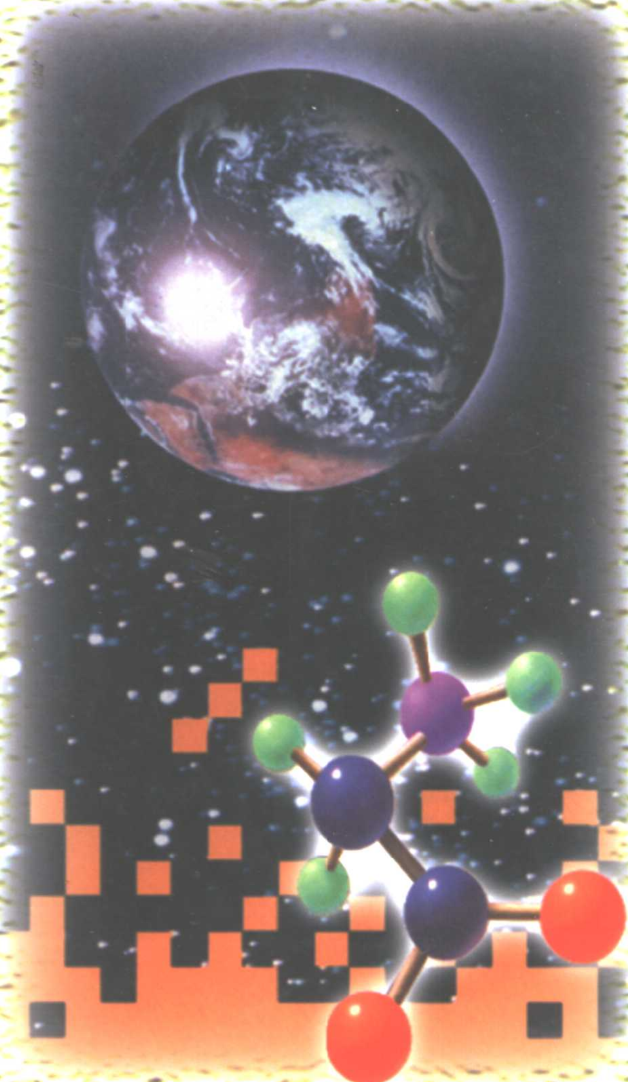

普 通 高 等 教 育
"九五"国家级重点教材

中国科学院研究生教学丛书

研 究 生 英 语 系 列 教 材

博士研究生英语精读
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张文芝 主编

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内 容 简 介

本书属于教育部立项的"普通高等教育'九五'国家级重点教材"，同时还被列为"中国科学院研究生教学丛书"。

本书由中国科学院研究生院外语教学部的资深教授根据多年的教学经验编写而成，是几代教师辛勤努力的结晶。书中所选文章的内容具有一定的思想和理论深度，突出了科学与社会这一主题，旨在激发学生对一些深层次问题的思考，从而全面提高英语的语言和文化修养。

本书适用于非英语专业博士研究生学位英语教学，也可作为高等院校各专业研究生及科研人员提高英语技能的参考用书。

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《中国科学院研究生教学丛书》序

在21世纪曙光初露,中国科技、教育面临重大改革和蓬勃发展之际,《中国科学院研究生教学丛书》——这套凝聚了中国科学院新老科学家、研究生导师们多年心血的研究生教材面世了。相信这套丛书的出版,会在一定程度上缓解研究生教材不足的困难,对提高研究生教育质量起着积极的推动作用。

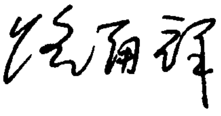
21世纪将是科学技术日新月异,迅猛发展的新世纪,科学技术将成为经济发展的最重要的资源和不竭的动力,成为经济和社会发展的首要推动力量。世界各国之间综合国力的竞争,实质上是科技实力的竞争。而一个国家科技实力的决定因素是它所拥有的科技人才的数量和质量。我国要想在21世纪顺利地实施"科教兴国"和"可持续发展"战略,实现邓小平同志规划的第三步战略目标——把我国建设成中等发达国家,关键在于培养造就一支数量宏大、素质优良、结构合理、有能力参与国际竞争与合作的科技大军。这是摆在我国高等教育面前的一项十分繁重而光荣的战略任务。

