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本书覆盖了当代科技发展的各个领域，涉及诸如数学、化学、物理、遗传工程、电信、计算机、机械及商业管理等领域的广泛内容，且课文全部选自最新国外报刊杂志，并略有改动，是大学基础英语和各专业英语之间的过度性英语阅读教材。

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Text A

Chaos Theory[1]: the Mathematics of Chaos

Why are tides predictable years ahead, whereas weather forecasts often go wrong within a few days?

Both tides and weather are governed by natural laws. Tides are caused by the gravitational attraction of the Sun and the Moon; the weather by the motion of the atmosphere under the influence of heat from the Sun. The law of gravitation is not noticeably simpler than the laws of fluid dynamics; yet for weather the resulting behavior seems to be far more complicated.

The reason for this is "chaos", which lies at the heart of one of the most exciting and most rapidly expanding areas of mathematical research, the theory of nonlinear dynamic systems.

Random behavior in dynamic systems

It has been known for a long time that dynamic systems—systems that change with time according to fixed laws—can exhibit regular patterns, such as repetitive cycles. Thanks to new mathematical techniques, emphasizing shape rather than number, and to fast and sophisticated computer graphics[2], we now know that dynamic systems can also behave randomly. The difference lies not in the complexity of the formulae that define their mathematics, but in the geometrical features of the dynamics. This is a remarkable discovery: random behavior in a system whose mathematical description contains no hint whatsoever of randomness.

Simple geometric structure produces simple dynamics. For example, if the geometry shrinks everything towards a fixed point, then the motion tends towards a steady state. But if the dynamics keep stretching things apart and then folding them together again, the motion tends to be chaotic—like food being mixed in a bowl.

The motion of the Sun and the Moon, on the kind of timescale that matters when we want to predict the tides, is a series of regular cycles, so prediction is easy. The changing patterns of the weather involve a great deal of stretching and folding, so here chaos reigns.

Fractals

The geometry of chaos can be explored using theoretical mathematical techniques such as topology— "rubber-sheet geometry"[3]—but the most vivid pictures are obtained using computer graphics. The geometric structures of chaos are "fractals": they have detailed form on all scales of magnification. Order and chaos, traditionally seen as opposites, are now viewed as two aspects of the same basic process, the evolution of a system in time. Indeed, there are now examples where both order and chaos occur naturally within a single geometrical form.

Predicting the unpredictable

Does chaos make randomness predictable? Sometimes. If what looks like random behavior is actually governed by a dynamic system, then short-term prediction becomes possible. Long-term prediction is not as easy, however. In chaotic systems any initial error of measurement, however small, will grow rapidly and eventually ruin the prediction. This is known as the butterfly effect: if a butterfly flaps its wings, a month later the air disturbance created may cause a hurricane.

Chaos can be applied to many areas of science, such as chemistry, engineering, computer science, biology, electronics, and astronomy. For example, although the short-term motions of the Sun and Moon are not chaotic, the long-term motion of the Solar System is chaotic. It is impossible to predict on which side of the Sun Pluto will lie in 200 million years' time. Saturn's satellite Hyperion tumbles chaotically.

Chaos caused by Jupiter's gravitational field can fling asteroids out of orbit towards the Earth. Disease epidemics, locust plagues, and irregular heartbeats are more down-to-earth examples of chaos, on a more human timescale.

Making sense of chaos

Chaos places limits on science: it implies that even when we know the equations that govern a system's behavior, we may not in practice be able to make effective predictions. On the other hand, it opens up new avenues for discovery, because it implies that apparently random phenomena may have simple, non-random explanations.

So chaos is changing the way scientists think about what they do: the relation between determinism and chance, the role of experiment, the computability of the world, the prospects for prediction, and the interaction between mathematics, science, and nature. Chaos cuts right across traditional subject boundaries, and distinctions between pure and applied mathematicians, between mathematicians and physicists, between physicists and biologists, become meaningless when compared to the unity revealed by their joint efforts.

(703 words)

New Words

1. gravitational *adj*. (related to gravity) 引力的
2. nonlinear *adj*. 非线性的
3. geometrical *adj*. 几何学的
4. topology *n*. 拓扑学
5. magnification *n*. 放大率，放大倍数
6. evolution *n*. 进化论
7. Pluto *n*. 冥王星
8. Jupiter *n*. 木星
9. Saturn *n*. 土星
10. Hyperion *n*. 许珀里翁（希神名，传说是天神 Uranus 和大地 Gaea 的儿子，太阳神 Helios 的父亲)，此处为土星卫星之一名。
11. asteroid *n*. 小行星
12. timescale *n*.（事件发生或发展一段时间的）时标
13. sophisticated *adj*. 复杂的，精密的
14. graphic *adj*. 图表的，图形的，绘图的
15. reign *v*. 占优势，统治
16. fractal *n*. 分形，（指经典几何学中没有表示的不规则碎片形）
17. hurricane *n*. 飓风
18. tumble *v*. 紊乱地动
19. fling *v*. 猛抛
20. epidemic *n*. 传染病
21. down-to-earth *adj*. 现实的，实际的

Phrases and Expressions

1. fluid dynamics：流体力学
2. locust plagues：蝗虫灾害

Notes

1. Chaos Theory：混沌理论。
2. …and to fast and sophisticated computer graphics："and to" = "and thanks to".
3. rubber-sheet geometry：海棉垫几何，拓扑几何学，亦称"变形几何学"（geometry of distortion）。

Exercises

Ⅰ Multiple Choice:

Choose A, B, C, or D to complete each unfinished statement, making it closest in meaning to the relevant parts of the text.

