新方法英语

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A New World of Science & Technology

科技新世界

何兆枢　牛成儒　编著

宇航出版社

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内 容 简 介

本书是大学科技英语课程教材，共编入 60 课课文，内容广泛，包括了现代科技主要领域的饶有趣味而又有现实意义的课题，例如：宇宙科学、航天、航空、能源、生物工程、计算机及其应用、人工智能、人工神经网络、机器人、地球资源卫星、激光通讯、高清晰度数字式电视机、环球抗干扰无线电广播、液晶显示、动画显示的计算机模拟、新材料与新工艺、基因工程、环境污染与环境保护、中短期天气预报技术、计算机辅助建筑设计技术，以及有关相对论、地球物理学、天体物理学、核物理学、天文学、地质学、生物学、遗传学、古人类学、语言学等自然科学领域的一些理论、实验、科研与观察。

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A New World of Science & Technology
科 技 新 世 界
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前　言

本书《A New World of Science & Technology》(科技新世界)是为理工科大学生、研究生设计的科技英语课程的泛读教材。具有相当英语水平的科学工作者，工程技术人员、技术学校和大学的教师都可以利用本教材提高英语阅读能力，扩大词汇量，拓宽知识面，开阔思路。TOEFL 和 GRE 应试者会发现本书很有用。

本书共编入 60 课课文，内容广泛，包括了现代科学技术主要领域的饶有趣味而又具有现实意义的课题，例如，环境污染与环境保护、新材料与新工艺、能源、生物工程、航空与宇航、宇宙科学、计算机及其应用、人工智能、人工神经网络、机器人、激光通讯、地球资源卫星、高清晰度数字式电视机、环球抗干扰无线电广播、液晶显示、动画显示的计算机模拟、基因工程、中短期天气预报技术、计算机辅助建筑设计技术，以及有关相对论、地球物理学、天体物理学、核物理学、天文学、地质学、生物学、遗传学、古人类学、语言学等自然科学领域的一些理论、实验、科研与观察。

本书取材着眼于科学性、知识性、趣味性和实用性。语言规范、流畅。讲解上注重条理性和逻辑性，力求用通俗易懂的实例帮助读者理解深奥的科技问题。毫无疑问，它能满足读者提高英语水平，增长知识的双重愿望。

每课课文之后的词汇表和理解性问题可以帮助学习者掌握本课生词和词组，并正确理解和记忆课文内容。

本书作者研读了国内、外多种专业的教科书和专著，并参考了国外刊物的有关文章，融合了自己的知识，按照自己的理解用英语写成这本教材。这是一次尝试。作者深切盼望国内学界同仁不吝指教。

本书由北京理工大学计算机系何兆柩副教授与航空航天大学外语系牛成儒副教授编著。部分课文由中国科学院沈阳自动化研究所研究员徐心平、华南师范大学副教授何廷柩撰稿。本书并请王幼纯教授审定，谨此致谢。

CONTENTS

Lesson One
Science and Technology in the News

(1) How Many Planets Might There Be in the Solar System?

On May 30, 1991, American astronomer Allen Sterne proposed a theory at a symposium sponsored by the American Astronomical Society that in the solar system there might be about 1, 000 planets.

This theory came out after a computer simulation was made to analyze several puzzling questions about celestial bodies in the solar system. The questions are:

(a) Why do the Pluto, the smallest planet of the solar system, and its satellite, Charon, orbit on the rim of the solar system, while other planets all are enormous planets?

(b) Why does the largest satellite of the solar system—Neptune's satellite-1 revolve around the Neptune in an opposite direction?

(c) Why does Uranus spin tilting on one side like a toppling top while others all rotate around an upright or nearly upright axis?

Astronomers explain their perversion like these: The Uranus was hit and tumbled over in a collision; the Neptune's satellite-1 had originally been a passerby celestial body and then happened to be captured by the Neptune; the Pluto and its satellite probably originated somewhere in the solar system and finally stayed where they are after they collided with each other.