中国科学院作为我国自然科学与高新技术的综合研究与发展中心,在建院之初就明确了出成果出人才并举的办院宗旨,长期坚持走科研与教育相结合的道路,发挥了高级科技专家多、科研条件好、科研水平高的优势,结合科研工作,积极培养研究生;在出成果的同时,为国家培养了数以万计的研究生。当前,中国科学院正在按照江泽民同志关于中国科学院要努力建设好"三个基地"的指示,在建设具有国际先进水平的科学研究基地和促进高新技术产业发展基地的同时,加强研究生教育,努力建设好高级人才培养基地,在肩负起发展我国科学技术及促进高新技术产业发展重任的同时,为国家源源不断地培养输送大批高级科技人才。

质量是研究生教育的生命,全面提高研究生培养质量是当前我国研究生教育的首要任务。研究生教材建设是提高研究生培养质量的一项重要的基础性工作。由于各种原因,目前我国研究生教材的建设滞后于研究生教育的发展。为了改变这种情况,中国科学院组织了一批在科学前沿工作,同时又具有相当教学经验的科学家撰写研究生教材,并以专项资金资助优秀的研究生教材的出版。希望通过数年努力,出版一套面向21世纪科技发展、体现中国科学院特色的高水平的研究生教学丛书。本丛书内容力求具有科学性、系统性和基础性,同时也兼顾前沿性,使阅读者不仅能获得相关学科的比较系统的科学基础知识,也能被引导进入当代科学研究的前沿。这套研究生教学丛书,不仅

适合于在校研究生学习使用，也可以作为高校教师和专业研究人员工作和学习的参考书。

“桃李不言，下自成蹊。”我相信，通过中国科学院一批科学家的辛勤耕耘，《中国科学院研究生教学丛书》将成为我国研究生教育园地的一丛鲜花，也将似润物春雨，滋养莘莘学子的心田，把他们引向科学的殿堂，不仅为科学院，也为全国研究生教育的发展作出重要贡献。



《研究生英语系列教材》序

中国科学院研究生教材建设项目是1996年启动的，其中中国科学院《研究生英语系列教材》已被教育部列为“普通高等教育‘九五’国家级重点教材”。

面对我国外语教育迫切呼唤改革与创新的现实，我们努力将多年的实践和思考融会在这一英语系列教材建设项目中，旨在探索构建我国硕/博研究生阶段英语教材建设的理论框架，注意扭转在这一层次上还依然存在着的以教授技能为核心的纯功利倾向。我们认为，硕/博阶段的外语教学应该强调教材的思想含量，应该批判性地引介西方的主流价值观和各种科学与文化思潮，从而使我们有可能从理论上给后期的、乃至全盘的外语教育做出正确的定位。

高层次的外语教学理应内容与语言并重，使学生广泛涉猎知识和全面提高语言能力二者同步，以此增强学生对语言的兴趣，培养他们运用语言的良好习惯。我们同时还认识到，帮助学生学会分析与比较，激发学生想象与思考，也是这一层次的外语教学应负有的使命。针对理工类硕/博研究生，我们不仅考虑到他们原有的教育背景和已有的知识结构，更考虑到他们今后的发展前景，力争弘扬人文精神和科学精神并举。我们认为，外语教育乃是素质教育的重要组成部分，在经济全球化大潮涌动的21世纪，对这一组成部分与素质教育的关系进行全面的理性思考，必将成为我国教育界，尤其是高等教育界的一个严肃课题。

本系列教材分为精读、泛读、速读、听说和写作五大类，按计划自2000年起陆续出版。藉此，我们对中国科学院研究生教材出版基金评审会、中国科学院人教局、科学出版社的各位有关成员所给予的支持与鼓励，对中国科学院研究生院、中国科学技术大学和中国科学院上海分院进修学院所有参与、指导编写工作的中外籍专家，以及参与教学实践与评估的老师、学生，表示最诚挚的感谢！正是通过大家的热情支持和参与，本系列教材才可能按计划完成和出版。

