高校专门用途英语（ESP）系列教材

EST Reading
科技英语阅读教程

主编 陈 勇 廖华英

清华大学出版社

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内 容 简 介

本教材专门为科技英语课程编写。全书共12个单元，涉及核能与核辐射、机器人与人工智能、教育研究、地质与地球科学、生物技术、行为科学、材料学、工程学、计算机科学、信息技术、网络安全、科学与社会等较为热门的专业领域。每单元由课堂精讲的课文A和扩展阅读的课文B、C组成。每单元之前配有导读；课文A后面配有阅读理解、摘要写作、科技词汇、讨论等练习；课文B和C也编写了阅读理解和翻译等练习。此外，在教材末尾还附有常见数字、数字符号和数学式表达等专题知识和部分习题的参考答案。本书另配有PPT课件，需要的读者请访问ftp://ftp.tup.tsinghua.edu.cn/下载使用。

本教材适用于科技英语专业学生、英语专业高年级学生，特别适用于理工类高校本科生和研究生，可作为科技英语、学术英语课程的必修课或选修课教材。

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前言
Foreword

在科学与技术飞速发展的今天，英语已成为全球范围内科技人员进行科学研究和学术交流必不可少的工具。查询与阅读科技文献、了解科技前沿发展状况、参加国内外学术交流，都离不开英语这一国际性语言。随着中国科技实力的进一步增长，中国人在科学与技术领域发出声音的机会越来越多，科技英语的重要性愈益凸显。作为英语的一种变体，科技英语有别于普通英语。科技英语在词汇、句子、语言风格等方面都有自身的特点，只有通过系统学习才能掌握。

当前，学生在完成基础阶段的大学英语课程之后，已经掌握了一定的语言知识和技能，但要应用于英语科技文献的阅读还有相当大的困难。为了填补普通英语与专业英语之间的空白，很多理工类高校开设了科技英语课程，试图在两者之间架设一座桥梁，让学生顺利进入专业英语的学习中。然而，由于科技英语不是主干课程，更由于大多数院校缺乏专门的科技英语教师，科技英语教学，尤其是教材建设面临很大的挑战。笔者在长期的科技英语教学实践中发现，在为数不多的已有教材中，科技英语的语言特征没有被有效地贯穿到学生的语言学习和训练中，还有改进的空间。正是在这样的背景下，我们组织了一批长期承担科技英语教学任务的教师编写了这本《科技英语阅读教程》。

本教材共12单元，每单元由同一学科领域的主课文A和扩展阅读课文B和C组成。课文主要节选自科技期刊*Scientific American*、*Science*、*Nature*等近期刊载的文章，其专业程度不超过非专业人士的理解能力，内容涉及核能与核辐射、机器人与人工智能、教育研究、地质与地球科学、生物技术、行为科学、材料学、工程学、计算机科学、信息技术、网络安全、科学与社会等较为热门的学科领域。教材末尾还附有常见数字、数字符号和数学式表达等专题知识。本教材编写的宗旨是满足理工类院校高年级本科生和硕士研究生学习科技英语的需要，重点培养其阅读理解的能力。

本教材具有以下几个独特的地方：

1. 科技英语词汇特点贯穿于整个练习编写中。练习的编写突出科技英语中科技术语、半科技术语的学习和掌握，促使学生充分认识一词多义现象，了解普通英语

和科技英语的差别，并通过练习来掌握上述词汇特点。

2. 教材编写遵循学生自主学习的原则，课文后面没有编写词汇表，重点词汇全部融入词汇练习中，目的是让学生在教师的引导下自主查找并编写个性化词汇表，以解决学生过度依赖已有词汇表的通病，通过自主学习，养成良好的学习习惯。

3. 阅读材料量大是本教材的又一个特点。本书编者认为，任何一项严谨的科学研究都需要一个完整的过程，将这个过程呈现出来，不仅需要严密的逻辑思维，还需要充分的材料，所以，一定的篇幅是必要的。而学生通过阅读这些文章，不仅能掌握科技语言，更能学习科学的思维方式和研究方法。

4. 批判性思维在教材编写中的贯彻。本教材所选的阅读材料大多涉及不同甚至相反的观点，引导学生从多个角度看待同一个研究问题；与同类教材相比，本教材所选阅读材料除了来自通常意义上的理工科领域之外，还有来自人文社科领域的主题，甚至有科学与社会的关系等。这些材料的选择有利于训练学生的思辨能力。

