

# nature

## The Living Record of Science

## 《自然》百年科学经典

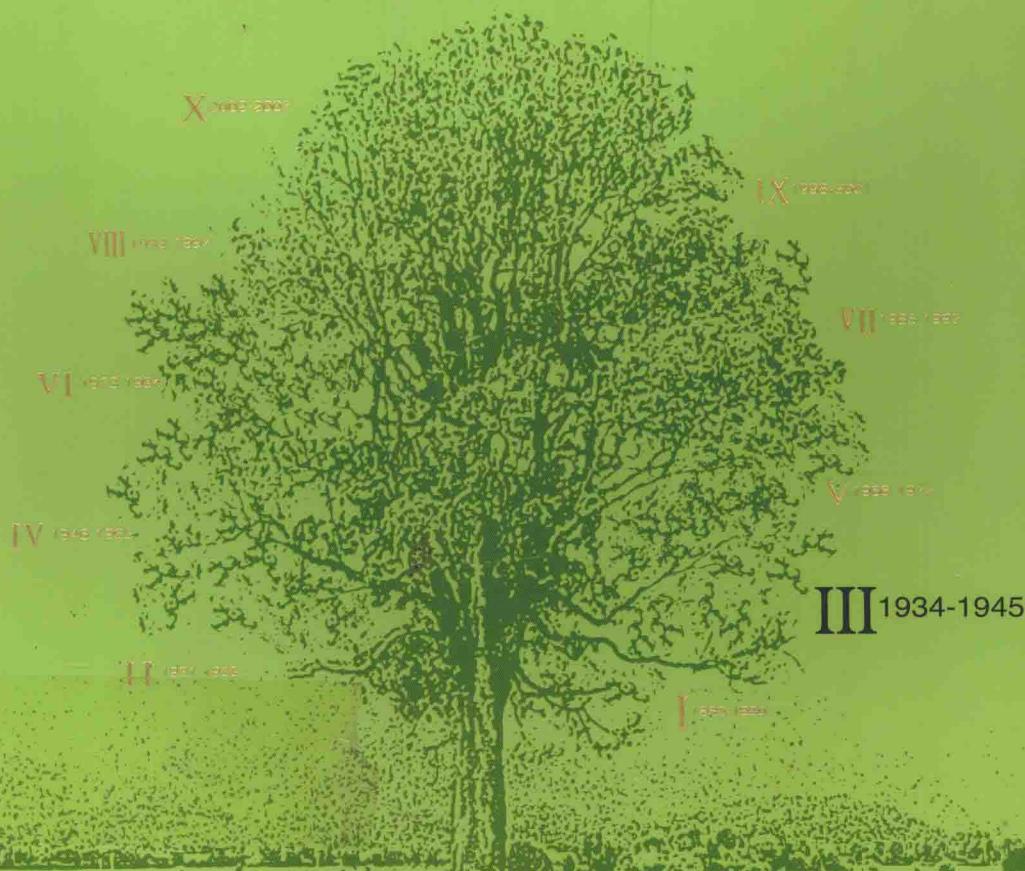
英汉对照版 (平装本)

### 第三卷 (下)

总顾问: 李政道 (Tsung-Dao Lee)

英方主编: Sir John Maddox  
Philip Campbell

中方主编: 路甬祥



外语教学与研究出版社 · 麦克米伦教育 · 自然科研

FOREIGN LANGUAGE TEACHING AND RESEARCH PRESS · MACMILLAN EDUCATION · NATURE/RESEARCH

# nature

The Living Record of Science

《自然》百年科学经典



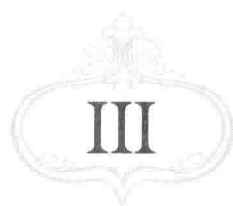
英汉对照版 (平装本)

第三卷 (下)

总顾问: 李政道 (Tsung-Dao Lee)

英方主编: Sir John Maddox  
Philip Campbell

中方主编: 路甬祥



1934-1945

外语教学与研究出版社 · 麦克米伦教育 · 自然科研

FOREIGN LANGUAGE TEACHING AND RESEARCH PRESS · MACMILLAN EDUCATION · NATURE RESEARCH

Original English Text © Macmillan Publishers Limited  
Chinese Translation © Foreign Language Teaching and Research Press

This edition is published under arrangement with Macmillan Publishers (China) Limited. It is for sale in the People's Republic of China only, excluding Hong Kong SAR, Macao SAR and Taiwan Province, and may not be bought for export therefrom.