限于全体编写人员的水平及经验，我们热切期望使用本套教材的专家学者和朋友从多方面给我们提出批评和指正，以期使本套教材得以不断提高和完善。

李 佩 龚 立

2000年12月

编者的话

概述

教材编写工作涉及到教育人的问题，非同一般。教材编写绝不能一蹴而就，它应建立在总结教师长期教学实践经验和教学理论研究的基础上。中国科学院研究生院外语教学部从20世纪80年代初就着手编写博士研究生英语阅读教材，到1990年略具雏形，将活页教材装订成书供内部使用。此后该教材又经历过两次重大修改。1996年中科院研究生教材建设项目开始启动，本书选用了原内部使用教材中师生反映很好的三课，并在此基础上开始了本书的编写工作。因此，本书不仅是几位编者的个人成果，亦是中科院研究生院外语教学部几代教师多年辛勤努力的结晶。

自1998年秋季起，本书中的课文陆续在中国科学院研究生院和中国科学院上海分院进修学院试用，发放了万余份调查问卷。经过计算机统计分析得出了每课的48项量化评估结果。根据评估结果，对教材进行了多次修改。鉴于本书收录的文章大部分选自美国的出版物，本书的编写采用了美国英语，但保留了选自英国出版物的课文原文。

编写与使用说明

一、课文选材

本教材的选材除考虑到语言、题材、体裁、长度等因素外，主要注重的是文章的思想内涵，突出了科学与社会这一主题，旨在激发使用者对一些深层次问题的思考，增强其思辨能力，使其能够批判性地引介西方的科学观、价值观和人生观，从而使学习者能通过理解语言的思想内涵去学习语言本身。这是高层次语言学习者，特别是博士研究生学习语言的需要，也是为了满足博士研究生未来工作的需要。

然而，由于所选文章的内容具有一定的思想和理论深度，这无形中加大了教材的使用难度。为此，每篇课文后对课文中涉及到的人物、事件、概念及难词、词组或表达式予以了注解（NOTES TO THE TEXT）。难词的界定标准参考了两本以语料库为基础纂写的词典 Longman Dictionary of Contemporary English（Longman Group Ltd., 1995）和 Collins Cobuild English Language Dictionary（William Collins Sons & Co Ltd., 1987）和两个语料库 British National Corpus 和 Oxford Corpus Collections 以及两本词频词表 Frequency Analysis of English Vocabulary and Grammar（Based on the LOB Corpus）（Oxford University Press, 1989）和 Word Frequency Book（American Heritage Publishing Co., Inc., 1971）。凡在以上文献中未出现或出现频率极低的词被视为无需本书使用者自己去查词典掌握的难词，在注解部分给予了注释。有些词、词组或表达式虽然不很偏或难，但考虑到使用者通过自查词典可能较难理解其在课文中的确切含义，或其含义容易被使用者忽略、误解，亦被列入了注解中。一些术语或专业词汇虽属难词或偏词，不需

使用者掌握，但并未被列入注解中，因为这些词很难用英文简单明了地给予定义，不如使用者自己查英汉词典更有效。

此外，每篇课文后还有对作者及文章相关内容的介绍（ABOUT THE AUTHOR），备使用者在阅读课文之前浏览，以便对课文及作者有一个概况性的了解，从而加深对课文内容的理解。

课文的排序考虑到了课文的难度、题材、内容、长度等因素。使用者可按序阅读，亦可视自己的具体情况而定。

二、练习编写

本书练习编写的原则是统一中有变化。每课的练习都由七大部分组成：PRE-READING QUESTIONS、COMPREHENSION QUESTIONS、QUESTIONS ON STYLISTIC FEATURES、QUESTIONS FOR DISCUSSION、VOCABULARY、TRANSLATION 和 READING。但练习中的具体内容和形式，课与课之间则根据课文的内容而有所不同，目的在于使每课练习达到最优化。本书的练习量较大，主要是考虑到练习的覆盖面和给使用者提供更多的可选择的练习。

1. PRE-READING QUESTIONS 和 QUESTIONS FOR DISCUSSION

学习者应在阅读课文之前考虑 PRE-READING QUESTIONS 中的问题。教师可以在让学生预习课文之前，请学生回答其中的问题，并与学生一起讨论，使学生在接触到课文内容之前充分发表自己对问题的看法，而不局限于课文作者的观点。这样可以增强学生的阅读兴趣，提高阅读效果，培养思辨能力。该练习的设计原则是由较接近学生实际的问题开始，使学生有内容可谈，逐渐引导学生进入到对文章具体内容的理解中去。与此相反，QUESTIONS FOR DISCUSSION 练习中的问题则是由文章中引出的问题开始，引申到学生感兴趣的其他更深入的问题，使学生学完课文后有所思，有所感。该部分练习中的问题也可作为写作的题目，让学生练习写作。