1) The term "fluid dynamics" refers to ________.

A. a simple theory

B. the law of gravitation

C. a complicated theory in physics

D. the factor that influences weather

2) According to the theory of nonlinear dynamic system, ________.

A. we found no hint of randomness in mathematics

B. the system with regular patterns can also exhibit randomness

C. dynamic systems are random

D. dynamic systems are not in line with their mathematical description

3) Which of the following phenomena shows chaos?

A. Weather forecasts often go wrong.

B. Asteroids of Jupiter may heat the earth.

C Irregular heartbeats.

D. All of the above.

4) By the term "butterfly effect", the author is trying to tell us that ________.

A. small carelessness may lead to a big mistake

B. long-term prediction of a chaotic system is difficult to make

C. butterflies have powerful wings

D. hurricane is usually caused by slight air disturbance

5) The relation between order and chaos can be described as ________.

A. two alternating factors in a same matter

B. two opposite aspects that compel each other

C factors that co-existing in the same process

D. two factors that often appear in time

6) Chaos theory brings challenge to traditional science in that ________.

A. it proves that equations are not always effective in making predictions

B. it limits the development of science

C. it brings explanation to random phenomena

D. it disagrees with the existing equations

7) According to the passage, determinism ________.

A. doesn't exist

B means the same as chance

C. is an important part in experiment

D. is not so absolute as it used to be

8) Which of the following statements is not true?

A. One can not draw a definite conclusion even after experiments.

B. There's no clear distinction between mathematics and biology.

C. In new mathematical techniques, number is more important than shape.

D. The result of mathematical calculation is not always reliable.

Ⅱ. Cloze:

Fill in the blanks with the words or phrases given below:

content, dictates, overall, complex, modelling, fluid, dynamic, concepts, lays, differential, contrary, formulae, until, therefore, different, process, minor, evolution, multiply, contract, deviations

Generally, chaos is the study of forever changing __1__ systems based on mathematical __2__ of recursion, whether in the form of a recursive __3__ or a set of __4__ equations __5__ a physical system. __6__ to popular belief, the chaos theory is not about disorder. The chaos theory __7__ emphasis on the universal behavior of similar systems. The chaos theory __8__ that __9__ changes can cause huge fluctuations. Small __10__ from the original system __11__ multiply themselves repeatedly __12__ numbers are entirely different to the original system. __13__, both systems will have entirely __14__ values at any given time, but the __15__ behavior of the system will be the same.

Ⅲ. Sentence Translation:

A. Translate the following English sentences into Chinese:

1) The law of gravitation is not noticeably simpler than the laws of fluid dynamics; yet for weather the resulting behavior seems to be far more complicated.

2) This is a remarkable discovery: random behavior in a system whose

mathematical description contains no hint whatsoever of randomness.

3) Order and chaos, traditionally seen as opposites, are now viewed as two aspects of the same basic process, the evolution of a system in time.

4) Disease epidemics, locust plagues, and irregular heartbeats are more down-to-earth examples of chaos, on a more human timescale.

5) Chaos cuts right across traditional subject boundaries, and distinctions between pure and applied mathematicians, between mathematicians and physicists, between physicists and biologists, become meaningless when compared to the unity revealed by their joint efforts.

B. Translate the following Chinese sentences into English:

1) 潮汐是由太阳和月亮的重力吸引所致；而天气则是因太阳的热量影响大气运动而形成的。

2) 天气的变化形式涉及到大量的伸延和翻卷运动，因此要用混沌理论来解释。

3) 在混沌系统中任何计量上的初始误差，不论多么微小，都可能迅速增大并最终毁掉整个预测效果。

4) 要预测在两亿年后冥王星会在太阳的哪一面是不可能的。

5) 即使我们知道计算某系统运动的等式，在实践中，我们也可能作不出有效的预测。

Ⅳ. Oral Practice:

Explain the following words or phrases according to what you have learned in the text.

1) chaos theory

2) fluid dynamics

3) topology

4) rubber-sheet geometry

5) butterfly effect

Text B

Floating Frogs

Magnets help living organisms defy gravity.

by Corinna Wu

Asked to think of an animal that can fly, most people don't picture[1] a frog. Nonetheless, in April, a team of British and Dutch researchers announced success in levitation a live frog by using a powerful magnet. According to one of the human observers, the frog emerged from the flight unharmed and "happily joined his fellow frogs in a biology department."

The amusing video image of the frog hovering in midair circulated widely and captured many people's fancy. The researchers received letters from all over the world inquiring about the demonstration. Their favorite came from the leader of a church who wanted to levitate himself to attract new members. "We have the One True Word[2] to save the world," the letter read, "but we have to do magic tricks to get the people to listen."

