

# nature

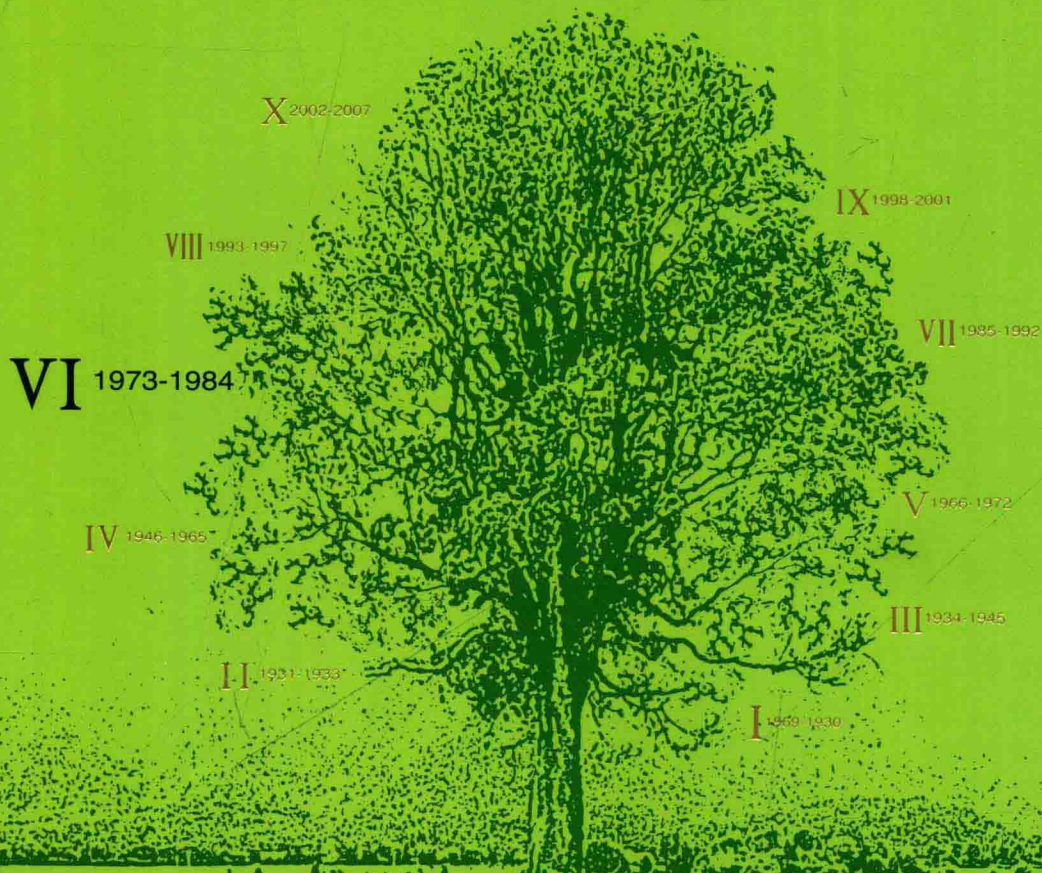
## The Living Record of Science 《自然》百年科学经典

英汉对照版 (平装本)

第六卷 (上)

总顾问: 李政道 (Tsung-Dao Lee)

英方主编: Sir John Maddox      中方主编: 路甬祥  
                 Sir Philip Campbell



X 2002-2007

IX 1998-2001

VIII 1993-1997

VII 1985-1992

VI 1973-1984

V 1966-1972

IV 1946-1965

III 1934-1945

II 1931-1933

I 1969-1930

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)

第六卷 (上)

总顾问: 李政道 (Tsung-Dao Lee)

英方主编: Sir John Maddox      中方主编: 路甬祥  
                 Sir Philip Campbell



1973-1984

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

北京 BEIJING

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. 第六卷. 上, 1973-1984: 英汉对照 / (英) 约翰·马多克斯 (Sir John Maddox), (英) 菲利普·坎贝尔 (Sir Philip Campbell), 路甬祥主编. -- 北京: 外语教学与研究出版社, 2017.8

