科技英语通俗读物

数学的奇境

〔英〕L. Hogben 著
田雨三注释

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科技英語通俗讀物

MAN MUST MEASURE

The Wonderful World of Mathematics

数学的奇境

[英] L. Hogben 著
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1964年·北京

Lancelot Hogben

MAN MUST MEASURE

The Wonderful World of Mathematics

RATHBONE BOOKS, LONDON, 1955.

內 容 提 要

本书以浅明生动的文字讲述从原始社会到現代人类在生活中应用数学的故事。本书内容饒有兴趣，引人入胜，并且讲述了一些基本的科学知識。本书文字朴素，語言純正、典范，特别适合理工科学生閱讀。

本书分为八章，个别地方曾略作删节。每章后附注释，书末附有总詞汇表。

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数学的奇境

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序

我是一个科学普及讀物的爱好者，我之所以爱好科普讀物，不仅仅是因为我是一个科学工作者，而是因为我生长在这新时代——祖国正在进入科学技术現代化的新时代，人人都必須具备些科学知識。更是因为这种书刊的影响很大，可以引导青年走上爱好科学的道路。同时作为在科学工作上先迈了一小步的人来說，也有責任关心一下青少年們的科学讀物。纵然是自己的能力差，写不出好科普讀物来，但看上一看，了解了解情况，推荐些好书，提出些疑点也是应尽的責任。

讲到科普讀物的写作眞不容易。深入淺出是眞功夫！是大学問！写得通俗，但不歪曲，不使人得出錯誤印象；把不懂的东西以为懂了，或把本来平凡的东西看得神秘了。我們不能沒有浪漫主义的想像力，但我們怎样可以使讀者不模糊地看到科学幻想与科学事实間的界限，也就是讀了之后，明确无誤地知道什么是科学成果，什么是科学幻想。趣味足以引人入胜，当然重要，但能写些科学小品也很重要。我最近看了一本1964年的历书，就为其中一些常用的科学知識所感动。这种知識虽然看来平常，但它的实用价值往往不亚于“西游記”式的、“哲学教材”式的、“学院”式的科普讀物。

我沒有忘記我是在写一篇小序，在为 L. 霍格本的《数学的奇境》的中文注释本写小序。我以上所說的是我一向对科普讀物的要求和願望。我很高兴地看到，其中不少要求都为本书所滿足了。当然，要一本书滿足以上所提的所有的要求是不可能的。

L. 霍格本教授是一位有国际声望的学者，他也擅长写通俗文章，这本书也特别写得簡明扼要，生动活泼。田雨三同志的中文注释也做得很恰当。理工科的同学讀了这本书既可以获得不少数学常識，又可以学习英文。一时高兴，我不辞冒昧地写这样一篇序言。

华罗庚

1964 年 2 月 10 日

于北京鉄狮子坟

前　言

本书原名 "Man Must Measure", 1955 年出版。副题 "The Wonderful World of Mathematics" (数学的奇境)較能显示出本书的內容,因以为名。著者 L. 霍格本 (1895—) 是英国生理学家, 教育学家, 統計学家,語言学家,历任动物学、生物学、实驗生理学教授, 是一位博学多識, 富有国际声望的学者, 尤以擅长写科学普及著作見称。本书是一本膾炙人口的数学常識故事讀物;因为极其通俗淺易,英国評論家誉为"学童数学" (Mathematics for Every Schoolchild)。

著者翔实地說明了数学是从丈量土地面积、建筑陵墓宫室、測定器皿容积、观察天象、記載曆书、航海貿易、射击防御、制造机械等的实际需要中产生的。关于数学的形成和发展过程及其对人类社会的功用: 从数目字的发明到几何、三角、代数等; 从远古以物易物, 人們用手指表示数量, 到堆石子、刻痕、結绳、筹签、算盘、計算尺、电子計算机等精密仪器对今天工业的密切关系等, 虽然用字不多,无不写得鮮明如画,酷似鏡头一样, 一个接着一个在紙上浮动起来。

著者的文字朴实、流利、純正; 不同于从它种語文譯成的一般英語或非英美人的英語。选注者是把本书当作学习英語的范本来介紹給讀者的。对于自修英語的同志和高等院校理工科的学生,这是一本較好的讀物。