But Sterne said the possibility of simultaneous occurrence of these three events was very slim. He speculated that besides the 9 planets as we know them, there might be unnumbered planets each with the size of the Pluto in the primitive solar system about 5 billion years ago when the solar system formed. They remain circling the sun somewhere beyond the known boundary of the solar system. Why they stay so far away from the sun is that they are repelled by the large planets.

Sterne said they are beyond our observation using the present telescopes. He predicted that the spacial infrared telescope which is to be deployed in space by the end of 1990s will be able to detect such planets as many as some dozens.

(2) An Astronomic Prodigy in the 20th Century

On July 11, 1991, a total solar eclipse occurs, which is one astronomic prodigy in the 20th century. The eclipse lasts 7 minutes, starting from Hawaii, passing the Pacific, Mexico, Central America and ending at Columbia and Brazil, covering a zone as long as 10, 000 kilometers and as wide as 250 kilometers.

Three billion people watch that eclipse through live telecast while 220 million witness it in that region.

This "century eclipse" has aroused intense interest among scientists and tourists, as it is a very rare chance in a century. According to experts, solar and lunar eclipses may occur at least 7 times a year, and every 18 months there may be a solar eclipse, but most of them are partial eclipse. At a certain place on earth, a solar eclipse can be observed every 200 years. Astronomers say, by 2132, in the region where this solar eclipse is now observed, no other eclipse can be seen.

The best place where people observe this eclipse is Lower California, Mexico, which now becomes a hot spot attracting scientists and tourists. All hotel rooms have already been booked up there. As estimated, 50 million dollars will be brought in on that single day. Mexico authorities have arranged 10, 000 policemen on duty to insure tourists security. Other tourist agencies too benefit from that eclipse. In Hawaii, a first full-house record in many years is now achieved. Costa Rican government decided to increase their fees for trips around the Pacific region to 100 dollars. Many companies take the advantage of the eclipse. Some provide filters at 3 dollars each and T-shirts with the magiclike word *Eclipse* and patterns depicting the shadowed sun. This eclipse has been blurbed in many countries in that zone. In Salvado and Honduras, authorities decided that all schoolchildren are allowed to have a day off to watch the eclipse.

As a contrast, in some backward regions of these countries, residents, especially those of American Indian minority, hold superstitious belief in eclipse. In Mexico, people highly worship the sun and the moon as the supreme divinity. They think mishaps will befall them once the sun disappears. American Indian tribes strike iron plates and wooden items on that day in the hope of driving devils away. Pregnant women stay home lest their babies suffer misfortune. Some Brazilian witches declare that the eclipse will have adverse influence on political decisions made on that day. To confirm their claim, they point to the Gulf war that broke out soon after a lunar eclipse. While these fantastic beliefs and practices are surely absurd, one phenomenon is certain: Creatures will be affected by an eclipse to some extent. Scientists say that atmospheric temperature will drop even by 20 degrees Celsius during an eclipse and some animals in deep sleep will awake several minutes after the sun re-appears and their biological clock will run in confusion.

(3) Attracting Fish to A Spawning Field Using Scents

The fish have a remarkable aptitude: a fish captured and set free to another spot either upstream or downstream will return to the original place where it lived. This phenomenon is called "home sense".

It is believed that this aptitude is because of the fish' reaction to the unique scent that exists in the water where they live. The salmon shows this aptitude in the most unusual way. Every adult salmon will return to its home river when it spawns several years after it left the river. No fault has been observed. Now a question arises: Is it possible to attract the salmons to spawn in a fish farm where their eggs will be protected and the adult fish can be added to the catch after they spawn and then die?

If the baby fish can memorize the scent of a synthetic matter called "marin" spread in the water, then after several years living in sea, they will return to a river specially arranged to have a thin scent of marin and spawn, although this river is not the original one where they were born. The key point is that the water there must release a scent like that in the home river.