ISBN 978-7-5135-9428-8

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 (2017) 第 217341 号

出版人 蔡剑峰  
项目统筹 章思英 Charlotte Liu (加拿大)  
项目负责 刘晓楠 黄小斌 Chris Balderston (美)  
责任编辑 黄小斌 蔡迪  
执行编辑 王丽霞  
装帧设计 彩奇风  
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 38.5  
版次 2017 年 10 月第 1 版 2017 年 10 月第 1 次印刷  
书号 ISBN 978-7-5135-9428-8  
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: 294280001

# 《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

Sir 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）

丁梅	于天源	马宇蓓	王崑	王敏康	王鹏云	冯兴无
邢松	同号文	刘武	刘京国	刘朝阳	安俊岭	许冰
李三忠	李芝芬	李典谟	李素霞	肖伟科	吴庆举	吴学兵
吴新智	何香涛	沈杰	沈志侠	宋心琦	张忠杰	张健旭
陈方	陈尔强	陈继征	陈新文	林圣龙	昌增益	周筠梅
周新华	孟庆任	赵俊猛	赵凌霞	郝伟	胡卓伟	秦志海
顾孝诚	徐义刚	徐仁新	黄晓航	曹文广	崔巍	崔娅铭
梁前进	彭小忠	董为	曾少举	曾长青		

## 编译委员会

### 本卷翻译工作组稿人 (以姓氏笔画为序)

王晓蕾 王耀杨 刘 明 刘晓楠 关秀清 李 琦 何 铭  
沈乃徵 郭红锋 蔡 迪 蔡则怡

### 本卷翻译人员 (以姓氏笔画为序)

王耀杨 毛晨晖 邓铭瑞 田晓阳 冯 翀 吕 静 刘 霞  
刘振明 刘皓芳 齐红艳 阮玉辉 孙惠南 李 响 李 梅  
李任伟 肖 莉 吴 彦 沈乃徵 张玉光 张效良 张锦彬  
周志华 周旻辰 郑建全 荆玉祥 姜 薇 钱 磊 高如丽  
董培智

### 本卷校对人员 (以姓氏笔画为序)

于 萌 于平蓉 马 荣 马晨晨 王 可 王 羽 王 敏  
王帅帅 王向东 王志云 王杰琼 王珊珊 王晓敏 王海纳  
王德孚 云 欢 毛俊捷 公 晗 史 骁 巩克瑞 吕秋莎  
乔萌萌 任 奕 任峻铭 刘 伟 刘 佩 刘 婷 刘子怡  
刘良子 刘若青 闫 妍 许长虹 许梅梅 孙 瑶 李 四  
李 芳 李 娟 李 景 李 静 李盎然 邱彩玉 攸 乔  
邹伯夏 宋 乔 张 炜 张 越 张世馥 张向东 张宜嘉  
张瑞玉 张颖之 陈 云 陈思婧 陈露芸 范艳璇 周少贞  
周玉凤 周晓明 郑娇娇 宗伟凯 赵广宇 侯彦婕 施家靖  
郭晓博 黄 欢 黄 璐 黄 璞 黄元耕 黄晓东 崔天明  
第文龙 葛 越 焦晓林 曾芃斐 谢周丽 蔡军茹 熊华晖  
潮兴娟 潘卫东

Eric Leher (澳)

Joanna Pierce (爱尔兰)