不足的是沒有提及我国古代先賢在数学方面的成就和貢献。但本书毕竟不是世界数学的正史; 而学外語的首要目的在于"知彼",即掌握了外語,从而把外国人的长处介紹到中国

来，以促进我国經济和文化的发展，而不在于“知己”。从这个角度看来，虽有不足，似亦未可厚非。

承中国科学院数学研究所所长、中国科学技术大学副校长华罗庚先生在百忙之中为本书作序，謹誌謝忱。

罗信耀同志代为打出底稿，胡君倩同志代为謄写中文注释并編排詞汇表，一并致謝。

因限于水平，注释不妥之处在所难免，請讀者指正。

田雨三

1964年2月24日

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I. TIME AND TALLY

For[1] *my one deer you must give me three of your spearheads.* The earliest men and women like ourselves lived about twenty-five thousand years ago.[2] They could say all this with their hands, simply by pointing[3] one finger at the deer and three at the spearheads. The primitive way of counting with one finger for[4] one thing and three fingers for three things, was the only kind of arithmetic they knew. For thousands of years such people thought of any quantity greater than three as a heap or pile.

They had no towns, no villages. They were wanderers who trekked from place to place in search of[5] animals and birds to hunt and of berries, roots, and grain to gather. The only goods they possessed[6] were the skins of animals, to protect them from the cold night air, a few hunting weapons,[7] crude vessels to hold water, and perhaps some kind of lucky charm, such as[8] a necklace of bear's teeth or sea-shells.

There was no need for them to know much arithmetic. Even their simple finger-counting[9] was useful only on the rare occasions[10] when they wanted to exchange goods with the members of some other tribe. Much more important to these hunters and food-gatherers was a knowledge of the seasons and of direction.[11] Knowledge of the seasons could help them to forecast[12] when the nuts and berries were beginning to ripen in some far-off

forest, and a knowledge of direction would help them to find their way there. With neither calendars nor maps to help them they had to[13] learn these things slowly, by long experience through trial and error.[14]

While they were wandering through countryside they knew, they could find their way by remembering the positions of familiar hills, lakes and streams; but when drought or hunger drove them to seek new hunting grounds they had only the sun, moon and stars to guide them.

Tribes living near the sea might notice that the sun seemed to rise each morning out of the waves and set each night behind some distant line of hills. They could find their way to the sea by marching towards the rising sun, or to the hills by marching towards the setting sun. But this bit of knowledge would give them only a very rough-and-ready guide,[15] for the sun's rising and setting positions change from season to season.

The stars of the night sky offered a much more reliable clue to direction but it must have taken[16] many, many years for the wise men or women of these early tribes to discover it. We can imagine them, after the day's hunting was over, sitting by the opening of a shelter or the mouth of a cave and gazing up into the starlit sky. After a time they would notice certain clusters of stars that formed simple patterns which they could pick out[17] night after night.[18] These star-clusters seemed to trace part of a circular path[19] across the sky, moving slowly round like the hands of some giant clock.[20]

Some clusters seem to circle around a fixed point in

the northern sky. There lies what we now call the North Pole Star,[21] which scarcely changes its position in the night sky in a hundred years. Since it seems to be fixed, it is a kind of signpost. Nightlong this star shows us where what we call north lies, if we can spot it[22] among all the hundreds of other stars that shine and twinkle in the sky.

Like us, the hunter of twenty-five thousand years ago could locate this signpost by spotting a cluster of seven stars, shaped rather like a big dipper or an ancient plough.[23] This cluster circles around the Pole Star. Wherever we see it in the night sky, two of its stars point almost directly to the Pole Star. If we go the way they point, we are going northwards.

Sun, moon and stars were not only man's first signposts, they were also his first clock. During the day, the early hunter living north of the tropics would see the long morning shadows point westward.[24] He would watch them grow gradually shorter until the sun reached its highest point in the heavens at noon. As[25] the sun sank lower, he would then see the shadows, now pointing eastward, slowly lengthen again. By noticing the length of shadow he could roughly tell what we now call the time of day.

Watching by the camp fire,[26] these early folk would notice that the moon when full[27] is highest in the sky just halfway through the night. In time, the more observant ones would also learn to judge the night hours by following the course of certain star-clusters which circle around the Pole Star.

To measure longer periods of time, our first forefathers must have relied on[28] the moon. Night by night they saw how it gradually changes from a full disc of silver to a slim crescent and then disappears altogether. After a few dark nights, it reappears as a crescent and slowly grows again to its full size.[29]

Just as[30] the full moon was rising, a hungry tribe might pitch its tents[31] near a wood whose boughs were laden with sour, green berries.[32] The wise ones might say: Let us not touch these berries now; let us come back when the moon is once more full; then they will be black and good for plucking.[33] The clan would then wander far afield in search of other food. Somehow they had to make sure of getting back at the right time. To do that, they would need to count the days.