### 图书在版编目 (CIP) 数据

《自然》百年科学经典. 第三卷. 下, 1934—1945: 英汉对照 / (英) 约翰·马多克斯 (Sir John Maddox), (英) 菲利普·坎贝尔 (Philip Campbell), 路甬祥主编. — 北京: 外语教学与研究出版社, 2016.9

ISBN 978-7-5135-8074-8

I. ①自… II. ①约… ②菲… ③路… III. ①自然科学—文集—英、汉 IV. ①N53

中国版本图书馆 CIP 数据核字 (2016) 第 225016 号

出版人 蔡剑峰  
项目负责 章思英 王 勇  
责任编辑 刘晓楠 黄小斌  
执行编辑 张梦璇  
装帧设计 孙莉明 张子煜  
出版发行 外语教学与研究出版社  
社 址 北京市西三环北路 19 号 (100089)  
网 址 <http://www.fltrp.com>  
印 刷 北京华联印刷有限公司  
开 本 787×1092 1/16  
印 张 32  
版 次 2016 年 9 月第 1 版 2016 年 9 月第 1 次印刷  
书 号 ISBN 978-7-5135-8074-8  
定 价 168.00 元



购书咨询: (010) 88819926 电子邮箱: [club@fltrp.com](mailto:club@fltrp.com)  
外研书店: <https://waiyants.tmall.com>  
凡印刷、装订质量问题, 请联系我社印制部  
联系电话: (010) 61207896 电子邮箱: [zhijian@fltrp.com](mailto:zhijian@fltrp.com)  
凡侵权、盗版书籍线索, 请联系我社法律事务部  
举报电话: (010) 88817519 电子邮箱: [banquan@fltrp.com](mailto:banquan@fltrp.com)  
法律顾问: 立方律师事务所 刘旭东律师  
中咨律师事务所 殷 斌律师  
物料号: 280740001

# 《自然》百年科学经典（英汉对照版）

总顾问：李政道（Tsung-Dao Lee）

英方主编：Sir John Maddox

中方主编：路甬祥

Philip Campbell

## 编审委员会

英方编委：

Philip Ball

Vikram Savkar

David Swinbanks

中方编委（以姓氏笔画为序）：

许智宏

赵忠贤

滕吉文

## 本卷审稿专家（以姓氏笔画为序）

|     |     |     |     |     |     |     |
|-----|-----|-----|-----|-----|-----|-----|
| 于 淦 | 马宇蓓 | 王乃彦 | 王晓晨 | 王鹏云 | 邓祖淦 | 厉光烈 |
| 田伟生 | 冯兴无 | 朱永生 | 刘 纯 | 刘 武 | 刘京国 | 李 淼 |
| 李三忠 | 李芝芬 | 李军刚 | 杨 志 | 吴庆举 | 何香涛 | 汪长征 |
| 张元仲 | 张焕乔 | 陈平富 | 昌增益 | 金 侠 | 周筠梅 | 郑东宁 |
| 孟庆任 | 赵见高 | 赵凌霄 | 郝 项 | 秦志海 | 莫 韞 | 栗付平 |
| 夏海鸿 | 顾孝诚 | 陶宏杰 | 葛墨林 | 蒋世仰 | 鲍重光 |     |

## 编译委员会

### 本卷翻译工作组稿人（以姓氏笔画为序）

|     |     |     |     |     |     |     |
|-----|-----|-----|-----|-----|-----|-----|
| 王耀杨 | 刘 明 | 关秀清 | 李 琦 | 沈乃澂 | 张 健 | 郭红锋 |
| 黄小斌 | 蔡则怡 |     |     |     |     |     |