Some scientists from the Moscow University, Academy of Science of the U. S. S. R. and Ministry of Fishery have achieved some hopeful results in this experiment. They inspected the sensitivity of some carp to the scent of very thin marin and found out in a series of complicated electro-physiological tests that the minimum concentration of marin needed is less than several one-hundredths of a milligram dissolved in a liter of water. As the scent of that marin is enough to override the natural "home scent", it is possible to use marin as a means for directing migration of fish, resulting in increase of their population and catch of some precious fish.

(4) The Miraculous Membrane

To your surprise, a piece of membrane as thin as 0. 1 mm can be miraculously useful in scientific research, medical treatment, environmental engineering and even food-processing industry.

In hospitals, a new type of membrane is now tested as an artificial skin spread on burns with remarkable results: The membrane has caused very little rejecting reaction and infection. This type of membrane will soon become a commercially available product.

In desalination of sea water to make drinkable water, membrane will play a bet- -role than the conventional method of evaporation. The new method is based on inversive of the membrane. Compared with the conventional method, membrane saves ele-

50% and the investment is less, too. It is hopeful to solve the problem of water shortage by using membrane. Membrane can be used to improve food composition. For example, wine made from grape juice is not sweet enough and sugar is thus added in the ferment process. Membrane can help condense the juice by removing water contained in it. As a result, the process of adding sugar can be dispensed with and its taste improved. Membrane can also be used to make low-salt sauces, purify fruit juice and remove unwanted colors and scents from liquids.

Some membranes can produce photosynthesis or present photosensitivity or taste-sensitive effect, which means a new area in molecular bionics.

The basic material of this type of membrane is high polymers, for example, polycarbonate. Other ingredients are added to produce special effects. For example, antibiotic is an extra composition of those membranes used as artificial skin or made into a tiny capsule to be put in a wound, which, being sensitive to the temperature in the wound, will release proper amount of medicine when the temperature increases due to infection and thus produces dynamic remedial effect.

(5) A New Generation of Supercomputers

A computer component called Multiple Array Processors System (MAPS) is now under final test before it is used to construct a new supercomputer that will enable scientists to understand the subatomic structure.

This component is an array made of 660 microprocessors, each of which as small as a fingernail can operate several hundred times faster than a standard microcomputer. Constructed with such arrays, the new supercomputer can function some dozen times better than any existing supercomputer. With this supercomputer, scientists believe they can verify a hypothesis about the characteristics of the fundamental particle called Quark. Now at least 5 groups of scientists in the U. S., Italy and Japan are competing in making such a computer which, as scientists expect, can provide strong arguments to verify or negative some basic hypotheses in modern physics. Based on a technique called parallel operation, this supercomputer divides the entire task into several hundred small tasks and assigns each to a component microprocessor, resulting in dramatically high working speed. It can perform 1,000 billion floating-point arithmatic operations per second, much faster than any existing supercomputer, whose speeds range from 3 billion to 5 billion operations per second. Scientists believe what they create is the fastest computer in the world.

(6) A New Prosthetic Material

A new prosthetic material is now bringing great changes to prosthetic surgery. The prosthetic material will gradually disapear after it is implanted into the human body; but there is no vacancy left; instead, it is replaced by cells and tissues produced by the body itself. This prosthetic material causes little after-effect rejecting alien objects. As a contrast, 50% of women who have received implanted artificial mammas made of silicon ketone will have to suffer another operation because a fibrillate shell as hard as wood forms around the prosthesis.

Two French doctors thought coral, having a porous structure, can be used in prosthetic surgery to repair broken bones, as its structure is similar to that of the vertebra and it thus can provide a special interface between prosthetic materials and human bones. The cells of the broken bone can metabolize to develop new tissues and eat off the implanted coral material. This process may take several months or several years, resulting in a new bone, for example, a piece of thighbone as long as 20 centimeters.

But only 5 out of 2, 500 species of coral can be used as prosthetic material. Besides, as coral's strength is rather low, it cannot be used to repair those bones that sustain heavy burden. That it takes several years to form a new bone is another disadvantage.

(7) Sex-reversal Done on A Mouse

Biologists at the National Medical Research Institute, London, have reversed the sex of a female mouse embryo by genetic engineering. Their method involves implanting a single gene from the Y chromosome of male mice into fertilised mouse eggs that carry two X chromosomes, the usual complement for females.