5. 本教材提供了练习答案和PPT课件，作为教学参考。有需要课件的读者请访问ftp://ftp.tup.tsinghua.edu.cn/下载使用。

本教材适用于科技英语专业学生、英语专业高年级学生，特别适用于理工类高校本科生和研究生，可作为科技英语、学术英语课程的必修课或选修课教材，亦可作为英语爱好者学习和进修的参考书。

本书选取了近年来国外科技期刊的内容，我们首先要对原文作者表示最诚挚的谢意。本书的编写采用主编总体设计，编者各负其责的模式。在编写阶段，具体分工如下：陈勇负责第一单元至第五单元的编写；廖莉莉负责第六、十二单元；鄢菁萍负责第七、八单元；官芬芬负责第九单元至第十一单元；胡步芬负责附录的编写。策划阶段还得到了江西省质谱科学与仪器重点实验室、东华理工大学研究生院院长李满根教授的大力支持，清华大学出版社的编辑刘艳女士给予了悉心的指导和帮助，在此一并致以谢意。

作为一项有益的尝试，全体编写人员付出了辛苦与努力，但漏误在所难免，恳请使用本书的读者不吝赐教，以便将来再版时修正。

编者

2017年6月

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Unit 1
Nuclear Power and Nuclear Radiation

导读

本单元主要涉及核能与核辐射研究。Text A以福岛核泄漏事件为样本，详细分析了低剂量核辐射对家燕的影响，并驳斥了部分研究者认为低剂量核辐射对环境生物无负面影响的观点，明确阐述了低剂量辐射对环境生物影响研究的意义。Text B则阐述了各种异于传统的聚变能研究方法和技术路线。Text C再次回到福岛核泄漏事件，从日本国内研究人员的视角来深度分析该事件暴露出来的日本科学界存在的严重问题，并提出解决办法。

Part I Intensive Reading

Text A

The Swallows of Fukushima

We know surprisingly little about what low-dose radiation does to organisms and ecosystems. Four years after the disaster in Fukushima, scientists are beginning to get some answers.

By Steven Featherstone

Until a reactor at the Chernobyl nuclear power plant exploded on April 26, 1986, spreading the equivalent of 400 Hiroshima bombs of fallout across the entire Northern Hemisphere, scientists knew next to nothing about the effects of radiation on vegetation and wild animals. The catastrophe created a living laboratory, particularly in the 1,100 square miles around the site, known as the exclusion zone.

In 1994 Ronald Chesser and Robert Baker, both professors of biology at Texas Tech University, were among the first American scientists allowed full access to the

zone. "We caught a bunch of voles, and they looked as healthy as weeds. We became fascinated with that." Baker recalls. When Baker and Chesser sequenced the voles' DNA, they did not find abnormal mutation rates. They also noticed wolves, lynx and other once rare species roaming around the zone as if it were an atomic wildlife refuge. The Chernobyl Forum, founded in 2003 by a group of U.N. agencies, issued a report on the disaster's 20th anniversary that confirmed this view, stating that "environmental conditions have had a positive impact on the biota" in the zone, transforming it into "a unique sanctuary for biodiversity".

Five years after Baker and Chesser combed the zone for voles, Timothy A. Mousseau visited Chernobyl to count birds and found contradicting evidence. Mousseau, a professor of biology at the University of South Carolina, and his collaborator Anders Pape Møller, now research director at the Laboratory of Ecology, Systematics and Evolution at Paris-Sud University, looked in particular at Hirundo rustica, the common barn swallow. They found far fewer barn swallows in the zone, and those that remained suffered from reduced life spans, diminished fertility (in males), smaller brains, tumors, partial albinism—a genetic mutation—and a higher incidence of cataracts. In more than 60 papers published over the past 13 years, Mousseau and Møller have shown that exposure to low-level radiation has had a negative impact on the zone's entire biosphere, from microbes to mammals, from bugs to birds.

Mousseau and Møller have their critics, including Baker, who argued in a 2006 *American Scientist* article co-authored with Chesser that the zone "has effectively become a preserve" and that Mousseau and Møller's "incredible conclusions were supported only by circumstantial evidence".

Almost everything we know about the health effects of ionizing radiation comes from an ongoing study of atomic bomb survivors known as the Life Span Study, or LSS. Safety standards for radiation exposures are based on the LSS. Yet the LSS leaves big questions about the effects of low-dose radiation exposure unanswered. Most scientists agree that there is no such thing as a "safe" dose of radiation, no matter how small. And the small doses are the ones we understand the least. The LSS does not tell us much about doses below 100 millisieverts (mSv). For instance, how much

radiation does it take to cause genetic mutations, and are these mutations heritable? What are the mechanisms and genetic biomarkers for radiation-induced diseases such as cancer?