### 本卷翻译人员（以姓氏笔画为序）

|     |     |     |     |     |     |     |
|-----|-----|-----|-----|-----|-----|-----|
| 王 静 | 王耀杨 | 毛晨晖 | 田晓阳 | 史春晖 | 刘 霞 | 刘东亮 |
| 刘振明 | 刘皓芳 | 齐红艳 | 孙惠南 | 李世媛 | 李忠伟 | 吴 彦 |
| 沈乃澂 | 张玉光 | 张效良 | 张锦彬 | 金世超 | 周 杰 | 赵凤轩 |
| 胡雪兰 | 钱 磊 | 韩伶俐 | 蔡则怡 |     |     |     |

### 本卷校对人员（以姓氏笔画为序）

|     |     |     |     |     |     |     |
|-----|-----|-----|-----|-----|-----|-----|
| 王帅帅 | 王阳兰 | 王晓萌 | 王晓蕾 | 王赛儿 | 王德孚 | 甘秋玲 |
| 丛 岚 | 冯 翀 | 乔萌萌 | 刘 明 | 孙 娟 | 孙 琳 | 苏 慧 |
| 杜赛赛 | 李红菊 | 吴 茜 | 何 铭 | 何思源 | 张世馥 | 张竞凤 |
| 张媛媛 | 陈学雷 | 周玉凤 | 郑期彤 | 徐秋燕 | 崔天明 | 梁 瑜 |
| 韩少卿 | 曾红芳 | 蔡 迪 | 管 冰 | 潘承志 |     |     |

# Contents

## 目录

|                                                                                            |    |
|--------------------------------------------------------------------------------------------|----|
| Planetary Photography .....                                                                | 2  |
| 行星的照相分析 .....                                                                              | 3  |
| Experiments in the Stratosphere .....                                                      | 14 |
| 平流层中的实验 .....                                                                              | 15 |
| Reaction Rates of the Hydrogen Isotopes .....                                              | 20 |
| 氢同位素的反应速率 .....                                                                            | 21 |
| Recent Discoveries at Choukoutien .....                                                    | 22 |
| 周口店的最新发现 .....                                                                             | 23 |
| The Ether-Drift Experiment and the Determination of the Absolute Motion of the Earth ..... | 28 |
| 以太漂移实验和地球绝对运动的确定 .....                                                                     | 29 |
| Heavy Hydrogen and Heavy Water .....                                                       | 38 |
| 重氢和重水 .....                                                                                | 39 |
| Ernst Haeckel .....                                                                        | 46 |
| 恩斯特·海克尔 .....                                                                              | 47 |
| Artificial Production of a New Kind of Radio-Element .....                                 | 54 |
| 一种新放射性元素的人工制造 .....                                                                        | 55 |
| The Indian Earthquake (1934) Area .....                                                    | 58 |
| 1934年印度地震的区域 .....                                                                         | 59 |
| Recent Developments of Sterol Chemistry in Relation to Biological Problems .....           | 64 |
| 与生物学问题相关的甾体化学的最新进展 .....                                                                   | 65 |
| Evolution of the Mind .....                                                                | 72 |
| 思维的进化 .....                                                                                | 73 |
| A Velocity-Modulation Television System .....                                              | 96 |
| 一个基于速度调制的电视系统 .....                                                                        | 97 |

|                                                                   |     |
|-------------------------------------------------------------------|-----|
| The Positron .....                                                | 102 |
| 正电子 .....                                                         | 103 |
| Production of Induced Radioactivity by High Velocity Protons..... | 116 |
| 由高速质子产生的感生放射性.....                                                | 117 |
| Designation of the Positive Electron.....                         | 120 |
| 正电子的命名 .....                                                      | 121 |
| Hormones of the Anterior Lobe of the Pituitary Gland.....         | 122 |
| 垂体前叶激素 .....                                                      | 123 |
| Transmutation Effects Observed with Heavy Hydrogen.....           | 132 |
| 通过重氢观察到的嬗变效应 .....                                                | 133 |
| Liquid Crystals.....                                              | 136 |
| 液晶 .....                                                          | 137 |
| Supraconductivity of Films of Tin .....                           | 174 |
| 锡膜的超导电性 .....                                                     | 175 |
| Persistent Currents in Supraconductors.....                       | 178 |
| 超导体中的持续电流 .....                                                   | 179 |
| The Velocity of Light.....                                        | 182 |
| 光的速度 .....                                                        | 183 |
| Attempt to Detect a Neutral Particle of Small Mass .....          | 186 |
| 探测小质量中性粒子的尝试 .....                                                | 187 |
| The New Hydrogen .....                                            | 188 |
| 氢的新同位素 .....                                                      | 189 |
| Developments of Television .....                                  | 202 |
| 电视的发展.....                                                        | 203 |
| A Rapid Test for the Diagnosis of Pregnancy .....                 | 206 |
| 一项快速诊断妊娠的实验方法.....                                                | 207 |
| The “Neutrino” .....                                              | 210 |
| “中微子” .....                                                       | 211 |

