.

These galaxies are of many shapes and sizes.
这些星系形状大小各异。

What is beyond the Milky Way galaxy? Surrounding the galaxy for thousands and thousands of light-years is space. At great distances, however, billions of other galaxies are scattered. These galaxies are of many shapes and sizes. The Milky Way galaxy is shaped like a spiral disk. Other galaxies have been found to be shaped like spirals, too. In addition, still other galaxies are elliptical or irregular in shape.

Each galaxy, like the Milky Way, is believed to be made of gases, dust, and millions or billions of stars. The galaxy nearest the Milky Way galaxy is about 150,000 light-years away. It can be seen without instruments such as telescopes, but it looks like a faint star. However, with the proper instruments, millions of other galaxies can be observed.

The distances related to objects in the universe are so great that it is difficult to imagine them. The universe is vast and its limits, if any, are not known. With distances so great, how do scientists observe the stars and other bodies?

Stars and other bodies in the universe may be studied by observing the energy which they give off. You will be reading about some of the instruments which are used for studying these bodies. First, however, you should review some of the characteristics of the energy given off.

What are some characteristics of electromagnetic energy?

All bodies in the universe give off a form of energy known as electromagnetic energy. Sometimes this form of energy is called radiant energy or radiation. Electromagnetic energy travels through space as waves, somewhat in the same way that ripples travel over the surface of water in a pond or pool.

A characteristic of any wave motion is its wavelength.Ripples in a pond have wavelengths, the waves in the ocean have wavelengths, and electromagnetic waves have wavelengths. A wavelength is the distance from any point on one wave to a similar point on the next wave. Electromagnetic wavelengths usually are measured in meters or centimeters.

如何研究宇宙?

太阳系周围的宇宙里有些什么?你知道，太阳系由太阳、它的9颗大行星以及其他绕日运行的天体组成。但太阳系只不过是另一个大得多的体系的一个微小部分，这个体系由气体、尘埃和1,000亿颗或更多的恒星所组成。这个巨大的体系就是银河系。

银河系以外还有些什么?银河系周围亿万光年范围是太空。在遥远的距离以外，分布着数以十亿计的其他星系。这些星系形状大小各异。银河系状如螺旋形圆盘。人们发现另外一些星系也像螺旋形。此外，还有别的星系呈椭球状或具有不规则的形状。

像银河一样，人们认为每个星系都由气体、尘埃和数以百万计或数以十亿计的恒星组成。最靠近银河系的星系约位于150,000光年以外。它无须借助于望远镜之类的仪器就能看到，只是看起来像是一颗昏暗的恒星。不过，有了适当的仪器，就能观察到数以百万计的其他星系。

宇宙里天体间的距离之大，令人难以想像。宇宙广袤无垠，即使有边际，也在未知之数。距离这么遥远，科学家又如何能观察众恒星和其他天体呢?

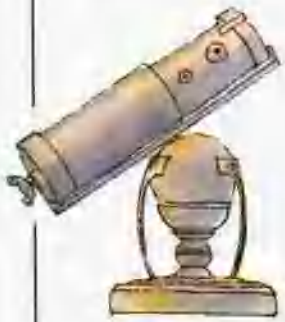
These galaxies are of many shapes and sizes.
这些星系形状大小各异。

可以通过观测宇宙间众恒星和其他天体发射出来的能量，来对它们进行研究。下面将向你介绍一些用于研究这些天体的仪器。不过，首先你得回顾一下发射出的能量的一些特性。

电磁能有哪些特性?

宇宙间所有天体都向外发射一种称为电磁能的能量。有时把这种形式的能量称为辐射能或辐射。电磁能以波的形式在空间传播，有点像涟漪在池塘或水池表面行进那样。

任何波状运动都有一个特征——它的波长。池塘中的涟漪有波长，海洋中的波浪有波长，电磁波也有波长。所谓波长，就是波上任一点到下一个波上相似点间的距离。电磁波的波长通常以米或厘米来计量。



In the early 1600's, the telescope was invented.

