THE GREATEST ENGINEERING ACHIEVEMENTS OF THE 20TH CENTURY

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20世纪最伟大的工程技术成就

美国国家工程院 编
常 平 白玉良 译

暨南大学出版社
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THE GREATEST ENGINEERING ACHIEVEMENTS
OF THE 20TH CENTURY

A Collaborative Project
Led by the National Academy of Engineering
With National Engineers Week,
The American Association of Engineering Societies,
and 27 Professional Engineering Societies

20世纪最伟大的工程技术成就

美国国家工程院主持的联合项目
《国家工程师周刊》
美国工程学会联合会
和27个专业工程学会参与

常　平　白玉良　译
常平译："导言"，1、2、3、5、6、8至15章，附录
白玉良译："工程师铸造的世纪"及4、7、16至20章

参加本书校订的中国工程院院士：
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参加本书部分校译工作的人员：
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C O N T E N T S

INTRODUCTION

Perhaps more than any other factor, engineering has been the impetus for change in the 20th century. Yet, the average citizen, political leader, or opinion leader in America today does not understand the integral role engineering plays in daily decisionmaking. Greatest Engineering Achievements of the 20th Century is a comprehensive public awareness campaign that is marking the millennium by calling attention to the significant impact engineering has had upon quality of life in the 20th century.

Twenty-seven engineering societies, National Engineers Week, and the American Association of Engineering Societies have come together with the National Academy of Engineering in a collaborative project that will encompass a four year public awareness campaign. Their goal is to maximize impact by communicating one common message through a coordinated effort and a variety of media and outreach tools including radio, print, television, the Web, special events, and informal and K-12 education.

Project Overview

The heart of this public awareness campaign is telling stories about engineering to illustrate the impact it has had on the 20th century. These stories will be the basis for developing educational and public awareness materials, and

导　言

20 世纪的进步，工程的贡献大于其他任何因素。然而，今日美国的公民、政治领袖和舆论引导者却不了解工程在每天的决策中的无可替代的作用。“20 世纪最伟大的工程成就”是千年交替之际的一项广泛的公众教育活动，旨在使人们认识工程在 20 世纪为改进人类生活质量所起的重要作用。

27 个工程学会、《国家工程师周刊》、美国工程学会联合会（AAES）与美国国家工程院(NAE)一起参与这项持续四年的公众教育活动。该活动的目标是，通过协调努力，借助各种媒体及延伸手段（包括广播、出版、电视、网络、专项活动、非在校教育和 12 年义务教育),传播一个共同的信息，使社会理解工程的重大作用。

项目概述

本项公众教育活动的核心是讲述工程的故事，说明工程对 20 世纪的重大影响。这些故事是开发教学材料和公众普及材料的基础，将展示工程为什么及如何改善人类生活质量，展示工程为什么及如何与每天的决策息息相关。

1999 年秋，各专门学科的工程学会要求其会员推荐20

they will demonstrate *why* and *how* engineering impacts quality of life and is relevant in everyday decisionmaking.

During the fall of 1999, the discipline-specific engineering societies asked their members to nominate engineering innovations that have had the greatest impact on society during the 20th century. Each society then selected five nominations to submit to an anonymous committee comprised of members of the National Academy of Engineering, which represents all of the various engineering disciplines. The NAE Selection Committee convened during the first week of December 1999 to select the top twenty engineering achievements from the list of nominations. National Engineers Week in February 2000 was the kick-off for the public awareness campaign, and the release of products and programs is planned to spread over the next three to four years.

Project Goals

- The Greatest Achievements project will honor the people, institutions, and innovations in engineering that have changed the quality of life in the 20th century;
- stimulate public discussion about the connection between engineering and quality of life; and
- change the image of engineers and the engineering profession.

世纪对社会产生最大影响的工程革新。随后，每个学会推选出5项交给由美国国家工程院院士组成并代表各工程学科的匿名评选委员会。国家工程院评选委员会于1999年12月的第一周举行会议，从推荐的项目中遴选20项突出的工程成就。2000年2月，《国家工程师周刊》拉开了这项公众教育活动的序幕，相关的宣传品和广播电视节目计划在3～4年内推出。

项目宗旨

——表彰为改善20世纪人类生活质量而取得伟大成就的人员、机构和工程技术革新；

——激励公众讨论工程与人类生活质量的关系；

——再塑工程师和工程职业的形象。

目　标

——编写出文字内容，采用多种方式，展示工程与人类生活质量是如何密切相关且至关重要的；使全体工程师和工程学会能用到这些宣传品。

——充分利用2000－2001年的各种千年纪念活动，借助广泛的媒体宣传，吁请社会各界关注工程的重要性。

——所有参与此项目的学会协调一致，合理分工，尽

Objectives

- To generate content and outreach mechanisms that clearly demonstrate how engineering is relevant and critical to the quality of life, and make these outreach products available for all engineers and engineering societies.
- To capitalize on millennium activities in 2000 and 2001 by calling attention to the critical role of engineering through a comprehensive media campaign.
- To maximize the impact of the efforts of each collaborating institution through a coordinated dissemination and distribution effort.