# Contents

## 目录

Monitoring Underground Explosions .....	2
监控地下爆炸.....	3
DNA Replication Sites within Nuclei of Mammalian Cells.....	32
哺乳动物细胞核内的DNA复制位点.....	33
Response of a General Circulation Model of the Atmosphere to Removal of the Arctic Ice-cap .....	52
大气环流模式对北极冰盖消融的响应.....	53
Deep-sea Sediment Source Areas: Implications of Variable Rates of Movement between California and the Pacific Plate.....	58
来自深海沉积物源区的启示: 加利福尼亚板块与太平洋板块之间相对运动速率的变化.....	59
<i>In vitro</i> Fertilization of Rat Eggs.....	66
大鼠卵细胞的体外受精 .....	67
Earth-Moon Mass Ratio from Mariner 9 Radio Tracking Data .....	74
由水手9号射电跟踪数据得到的地月质量比.....	75
Do Honey Bees Have a Language? .....	82
蜜蜂有语言吗? .....	83
The Search for Signals from Extraterrestrial Civilizations .....	110
地外文明信号搜寻.....	111
On the Origin of Deuterium .....	122
氘的起源 .....	123
Afar Mantle Plume: Rare Earth Evidence.....	138
阿法尔地幔柱: 稀土元素证据.....	139
T and B Lymphocytes and Immune Responses .....	158
T淋巴细胞、B淋巴细胞与免疫应答 .....	159

Cometary Collisions and Geological Periods .....	182
彗星碰撞与地质年代 .....	183
On Estimating Functional Gene Number in Eukaryotes .....	190
真核生物功能基因数的估计 .....	191
Descent of Lithosphere beneath New Hebrides, Tonga-Fiji and New Zealand: Evidence for Detached Slabs .....	204
新赫布里底群岛、汤加-斐济及新西兰地区岩石圈的下降: 拆沉板片的证据 .....	205
Fusion of Rat and Mouse Morulae and Formation of Chimaeric Blastocysts .....	222
大鼠与小鼠桑葚胚的融合以及嵌合囊胚的形成 .....	223
Linkage Analysis in Man by Somatic Cell Genetics .....	232
人类体细胞遗传学连锁分析 .....	233
Non-equilibrium Isotopic Fractionation between Seawater and Planktonic Foraminiferal Tests .....	256
海水与浮游有孔虫壳体间的非平衡同位素分馏 .....	257
Image Formation by Induced Local Interactions: Examples Employing Nuclear Magnetic Resonance .....	270
诱导局域相互作用成像: 核磁共振应用实例 .....	271
Isolation of the Islets of Langerhans for Transplantation .....	278
用于移植的朗格汉斯岛(胰岛)的分离 .....	279
Seismic Travel Time Evidence for Lateral Inhomogeneity in the Deep Mantle .....	286
深地幔横向非均匀性的地震波走时证据 .....	287
Evidence for an Advanced Plio-Pleistocene Hominid from East Rudolf, Kenya .....	306
来自肯尼亚鲁道夫湖以东的一个高级上新世-更新世人科动物证据 .....	307
Practical Application of Acupuncture Analgesia .....	322
针刺镇痛的实际应用 .....	323
Experiments on Polishing of Diamond .....	332
金刚石抛光实验 .....	333
Tectono-eustatic Changes in Sea Level and Seafloor Spreading .....	352
构造-海平面变化和海底扩张 .....	353