|                                                                                                 |     |
|-------------------------------------------------------------------------------------------------|-----|
| Disintegration of the Diproton .....                                                            | 216 |
| 氘核的蜕变 .....                                                                                     | 217 |
| Apparent Clustering of Galaxies .....                                                           | 220 |
| 星系的视成团 .....                                                                                    | 221 |
| The Inheritance of Acquired Habits .....                                                        | 226 |
| 获得性习性的遗传 .....                                                                                  | 227 |
| Commercial Production of Heavy Water .....                                                      | 234 |
| 重水的商业化生产 .....                                                                                  | 235 |
| The Neutrino .....                                                                              | 236 |
| 中微子 .....                                                                                       | 237 |
| Liquefaction of Helium by an Adiabatic Method without Pre-cooling with<br>Liquid Hydrogen ..... | 240 |
| 无液氢预冷的绝热法氦液化 .....                                                                              | 241 |
| Mass of the Neutron .....                                                                       | 246 |
| 中子的质量 .....                                                                                     | 247 |
| The Explanation of Superconductivity .....                                                      | 252 |
| 超导电性的解释 .....                                                                                   | 253 |
| Modern Ideas on Nuclear Constitution .....                                                      | 262 |
| 核组成的现代思想 .....                                                                                  | 263 |
| Radioactivity Induced by Neutron Bombardment .....                                              | 276 |
| 由中子轰击引发的放射性 .....                                                                               | 277 |
| X-Ray Photographs of Crystalline Pepsin .....                                                   | 282 |
| 胃蛋白酶晶体的X射线照片 .....                                                                              | 283 |
| Production of Large Quantities of Heavy Water .....                                             | 288 |
| 重水的大量生产 .....                                                                                   | 289 |
| Possible Production of Elements of Atomic Number Higher than 92 .....                           | 292 |
| 原子序数大于92的元素的可能生成 .....                                                                          | 293 |
| The Factor $\frac{137}{136}$ in Quantum Theory .....                                            | 300 |
| 量子理论中的137/136因子 .....                                                                           | 301 |

|                                                                                  |     |
|----------------------------------------------------------------------------------|-----|
| Exchange Forces between Neutrons and Protons, and Fermi's Theory .....           | 304 |
| 质子中子之间的交换力与费米理论 .....                                                            | 305 |
| Interaction of Neutrons and Protons .....                                        | 308 |
| 中子和质子的相互作用 .....                                                                 | 309 |
| A "Nuclear Photo-effect": Disintegration of the Diplon by $\gamma$ -Rays .....   | 312 |
| 一种“核的光效应”： $\gamma$ 射线引发的氘核蜕变 .....                                              | 313 |
| Quantum Mechanics and Physical Reality .....                                     | 318 |
| 量子力学和物理实在 .....                                                                  | 319 |
| Isotopic Constitution of Uranium .....                                           | 322 |
| 铀的同位素构成 .....                                                                    | 323 |
| Form, Drift, and Rhythm of the Continents .....                                  | 326 |
| 大陆的形成、漂移及节律 .....                                                                | 327 |
| The Fundamental Paradox of the Quantum Theory .....                              | 364 |
| 量子理论的基本佯谬 .....                                                                  | 365 |
| Uncertainty Principle and the Zero-Point Energy of the Harmonic Oscillator ..... | 368 |
| 测不准原理和谐振子的零点能 .....                                                              | 369 |
| Solar Magnetism .....                                                            | 372 |
| 太阳磁场 .....                                                                       | 373 |
| Crossing-Over and Chromosome Disjunction .....                                   | 382 |
| 染色体分离与交换 .....                                                                   | 383 |
| Crossing-Over and Chromosome Disjunction .....                                   | 386 |
| 染色体分离与交换 .....                                                                   | 387 |
| Chemical Detection of Artificial Transmutation of Elements .....                 | 390 |
| 元素人工嬗变的化学检测 .....                                                                | 391 |
| The Slowing Down of Neutrons by Collisions with Protons .....                    | 394 |
| 与质子碰撞而导致的中子慢化 .....                                                              | 395 |
| The Pattern of Proteins .....                                                    | 400 |
| 蛋白质结构模型 .....                                                                    | 401 |