The triple meltdown at the Fukushima Daiichi nuclear power plant in March 2011 created another living lab where Mousseau and Møller could study low doses of radiation, replicating their Chernobyl research and allowing them "much higher confidence that the impacts we're seeing are related to radiation and not some other factor," Mousseau says. Fukushima's 310-square-mile exclusion zone is smaller than Chernobyl's but identical in other ways. Both zones contain abandoned farmland, forests and urban areas where radiation levels vary by orders of magnitude over short distances. And they would almost certainly gain access to Fukushima more quickly than scientists could get into Soviet-run Chernobyl. In short, Fukushima presented an opportunity to settle a debate.

Within months of Fukushima, Mousseau and Møller were counting birds in the contaminated mountain forests west of the smoldering nuclear plant, but they could not get into the zone itself to see what was happening to the barn swallows. Finally, in June 2013, Mousseau was among the first scientists allowed full access to Fukushima's exclusion zone.

Sensitivity to radiation varies greatly in living things and among individuals of the same species, which is one reason it is important not to extrapolate from butterflies to barn swallows or from voles to humans. Butterflies are particularly radiosensitive, Mousseau says. In August 2012 the online journal *Scientific Reports* published a paper examining the effects of Fukushima's fallout on the pale grass blue butterfly. Joji Otaki, a biology professor at the University of the Ryukyus in Okinawa, revealed that butterflies collected near Fukushima two months after the disaster had malformed wings, legs and eyes. Mousseau and Møller's surveys of insects in Chernobyl and Fukushima show drop-offs in butterflies as a group. But Otaki's paper adds an important new wrinkle. When he bred mutant Fukushima butterflies with healthy lab specimens, the rate of genetic abnormalities increased with each new generation.

Mousseau believes that this phenomenon, the accumulation of genetic mutations,

is a hidden undercurrent eroding the health of radioactive ecosystems, occasionally revealing itself in the offspring of mutant butterflies or barn swallows with partial albinism. Even Baker agrees with Mousseau on Otaki's conclusions: "Clearly, there's something going on with the butterflies that's radiation-induced. Multigenerational exposure does result in an altered genome."

I met Mousseau and his postdoctoral fellow, an Italian named Andrea Bonisoli Alquati, at the airport and then we drove to our hotel in Minamisoma, north of the Fukushima power plant. We passed through one deserted town after the next, meandering north toward the nuclear plant. Mousseau scanned shuttered storefronts and empty houses for barn swallow nests as he drove. Barn swallows are ideal scientific subjects because they are philopatric, meaning the birds tend to return to breed in the same locations over a lifetime. Much is already known about them under normal conditions, and they share similar genetic, developmental and physiological characteristics with other warm-blooded vertebrates. The barn swallow is the proverbial canary in the coal mine, except the coal mine in question is radioactive[1]. Mousseau counted about a dozen old nest "scars", crescent-shaped blots of mud plastered under eaves, but not one new nest.

"They were showing such negative effects the first year," he said. "I figured it'd be very difficult to find them this year."

"I just can't believe there aren't any active barn swallow nests. I don't see any butterflies flying. Don't see any dragonflies flying. It's really a dead zone." he said.

Fukushima offers a vanishingly rare glimpse of an ecosystem's early response to radioactive contamination. Little is known about generations of Chernobyl's voles and barn swallows, not to mention other critters. Anecdotal reports point to massive die-offs of plants and animals, but no details exist about their recovery. Did some species evolve a heightened ability to repair DNA damaged by radiation? Studying Fukushima's ecosystem, right now, is critical to developing predictive models that could explain how adaptations to low-level radiation exposure, as well as the

[1] The barn swallow is the proverbial canary in the coal mine, except the coal mine in question is radioactive. 金丝雀对煤矿瓦斯特别敏感。当瓦斯含量超过一定限度而人还未觉察时，金丝雀已经毒发身亡。这里作者借用了金丝雀来打比方，即家燕对于核辐射的敏感如同煤矿里金丝雀之于瓦斯的敏感。

accumulation of genetic damage, progress over time.

Mousseau regretted that he could not get access to the zone immediately after the accident. "We'd have much more rigorous data on how many swallows were there, how many disappeared," he said after we arrived at the hotel. "Are the ones that are coming back the resistant genotypes, or are they just lucky in some way?"

