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PHYSICAL SCIENCE
物理科学
The Magic of Light and Sound
神奇的光和声
REBECCA L. JOHNSON （美）著
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物理科学

神奇的光和声

REBECCA L. JOHNSON (美) **著**

李文平 **注**

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致读者

如果你希望读到地道的英语，在享受英语阅读乐趣的同时又能增长知识、开拓视野，这套由外语教学与研究出版社与美国国家地理学会合作出版的“国家地理科学探索丛书”正是你的选择。

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这套丛书以英文注释形式出版，注释由国内重点中学教学经验丰富的英语教师完成。特别值得推荐的是本套丛书在提高青少年读者英语阅读能力的同时，还注重培养他们的科学探索精神、动手能力、逻辑思维能力和沟通能力。

本丛书既适合学生自学，又可用于课堂教学。丛书各个系列均配有一本教师用书，内容包括背景知识介绍、技能训练提示、评估测试、多项选择题及答案等详尽的教学指导，是对课堂教学的极好补充。

本套丛书是适合中学生及英语爱好者的知识读物。

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神奇的动物

植物的力量

你和你的基因

观察细胞

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今日科学聚焦

让全世界人都吃饱

全球变暖

濒危物种

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恐龙探究

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保护海洋

社会研究系列

文明的进程

中国

埃及

希腊

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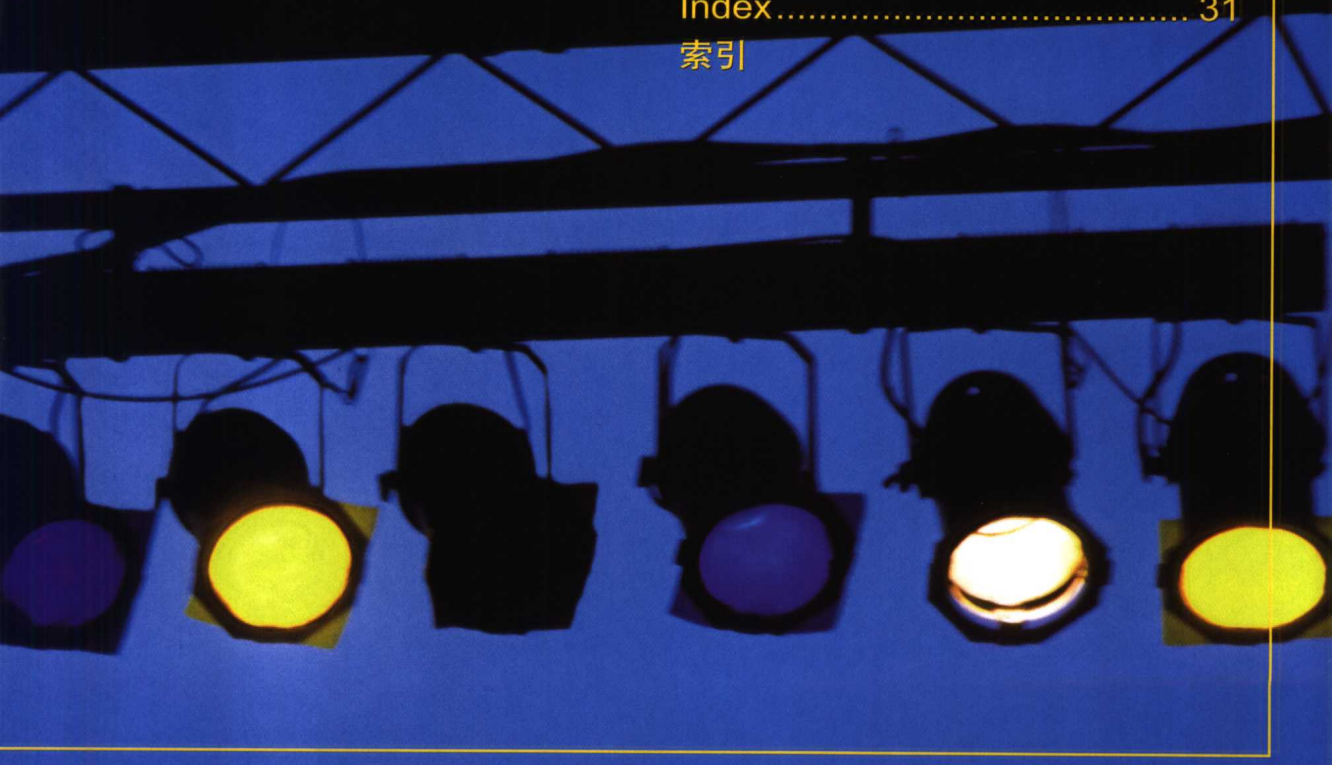