Target Audiences

- Mass media
- K-12 students and teachers
- Educated voting citizens
- Public policy community, "The Hill"

Possible Products and Programs

- Web site
- Museum exhibits
- Book
- Kiosks
- Teacher materials: K-12 and first year engineering
- Radio
- Television
- Video
- Film

可能地扩大影响。

对　象

——大众传媒

——中小学师生

——受过教育并有选举权的公民

——公众政策机构，国会

可能的产品和节目

——网站

——博物馆陈列品

——书籍

——公告亭

——中小学教材和大学一年级工科教材

——无线电广播节目

——电视节目

——录像

——电影

The Engineered Century

Neil A. Armstrong

A century hence, 2000 may be viewed as quite a primitive period in human history. It's something to hope for.

Fellow engineers, honored guests, ladies and gentlemen:

It is National Engineers Week, and I am honored to be speaking on behalf of the National Academy of Engineering and our nation's professional engineering societies.

Neil Armstrong, former astronaut, commander for Apolol 11, the first man to walk on the moon, member of the National Academy of Engineering. This article is an edited version of his remarks delivered at the National Press Club, 22 February 2000.

I am, and ever will be, a white-socks, pocket-protector, nerdy engineer – born under the second law of thermodynamics, steeped in the steam tables, in love with free-body diagrams, transformed by Laplace, and propelled by compressible flow.

As an engineer, I take a substantial amount of pride in the accomplishments of my profession. Bill Wulf, president of the National Academy of Engineering, has said that science is about what *is*, and engineering is about what *can be*. The Greek letter eta, in lower case, often shows up in engineering documents. Engineers pay a good bit of attention to improving eta because it is a symbol for efficiency – doing an equivalent or better job with less weight, less power, less time, less cost. The entire existence of engineers is dedicated to doing things better and more efficiently.

工程师铸造的世纪

尼尔 A · 阿姆斯特朗

一个世纪后，2000 年会被认为是人类历史上一个相当原始的时期。这是可以想象的。

各位同仁，尊敬的嘉宾，女士们，先生们：

现在是全国工程师周，我很荣幸地代表国家工程院（NAE）和全国工程技术协会发言。

尼尔 · 阿姆斯特朗，前宇航员，阿波罗 11 号飞船指令长，月球行走第一人，美国国家工程院院士。本文是他 2000 年 2 月 22 日在美国全国新闻俱乐部的讲话的整理稿。

我现在是、将来也是一个脚穿白袜、口袋里插有塑料护套的干练的工程师。在热力学第二定律下出生，谙熟蒸汽表，酷爱自由体受力图，拉普拉斯转换了我的方向，压缩流将我送上太空。

作为一名工程师，我为自己在专业上所取得的巨大成绩而感到骄傲。国家工程院院长沃尔夫（Bill Wulf）先生曾经说过：科学是关于“是什么”的学问，工程学是关于“怎样做”的学问。小写希腊字母（eta）时常出现在工程技术文献中。工程师花费了大量的精力去提高 eta，因为 eta 是效率的代表符号，即以较少的气力、较少的能量、较少的时间和较少的成本做完同一件工作或把工作做得更好。全心全意地投入，把事情做得更好，是工程师献身之

When knowledge, facts, or solutions are sought, there are a number of techniques available from which to select. These techniques can be ranked according to their effectiveness, from the most certain to the most uncertain. At the top, or level one, is measurement; but even excellent measurements can be subject to small amounts of error. Level two is cause and effect. That's a rigorous deduction based on the laws of nature; on tile conservation of mass, energy, and momentum; on Newtonian mechanics, Ohm's law, Charles's law, and all those kinds of relationships. These techniques for solving problems are not error free, but they do provide reliable and repeatable results.

At the third level I put correlation studies. These are statistical techniques which allow the drawing of general and reasonable conclusion, but imprecise conclusions. An example of this is when you hear a conclusion such as 62 percent of the people who eat pistachio ice cream 20 or more times a week tend to gain weight.

The fourth level is opinion sampling. Conclusions here can be useful, but they are often temperable and not repeatable. Levels five, six, seven, and eight include a variety, of techniques that vary from focus groups to intuition to dream analysis and just plain guessing.

Uncertainty increases with the number of independent variables. So engineers use measurement and cause-and-effect methods for problem solving as much as possible, and use correlation studies only when the number of inde-

所在。

在我们探索知识、查明事实或寻找解决方案的时候，可供选择的方法不止一二。这些方法根据其产生的效果，可以按照从最确切到最不确切的顺序进行排列，最顶端或第一个层次是计量方法。但即使是最佳计量方法也难免有细微的误差。第二个层次是因果方法，是一种严格遵循自然规律的推论。比如遵循质量、能量和动量守恒定律、牛顿的力学原理、欧姆定律、查理定律以及它们之间的各种关系等。虽然这些方法并非永远正确，但确实可以引出可靠并经得起重复检验的结果。

第三个层次我称之为相关分析方法。这些统计方法可以帮助我们得出大致的、合理的结论，但并非很精确。例如你可能会听到这样的结论：在每周吃 20 个或更多果仁冰激凌的人群中，有 62% 的人会发胖。

第四个层次是抽样调查法。这样得出的结论可能是有用的，但通常有出入，且不能重复使用。从第五到第八个层次包括各种各样的方法，从专题研究到直觉知识、梦的解析，直至纯粹的猜想。

随着自变量的增加，事物的不确定性也在相应增加。因此，工程师尽可能多地采用计量方法和因果方法来分析解决问题，只有在自变量的数字太大，找不到明确的答案