The next day, with Mousseau's permits validated, a line of officers waved our car through the barricades and into the exclusion zone. Mousseau planned to work his way along the coastal plain, counting every barn swallow, plotting the location of every nest and capturing as many of the birds as possible. "Every data point we get here is absolutely invaluable," he said to Bonisoli Alquati.

A mile from the nuclear plant Bonisoli Alquati spotted a barn swallow perched on a wire near a house. A nest made with fresh mud sat on a ledge inside the garage. Radiation levels peaked at 330 microsieverts per hour, more than 3,000 times above normal background radiation and the highest level Mousseau has ever recorded in the field. "In 10 hours, you'll get your annual dose," said Bonisoli Alquati, referring to the amount of background radiation the average person in the U.S. receives in an entire year.

Futaba is a ghost town, off-limits to all except former residents, who are allowed to return for only a few hours every month to check on homes and businesses. A sign over the town's commercial center reads, "Nuclear Power: Bright Future of Energy." Radiation levels on the main street were no worse than many contaminated areas outside the zone. Peering through binoculars, Kitamura counted six swallows circling near a smashed sporting goods shop.

"Set up the nets and poles!" he shouted.

Kitamura and Bonisoli Alquati crouched outside the store, a mist net bunched loosely between them. Swallows swooped and chattered overhead. Bird by bird, it took two hours to catch and sample all six swallows. Before releasing the birds, Mousseau fitted them with tiny thermoluminescent dosimeters (TLDs) to track their radiation dose. Down by the Futaba train station, where radiation levels were 10 times higher, they captured two more swallows.

The Japanese government initially vowed to clean up 11 of the most severely

contaminated municipalities in Fukushima Prefecture by March 2014. Their goal was to reduce annual dose rates to 1 mSv, the limit for the general public, according to the recommendations of the International Commission on Radiological Protection. But the bulk of the cleanup effort has so far been focused on stabilizing the damaged reactors at the nuclear plant, which continue to leak radiation into the Pacific. Japanese authorities no longer have a specific time frame for decontamination. Instead they have set 1 mSv per year as a long-term goal and are now encouraging some of the 83,000 evacuees to return to places with annual dose rates of up to 20 mSv, equivalent to the commission's dose limit for nuclear workers. The ruling party in Japan recently issued a report acknowledging that many contaminated areas will not be habitable for at least a generation.

This goalpost moving underscores the gap between our knowledge of the effects of low-dose radiation and public policy governing—among other things—nuclear cleanup protocols. Although scientists have not determined a "safe" dose of radiation, Japanese administrators need a target number to craft decontamination and resettlement policies, so they rely on advisory bodies such as the International Commission on Radiological Protection and imperfect studies such as the LSS.

Brenner's research shows evidence for increased rates of cancer associated with annual doses as low as 5 mSv. Below this arbitrary threshold, there is no firm evidence for or against direct health risks in humans, although Mousseau and Møller have observed negative effects in plant and animal populations. "Once you get down to these sorts of doses, you have to rely on best understandings of mechanisms," Brenner says, "and that's pretty limited."

In a residential neighborhood on the outskirts of Namie, Bonisoli Alquati spotted a barn swallow nest wedged in a narrow alley between two houses. It was the first active nest he had seen after a disappointing day of cruising the deserted districts around Futaba and Namie, counting dozens of empty nests and scars. Counting nests before the rain washes them all away is crucial to establishing a baseline for what swallow populations were before the accident, but Mousseau also needed samples from live birds for his lab work. The nest in the alley contained three chicks, the first he found in the zone, and three undeveloped eggs. "This is an important nest,"

Mousseau said.

Bonisoli Alquati sat in the front seat of the car. He scooped a chick out of a plastic container and measured it with various tools. Puffing on the downy underside of the chick's wing, he exposed a patch of skin and lanced it with a needle. Some of the blood went into a capillary tube; some got smeared on a glass slide. Then he cinched the chick in a canvas sack and lowered it into the "oven", a stack of lead bricks strapped together with duct tape. The bricks formed a shielded chamber, allowing Mousseau to measure the whole-body burden of individual birds without background radiation muddying the result.

"Our objective is to be able to look at individual birds from one year to the next and to determine whether the probability of survival is related to the dose they receive," he said. "If we really want to get at mechanisms of genetic variation and radio-sensitivity and how they impact individuals, then it's necessary to do this finer-scale dosimetry."