|                                                                                             |     |
|---------------------------------------------------------------------------------------------|-----|
| A New Fossil Anthropoid Skull from South Africa .....                                       | 410 |
| 发现于南非的一件新的类人猿头骨化石 .....                                                                     | 411 |
| Viscosity of Liquid Helium below the $\lambda$ -Point .....                                 | 420 |
| 液氦在 $\lambda$ 点以下的黏度 .....                                                                  | 421 |
| Flow of Liquid Helium II .....                                                              | 426 |
| 液氦II的流动 .....                                                                               | 427 |
| The $\lambda$ -Phenomenon of Liquid Helium and the Bose-Einstein Degeneracy .....           | 432 |
| 液氦的 $\lambda$ 现象和玻色—爱因斯坦简并 .....                                                            | 433 |
| Discovery of an Additional <i>Pithecanthropus</i> Skull .....                               | 440 |
| 又一件爪哇猿人头骨的发现 .....                                                                          | 441 |
| Mesotron (Intermediate Particle) as a Name for the New Particles of Intermediate Mass ..... | 444 |
| 将介子(中间粒子)定为一种中间质量新粒子的名字 .....                                                               | 445 |
| Structure of Proteins .....                                                                 | 448 |
| 蛋白质结构 .....                                                                                 | 449 |
| Nature of the Cyclol Bond .....                                                             | 452 |
| 环醇键的本质 .....                                                                                | 453 |
| New Broadcasting System .....                                                               | 466 |
| 新的广播系统 .....                                                                                | 467 |
| The Expanding Universe and the Origin of the Great Nebulae .....                            | 468 |
| 膨胀的宇宙和大星云的起源 .....                                                                          | 469 |
| Glaciological Results of the Jungfrauoch Research Party .....                               | 472 |
| 来自少女峰研究群体的冰川学成果 .....                                                                       | 473 |
| Interpretation of Beta-Disintegration Data .....                                            | 476 |
| 对 $\beta$ 衰变数据的解释 .....                                                                     | 477 |
| Liquid Helium .....                                                                         | 482 |
| 液氦 .....                                                                                    | 483 |
| Disintegration of Uranium by Neutrons: a New Type of Nuclear Reaction .....                 | 494 |
| 由中子引起的铀衰变: 一类新型核反应 .....                                                                    | 495 |

Theory of Mesons and Nuclear Forces ..... 500  
介子和核力理论 ..... 501

Physical Evidence for the Division of Heavy Nuclei under Neutron Bombardment ..... 506  
中子轰击导致重核分裂的物理证据 ..... 507

The Fundamental Length Introduced by the Theory of the Mesotron(Meson) ..... 510  
介子理论中的基本长度 ..... 511

Energy Obtained by Transmutation ..... 516  
嬗变产生的能量 ..... 517

Cause, Purpose and Economy of Natural Laws: Minimum Principles in Physics ..... 518  
自然规律的起源、宗旨和经济性：物理学的极小原理 ..... 519

Origin of the Earth’s Magnetic Field ..... 534  
地磁场的成因 ..... 535

The “Failure” of Quantum Theory at Short Ranges and High Energies ..... 538  
短程和高能中量子理论的“失败” ..... 539