Resonance Raman Spectroscopy of the Photoreceptor-like Pigment of <i>Halobacterium halobium</i> .....	368
盐生盐杆菌中类感光色素的共振拉曼光谱.....	369
Discontinuous Change in Earth's Spin Rate following Great Solar Storm of August 1972 .....	382
1972年8月强太阳风暴过后地球自转速度的不连续变化 .....	383
Removal of Xenon and Radon from Contaminated Atmospheres with Dioxygenyl Hexafluoroantimonate, O <sub>2</sub> SbF <sub>6</sub> .....	390
六氟合锑酸(V)双氧盐(O <sub>2</sub> SbF <sub>6</sub> )去除污染大气中的氙和氡 .....	391
Cores of the Terrestrial Planets .....	400
类地行星的核 .....	401
Physical State of the Earth's Core .....	412
地核的物理状态 .....	413
Formation of the Earth's Core .....	420
地核的形成.....	421
Properties of Ultra-high Modulus Linear Polyethylenes .....	428
超高模量线型聚乙烯的性质 .....	429
Double Helix at Atomic Resolution .....	434
原子分辨率的双螺旋 .....	435
Eukaryotes-Prokaryotes Divergence Estimated by 5S Ribosomal RNA Sequences .....	452
通过5S核糖体RNA序列估计真核生物-原核生物分化.....	453
Isolation and Genetic Localization of Three $\phi$ X174 Promoter Regions .....	460
三个 $\phi$ X174启动子区的分离和基因定位 .....	461
Tree-ring Calibration of Radiocarbon Dates and the Chronology of Ancient Egypt.....	474
放射性碳年代的树轮校正及古埃及年表 .....	475
Redshift of OQ 172 .....	496
类星体OQ172的红移 .....	497



Depression of Freezing Point by Glycoproteins from an Antarctic Fish.....	502
一种南极鱼类的糖蛋白具有降低凝固点的作用 .....	503
Muscular Contraction and Cell Motility.....	510
肌肉收缩与细胞运动 .....	511
Effect of Low-level Radioactive Silver on Photographic Emulsions .....	534
低放射水平的银对感光乳剂的影响 .....	535
Effect of Lithium on Brain Dopamine.....	538
锂对于大脑中多巴胺的作用 .....	539
L-Glutamic Acid Decarboxylase in Parkinson's Disease: Effect of L-Dopa Therapy .....	544
帕金森氏症中的L-谷氨酸脱羧酶: L-多巴的治疗效果 .....	545
Neutral Mutations .....	554
中性突变 .....	555
Relative and Latitudinal Motion of Atlantic Hot Spots .....	558
大西洋热点的相对运动和纬向运动 .....	559
Black Hole Explosions?.....	578
黑洞爆炸? .....	579
Further Evidence of Lower Pleistocene Hominids from East Rudolf, North Kenya, 1973 .....	586
1973年在肯尼亚北部鲁道夫湖以东下更新统发现更多人科动物证据 .....	587
Stratospheric Sink for Chlorofluoromethanes: Chlorine Atom-Catalysed Destruction of Ozone .....	602
氟氯甲烷的平流层汇: 氯原子催化破坏臭氧过程.....	603
Kinky Helix .....	614
有扭结的螺旋 .....	615
Continuous Cultures of Fused Cells Secreting Antibody of Predefined Specificity .....	630
可分泌特异性抗体的融合细胞的连续培养.....	631

Plio-Pleistocene Hominid Discoveries in Hadar, Ethiopia .....	646
在埃塞俄比亚哈达尔发现的上新世 - 更新世时期的人科动物 .....	647
<b>Single-Channel Currents Recorded from Membrane of Denervated Frog</b>	
Muscle Fibres .....	670
切除神经的青蛙肌纤维膜上的单通道电流 .....	671
Simple Mathematical Models with Very Complicated Dynamics .....	682
具有极复杂动力学行为的简单数学模型 .....	683
<i>Australopithecus, Homo erectus</i> and the Single Species Hypothesis .....	728
南方古猿、直立人及单物种假说 .....	729
Fossil Hominids from the Laetolil Beds .....	738
在莱托利尔层发现的人科动物化石 .....	739
Nucleotide Sequence of Bacteriophage $\phi$ X174 DNA .....	768
噬菌体 $\phi$ X174 的 DNA 核苷酸序列 .....	769
Radio Sources with Superluminal Velocities .....	800
超光速射电源 .....	801
<b>New Hominoid Primates from the Siwaliks of Pakistan and their Bearing on</b>	
Hominoid Evolution .....	822
巴基斯坦西瓦利克新发现的人猿超科灵长类动物及其在人猿超科进化上的	
意义 .....	823
Pliocene Footprints in the Laetolil Beds at Laetoli, Northern Tanzania .....	856
坦桑尼亚北部莱托利尔层中的上新世足迹 .....	857
0957+561 A,B: Twin Quasistellar Objects or Gravitational Lens ? .....	886
0957+561 A,B: 双类星体还是引力透镜? .....	887
<b>Single Strands Induce recA Protein to Unwind Duplex DNA for Homologous</b>	
Pairing .....	904
单链 DNA 诱导 recA 蛋白解旋 DNA 以利于同源配对 .....	905
Selfish Genes, the Phenotype Paradigm and Genome Evolution .....	922
自私的基因, 表型模式和基因组进化 .....	923