Time flies, and counting days or months[34] is not like counting dead deer or bear's teeth. We cannot make days stand in a row[35] while we count them on our fingers. Our forefathers most likely first solved the problem by cutting a notch on a tree, a stick or a stone to mark the passage of each day: one notch — one day, two notches — two days, and so on. In time they would discover that there are always thirty days between one full moon and the next.[36] So they might cut a bigger notch to mark a full moon. Twelve of these bigger notches would round off[37] 360 days — roughly a year. We then have our first crude moon-calendar embracing the four seasons[38] from spring to spring again.

After many thousands of years, some of these early hunters slowly began a new way of life. On returning

to[39] an old camping site, they would notice that grain left littered on their last visit[40] was now sprouting in plenty. From this experience they learned to set some aside[41] for planting. With the help of their constant companion, the dog, they also began to herd sheep, goats and cattle into ravines where it was easy to keep them penned in[42] ready for slaughter only when there was need for meat. Instead of[43] searching for wild herbs and berries, they sowed and reaped their own crops. They thus became shepherds and farmers.

As[44] they settled down in villages they collected more and more goods which they could call their own. With hoes and digging-sticks, fields and fences, crops and herds, men needed to keep a record of their possessions. The earliest way of recording was the tally-system of the calendar-makers[45] — one mark for[46] one thing, two marks for two things, and so on. Counting this way lasted over a long period. In the New World,[47] the Incas of Peru used to tie one knot in a cord to record[48] each sheaf of grain gathered in at harvest, and in parts of the Old World[49] there are still shepherds who cut chips in a stick when counting their flocks.[50]

As[51] men became farmers, they had to be able to forecast accurately the times of lambing and calving,[52] of sowing and reaping. The hunter's rough-and-ready moon-calendar was no longer[53] good enough. Nor was his way of recording numbers.[54] If the farmer uses a moon-calendar of 360 days to forecast the seasons, he will make an error of five days the first year, ten days the next year and so on. Thus the wise men who were

able to work out[55] a sun-calendar, which is accurate, became people of special importance. Farmers willingly provided them with a living, so that[56] they could devote their time to[57] foretelling the seasons.

More often than not[58] the calendar-specialists were also priests, who offered sacrifices to appease the gods of drought or storm and made thankofferings to the gods of harvest and abundance.

Though they thus mixed magic with their calendar-making, they did their job with surprising skill. Day by day they noted how the sun's rising position changed throughout the seasons; night by night they marked which star-clusters shone in the western sky where the sun had just set. In time they measured the length of the year to within an hour or two accurately. Without written records they could never have remembered all that their careful work taught them.

The earliest written numbers we know of[59] were used in Egypt and Mesopotamia about five thousand years ago. Although these two lands[60] are many miles apart, both their number systems seem to have started in the same way, by chipping notches on wood or stone to record the passing days. The priests of Egypt wrote on papyrus made from[61] reeds, those[62] of Mesopotamia on soft clay. So the shapes of their numbers are naturally different; but both[63] used simple strokes for ones and different marks for tens and higher numbers. Both built up the number they wanted simply by repeating the strokes and marks as often as necessary.

Three thousand years later the Romans still made

strokes for the numbers one to four. They used new signs, in the form of letters, for fives, tens, fifties and so on. At about the same time, the people of China used a different sign for every number up to ten but still used strokes for the first three numbers.

The most remarkable of all early number systems was that used by the Mayas of Central America. Completely cut off from the civilizations of the Old World, these people could write any number with the help of only three signs — a dot, a stroke and a kind of oval. With dots and strokes only, they could build up any number from one to nineteen (𝍠). By adding one oval below any number, they made it twenty times larger, thus: • = 1; 𝋡 = 20. Adding a second oval would again multiply the number by twenty. In time-reckoning, however, they adjusted this system: adding a second oval multiplied the number by eighteen instead of twenty, so that 𝋢 meant *not* 400 ($1 \times 20 \times 20$) but 360 ($1 \times 20 \times 18$). If we recall the moon-calendar of 360 days, we can understand why they used their number signs in this way.

In time the Mayas used a sun-calendar of 365 days. For their records of dates, carved on stone columns called steles, they used special numerals shaped like human faces.

NOTES

1. **for:** 交换. 如:

   I gave him a dollar a bushel *for* his wheat and ten cents a pound *for* his sugar.