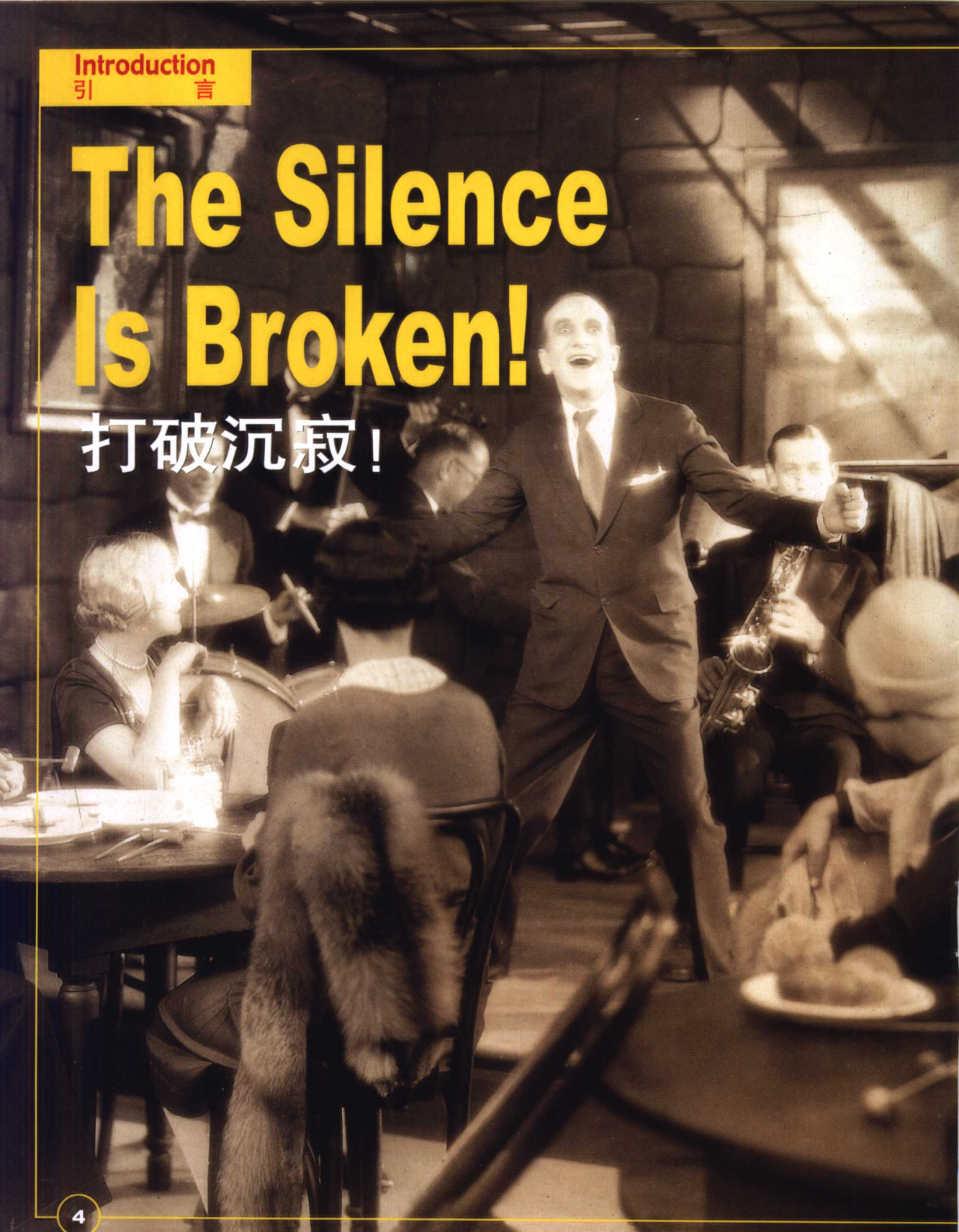
Contents
目　录

Stage lights



The Silence Is Broken!

打破沉寂！



In the back of the theater[1], the movie projector[2] comes to life. Then one of the actors[3] does something amazing[4]—he begins to talk and sing. For audiences[5] used to[6] silent movies[7], this seems like magic[8]!

The year was 1927 and the movie was *The Jazz Singer*. It was the first full-length "talking" picture. People had been experimenting[9] with cameras[10] that could capture[11] light on film[12] for many years. By the 1890s cameras were invented[13] to create "moving" pictures. These moving pictures were photographs[14] shown quickly on a screen[15] to create the illusion[16] of movement. But these early movies were silent. To know what the actors were saying, the audience read words flashed[17] on the screen.

In *The Jazz Singer*, light and sound came together in a new way. Inventors had found a way to record sound and play it back through speakers[18]. Moviegoers[19] could not only see the actors but also *hear* them.