A Living Fish of Mesozoic Type ..... 544  
一种存活至今的中生代鱼类 ..... 545

Element 43..... 550  
43号元素 ..... 551

Liberation of Neutrons in the Nuclear Explosion of Uranium ..... 556  
铀核爆炸时中子的释放 ..... 557

Products of the Fission of the Uranium Nucleus ..... 562  
铀核的裂变产物 ..... 563

The Structure of the Globular Proteins ..... 568  
球蛋白的结构 ..... 569

New Products of the Fission of the Thorium Nucleus ..... 578  
钍核裂变的新产物 ..... 579

Structure of Proteins..... 582  
蛋白质结构 ..... 583

Number of Neutrons Liberated in the Nuclear Fission of Uranium ..... 598  
铀核裂变时释放的中子数量 ..... 599

|                                                                                                                     |     |
|---------------------------------------------------------------------------------------------------------------------|-----|
| Use of Isotopes in Biology .....                                                                                    | 604 |
| 同位素在生物学中的应用 .....                                                                                                   | 605 |
| Surface Transport in Liquid Helium II.....                                                                          | 612 |
| 液氦II中的表面传输 .....                                                                                                    | 613 |
| The Living Coelacanthid Fish from South Africa .....                                                                | 618 |
| 在南非发现的现生腔棘鱼 .....                                                                                                   | 619 |
| Control of the Chain Reaction Involved in Fission of the Uranium Nucleus .....                                      | 626 |
| 铀核裂变中链式反应的控制 .....                                                                                                  | 627 |
| Emission of Neutrons Accompanying the Fission of Uranium Nuclei .....                                               | 630 |
| 伴随铀核裂变的中子发射 .....                                                                                                   | 631 |
| Fission of Heavy Nuclei: a New Type of Nuclear Disintegration .....                                                 | 634 |
| 重核裂变：一种新型的核蜕变 .....                                                                                                 | 635 |
| Energy of Neutrons Liberated in the Nuclear Fission of Uranium Induced by<br>Thermal Neutrons .....                 | 646 |
| 在热中子诱发的铀核裂变中释放出的中子的能量 .....                                                                                         | 647 |
| New Prospects in Isotope Separation .....                                                                           | 650 |
| 同位素分离的新视野 .....                                                                                                     | 651 |
| Nuclear Reactions in the Continuous Energy Region .....                                                             | 658 |
| 连续能量区域的核反应 .....                                                                                                    | 659 |
| The Scattering by Uranium Nuclei of Fast Neutrons and the Possible Neutron<br>Emission Resulting from Fission ..... | 666 |
| 铀核的快中子散射与可能源于裂变的中子发射 .....                                                                                          | 667 |
| Recent Experimental Results in Nuclear Isomerism.....                                                               | 672 |
| 核同质异能性的最新实验结果 .....                                                                                                 | 673 |
| Heavy Cosmic Ray Particles at Jungfraujoeh and Sea-Level.....                                                       | 682 |
| 少女峰和海平面处的重宇宙射线粒子 .....                                                                                              | 683 |
| Interpretation of the Red-Shifts of the Light from Extra-Galactic Nebulae .....                                     | 688 |
| 河外星云光谱红移的解释 .....                                                                                                   | 689 |
| Cosmic Ray Ionization Bursts.....                                                                                   | 694 |
| 宇宙射线的“电离暴” .....                                                                                                    | 695 |