2. **ago:** 用于过去时，指現在起多少时間以前. 如:

I visited Peking two years *ago*.

如在間接叙述句中，指过去某时起多少时間以前，即先过去时(过去完成时态)，則用 before. 如:

Mary told me that she had visited Peking two years *before*.

3. **by pointing:** 介詞短語. pointing 是 point 的动名詞，作 by 的宾語. 凡动詞用在介詞之后，必須加 -ing，变成动名詞. 本书此种用法甚多，不再一一加注. 請注意.
4. **for:** *instead of* 代表，代替. 如:

The letters P. M. stand *for* Postmaster.

5. **in search of...:** 寻找.
6. **the only goods they possessed...** = the only goods (that) they possessed... 关系代詞作宾語时按习慣用法可以省去. 凡先行詞 (antecedent) 为 the only 所修飾时，关系代詞一律用 that.
7. **hunting weapons:** weapons used for hunting，打猎用的武器. 此处 hunting 是动名詞修飾 weapons，凡动名詞作定語用时，表示"用途" (use). 或"目的" (purpose)，而現在分詞作定語用时則表示"性質" (quality) 或"状态" (state).
8. **such as:** like，例如:

Books *such as* this should he read carefully.

9. **finger-counting:** 弹指計数. 这是由名詞 + 动名詞而构成的合成名詞. 如:

paper-correcting 改卷子， calendar-making 制造日曆

10. **on (the) rare occasions:** 間或，偶尔.
11. **Much more important to these hunters and food-gatherers was a knowledge of the seasons and of direction.** = A knowledge of the seasons and of direction was much more important to these hunters and food-gatherers. 这句是为了强調句势，把謂語置于句首. 又如:

Spent was the day and *darkening was* the sky = The day was spent and the sky was darkening.

12. **help them to forecast:** 此处 to forecast 是不定式短語，作宾語 them 的补語. 在 help 后美国比英国更常省去 to.
13. **had to:** 系 must 的过去形式，表示"必然"，"不得不".
14. **through trial and error:** 通过試驗和錯誤再改的方法.
15. **a very rough-and-ready guide:** 一个簡便但很不精确的指南.
16. **taken** = required，需要.
17. **pick out:** distinguish from surrounding objects，鉴别，識别，认出.
18. **night after night:** night by night，每夜，夜夜.

19. **to trace part of a circular path:** 循着半圆軌道的一部分.

20. **like the hands of some giant clock:** 像个巨钟的时針.

21. **the North Pole Star:** 北极星.

22. **if we can spot it:** 如果我們能找(认)出它. 此处 it 指 the North Pole Star.

23. **shaped rather like a big dipper or an ancient plough:** 頗像一支大杓或一把古代的犁的样式. 这个过去分詞短語修飾 seven stars.

24. **... see the long morning shadows point westward:** 此处 point 之前省去 to. 凡动詞 behold, bid, feel, have, help, know, let, make, observe, notice, see, smell, watch 等之宾語后跟不定式、作宾語的补語时, 都省去 to. 下句 He would watch them grow 及以后各章此种构造尙多, 不再一一加注.

25. **as** = when. 此处 as 在意义上相当于 when (当...之时). 一般說来, 表示动作时用 as 或 when 都可以. 如:

The lark sings merrily *as* (=when) it flies high. 当云雀高飞时, 唱得很快活.

但是如果表示状态时, 那就只能用 when, 不能用 as. 如:

when I was a boy 当我是孩子的时候, when young 当年輕的时候.

这便是表示一种状态, 如若用 as 来代替 when 就不对了.

26. **watching by the camp fire** = when or as they watched by the camp fire.

27. **when full** = when she is full. 凡由 when, while, if, though 等連接的从句中的主語, 若和主句中的主語相同, 可以省去从句中的主語和动詞 be.

28. **relied on:** depended upon, 依賴.

29. **full size** = full moon 圓月, 滿月.

30. **as** = when.

31. **pitch its tents:** begin to live in a place; settle, 落戶; 定居.

32. **laden with sour, green berries** 結滿酸的、还不熟的果实.

33. **good for plucking:** 适于采摘.

34. **counting days or months:** 此处 counting 是动名詞, 作主語. 凡表示一般事理都用动名詞.

35. **stand in a row:** 站成一排 (行, 列).

36. **one full moon and the next** = one full moon and the next full moon. 前后对照时, 凡相同的詞无須重复, 可以省去.

37. **round off:** bring to a satisfactory conclusion, 完成.