And that was just the beginning. This is a book about light and sound—two forms of energy[20] that let us experience[21] the world around us in exciting ways. So keep your eyes and ears open as we explore[22] the magic!

1. theater	*n.*	剧院	12. film	*n.*	胶片
2. projector	*n.*	(电影)放映机	13. invent	*v.*	发明
3. actor	*n.*	演员	14. photograph	*n.*	照片
4. amazing	*adj.*	令人惊异的	15. screen	*n.*	屏幕
5. audience	*n.*	观众	16. illusion	*n.*	幻觉；错觉
6. be used to		惯于；习惯	17. flash	*v.*	闪现
7. silent movie		无声(电)影片；默片	18. speaker	*n.*	扬声器
8. magic	*n.*	魔术；魔法	19. moviegoer	*n.*	(常)看电影的人
9. experiment	*v.*	做实验	20. energy	*n.*	能量
10. camera	*n.*	照相机；摄影机	21. experience	*v.*	体验
11. capture	*v.*	捕捉；捕获	22. explore	*v.*	探索；探寻

An image from the film *The Jazz Singer*

Chapter 第一章 1

Energy with a Beat:

Waves of Sound

振动的能量：声波

Whether it's a loud blast[1] from trumpets[2] or quiet notes[3] from songbirds[4], sounds fill your ears each day. What sounds have you heard today?

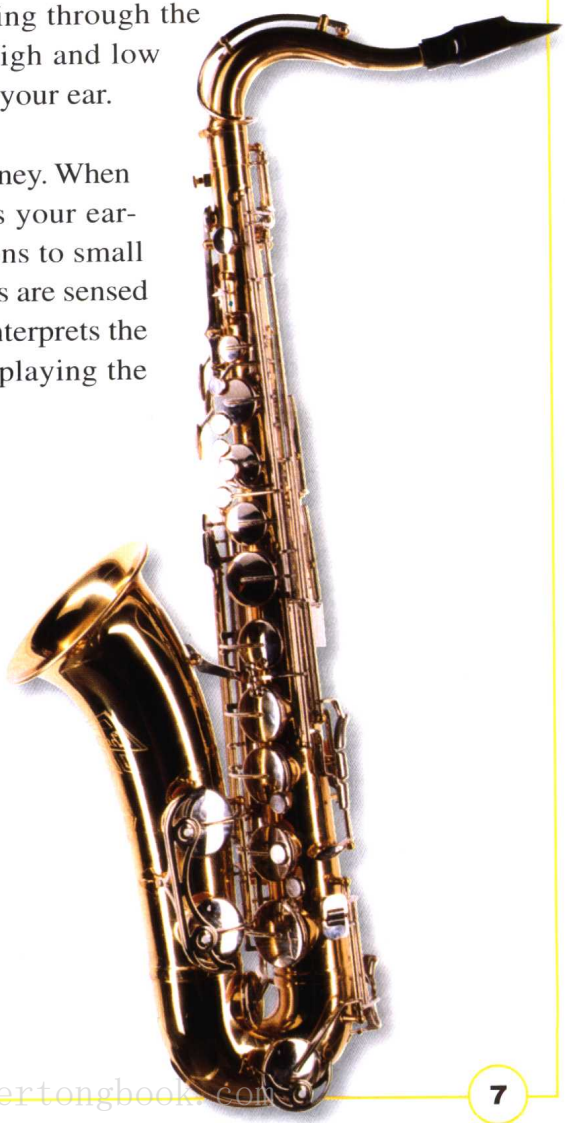
1.	blast	*n.*	(管乐器的)吹奏
2.	trumpet	*n.*	喇叭，小号
3.	note	*n.*	音调，音符
4.	songbird	*n.*	歌鸟

We experience our surroundings[1] largely through what we see and hear. Both light and sound are forms of energy that travel[2] in waves. When our eyes or ears sense[3] sound and light waves, our brains interpret[4] them as sights or sounds. Before we explore the light around us, let's think about sound.

Sounds Get Things Shaking

Sounds are a form of energy. Vibrations[5], or back and forth[6] movements, are the sources[7] of all sounds. Think about the music made by a saxophone[8] during a concert[9]. The sounds are produced[10] as the musician[11] blows air into the mouthpiece[12] of the saxophone. The mouthpiece has a reed[13] that causes the particles[14] that make up the air around the reed to vibrate, or move back and forth. The keys are pressed to make the air moving through the saxophone vibrate faster or slower to produce high and low sounds. Then the air carries these sound waves to your ear.

Saxophone



Inside your ear, the vibrations continue on their journey. When the vibrating air moves inside your ear, it causes your eardrum[15] to vibrate. The eardrum sends the vibrations to small bones and a fluid[16] inside your ear. These vibrations are sensed by nerves[17] and carried to your brain. Your brain interprets the vibrations as the smooth[18] sounds of a musician playing the saxophone.