|                                                                             |     |
|-----------------------------------------------------------------------------|-----|
| Social Biology and Population Improvement .....                             | 700 |
| 社会生物学与人种改良 .....                                                            | 701 |
| Myosine and Adenosinetriphosphatase .....                                   | 708 |
| 肌球蛋白与三磷酸腺苷酶 .....                                                           | 709 |
| Action Potentials Recorded from Inside a Nerve Fibre .....                  | 714 |
| 从神经纤维内记录到的动作电位 .....                                                        | 715 |
| Solar and Terrestrial Relationships .....                                   | 720 |
| 日地关系 .....                                                                  | 721 |
| Gene and Chromosome Theory .....                                            | 730 |
| 基因与染色体理论 .....                                                              | 731 |
| Physiological Genetics .....                                                | 740 |
| 发育遗传学 .....                                                                 | 741 |
| The Crab Nebula: a Probable Super-Nova .....                                | 744 |
| 蟹状星云可能是一颗超新星 .....                                                          | 745 |
| The Relationship between Pithecanthropus and Sinanthropus .....             | 748 |
| 爪哇猿人与中国猿人的关系 .....                                                          | 749 |
| Measurements of the Velocity of Light .....                                 | 760 |
| 光速的测定 .....                                                                 | 761 |
| The Evolution of the Stars .....                                            | 764 |
| 恒星的演化 .....                                                                 | 765 |
| Radioactive Gases Evolved in Uranium Fission .....                          | 772 |
| 铀核裂变时放出的放射性气体 .....                                                         | 773 |
| Scattering of Mesons and the Magnetic Moments of Proton and Neutron .....   | 778 |
| 介子散射与质子和中子的磁矩 .....                                                         | 779 |
| Interpretation of Nebular Red-Shifts .....                                  | 784 |
| 对星云红移的解释 .....                                                              | 785 |
| Evidence for Transformation of Mesotrons into Electrons .....               | 792 |
| 介子向电子转化的证明 .....                                                            | 793 |
| Some Biological Applications of Neutrons and Artificial Radioactivity ..... | 800 |
| 中子与人工放射性的若干生物学应用 .....                                                      | 801 |

|                                                                                                                       |     |
|-----------------------------------------------------------------------------------------------------------------------|-----|
| Radium Treatment .....                                                                                                | 810 |
| 镭疗 .....                                                                                                              | 811 |
| Cancer-Producing Chemical Compounds .....                                                                             | 820 |
| 诱发癌症的化合物 .....                                                                                                        | 821 |
| Molecular Structure of the Collagen Fibres .....                                                                      | 832 |
| 胶原纤维的分子结构 .....                                                                                                       | 833 |
| Capture Cross-Sections for Thermal Neutrons in Thorium, Lead and Uranium 238 .....                                    | 840 |
| 钍、铅和铀-238中热中子的俘获截面 .....                                                                                              | 841 |
| The Mass Centre in Relativity .....                                                                                   | 846 |
| 相对论中的质心 .....                                                                                                         | 847 |
| The Theory of Nuclear Forces .....                                                                                    | 852 |
| 核力的理论 .....                                                                                                           | 853 |
| True and False Teleology .....                                                                                        | 866 |
| 正确的和错误的目的论 .....                                                                                                      | 867 |
| True and False Teleology .....                                                                                        | 870 |
| 正确的和错误的目的论 .....                                                                                                      | 871 |
| Separation of Uranium Isotopes .....                                                                                  | 872 |
| 铀同位素的分离 .....                                                                                                         | 873 |
| Chemical Estimation of Vitamin B <sub>6</sub> in Foods by Means of the Diazo Reaction<br>and the Phenol Reagent ..... | 876 |
| 利用重氮化反应和酚试剂对食物中的维生素 B <sub>6</sub> 进行化学测定 .....                                                                       | 877 |
| The Hydrogen Bond .....                                                                                               | 880 |
| 氢键 .....                                                                                                              | 881 |
| Excited States of Stable Nuclei .....                                                                                 | 890 |
| 稳定核的激发态 .....                                                                                                         | 891 |
| Considerations Concerning the Fundaments of Theoretical Physics .....                                                 | 898 |
| 关于理论物理基础的思考 .....                                                                                                     | 899 |
| Dextran as a Substitute for Plasma .....                                                                              | 914 |
| 作为血浆替代物的葡聚糖 .....                                                                                                     | 915 |