Selfish DNA: the Ultimate Parasite .....	938
自私的DNA: 最终的寄生物 .....	939
Selfish DNA .....	960
自私的DNA .....	961
Modes of Genome Evolution.....	970
基因组的进化模式.....	971
Mutations Affecting Segment Number and Polarity in <i>Drosophila</i> .....	978
影响果蝇体节数量和极性的突变 .....	979
Establishment in Culture of Pluripotential Cells from Mouse Embryos.....	1002
小鼠胚胎多能细胞培养体系的建立 .....	1003
Test-tube Babies, 1981 .....	1014
试管婴儿, 1981 .....	1015
Enzymatic Replication of <i>E. coli</i> Chromosomal Origin is Bidirectional.....	1036
大肠杆菌染色体起始位点的酶促复制是双向进行的 .....	1037
Temperature Control of Oxygen-Isotope Fractionation of Cultured Planktonic Foraminifera .....	1054
培养条件下温度对浮游有孔虫中氧同位素分馏的控制.....	1055
Human EJ Bladder Carcinoma Oncogene is Homologue of Harvey Sarcoma Virus <i>ras</i> Gene .....	1062
人类EJ膀胱癌基因是哈维肉瘤病毒 <i>ras</i> 基因的同源基因 .....	1063
Neurone Differentiation in Cell Lineage Mutants of <i>Caenorhabditis elegans</i> .....	1084
秀丽隐杆线虫细胞谱系突变体的神经元分化 .....	1085
A Millisecond Pulsar .....	1098
一颗毫秒脉冲星 .....	1099
Evidence on Human Origins from Haemoglobins of African Apes .....	1114
来自非洲猿血红蛋白的人类起源证据 .....	1115
Constraints on Evolution of Earth's Mantle from Rare Gas Systematics.....	1128
稀有气体系统对地幔演化的制约 .....	1129

A Conserved DNA Sequence in Homoeotic Genes of the <i>Drosophila</i>	
Antennapedia and Bithorax Complexes.....	1150
果蝇触角足和双胸基因复合体同源异型基因中的保守DNA序列.....	1151
Evidence from Crater Ages for Periodic Impacts on the Earth .....	1176
来自陨石坑年龄的地球周期性受碰撞的证据 .....	1177
“Melting Ice” I at 77 K and 10 kbar: a New Method of Making Amorphous	
Solids.....	1192
77 K和10 kbar条件下的“熔融冰”I: 制取无定形固体的一种新方法 .....	1193
Appendix: Index by Subject	
附录: 学科分类目录 .....	1207

**Volume VI**  
**(1973-1984)**

# Monitoring Underground Explosions

D. Davies

## Editor's Note

During the Cold War, the testing of nuclear weapons proceeded in parallel with international discussions about whether they might be banned. One of the obstacles to a ban was the problem of verifying a nation's adherence to it. The Soviet Union was particularly reluctant to agree to external inspections of its weapons facilities, so that verification would need to rely on a capacity for detecting tests from afar. Underground tests, still being conducted in the early 1970s, create seismic waves, but to use these for verification they would need to be distinguished from earthquakes. Here David Davies of the Massachusetts Institute of Technology reviews progress towards a sufficiently discriminating seismology, concluding that techniques were becoming adequate but still not infallible.