1.	surrounding	*n.*	周围的事物；环境
2.	travel	*v.*	传播
3.	sense	*v.*	感觉到
4.	interpret	*v.*	解释；理解
5.	vibration	*n.*	振动；颤动
6.	back and forth		来回的(地)
7.	source	*n.*	源；根源
8.	saxophone	*n.*	萨克斯管
9.	concert	*n.*	音乐会
10.	produce	*v.*	产生；生产
11.	musician	*n.*	音乐家
12.	mouthpiece	*n.*	(乐器的)吹口
13.	reed	*n.*	簧片
14.	particle	*n.*	粒子；微粒
15.	eardrum	*n.*	耳鼓
16.	fluid	*n.*	流体；液体
17.	nerve	*n.*	神经
18.	smooth	*adj.*	平滑的；流畅的

Catching a Wave

To get an idea of what a sound wave is like, draw a wavy line on a sheet of paper. The distance[1] between the top of one wave and the top of the next wave is a wavelength[2]. Each wave of sound has a frequency[3]. Frequency is the number of wavelengths that pass by a particular[4] point in a given length of time. Waves with longer wavelengths have lower frequencies. Waves with shorter wavelengths have higher frequencies. That means that in one second fewer long waves pass by than short waves.

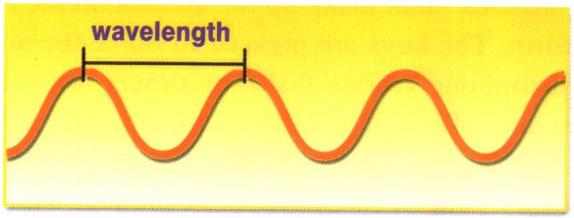
People can hear a wide range[5] of frequencies—but not all frequencies of sound. Sound with a frequency higher than we can detect[6] is called ultrasound[7]. Insect-eating bats produce ultrasound to find food and avoid[8] flying into things in the dark. Sound with a frequency lower than our ears can detect is called infrasound[9]. Elephants sometimes communicate[10] with each other using infrasound.

1. distance	*n.*	距离
2. wavelength	*n.*	波长
3. frequency	*n.*	频率
4. particular	*adj.*	特别的
5. range	*n.*	范围
6. detect	*v.*	察觉；发觉
7. ultrasound	*n.*	超声(波)
8. avoid	*v.*	避免
9. infrasound	*n.*	次声
10. communicate	*v.*	交流
11. material	*n.*	物质；材料
12. solid	*n.*	固体
13. liquid	*n.*	液体
14. vacuum	*n.*	真空
15. depend on		依……而定

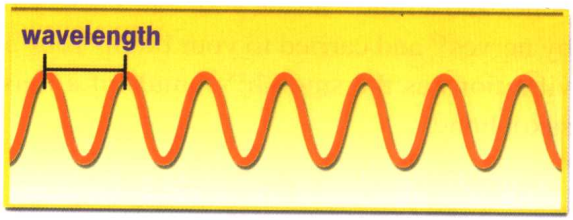
Traveling Sounds

Sound waves can travel through air. They also can travel through materials[11] such as solids[12] and liquids[13]. However, sound can't travel through empty space. Outer space is a vacuum[14]. A vacuum is a place without air or other kinds of matter. Because there is no matter to vibrate, no sound can be made.

Sound moves at different speeds depending on[15] what material it travels through. Sound