The researchers stress that they have no intention of applying the technique to humans. The experiments were done to prove a scientific point. Many biologists believe that a single gene is in control; the Sry is the "testes-determining factor". But without direct evidence of the gene's involvement in sex determination, the researchers refrained from calling it the testes-determining factor. The sex-reversal experiments are done to clear up the whole issue of whether Sry determines sex.

To get their sex-reversed embryos, the researchers injected DNA containing the Sry gene into hundreds of eggs. As is usual in such experiments, only a fraction of the eggs incorporated the DNA into their own genetic material, so the researchers obtained only a handful of "transgenic" embryos. Of these, three were sex-reversed, and one sex-reversed mouse was born. This mouse, like all males born with two or more X chromosomes, was sterile. Most fe-

male embryos carrying the Sry gene developed as perfectly normal females. "Why the gene doesn't work in all cases?" The researchers say that they don't know yet.

(Adapted from *Reference News*, 1991)

Words and Expressions

symposium [sim'pəuziəm], (复) symposia[sim'pouziə]n. 专题讨论会
simulation [simju'leiʃən] n. 模拟
celestial [si'lestjəl; 美 si'lestʃəl] a. 天空的,天的,天上的
Pluto ['plu:təu] n. 冥王星
Uranus ['juərənəs] n. 天王星
Neptune ['neptju:n] n. 海王星
tilt [tilt] vi. 倾斜,歪斜,vt. 使倾斜,使歪斜
top [tɔp] n. 陀螺
perversion [pə'və:ʃən] n. 反常,歪曲,颠倒
tumble ['tʌmbl] vt. 使摔倒,使翻滚
collision [kə'liʒən] n. 碰撞,冲突
collide [kə'laid] vi. 猛撞,冲突
simultaneous [ˌsiməlf'teinjəs] a. 同时发生的,同时进行的
speculate ['spekjuleit] vt. 推测,推断
repel [ri'pel] vt. 排斥,推斥
infrared ['infrə'red] a. 红外线的
prodigy ['prɔdidʒi] n. 奇观,奇迹,奇事,奇物,奇才
eclipse [i'klips] n. (日,月)食
filter ['filtə] n. 滤光镜,过滤器
pattern ['pætən] n. 图案,样式,模式
depict [di'pikt] vt. 描绘,描述
blurb [blə:b] vt. 大造广告,(在广告等中)推荐、吹捧
minority [mai'nɔriti] n. 少数民族
superstitious [ˌsju:pə'stiʃəs] a. 迷信的
supreme [sju'pri:m] a. 至高无上的,最大的,最重要的
divinity [di'viniti] n. 神性,神力,神威,神德
mishap ['mishæp] n. 不幸的事,灾祸
pregnant ['pregnənt] a. 怀孕的
lest [lest] conj. 唯恐,免得(从句里要用原形动词)
witch [witʃ] n. 巫婆,巫士
adverse ['ædvə:s] a. 有害的,不利的
confirm [kən'fə:m] vt. 证实
claim [kleim] n. vt. 声称,声言
absurd [əb'sə:d] a. 荒谬的,可笑的,愚蠢的
phenomenon [fi'nɔminən], (复) phenomena[fi'nɔminə]n. 现象
extent [ik'stent] n. 程度,限度,范围
confusion [kən'fju:ʒən] n. 混乱
spawn [spɔ:n] vi,vt. 产卵
scent [sent] n. 气味
aptitude ['æptitju:d] n. 能力,才能,自然倾向
unique [ju:'ni:k] a. 独一无二的,无可匹敌的
salmon ['sæmən] n. 鲑鱼
synthetic [sin'θetik] a. 合成的
release [ri'li:s] vt. vi. 放出,释放
sensitivity [ˌsensi'tiviti] n. 灵敏度,敏感性
carp [kɑ:p] n. 鲤鱼
complicated ['kɔmplikeitid] a. 复杂的;难懂的
physiological [ˌfiziə'lɔdʒikəl] a. 生理的
minimum ['miniməm] n. 最小值
concentration [ˌkɔnsən'treiʃən] n. 浓度