2. COMPREHENSION QUESTIONS 和 QUESTIONS ON STYLISTIC FEATURES

COMPREHENSION QUESTIONS 中的问题主要针对课文的内容重点和语言难点。学生可以在预习过程中试着回答该部分的问题，这有助于对文章内容的理解，并抓住重点。教师可以在讲解课文过程中或之后帮助学生回答这些问题。

QUESTIONS ON STYLISTIC FEATURES 帮助学生从课文的宏观结构、写作手法及修辞等方面去理解课文，从而通过语言和写作知识的学习提高学生的阅读能力和阅读效果。该练习的设计往往从宏观问题开始逐渐过渡到细节问题。该练习有一定的难度，答案亦不惟一，教师可充分阐述自己的独到见解。

3. VOCABULARY

词汇练习的选词以实用为原则。选择要练习的词、词组、表达式、词根、词缀时参考了在课文选材部分中提到的 6 种文献以及 Webster's New World Dictionary of the American Language (Second College Edition) (William Collins Publishers, 1980) 和 The American Heritage College Dictionary (Houghton Mifflin Company, 1983)，并考虑到了理工类博士生的具体要求。每课都进行了生词问卷调查和词汇练习反馈调查，在此基础上对词汇进行了仔细筛选。

每课的词汇练习都包括五部分，具体的练习形式根据课文内容而定，课与课的词汇练习形式不同，本书中出现的词汇练习形式总共有 17 种。每课的第一和第二部分（SECTION A 和 SECTION B）的练习形式都相同（第 11 课除外）。SECTION A 练习的是博士研究生阶段学生需要掌握但又相对陌生的重点词，SECTION B 中练习的是需要掌握的词组和表达式。但为了便于理解和掌握，编者也将一些自认为重点的词汇放入到了其他部分的练习中。本书中的词汇练习较多，重点练习哪些部分、哪些词汇，教师应根据学生的具体情况而定。譬如，对有些学生来讲可能扩大词汇量很重要，那么词根、词缀的练习或许就应是重点；如果学生将来需要动笔写作的机会多，也许给出单词的第一个字母让学生根据定义或上、下文写出该词的练习就应是重点；如果学生的词汇量虽大，但只知其概念，不知其含义和用法，则同义词或近义词比较的练习可能应是重点。

本书中的词汇练习具有一定的前后连惯性，同一个要练的词或词组如果在不同课中出现，它将以不同或相同的形式在这几课中得到练习。如果要练的词相对简单则尽量在较前面的课中练习到。在编写每课的练习时，我们尽量考虑选用书中练习到的词汇，以达到重复记忆的效果。

词汇练习中的许多句子都选自 200 万词的 Oxford Corpus Collections 和一亿词的 British National Corpus 两个语料库。学生可以在练习词汇的同时，阅读活的、真实的语言。由于所选句子脱离了原文的上下文，致使有些句子较难理解，给词汇练习增加了一定的难度，但编者认为这也是博士研究生阶段教学的需要，博士研究生应该具有更强的理解力。

4. TRANSLATION

TRANSLATION 练习中的 SECTION A 主要是检查学生对课文（或相关内容的段落）中语言点的准确理解。SECTION B 则希望学生通过对课文的掌握，能够运用课文中出现的词汇和表达式将内容与课文相关的中文翻译成英文。语言学习要既有输入，又有输出。

5. READING

该部分练习中选了与课文内容相关的一些短文或段落，将短文段落顺序打乱让学生通过找出段与段之间的逻辑关系重组短文，或将原文中起重要逻辑作用的句子抽出，让学生重新选择填入。这一练习形式是针对学生在阅读时只注重读懂词和句子，而不注重文章整体思想的理解这一弱点而设计的。希望学生在阅读时不要只见树木，不见森林。理解文章的整体思想和内容应该是高层次语言学习者的重点。