Long wavelength with a low frequency



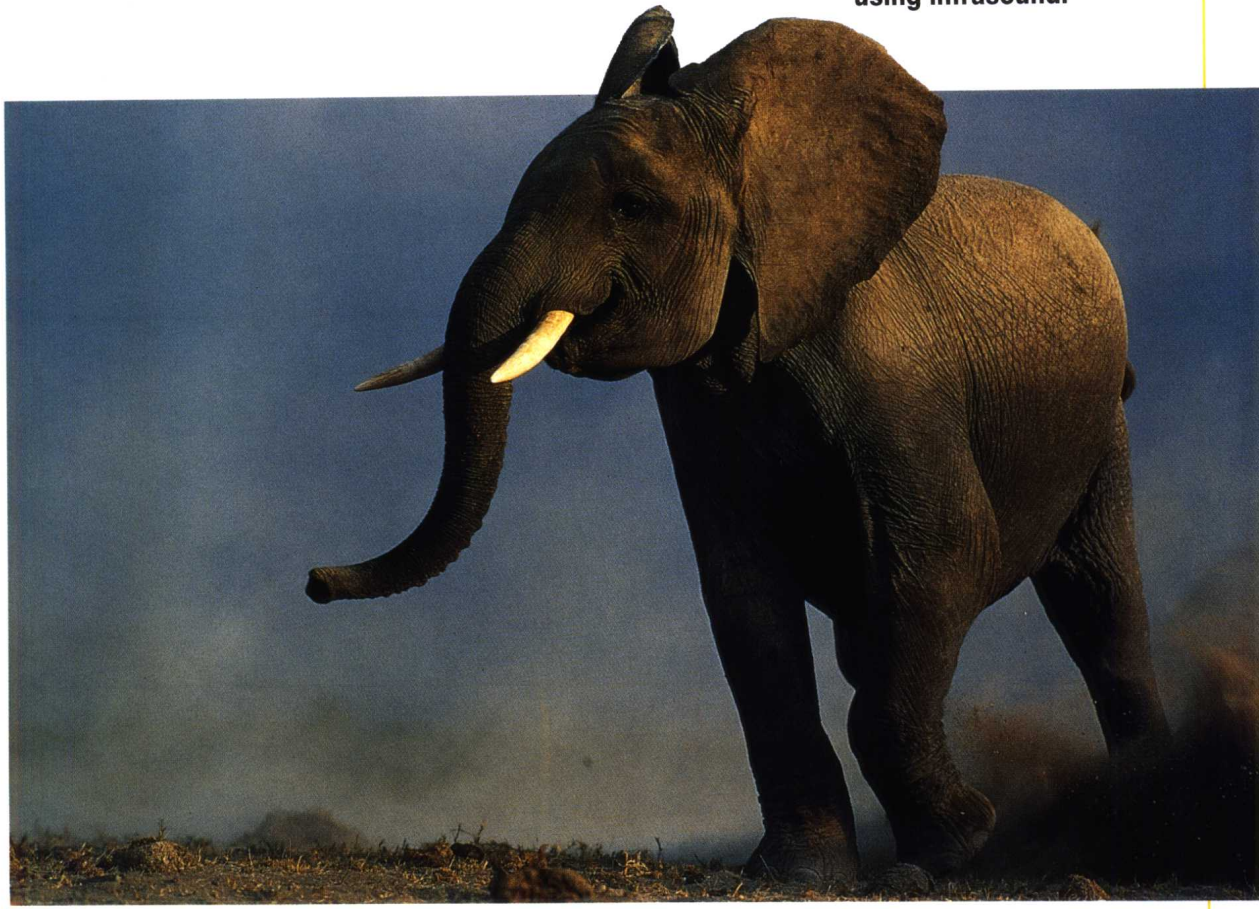
Short wavelength with a high frequency

Ultrasound is sound with a frequency higher than humans can hear. Some bats use ultrasound to catch food.

travels through air at about 340 meters (1,115 feet) a second. Sound travels four to five times faster through liquids, like water, than through air. Sound waves travel even faster through many solids.

Through what materials can sound travel?

Infrasound is sound with a frequency lower than humans can hear. Some elephants communicate using infrasound.