早在17世纪初，人类就发明了望远镜。

Electromagnetic energy travels in certain wavelengths. The type of electromagnetic energy may be determined by the range of the wavelength. For example, the sun gives off different kinds of electromagnetic energy, each kind traveling in a different wavelength. Because your eyes are sensitive to waves within a certain range of wavelengths, you can see only one kind of electromagnetic wave. You know this kind as sunlight. The scientific term for the light you can see is visible light. Visible light is electromagnetic energy traveling in a wavelength within a specific range.

Electromagnetic energy that travels in wavelengths longer than the wavelength range of visible light includes infrared rays, microwaves, and radio waves. Electromagnetic energy that travels in wavelengths shorter than the range of visible light includes ultraviolet rays, X rays, gamma rays, and cosmic rays.

How is electromagnetic energy used to view the universe?

For centuries, men observed the stars and other objects in the universe with the human eye as the chief instrument. They were observing the light radiation, or waves of visible light that are given off by bodies in the universe.

In the early 1600's, the telescope was invented. Scientific knowledge in astronomy grew as telescopes were improved.

With telescopes, scientists could observe more light radiation than the human eye alone was capable of receiving. Telescopes, therefore, made it possible for scientists to observe stars or other objects that are invisible to the unaided eye.

Until 1945, the only telescopes used by scientists to view objects in the universe were those which gathered light radiation. Such telescopes are called optical telescopes. After 1945, the radio telescope was developed. The radio telescope may be thought of as a gatherer of radio waves. Like light radiation, radio waves are electromagnetic waves. Unlike visible light, however, radio waves cannot be seen by the human eye.

Light radiation had long been the only "window" through which scientists could observe the universe. With the radio telescope, scientists had gained another "window". Today, both optical telescopes and radio telescopes are among the chief instruments used to observe the universe.

电磁能以一定的波长传播。电磁能的类型可由波长的范围决定。例如，太阳发射出不同种类的电磁能，各以不同的波长传播。由于你的眼睛只能感受一定波长范围内的波，因此你只能看到一种电磁波。你知道这种电磁波就是太阳光。你所能看到的光的正式术语是可见光。可见光是以特定范围内波长进行传播的电磁能。

以比可见光波长范围更长的波长进行传播的电磁能包括红外线、微波和无线电波。以比可见光波长范围更短的波长进行传播的电磁能包括紫外线、X射线、伽玛射线和宇宙射线。

怎样利用电磁能观察宇宙？

千百年来，人类用肉眼作为主要的工具，观察宇宙间的众多恒星和其他天体。他们看到的是宇宙间天体发出的光辐射，也就是可见光波。

早在17世纪初，人类就发明了望远镜。随着望远镜的改进，天文学方面的知识也日渐增长。

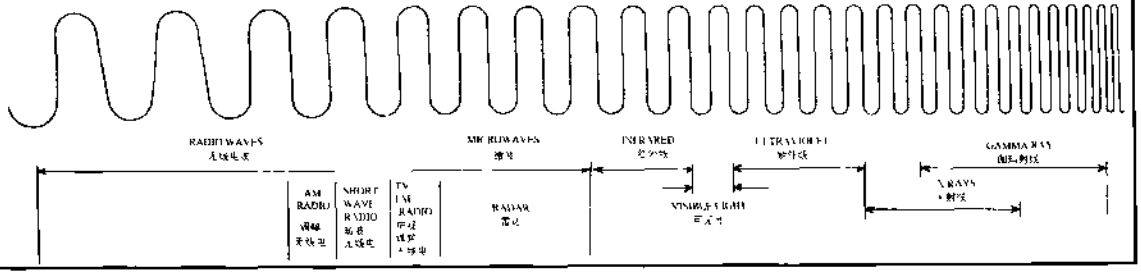
有了望远镜，科学家就能接收到比单用肉眼时更多的光辐射。因此，有了望远镜，科学家才能观察到肉眼看不到的恒星和其他天体。