三、词表附录（GLOSSARY INDEX）

本附录中收录了词汇练习中练习到的所有词汇。对于在练习中附带出现且在课文中出现的词，如果编者认为需要学生掌握的，也被收入了附录，收录时参考了 Longman Dictionary of Contemporary English（Longman Group Ltd.，1995）中给出的最常用的 3000 口语词汇和 3000 书面词汇以及 Cambridge English Lexicon（Roland Hindmarsh，Cambridge University Press，1986），排除掉了过于简单的词汇。本附录共收入单词（WORDS）806 条，词组及表达式（PHRASES & EXPRESSIONS）197 条，给出了每个词条在课文和练习中的位置，可望给教学带来极大的方便。

如果一个词有两种或多种词性则作为一个词条列人词表。对于一词多义，词汇练习中未练到的词义如果在课文中出现，也给了该词在课文中的位置。词组及表达式的排序以主词或第一个出现的主词（黑体）为准。

四、教师参考书（TEACHER'S REFERENCE BOOK）

鉴于本教材具有一定的难度，为了使教师能够站在更高的层面上理解、讲解课文，教师参考书中对每篇课文的作者和主题背景作了详尽的介绍（BACKGROUND INFORMATION），对课文中出现的人物、事件、概念及难点给出了非常详细的注解（NOTES TO THE TEXT），并且为每一部分练习都提供了尽量详尽的参考答案。虽然编者在教师参考书中倾注了很多的心血和努力，但编者对课文的注解是基于编者个人对课文的理解，绝非尽善尽美，注解和答案仅供本教材使用者参考。

五、配套的泛读材料

《博士研究生英语精读》中的每篇课文都配有2～4篇泛读材料，泛读材料从不同或相反的角度探讨了同一主题，旨在进一步激发学生对课文内容的思考，使他们在解析文章思想内涵的过程中进一步提高英语阅读理解能力。与精读课文配套的泛读材料另册成书，见《博士研究生英语泛读》。

结束语

在本书编写过程中，我们得到了许多专家和老师的支持与帮助。中国科学院研究生院张亦政教授从多方面指导了本书的编写工作，于振中教授对本书提出了许多指导性的建议和意见。中国科学技术大学龚立教授、陈纪梁教授和中国科学院上海分院进修学院金朝亮教授、张林副教授对本书提出了宝贵意见。在教材编写初期，中国科学院研究生院全体英语老师为本书提供了素材，部分老师试用了本书并提出了修改意见。加拿大籍教师 Philip J. Dykshoorn，美籍教师 Sandra L. Mah 和 Terry J. Benzie 认真地通读了全书并提出了一些修改意见。中国科学院研究生院陈谨为本书设计了问卷调查统计软件并完成了全部统计工作，刘红参与了文字录入工作。在此，我们向各位专家和老师表示最诚挚的谢意。

目　录

Lesson 1

THE PARADOX OF KNOWLEDGE

BACKGROUND INFORMATION

Some scientists speculate that our society has increased its body of knowledge to such a point that an ultimate "TOE" (Theories Of Everything) will be found to explain all phenomena. Man can finally know the mind of God. Others suggest that science may be reaching its end. John Horgan, a staff writer for *Scientific American*, in his controversial bestseller *The End of Science* (1997) manages to elicit from some of the most famous scientists of our time (as Noam Chomsky, Stephen Hawking, Stephen Jay Gould, Thomas Kuhn, and Karl Popper) their fears and desires surrounding the possibility that we have come to a juncture in knowledge that can only add details to already existing theories. He interviewed some popular scientists and posed the tough question: Is pure science in sight of completely understanding the universe, thereby foreclosing any further revolutionary scientific discoveries? A question most resonant in physics, it provokes titles such as Steven Weinberg's *Dreams of a Final Theory* (1992) and vexes theorists of cosmology, biology, and chaos and complexity. Horgan's book highlights the debates on what the future of science is and what science holds for our future as a civilization. The assumption that science has come to its end has been attacked by many scientists, though some people claim the reaction of some scientists to it sounds more like church leaders defending orthodoxy than like individuals interested in the pursuit of objective truth.

Using specific examples in science, Lee Loevinger suggests in this article that science will never come to its end because we can never find the "TOE." The more we know, the more we perceive we do not know. This is the paradox of knowledge.