dissolve [di'zɔlv] vi,vt. 溶解
override [ˌəuvə'raid] vt. 压倒,胜过,使无效
migration [mai'greiʃən] n. 迁徙
miraculous [mi'rækjuləs] a. 奇迹般的,超自然的,非凡的
membrane ['membrein] n. 薄膜;细胞膜
artificial [ˌɑ:ti'fiʃəl] a. 人工的,人造的
infection [in'fekʃən] n. (细菌)感染,发炎
desalination [di:ˌsæli'neiʃən] n. (海水)淡化
inversive [in'və:siv] a. 反向的,倒转的,逆的
osmosis [ɔz'məusis] n. 渗透,渗透作用
composition [ˌkɔmpə'ziʃən] n. 成分;构成
ferment ['fə:ment] n. 发酵
condense [kən'dens] vi,vt. 浓缩,(使)凝聚
dispense(with) [dis'pens] vi. 省却;屏弃
photosynthesis [ˌfəutəu'sinθisis] n. 光合作用
photosensitivity [ˌfəutəusensi'tiviti] n. 光敏作用,光敏性
molecular [məu'lekjulə] a. 分子的
bionics [bai'ɔniks] n. 生物模拟,仿生学
polymer ['pɔlimə] n. 聚合物
polycarbonate [ˌpɔli'kɑ:bənit] n. 聚碳酸盐(酯)
antibiotic [ˌæntibai'ɔtik] a. 抗生素
capsule ['kæpsju:l] n. 胶囊(丸)
remedial [ri'mi:djəl] a. 治疗的,补救的,修补的
component [kəm'pəunənt] n. 组成部分,部件
array [ə'rei] n. 阵列
processor ['prɔsesə] n. 处理器,信息处理机
microprocessor [ˌmaikrəu'prɔsesə] n. 微处理器
verify ['verifai] vt. 验证
hypothesis [hai'pɔθisis]; (复) hypotheses[hai'pɔθisi:z]n. 假设,假说
Quark [kwɑ:k] n. 夸克(一种假设的基本粒子)
negative ['negətiv] vt. 否定,否认,驳斥
parallel operation ['pærəlel ˌɔpə'reiʃən] n. 并行操作
prosthetic [prɔs'θetik] a. 修复术的,弥补术的
vacancy ['veikənsi] n. 空白,空处
tissue ['tisju:] n. (生物的)组织
alien ['eiljən] a. 相异的,不相容的,外来的,异己的
mamma ['mæmə] n. 乳房
silicon ['silikən] n. 硅
ketone ['ki:təun] n. 酮
fibrillate ['faibrileit] a. 有原纤维的,纤维组织的
prosthesis ['prɔsθisis] n. 修复术,弥补术,修补物
coral ['kɔrəl] n. 珊瑚
porous ['pɔ:rəs] a. 多孔的
vertebra ['və:tibrə]; (复) vertebrae ['və:tibri:]n. 椎骨,脊椎
interface ['intəfeis] n. 接口,界面
metabolize [me'tæbəlaiz] vt. vi. (使)产生代谢变化,新陈代谢
thighbone ['θaibəun] n. 腿骨,股骨
sustain [sə'stein] vt. 蒙受,经受,支撑,承受住
reverse [ri'və:s] vt. 使变得相反
embryo ['embriəu] n. 胚胎
genetic engineering [dʒi'netik ˌendʒi'niəriŋ] n. 遗传工程
implant [im'plɑ:nt] n. vt. 移植
chromosome ['krɔməsəm] n. 染色体
fertilise ['fə:tilaiz] vt. 使受精
stress [stres] vt. 强调
gene [dʒi:n] n. 基因

testes ['testis] n. 睾丸
refrain (from) [ri'frein] vi. 抑制，制止，戒除，忍住
issue ['isju:] n. 问题，争端，争论点
DNA 脱氧核糖核酸
fraction ['frækʃən] n. 小部分
incorporate [in'kɔ:pəreit] vt. 结合，合并，使混合
transgenic [ˌtræns'dʒinik] a. 转基因的
sterile ['sterail] a. 不育的