|                                                                                      |      |
|--------------------------------------------------------------------------------------|------|
| A Labour-saving Method of Sampling .....                                             | 920  |
| 一种省力的抽样方法 .....                                                                      | 921  |
| A Quantum Theory of the Origin of the Solar System .....                             | 924  |
| 太阳系起源的量子理论 .....                                                                     | 925  |
| A Quantum Theory of the Origin of the Solar System .....                             | 936  |
| 太阳系起源的量子理论 .....                                                                     | 937  |
| Plant Viruses and Virus Diseases .....                                               | 942  |
| 植物病毒和病毒性疾病 .....                                                                     | 943  |
| Action of Penicillin on the Rate of Fall in Numbers of Bacteria <i>in vivo</i> ..... | 954  |
| 在体内青霉素对于细菌数量减少速率的作用 .....                                                            | 955  |
| Biphasic Action of Penicillin and Other Sulphonamide Similarity .....                | 960  |
| 青霉素与磺胺的类似性：两相行为及其他.....                                                              | 961  |
| Causality or Indeterminism? .....                                                    | 968  |
| 因果律还是非决定论? .....                                                                     | 969  |
| Mode of Action of Penicillin .....                                                   | 978  |
| 青霉素的作用机制.....                                                                        | 979  |
| Natural History of Granite .....                                                     | 984  |
| 花岗岩的自然史 .....                                                                        | 985  |
| Rubbers and Their Characteristics: Real and Ideal.....                               | 1000 |
| 橡胶及其特性：现实的和理想的 .....                                                                 | 1001 |
| Penicillin Treatment of Venereal Disease and Spirochaetal Infections .....           | 1014 |
| 青霉素治疗性病和螺旋体感染.....                                                                   | 1015 |
| Comments on Chromosome Structure .....                                               | 1020 |
| 关于染色体结构的评论 .....                                                                     | 1021 |
| Artificial Protein Fibres: Their Conception and Preparation .....                    | 1030 |
| 人造蛋白纤维：概念与制备 .....                                                                   | 1031 |
| Appendix: Index by Subject .....                                                     |      |
| 附录：学科分类目录 .....                                                                      | 1045 |

**Volume III**  
**(1934-1945)**

# Products of the Fission of the Uranium Nucleus

L. Meitner and O. R. Frisch

## Editor's Note

Lise Meitner and Otto Frisch here report new experiments probing the products of uranium fission experiments. Earlier work suggested that fission fragments should emerge with energies of several hundred electron volts. Here the researchers sent neutrons into a sample of uranium hydroxide and attempted to collect the fission fragments 1 mm away, either in a paper surface or in water. They found evidence for a range of different fission fragments. It seemed most unlikely that the mere absorption of a neutron could give a uranium nucleus enough kinetic energy to reach their collecting surfaces. This new technique offered a route to the more detailed examination of the nuclear fragments created in fission processes.

O. Hahn and F. Strassmann<sup>1</sup> have discovered a new type of nuclear reaction, the splitting into two smaller nuclei of the nuclei of uranium and thorium under neutron bombardment. Thus they demonstrated the production of nuclei of barium, lanthanum, strontium, yttrium, and, more recently, of xenon and caesium.

It can be shown by simple considerations that this type of nuclear reaction may be described in an essentially classical way like the fission of a liquid drop, and that the fission products must fly apart with kinetic energies of the order of hundred million electron-volts each<sup>2</sup>. Evidence for these high energies was first given by O. R. Frisch<sup>3</sup> and almost simultaneously by a number of other investigators<sup>4</sup>.

The possibility of making use of these high energies in order to collect the fission products in the same way as one collects the active deposit from alpha-recoil has been pointed out by L. Meitner (see ref. 3). In the meantime, F. Joliot has independently made experiments of this type<sup>5</sup>. We have now carried out some experiments, using the recently completed high-tension equipment of the Institute of Theoretical Physics, Copenhagen.

A thin layer of uranium hydroxide, placed at a distance of 1 mm. from a collecting surface, was exposed to neutron bombardment. The neutrons were produced by bombarding lithium or beryllium targets with deuterons of energies up to 800 kilovolts. In the first experiments, a piece of paper was used as a collecting surface (after making sure that the paper did not get active by itself under neutron bombardment). About two minutes after interrupting the irradiation, the paper was placed near a Geiger-Müller counter with aluminium walls of 0.1 mm. thickness. We found a well-measurable activity which decayed first quickly (about two minutes half-value period) and then more slowly. No attempt was made to analyse the slow decay in view of the large number of periods to be expected.