The omitted parts of the original article are provided as the following:

(Line 71) In the sixth century B.C., Pythagoras proposed the notion of a spherical Earth and of a universe with objects in it that moved in accordance with natural laws. Later Greek philosophers taught that the sky was a hollow globe surrounding the Earth, that it was supported on an axis running through the Earth, and that stars were inlaid on its inner surface, which rotated westward daily. In the second century A.D., Ptolemy propounded a theory of a geocentric (Earth-centered) universe in which the sun, planets, and stars moved in circular orbits of cycles and epicycles around the Earth, although the Earth was not at the precise center of these orbits. While somewhat awkward, the Ptolemaic system could produce reasonably reliable predictions of planetary positions, which were, however, good for only a few years and which developed substantial discrepancies from actual observations over a long period of time. Nevertheless, since there was no evidence then apparent to astronomers that the Earth itself moves, the Ptolemaic system remained unchallenged for more than 13 centuries.

In the sixteenth century Nicolaus Copernicus, who is said to have mastered all the knowledge of his day in mathematics, astronomy, medicine, and theology, became dissatisfied with the Ptolemaic system. He found that a heliocentric system was both mathematically possible and aesthetically more pleasing, and wrote a full exposition of his hypothesis, which was not published until 1543, shortly after his death. Early in the seventeenth century, Johannes Kepler became imperial mathematician of the Holy Roman Empire upon the death of Tycho Brahe, and he acquired a collection of meticulous naked-eye observations of the positions of celestial bodies that had been made by Brahe. On the basis of these data, Kepler calculated that both Ptolemy and Copernicus were in error in assuming that planets traveled in circular orbits, and in 1609 he published a book demonstrating mathematically that the planets travel around the sun in elliptical orbits. Kepler's laws of planetary motion are still regarded as basically valid.

In the first decade of the seventeenth century Galileo Galilei learned of the invention of the telescope and began to build such instruments, becoming the first person to use a telescope for astronomical observations, and thus discovering craters on the moon, phases of Venus, and the satellites of Jupiter. His observations convinced him of the validity of the Copernican system and resulted in the well-known conflict between Galileo and church authorities. In January 1642 Galileo died, and in December of that year Isaac Newton was born. Modern science derives largely from the work of these two men.

Newton's contributions to science are numerous. He laid the foundations for modern physical optics, formulated the basic laws of motion and the law of universal gravitation, and devised the infinitesimal calculus. Newton's laws of motion and gravitation are still used for calculations of such matters as trajectories of spacecraft and satellites and orbits of planets. In 1846, relying on such calculations as a guide to observation, astronomers discovered the planet Neptune.

While calculations based on Newton's laws are accurate, they are dismayingly complex when three or more bodies are involved. In 1915, Einstein announced his theory of general relativity, which led to a set of differential equations for planetary orbits identical to those based on Newtonian calculations, except for those relating to the planet Mercury. The elliptical orbit of Mercury rotates through the years, but so slowly that the change of position is less than one minute of arc each century. The equations of general relativity precisely accounted for this precession; Newtonian equations did not.

Einstein's equations also explained the red shift in the light from distant stars and the deflection of starlight as it passed near the sun. However, Einstein assumed that the universe was static, and, in order to permit a meaningful solution to the equations of relativity, in 1917 he added another term, called "cosmological constant," to the equations. Although the existence and significance of a cosmological constant is still being debated, Einstein later declared that this was a major mistake, as Edwin Hubble established in the 1920s that the universe is expanding and galaxies are receding from one another at a speed proportionate to their distance.

Another important development in astronomy grew out of Newton's experimentation in optics, beginning with his demonstration that sunlight could be broken up by a prism into a spectrum of different colors, which led to the science of spectroscopy. In the twentieth century, spectroscopy was applied to astronomy to gain information about the chemical and physical condition of celestial bodies that was not disclosed by visual observation. In the 1920s, precise photographic photometry was introduced to astronomy and quantitative spectrochemical analysis became common. Also during the 1920s, scientists like Heisenberg, de Broglie, Schrödinger, and Dirac developed quantum mechanics, a branch of physics dealing with subatomic particles of matter and quanta of energy. Astronomers began to recognize that the properties of celestial bodies, including planets, could be well understood only in terms of physics, and the field began to be referred to as "astrophysics."