Comprehension Questions

1. What abnormal phenomena have been observed in the solar system?
2. What does the computer simulation suggest about those puzzling questions concerning celetial bodies in the solar system?
3. What an astronomic prodigy became the source of excitement in science and business and among schoolchildren?
4. What is the phenomenon called "home sense" observed in some species of fish?
5. What experiments have been done to make use of "home sense" in a hope of increasing fishery catch?
6. What miraculous effects can some membranes produce?Cite 5 examples.
7. What is the architecture of the new generation supercomputers?
8. What do scientists expect the supercomputers to do?
9. What is special in the newly developed prosthetic materials?
10. What is the major problem in prosthetic surgery?
11. What have the British biologists done in their recent experiments?Explain its significance.

Lesson Two
Trend of High-Technology in the 1990s

A new round of competition in high technology area among developed countries turns intense. Experts predict rapid development in electronics and information processing technique, biological engineering, space exploration and exploitation of energy resources during the 1990s.

(1) Electronics and information processing technique will continue to play a key role in every field. In 1990s, the highlight will focus on Large Scale Integrated Circuits (LSIC), computers, robots, communication, and high-resolution television.

LSIC. Today, 1-million-bit, 4-million-bit memory chips have been popular: 16-million-bit chips are under way. Japanese companies like National and Hitachi declared early this year that they had succeeded in producing 64-million-bit chips. Experts predict that by 2000, Dynamic Random Access Memory (DRAM) with 100 million bits will be mass-produced. In those circuits, the width of stripes is only 0.2 micrometer. Meanwhile, 1000-million-bit ROM (Read Only Memory) chips can be made. Besides, great progress will be achieved in optical integrated circuits and biological integrated circuits.

Computers. The so-called fifth generation computers will come into being. They will be supercomputers based on parallel operations. Their working speed is dramatically high and they can process simultaneously huge amount of information. The Japanese declared that their research project on the sixth generation computers would begin in April, 1992 and would last 10 years, the largest project in Japanese history. This type of computers is expected to be able to mimic human mental process, speak and understand human language and learn (to increase the knowledge storage), that is to say, an intelligent computer.

Robotics. The population of robots will grow and they will take over a great portion of labor in factories and on farms. They resemble human beings in that they have arms, legs, eyes and ears. But more important than all, they have certain intelligence. Robots that understand and speak human language can be controlled with verbal commands, and they respond in simple words. Bionic robots will come in 1990s. M. I. T. has created a robot resembling an insect. On its legs, microprocessors and sensors are installed to detect obstacles in a hazardous environment where they are expected to take difficult jobs, for example, space exploration, mining, underwater probing, handling nuclear wastes.

Communication. Digital technique, microwave, laser, fibre optics, and satellites will be in-

tegrated into a worldwide communication system including telephones, video-telephones, telex, teletext, television and data transmission.

Communication networks will expand to provide convenient services. For example, people can use video-telephones to do shopping at home, examining the goods displayed on the screen. An average family might install a miniature satellite ground station at home to receive 24-hour worldwide telecast.

High-resolution television. Based on digital techniques, high-resolution television provides high quality pictures and multiple channel display and other unusual performances. In 1990s, high-resolution television will become popular, a main product that renders all existing television sets obsolete.

Compatible with other digital equipment, high-resolution television will be integrated into any information processing system as an excellent display unit, even at home.

(2) Biologic engineering provides various means to create new strains of crop, poultry and livestock with remarkable advantages. For example, in the Philippines, scientists have created the superpaddy that is disease-resistant and has strong stalk and big ear. Australian scientists succeeded in implanting nodule bacteria to wheat, which means a great deal of nitrogenous fertilizer saved. Crops with high efficiency of photosynthesis can yield higher output per unit area. Improving quality of plant products by increasing the contents of some nutritions, especially protein, is one goal of genetic breeding.