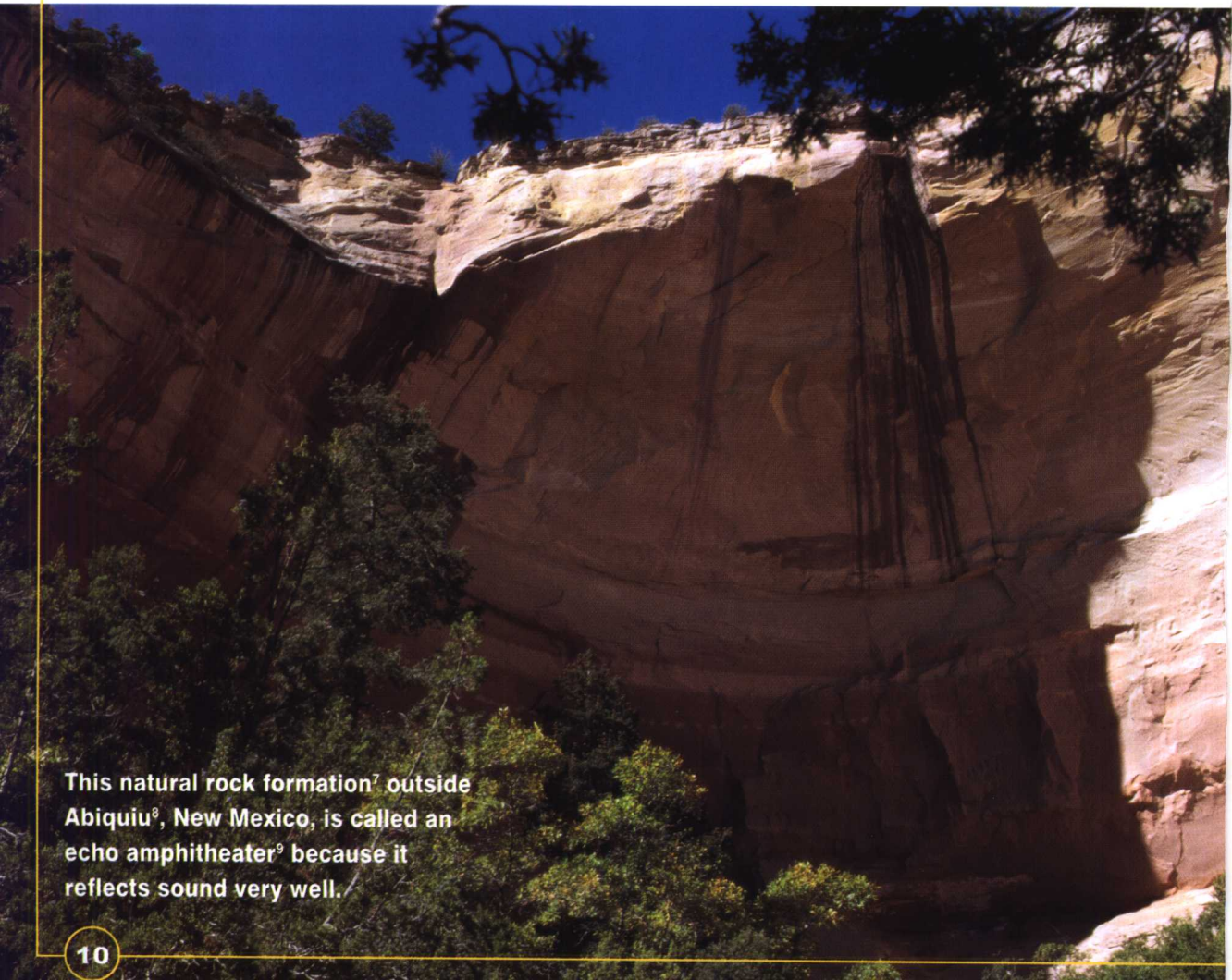


Bouncing[1] Sounds

Now you know that you can hear sound through different kinds of materials. Did you also know that you can hear sound waves that reflect[2], or bounce, off a surface[3]? Sound waves can strike[4] a smooth surface, like a wall or the side of a cliff[5]. These waves also can bounce off the wall and back to you.

A sound that bounces back to its source is called an echo[6]. Imagine standing some distance away from a large wall with a hard surface. If you shout, your words will return to you a few moments later. The farther you are from the wall, the longer it will take for the sound to bounce back. And the longer it will take for you to hear the echo.

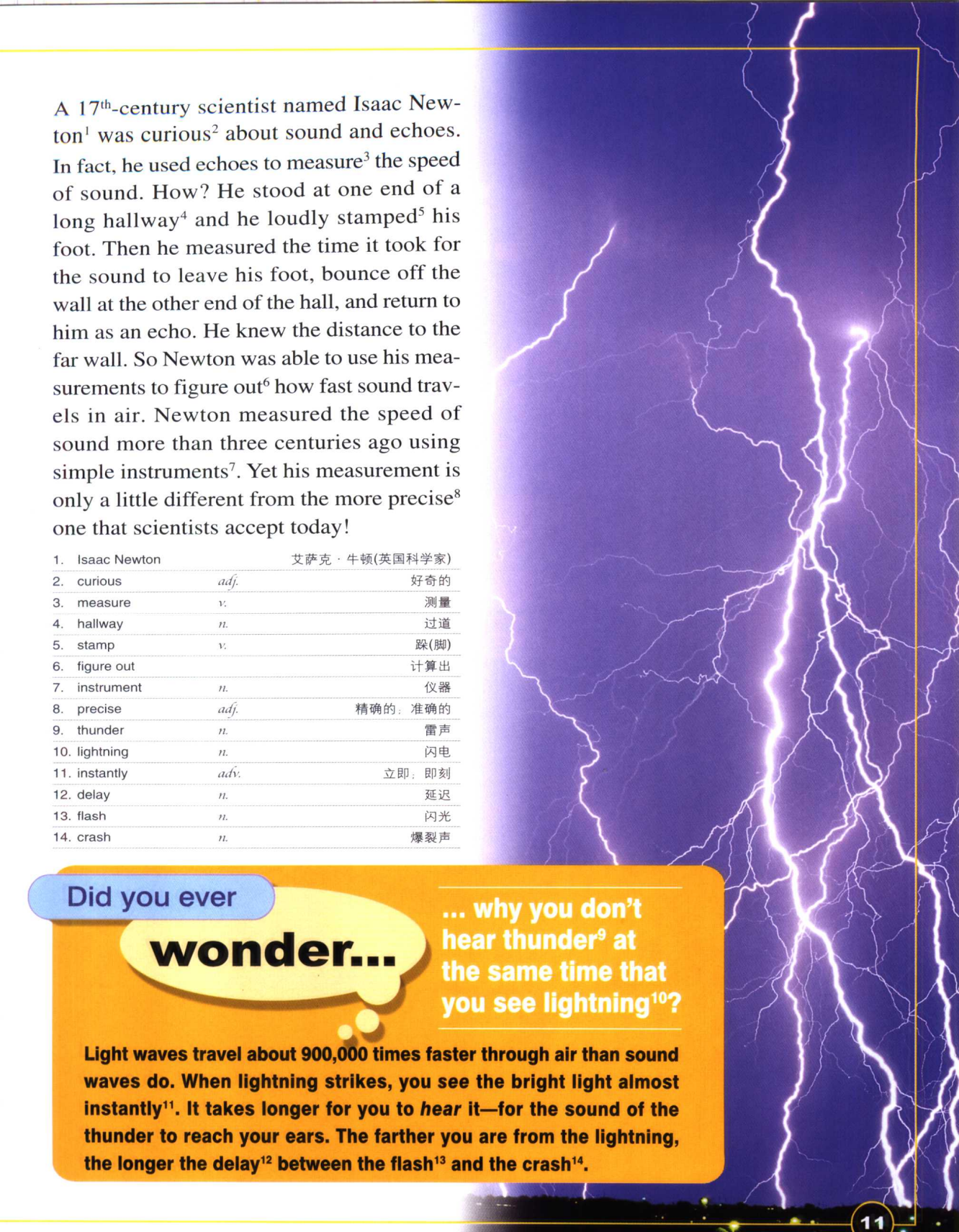
1.	bounce	*v.*	反射；弹回
2.	reflect	*v.*	反射
3.	surface	*n.*	表面
4.	strike	*v.*	撞击
5.	cliff	*n.*	悬崖；峭壁
6.	echo	*n.*	回声
7.	formation	*n.*	形成
8.	Abiquiu		阿比丘
9.	amphitheater	*n.*	圆形露天剧场