The seeming ability to defy gravity is what delights most people, but the demonstration also highlights a more subtle idea that is often overlooked in everyday life that many objects considered nonmagnetic do, in fact, possess magnetic properties. The water, proteins, and organic molecules that make up frogs and other living things are diamagnetic, which means that in the presence of a magnetic field they become weakly magnetized in such a way as to oppose the applied field.

Diamagnetism is what allowed the researchers to float the frog. Scientists are now looking into this phenomenon to simulate zero gravity and thus provide a low-cost substitute for experiments now possible only in outer space. They plan to tease out how the absence of gravity affects biological systems, especially developing embryos.

The National Aeronautics and Space Administration's[3] obvious interest in low-gravity situations has fueled the myth that astronauts prepare for their missions in a top-secret antigravity chamber. Accordingly, many visitors to the Johnson Space Center[4] in Houston are disappointed to find that NASA's low-gravity chamber is nothing more than a large swimming pool.

A pool is one of the few ways to simulate low gravity on Earth. Astronauts training for a mission wear weights to achieve what they call neutral buoyancy, a position under the water but not touching the pool bottom. Underwater suspension doesn't truly mimic weightlessness[5], however, says James M. Valles Jr., a physicist at Brown University in Providence, R.I.[6] The water still pushes on the body, so the cells continue to experience stresses due to gravity.

Another low-gravity method involves an airplane nicknamed "the Vomit Comet," which flies up and down roller-coaster-style. The quick transitions from climbs to descents provide about half a minute of weightlessness at the top of each arc. Lengthier low-gravity experiments must be performed on the Space Shuttle or another such station in orbit.

Magnets can levitate small objects without the need for space flight. A popular toy known as a Levitron keeps a spinning top afloat above a special base. The permanent magnets in the top and the base are oriented so that similar poles—either two north or two south poles-point toward each other and therefore repel. That repulsive force makes it possible for the top to spin in midair.

With the advent of high-temperature superconductors, magnetic levitation of nonmagnetic material became an easy tabletop demonstration too. A chunk of superconductor can hover above an ordinary refrigerator magnet when cooled to liquid nitrogen temperatures or lower. A superconductor acts as a perfect diamagnet and excludes an applied magnetic field, says Simon Foner, former associate director of the Massachusetts Institute of Technology's Francis Bitter Magnet Laboratory. In effect, electrons within the superconductor move in a way that generates a field equal and opposite to the applied field. Because superconductors are such good diamagnets, a relatively weak magnetic field is enough to make them float.

Frogs are much poorer diamagnets. In the presence of a magnetic field, the electrons orbiting a frog's atoms generate an opposing field that has only a tiny fraction of the applied field's strength. It therefore takes a stronger applied field combined with a change in magnetic field, or gradient, to create enough repulsion to support a frog's weight.

To perform their trick, the researchers—from the University of Nijmegen in the Netherlands, the University of Sao Carlos in Brazil, and the University of Nottingham in England—used a powerful water-cooled solenoid magnet, a cylindrical coil wound from a few hundred turns of wire. Current passing through the wire creates a field whose north-south axis lies along the center of the coil and whose strength varies along the axis.

Placed in the hollow core of the coil, a vertical tube a few inches in diameter, the frog, generates a diamagnetic field that could theoretically be detected by a compass, says Nijmegen's Andre Geim.

When the frog is in an area of the magnet where it experiences a large combined effect between the gradient in the applied magnetic field and field strength, a repulsive force pushes the frog up. At the point where magnetic repulsion and gravity counterbalance each other, the frog floats.

Even though the magnetic field needed to levitate the frog is much larger than that of a household magnet, it's still low enough to be reproduced easily in a laboratory. "It takes only 100 times higher fields" than for the superconductor demonstration, says Geim. The relative ease of levitation a frog "appeared to be strikingly counterintuitive for many, including myself and my colleagues."

Many scientists tend to discount the effect of magnetic fields on water and organic materials, Geim notes, because the response of those materials to a magnetic field is a billionth of iron's response. A sufficiently strong magnetic field can levitate almost anything—and do it at room temperature, the researchers argue.

Geim says that he and his colleagues have levitated frogs, grasshoppers, plants, and water droplets to "break down the prejudice that the world around us is nonmagnetic." They aren't planning on pursuing the research much further, however, Valles, along with biologist Kimberly L. Mowry and their colleagues at Brown, has been focusing on magnetic levitation as a way of studying gravity's effect on the development of frog embryos.

The group's preliminary results show that magnets may provide a way to cheat the maxim that any experiment performed on Earth comes under the influence of gravity. Working at Bitter Lab, the researchers first levitate water droplets in a solenoid magnet, then add frog embryos to them.

They keep the embryos suspended in the magnet long enough to see the single cells divide into eight. By measuring the density of the embryos, the researchers determined that the gravitational forces on the embryos were one-tenth of normal values. Valles, Mowry, and their colleagues reported their findings in the August BIOPHYSICAL JOURNAL.