直到1945年，科学家用来观察天体的都只是那些能收集光辐射的望远镜。这种望远镜叫做光学望远镜。1945年之后，人们研制了射电望远镜。可以把射电望远镜看做是无线电波的收集器，同光辐射一样，无线电波也是电磁波。但无线电波又不同于可见光，因为它不能被肉眼所看见。

长时期以来，光辐射是科学家借以观察宇宙的唯一"窗口"。有了射电望远镜，科学家就取得了另一个"窗口"。今天，光学望远镜和射电望远镜都是用来观察宇宙的主要仪器。

Electromagnetic energy travels in certain wavelengths. The type of electromagnetic energy may be determined by the range of the wavelength.

电磁能以一定的波长传播。电磁能的类型可由波长的范围决定。



How do optical telescopes work?

Optical telescopes are mainly of two types. The older and simpler type is called the refracting telescope. The larger of the two types is known as the reflecting telescope.

The refracting telescope operates on the same principle as the hand lens or magnifying glass. Convex lenses bend or refract light radiation. If two convex lenses are held some distance apart, the lens closer to the eye will magnify the image formed by the lens farther from the eye. Larger and more powerful lenses increase the magnifying power of the telescope.

the Palomar Observatory in California

美国加利福尼亚州的帕洛玛天文台

The refracting telescope is made up of a long, heavy tube. Convex lenses are at both ends of the tube. The first lens magnifies the object. The second lens magnifies the image formed by the first lens.

The largest refracting telescope has a first lens 40 inches in diameter. The tube of the telescope is 62 feet long. This telescope magnifies light from a star or planet 4,000 times.

The reflecting telescope gathers light on a mirror instead of on a lens. The mirror is curved and focuses the light so that it is intensified. The larger the mirror, the more light it can gather and focus. The largest reflecting telescope is the Hale telescope at the Palomar Observatory in California. Its reflecting mirror has a diameter of 200 inches.

A third type of optical telescope, which combines certain features of refracting and reflecting telescopes, was invented by Bernhardt Schmidt. It is known as the Schmidt telescope.

What are some disadvantages of optical telescopes?

Have you ever looked at something in the distance while viewing it through air above a warm object? If you have, you may remember that the distant object appeared hazy or even to be moving or wiggling. The various layers of air in the atmosphere act in much the same way upon light coming to the Earth from glowing objects such as stars. The "twinkling" of starlight is one example of this kind of effect. A telescope lens not only magnifies the objects, but it also magnifies the effect of the atmosphere. This is one disadvantage of optical telescopes.

光学望远镜如何工作?

光学望远镜主要有两种类型。较老式且较为简单的类型叫做折射望远镜，两种类型中较大的一种叫做反射望远镜。

折射望远镜的工作原理同放大镜一样，凸透镜能折射光线。如果让两片凸透镜隔开一定距离，离眼睛较近的那片凸透镜就会将较远的那片凸透镜所成的像加以放大。使用更大型和放大率更高的透镜，就能增强望远镜的放大能力。

折射望远镜用又长又重的镜筒制成。凸透镜位于镜筒的两端。第一片透镜对物体进行放大。第二片透镜再对第一片透镜所成的像进行放大。

最大型折射望远镜的第一块透镜直径达 40 英寸，望远镜的镜筒长达 62 英尺。这台望远镜能把恒星或行星射来的光增强 4,000 倍。

反射望远镜用镜面代替透镜收集光线，镜面是弯曲的，能使光线会聚，从而予以增强。镜面越大，它能收集和会聚的光也越多。最大的反射望远镜是美国加利福尼亚州的帕洛玛天文台的海尔望远镜，它的反射镜面直径达 200 英寸。

第三种类型的光学望远镜把折射和反射望远镜的某些特点结合起来。它的发明者是伯恩哈特·施密特，因此称为施密特望远镜。

光学望远镜有哪些不足之处?