Biological engineering can also multiply seedlings and saplings on a large scale by cultivating tissues taken from plants in an automatic nursery.

Biological pesticide means cultivating natural killers of harmful insects or making them sterile. Insects such as the ladybug are instinctive killers of harmful insects like the aphid. Certain virus, germs, larva of some insects parasite on some harmful insects are effective, safe and economic pesticide.

With all these biological engineering techniques developed in the 1990s we can expect steady, bumper harvests from agirculture, forestry, animal husbandry, poultry farms and fishery, and the world can be relieved from the constant threat of famine.

Genetics will be a focus of medical study. Human genes will be thoroughly studied and examined. Knowledge accumulated about genes will help disclose the secret of life and evolvement of creatures, and the mechanism of heredity, mechanism of growth, mechanism of immunity. With achievements made in these areas, experts predict that some diseases which used to be incurable, such as AIDS, cancer, and hereditary diseases, can be cured with newly developed medicines.

Microbes produce enzyme that can be used in industrial production as catalyst. For example, methane oxidative microbe can be used as oxidative catalyst. It can also eliminate gas in mines.

Microbes are bred to decompose wastes and pollutants and turn them into useful matter, or fuel, or feed. During the 1990s, microbe processing techniques will become pragmatically

useful in environmental protection and chemical production. For example, petroleum industry relies more on biological enzyme than on traditional chemical catalysts. Biological enzyme can help turn crude oil into protein used as additive to feed livestock and poultry. Microbe can eat off crude oil spilt from oil tanks or oil wells and is thus used as an effective means in environmental protection. Garbage is no longer garbage but raw material for producing fuel, feed and fertilizer, using microbes, on a large scale.

(3) In the 1990s, **space exploration** will extend to the outer solar system. Mars is the first destination for manned space trips. But before that, spacecraft will be launched to visit the planet. A Martian probe will be deployed on orbit around Mars in 1992, to make a thorough study of its atmosphere (composition, temperature, moisture), and to survey its ground surface (mountains, craters, deserts) and magnetic field. A probe will fly to Saturn in 1996, soft-landing on one of its satellites, from which, parachutes carrying instruments will be dropped to its ground. There are multitude of asteroids in between Jupiter and Mars. The small one may be less than 1 kilometer in diameter while the big one is hundreds of kilometers across. Scientists know that some asteroids fly among planets and believe that some of them may enter the earth's atmosphere and the larger ones may fall on the ground and cause severe explosions as they cannot burn out in the atmosphere. To predict cosmic catastrophe, scientists need to know more about these minor planets. A probe will be sent out to reach for them in 1995.

Following *Hubble* and *Magellan* spacecraft, more spacecraft for observing the universe will be launched, for example, a sophisticated X-ray telescope (to be launched in 1997) and an 8-meter-diameter telescope (to be launched in 2000).

NASA will cooperate with its counterparts in Western Europe, Japan, to build a huge space station called *Liberty* in the earth's orbit. This project, as estimated, will cost nearly 0.1 trillion dollars. And *Columbus* space lab as a part of *Liberty* will be made and tested and launched using *Aliane*-5 rocket. Meanwhile, a new type of space shuttles will be put into space services, which, in much the same way as a jet does, takes off and lands on a runway.

In the 1990s, space exploitation will be a major goal of space efforts. For example, space industry will become a profitable business, in which medicines, special materials (metal-ceramic compound, semiconductor) are made in space labs under weightless conditions. Space travel will be commercially available to everyone attracted by the wonder of space. To exploit the moon, a certain number of lunar bases will be set up on the moon, using space shuttles as main transport vehicles.

Down to the earth, more and more meteorological satellites, resources satellites, communication satellites will continue to join those already in the earth's orbit, to monitor the atmosphere, forests, oceans, rivers, lakes; explore deposits of minerals, underground water resources and oil; relay global TV and telephone signals.

The 1990s will see an unprecedented era of competition as well as cooperation among developed countries in space efforts.