---

Seismological means for detecting and identifying underground nuclear explosions have improved steadily during the past ten years. A technique exists for separating explosions from earthquakes. The problem now is lowering the threshold and understanding the occasional problematic event.

---

AN underground nuclear explosion converts about 1 percent of its energy into seismic waves and these carry information about the time, size, and location of the event. They may also indicate that the event is indeed an explosion and not an earthquake. This information is somewhat more difficult to extract, and research in many countries for the past few years has been intensively directed towards discrimination between natural and artificial events. There is no other known way of identifying underground explosions that can be used on a world-wide basis. In this article, I shall describe the progress that has been made recently in this science, which has such obvious implications for arms control. The conclusions that I reach should not, however, be construed as a measure of the prospect of a total test ban. Many ingredients go into the making of a treaty, and ability to police it is only one of them. Seismological capability is thus not sufficient, but it may be necessary, at least down to some level of explosive yield. What would constitute an adequate level is a matter of some discussion at present. The science reported here is the result of the research of many seismologists. In order to reduce the number of references to a manageable level, however, I have cited only a few large compilations of results in which the genealogy of the various ideas and instruments may be found.

# 监控地下爆炸

戴维斯

## 编者按

冷战期间，核武器试验在进行的同时，国际上对于是否应该禁止核试验的讨论也在继续。禁止核试验的障碍之一是如何证实一个国家是否遵守此禁令。苏联特别不情愿外界对其核武器设施进行监测，因此，证实是否进行核试验将需要依赖于从远处监测核试验的能力。地下核试验直到 20 世纪 70 年代早期还在进行，试验会产生地震波，但是利用这些地震波进行核实的话需要将其和天然地震区分开来。本文中，麻省理工学院的戴维·戴维斯综述了地震学识别的进展，并得出结论，该技术已经能够胜任监测需要，但还不是绝对可靠的。

---

在过去的十年里，监测和识别地下核爆炸的地震学方法取得了稳步发展。这门技术可以将爆炸和地震区分开来。目前的问题是要降低阈值和理解偶然性的有问题事件。

---

一次地下核爆炸所释放的能量中，有百分之一转化为地震波，而这些地震波中就携带着关于这一事件的时间、规模和地点等信息。它们也可以说明，这一事件确实是一次爆炸而不是地震。这种信息的提取还要更难一些，因而在过去的几年中，很多国家的研究都集中指向了对天然事件与人为事件的识别。还不知道有其他识别地下爆炸的方法能够应用于全世界范围。在本文中，我将描述这一学科在最近所取得的进展，这些进展对于武器控制具有如此明显的作用。但是，我所得到的结论并不能被解释为完全禁止核试验前景的一种度量。促进条约制定的因素有很多，监管能力只是其中之一。由此看来，地震学方法的作用并不足够强，但是，至少具体到某些爆炸当量水平时，它可能是必要的。如何制定出合适的水平标准目前还是一件有争议的事情。这里所报道的是很多地震学家的研究成果。不过，为了将参考文献数量减少到可控制的限度，我只引用了一些大型的研究结果汇编，其中汇集了各种研究思想和研究工具。

The reason for testing nuclear weapons underground is not, of course a matter of public discussion, but a paper by Neild and Ruina<sup>1</sup> probably provides a reasonably complete list of purposes. Between 1968 and 1971 there was an average of about twenty-five underground tests a year announced by the United States compared with about ten presumed tests a year for the Soviet Union, one test per year for China and about five a year for France—all but one of the Chinese tests and all of the French tests being atmospheric. Britain has not announced a test for seven years.