你是否曾经透过热物体上方的空气，望远处的什么东西?如果你看过，你可能记得远处的物体会模糊不清，甚至会移动或摇曳。大气层里的各层空气，同样也会对恒星之类炽热天体射向地球的光线起干扰作用。星光的“闪烁”，就是这种效应的一个例子。望远镜的透镜不但放大天体，同时也有放大大气的效应。这是光学望远镜的一个不足之处。

The refracting telescope is made up of a long, heavy tube.

折射望远镜用又长又重的镜筒制成。

Another disadvantage is presented by cloudy weather. On completely overcast days and nights, viewing with optical telescopes is impossible. Visible light cannot penetrate the clouds.

Optical telescopes also are limited in their use because of interstellar dust, or tiny particles of dust between stars. It was once thought that the dark areas seen in the sky were due to a lack of stars in those areas. It is now clear that these dark patches are due to particles of interstellar dust, through which visible light cannot penetrate.

interstellar dust
星际尘埃

Actually, there is very little dust in comparison to the dust in the atmosphere of the Earth. It is estimated that there is one speck of microscopic dust in every cubic metre of space. On the Earth, this amount is hardly enough to consider. In space, however, the volume is huge enough to blot out 99 percent of the starlight that would be received by the Earth if there were no interstellar dust.

How was the radio telescope developed?

Until 1931, visible light was the only "window" through which astronomers viewed the universe. Then a young engineer, unknown in the world of professional astronomers, published a report of his experiments in an engineering publication. In his report, the young engineer claimed that his experiment provided evidence in support of his conclusion that the Earth was receiving radio waves from the Milky Way galaxy. The young engineer was Karl G. Jansky, about whom you read earlier. The newspapers reported the claim to the public, but most astronomers seemed to take little notice.

In Wheaton, Illinois, Grote Reber, an amateur radio operator, read about Jansky's experiments and findings with great interest. Reber decided to conduct his own experiments, but first he had to build an instrument capable of receiving radio waves. In 1937, Reber was ready to begin his experiments. He had completed building his instrument, which included receivers and a bowl-shaped reflector 9 m in diameter. This instrument is now considered to have been the first real radio telescope.

另一个不利条件是多云天气带来的。在完全阴天的日日夜夜，是不可能用光学望远镜进行观察的。可见光无法穿透云层。

光学望远镜的使用还受到星际尘埃（恒星间的细小尘粒）的限制。人们曾认为天空中的暗区是由于这些区域缺少恒星。现在才知道这些暗区是由星际尘埃的颗粒引起的，可见光无法穿透它。

实际上，同地球大气中的尘埃比起来，空间里尘埃是非常少的。据估计，每立方米空间，只含有一粒微尘，在地球上，这么一点数量是不予以考虑的。可是，它们在空间的总量却大到能挡住99%的星光。如果不存在星际尘埃的话，这99%的星光原是能被地球接收到的。

射电望远镜是怎样发明出来的?

直到1931年，可见光还是天文学家用以观察宇宙的唯一"窗口"。那时有一位不闻名于职业天文学界的年轻工程师，在一本工程出版物上发表了他的一份实验报告。年轻工程师在他的报告里声称，他的实验为他的结论提供证据。结论认为：地球一直在接受来自银河系的无线电波。这位年轻工程师就是前面提到过的卡尔·G·扬斯基。报纸把声明向公众报道，但大多数天文学家似乎无动于衷。

在伊利诺州的惠顿城，一位名叫格罗特·里伯的业余无线电操作人员怀着极大的兴趣阅读了扬斯基的实验和发现。里伯决定自己进行实验，但他首先得建造一台能接收无线电波的仪器。1937年，里伯已准备好开始进行他的实验。他已造成了仪器，包括接收器和一个直径为9米的碗形反射器。现在认为这台仪器是第一台真正的射电望远镜。

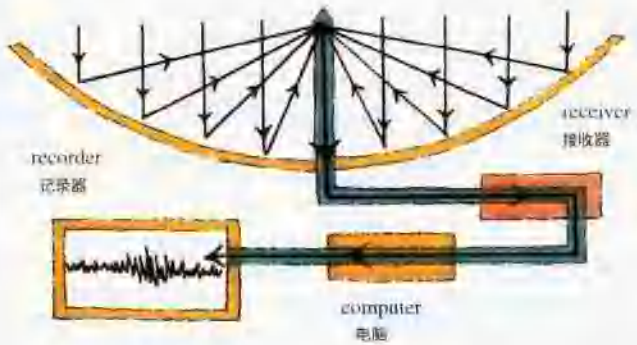
The Earth was receiving radio waves from the Milky Way galaxy.