This natural rock formation[7] outside Abiquiu[8], New Mexico, is called an echo amphitheater[9] because it reflects sound very well.

A 17th-century scientist named Isaac Newton[1] was curious[2] about sound and echoes. In fact, he used echoes to measure[3] the speed of sound. How? He stood at one end of a long hallway[4] and he loudly stamped[5] his foot. Then he measured the time it took for the sound to leave his foot, bounce off the wall at the other end of the hall, and return to him as an echo. He knew the distance to the far wall. So Newton was able to use his measurements to figure out[6] how fast sound travels in air. Newton measured the speed of sound more than three centuries ago using simple instruments[7]. Yet his measurement is only a little different from the more precise[8] one that scientists accept today!

1.	Isaac Newton		艾萨克·牛顿(英国科学家)
2.	curious	*adj.*	好奇的
3.	measure	*v.*	测量
4.	hallway	*n.*	过道
5.	stamp	*v.*	跺(脚)
6.	figure out		计算出
7.	instrument	*n.*	仪器
8.	precise	*adj.*	精确的；准确的
9.	thunder	*n.*	雷声
10.	lightning	*n.*	闪电
11.	instantly	*adv.*	立即；即刻
12.	delay	*n.*	延迟
13.	flash	*n.*	闪光
14.	crash	*n.*	爆裂声



Did you ever **wonder...**

... why you don't hear thunder[9] at the same time that you see lightning[10]?

Light waves travel about 900,000 times faster through air than sound waves do. When lightning strikes, you see the bright light almost instantly[11]. It takes longer for you to *hear* it—for the sound of the thunder to reach your ears. The farther you are from the lightning, the longer the delay[12] between the flash[13] and the crash[14].