When the banning of nuclear tests first became an international issue in 1958, a conference on the technical problems in Geneva clearly indicated that the science of seismology would need substantial advances to reach a stage at which instrumental observations could indicate unambiguously that an explosion with a yield of a few kilotons (kton) had been detonated. Indeed the rather meagre data available during that conference and the subsequent negotiations (there had at that time only been two or three quite small underground tests) suggested that a first objective could reasonably be an international network of about 170 stations which could detect seismic signals down to a certain threshold but not necessarily identify their source. It was expected that most seismic events would clearly indicate their earthquake nature by their location and depth, their radiation pattern and the shape of their signal, but there would be a residue which would need further investigation. In the early days of international negotiations, inspections of the sites of a fraction of these suspicious events were discussed in detail—the number and nature of such inspections being particularly contentious topics. With time, the position of the Soviet Union on the inspection issue hardened to the assertion that inspections were unnecessary, and that purely national means of policing would be satisfactory. Thus the “Geneva network” was never built.

The two issues which were seen as central in 1958 are central today. Background seismic noise (from wind, traffic, ocean waves, and so on) placed a limitation on the detection of events; and a certain number of earthquakes did not immediately reveal themselves as such. The advances in seismology have been substantial since 1958, but increasing the signal-to-noise ratio (s.n.r.) and finding improved methods of separating earthquakes and explosions are still the principal fields of research. The rather narrow frequency bands involved in seismology have controlled techniques rigorously, and because the work is concentrated in situations of low s.n.r., the problem has been that of finding the frequency at which the s.n.r. is highest, and aiming improvement at that frequency, rather than trying to encompass the whole spectrum of the seismic signal. This “mission-oriented” approach to seismology, when combined with the intellectually stimulating problems that have arisen on the way, has exerted a vital role in the development of seismology since 1958.



在地下进行核武器试验的原因，显然不是一个公开讨论的问题，不过尼尔德和鲁伊纳的论文中基本上为此提供了合理的完整解释<sup>[1]</sup>。在1968年至1971年间，美国宣称平均每年进行大约25次地下核试验，与之相比，苏联每年大约进行10次核试验，中国每年1次，而法国大约每年5次——不过中国所进行的除1次以外的所有试验和法国进行的所有试验为地上试验。英国已有7年没有宣布过核试验。

1958年，禁止核试验首次成为国际问题，在日内瓦举行的关于技术问题的会议明确指出，地震学需要取得实质性的进展，使得仪器观测毫不含糊地指出具有几千吨(kton)当量水平的爆炸的发生。确实，那次会议和随后的商谈中可用数据甚少(当时只有两次或者三次规模很小的地下试验)，因此，首要目标是建立包括大约170个台站的国际台网，该台网能够检测到一定阈值之上的地震信号，但是不必确定其来源。人们期望，绝大多数地震事件可以通过其位置、深度、辐射模式和信号形状明确地体现出天然地震的特征，但还剩余少数事件有待于进一步研究。在早期的国际磋商过程中，详细讨论了如何对一小部分可疑事件发生的地点进行检查——检查的数量和性质是争议较大的问题。同时，苏联对于检查问题的立场渐趋强硬，并最终断言检查是不必要的，而单纯的国家监管方式就能满足需要了。因此“日内瓦国际台网”从未曾建立起来。

1958年时所关注的两个中心议题到今天仍然是焦点。地震背景噪声(来自风、交通工具、海浪等)限制了地震事件检测的进行；而且某些地震也不是马上就显现出天然地震的性质。自1958年以来，地震学已经取得了显著进展，不过提高信噪比(s.n.r.)和寻找区分地震与爆炸事件的改进方法仍然是主要研究领域。地震学中所涉及的极为狭窄的频率段严格地限制着这项技术，由于研究工作集中于低信噪比条件下，因此关键是找到具有最高信噪比的频率，集中在该频率下取得进展，而不是试图包揽震动信号的全部图谱。地震学中这种“任务导向式”的方法，再加上研究过程中产生的理性所激发出的问题，对于地震学自1958年以来取得的发展具有重要的作用。