But radiation levels in this spot were too hot for accurate measurements. Mousseau moved the car down the street and reset the gamma spectrometer. After a few minutes, it displayed a distinct signal for cesium 137 contamination, the main isotope in Fukushima's fallout. The chick, perhaps a week old, was radioactive.

Barn swallows are omens of good fortune in Japan. Many people nail little wooden platforms over the doors of their houses to attract the birds. In the zone, the platforms, like the houses, were all empty. Each day after the zone closed, Mousseau and Bonisoli Alquati worked well into the night, capturing barn swallows in clean areas north of Fukushima to establish a control group. Clean is a relative term. Background radiation in Minamisoma, which was evacuated during the disaster, is still twice that of normal. It was strange to find barn swallow nests overflowing with fat, peeping chicks.

On Mousseau's last day in Japan, he spotted an active barn swallow nest on a gritty side street in Kashima. Mousseau received permission from a neighbor to net the birds. A member of the local river society, he said he was glad somebody was investigating the radioactive contamination because the government was not. "Always secret, the government," he said, complaining about fallout washing into the river.

Koi fish caught there registered 240,000 becquerels of cesium per kilogram, he said. People do not eat these fish, which is fortunate, because the radiation limit for fish consumption in Japan is 100 becquerels per kilogram.

Forty percent of us will one day be diagnosed with some form of cancer. If there is a signal hidden in the noise of this sobering statistic, one that might point to low-dose radiation-induced cancers, it is too faint for epidemiologists to hear. The big questions about low-dose radiation will eventually be answered by researchers studying "radiation-induced chromosome damage, or radiation-induced gene expression, or genomic instability," Brenner says. This is the direction Mousseau and Møller are beginning to take with their research on barn swallows.

"Unfortunately, tumors don't tell us if they were caused by radiation or something else," Mousseau says. If he had enough funding, Mousseau would sequence the DNA of every swallow that he fitted with a TLD in the field. By comparing the results with individual dose estimates, he might be able to locate genetic biomarkers for radiation-induced diseases.

Last November, Mousseau made his 12th trip to Fukushima, 18 months after I accompanied him to the zone. Mousseau and Møller have published three papers demonstrating steep declines in Fukushima's bird populations. Mousseau says that the latest census data, which they are preparing to publish in the *Journal of Ornithology*, provide "pretty striking" evidence for continued declines, "with no evidence of a threshold effect." But for some reason, radiation appears to be killing off birds in Fukushima at twice the rate it is in Chernobyl. "Perhaps there is a lack of resistance, or there is an increased radiosensitivity in Fukushima's native populations," Mousseau says. "Perhaps Chernobyl birds have evolved resistance to some degree, or the ones that are susceptible have been weeded out over the past 26 years. We don't really know the answer to that, but we're hoping to get to it." The answer might be found in the blood of the barn swallows that Mousseau and Bonisoli Alquati collected on our trip. A preliminary analysis of those samples does not reveal any evidence for a significant increase in genetic damage, although it is still too early to tell. Mousseau needs many more samples from barn swallows in the most contaminated areas, where populations are crashing.

Although Mousseau and Møller's initial findings afford a compelling glimpse of a troubled ecosystem in Fukushima, the 2014 report by the U.N. Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) echoes its earlier assessment of the Chernobyl disaster, declaring that radiation effects on "nonhuman biota" in highly contaminated areas are "unclear" and are "insignificant" in less contaminated ones.

"We're doing basic science, not toxicology, but UNSCEAR hasn't gone to the trouble of either asking us about our work or finding someone to interpret our findings," Mousseau says. "They set the standard for human health, and they're ignoring a large portion of potentially relevant information."

He says the evidence being ignored is substantial. "In my years of experience at Chernobyl and now Fukushima, we've found signals of the effects of increased mutation rates in almost every species and every network of ecological processing that we've looked at," Mousseau says.

Baker has no plans to conduct research in Fukushima, but he recently sequenced DNA from a different genus of vole from Chernobyl. The new data appear to support Mousseau's and Otaki's conclusions that elevated mutation rates are linked to radiation exposure. The consequences of multigenerational exposure, whether or not it diminishes an animal's fitness or reproductive capabilities or causes birth defects or cancers in future generations, are still unclear.

(Excerpt from *Scientific American*, February 2015)

Exercises

I. Reading Comprehension

• Section One

Directions: Answer the following questions based on the information from the text.

1. What was Ronald Chesser and Robert Baker's opinion about radioactive impact on the biota? What was the contradicting evidence Timothy A. Mousseau found in Chernobyl five years later? Compare their interpretations and draw your own conclusions.