地球一直在接受来自银河系的无线电波。

the first real radio telescope

第一台真正的射电望远镜

Reber observed the sky with his telescope for two years before he had his first success. In 1939, he identified a small region in Sagittarius, a constellation in the Milky Way galaxy, as a source of radio waves. Other sources were found in other constellations, such as Cygnus, Canis Major, Aquila, and Cassiopeia. Reber reported his findings in an astronomy publication. Some astronomers seemed to be interested, but the beginning of World War II shifted their interest.



A radio telescope is like a big radio set.
射电望远镜犹如一台大的无线电接收机。

During World War II, better instruments were developed for receiving radio waves. After the war, there was increased interest in radio astronomy.

How do radio telescopes work?

A radio telescope is like a big radio set. It has an antenna and circuits for changing electromagnetic waves into electric current.

The reflector is built in a shape similar to that of the curved lenses or mirrors of an optical reflecting telescope. The antenna is at the point of focus. When radio waves strike the reflector, they bounce to the focal point, where they are received by the antenna and transmitted to the receiver. The antenna can be tuned to receive the desired wavelengths, and the waves can be recorded.

Radio telescope reflectors need not be made as perfectly as those of optical telescopes. Light waves have such tiny wavelengths that the smallest imperfection will interfere with observation. Wavelengths of radio waves are much longer. Radio telescopes can be built much larger than optical telescopes.

There are different types and sizes of radio telescopes. A "steerable" telescope at Jodrell Bank in England has a reflector 200 feet in diameter. This reflector is so big that a stadium the same size could hold 10,000 people.

Other telescopes have immovable reflectors. They have masts and aerials which move to pick up signals from the desired directions. One such telescope, near Arecibo, Puerto Rico, is 1,000 feet in diameter and covers an area of 7.5 hectares.

里伯用他的望远镜花了两年时间观察天空，而后才取得初次成功。1939年，他确定出人马座（银河系里的一个星座）里的一个小区域，是无线电波的来源。后来又在诸如天鹅座、大犬座、天鹰座和仙后座等星座里发现了其他来源。里伯在一家天文学出版物上报道了他的发现。有些天文学家似乎发生了兴趣，但第二次世界大战的开始转移了他们的兴趣。

在二次大战期间，又研制成更为灵敏的无线电波接收仪器。战后，人们对射电天文学的兴趣大增。

射电望远镜如何工作？

射电望远镜犹如一台大的无线电接收机。它有一个天线和能把电磁波转变为电流的线路。

制成的反射器，形状同光学反射望远镜的透镜或反射镜的曲面很相似。天线位于焦点。无线电波到达反射器后，就反射回焦点，在那儿被天线所接收并传送到接收器。天线可以调谐，以接收想要接收的波长，还能把电磁波记录下来。

射电望远镜的反射器无需制造得同光学望远镜反射器一样精确。因为光波的波长很短，制作上最小的缺陷也会对观察发生干扰。无线电波的波长要长得多。射电望远镜可制造得比光学望远镜大得多。

射电望远镜有不同的类型和大小。英国约德莱尔岸的那台“可操纵”望远镜，其反射器直径达200英尺（1英尺=0.3048米）。这个反射器如此之大，同样大小的看台，足能容纳10,000名观众。

其他望远镜的反射器无法移动。它们依靠移动天线杆和天线，以从所要求的方向接收信号。波多黎各靠近阿雷西波的一台这种望远镜，直径1,000英尺，覆盖面积达7.5公顷。

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