Chapter 2
第 二 章

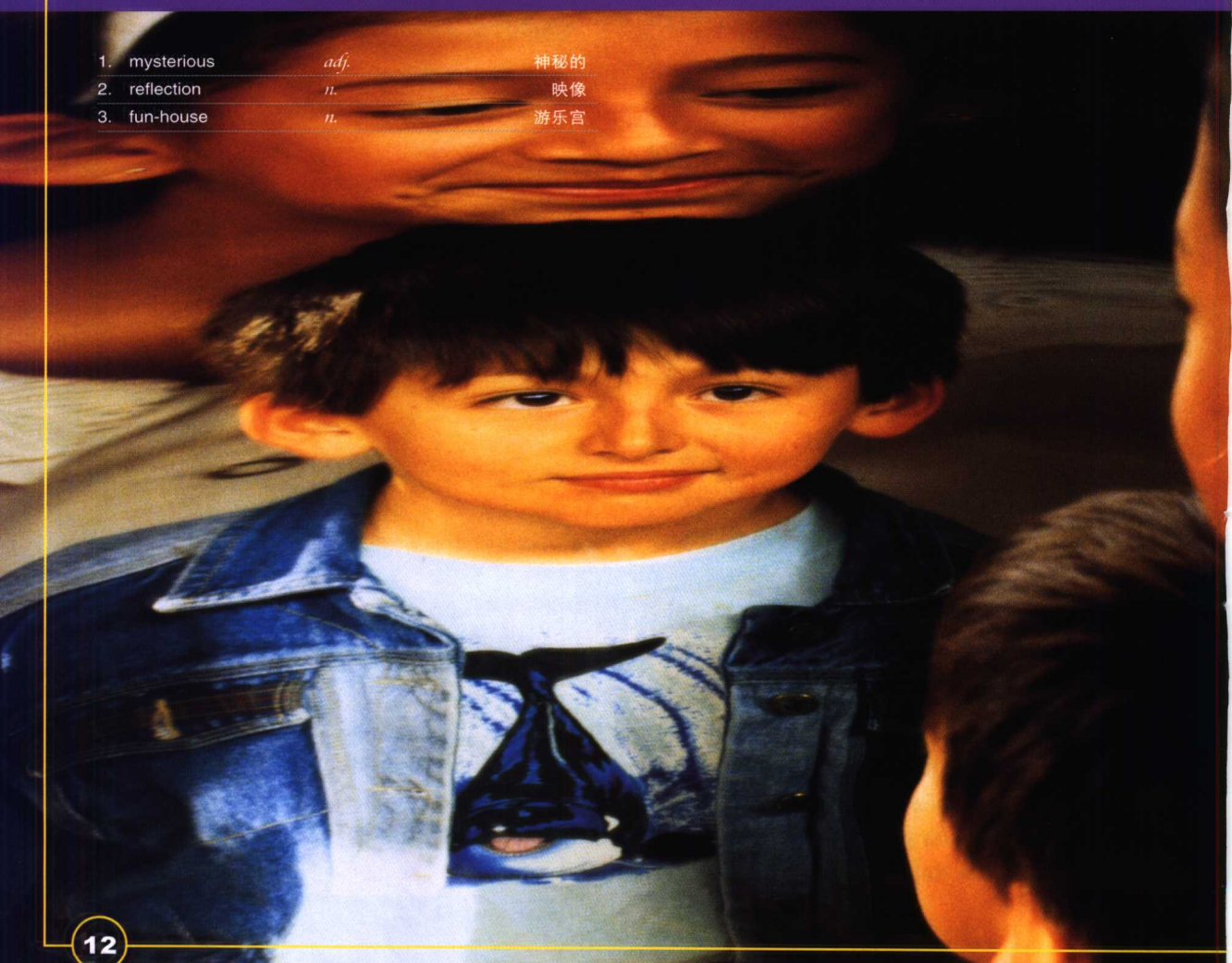
Energy with a Vision:

Waves of Light

视觉的能量：光波

Waves of sound and light do more than just move. They can act in strange and mysterious[1] ways. Have you ever seen your reflection[2] in a fun-house[3] mirror? Light bouncing off a fun-house mirror can make you look pretty strange!

1. mysterious *adj.* 神秘的
2. reflection *n.* 映像
3. fun-house *n.* 游乐宫



Like sound waves that reflect off a wall, light waves can also reflect off a surface. When light strikes an object[1], some of the light waves are absorbed[2]. Some waves may go through the object. Still other light waves may be reflected from it. When we see something that doesn't give off[3] its own light, our eyes are seeing reflected light waves.

Look at your reflection in a mirror. Did you know you're seeing light waves that have been reflected twice? First, the light reflects off your body. Then that light reflects off the mirror. A flat, shiny[4] surface like a mirror reflects light very precisely[5]. That means light waves bounce off the mirror at exactly the same angle[6] that they struck the mirror. The result is an image that looks much like its source.

Sometimes a shiny surface is not flat but curved[7], like a fun-house mirror or the back of a spoon[8]. This makes light waves reflect at different angles. The image you'll see won't look exactly like its source because the reflecting surface was curved. The image you see could look very different from the object in front of the curved mirror or spoon.

1.	object	*n.*	物体；对象
2.	absorb	*v.*	吸收
3.	give off		发出(光)
4.	shiny	*adj.*	发亮的
5.	precisely	*adv.*	精确地；准确地
6.	angle	*n.*	角度
7.	curve	*v.*	成曲形
8.	spoon	*n.*	匙；调羹
9.	studio	*n.*	排练房

A flat surface, like a mirror in a dance studio[9], makes an image that looks much like its source.

A curved surface, like a fun-house mirror, makes an image that is different from its source.