These developments created an explosive expansion in our knowledge of astronomy.... (Line 109) Furthermore, the observations astronomers make with new technologies disclose a total mass in the universe that is less than about 10 percent of the total mass that mathematical calculations require the universe to contain on the basis of its observed rate of expansion. If the universe contains no more mass than we have been able to observe directly, then according to all current theories it should have expanded in the past, and be expanding now, much more rapidly than the rate actually observed. It is therefore believed that 90 percent or more of the mass in the universe is some sort of "dark matter" that has not yet been observed and the nature of which is unknown. Current theories favor either WIMPs (weakly interacting massive particles) or MACHOs (massive compact halo objects). Other similar mysteries abound and increase in number as our ability to observe improves.

NOTES TO THE TEXT

1. Lines 17-18 "'ontogeny recapitulates phylogeny'"

   Ontogeny (onto-: organism; -geny: origin, production, development) refers to the life cycle of a single organism or the biological development of the individual, distinguished from phylogeny. Phylogeny (phylo-: tribe, race, phylum), coined (1866) by Ernst Heinrich Haeckel (1834-1919, German philosopher and naturalist), refers to the history of the evolution of a species or group, especially in reference to lines of descent and relationship among broad groups of organism. Fundamental to phylogeny is the proposition, universally accepted in the scientific community, that plants or animals of different species descended from common ancestors. The evidence for such relationships, however, is nearly always incomplete, for the vast majority of species that have ever lived have become extinct, and relatively few of their remains have been preserved. Most judgements of phylogenicity, then, are based on indirect evidence and cautious speculation. Even when biologists use the same evidence, they often hypothesize different phylogenies, though they do agree that life is the result of organic descent from earlier ancestors and that true phylogenies are discoverable, at least in principle.

The "law of recapitulation" has been discredited since the beginning of the twentieth century. Experimental morphologists and biologists have shown that there is not a one-to-one correspondence between phylogeny and ontogeny. Although a strong form of recapitulation is not correct, phylogeny and ontogeny are intertwined, and many biologists are beginning to both explore and understand the basis for this connection. Studying ontogeny is still one way to discover phylogeny, since ontology may be an analogue of phylogeny.

Ernst Heinrich Haeckel is best remembered for his vociferous support of Darwin's theory of evolution, and for his own theory that "ontogeny recapitulates phylogeny." Haeckel was always quotable, even when wrong. Although best known for the famous statement "ontogeny recapitulates phylogeny," he also coined many words commonly used by biologists today, such as phylum, phylogeny, and ecology. On the other hand, Haeckel also stated that "politics is applied biology," a quote used by Nazi propagandists. The Nazi party, rather unfortunately, used not only Haeckel's quotes, but also Haeckel's justifications for racism, nationalism and social Darwinism.

Although trained as a physician, Haeckel abandoned his practice in 1859 after reading Darwin's *Origin of Species*. Always suspicious of teleological and mystical explanation, Haeckel used the *Origin* as ammunition both to attack entrenched religious dogma and to build his own unique world view.

Haeckel studied under Carl Gegenbauer in Jena for three years before becoming a professor of comparative anatomy in 1862. Between 1859 and 1866, he worked on many "invertebrate" groups, including radiolarians, poriferans (sponges) and annelids (segmented worms). He named nearly 150 new species of radiolarians during a trip to the Mediterranean. "Invertebrates" provided the fodder for most of his experimental work on development, leading to his "law of recapitulation." Haeckel was also a free-thinker who went beyond biology, dabbling in anthropology, psychology, and cosmology. Haeckel's speculative ideas and possible fudging of data, plus lack of empirical support for many of his ideas, tarnished his scientific credentials. However, he remained an immensely popular figure in Germany and was considered a hero by his countrymen.

"I established the opposite view, that this history of the embryo (ontogeny) must be completed by a second, equally valuable, and closely connected branch of thought—the history of race (phylogeny). Both of these branches of evolutionary science, are, in my opinion, in the closest causal connection; this arises from the reciprocal action of the laws of heredity and adaptation 'ontogenesis is a brief and rapid recapitulation of phylogenesis,