

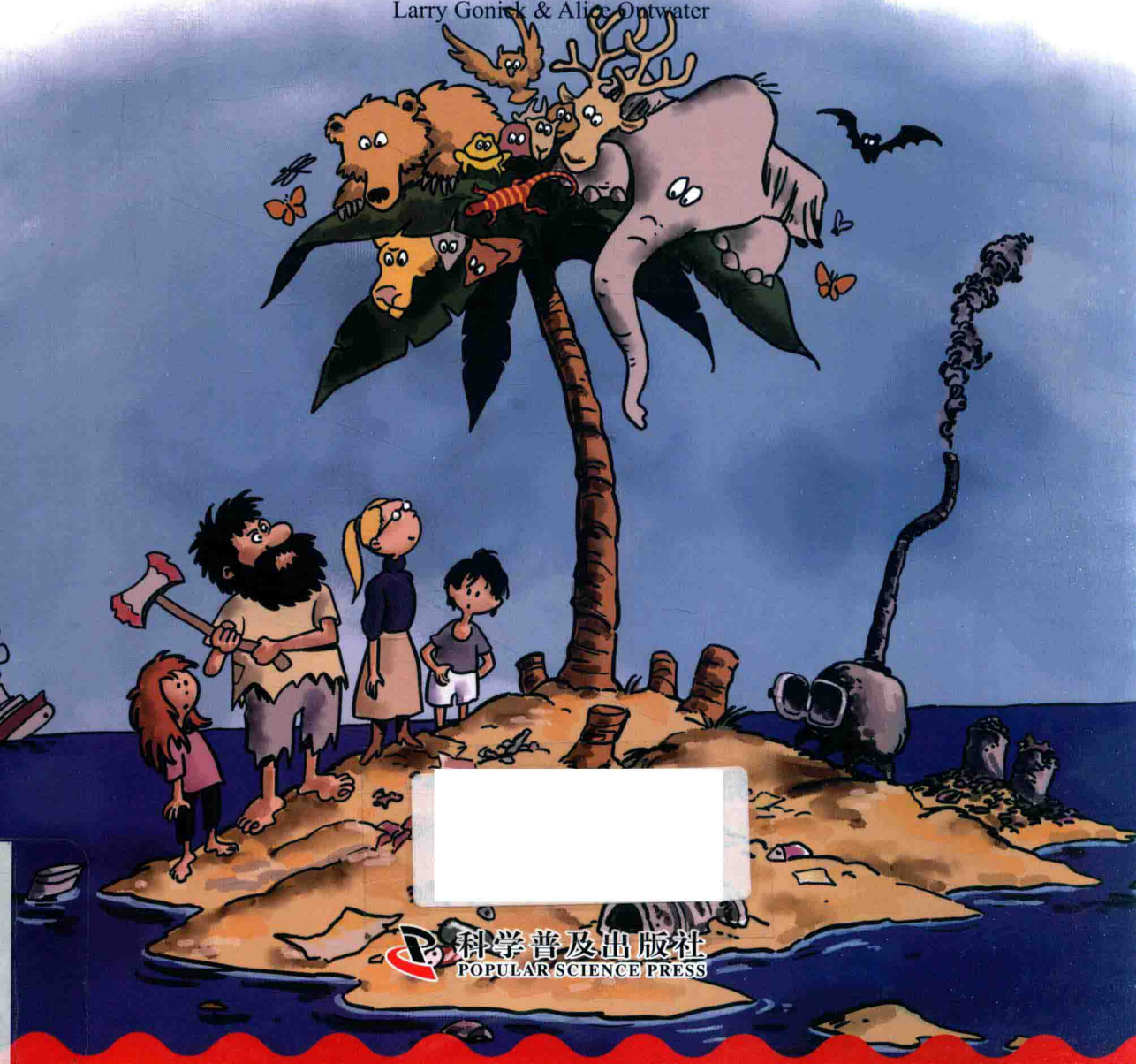
THE CARTOON GUIDE TO ENVIRONMENT

爆笑科学漫画

环保超人

[美] 拉里·高尼克 爱丽丝·奥特瓦特◎著 叶云屏◎等译 刘夙◎校订

Larry Gonick & Alice Ontwater



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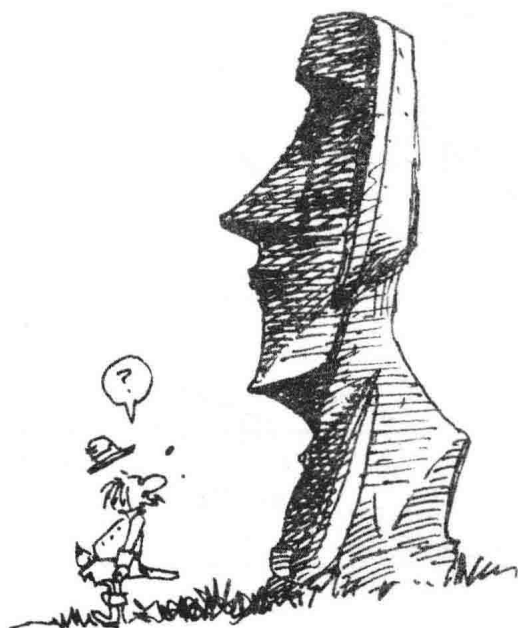
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TO BOB, WITHOUT WHOM THIS
BOOK WOULD NEVER HAVE BEEN
WRITTEN

致鲍勃，没有他的鼓励，本书不可能完成。



◆CONTENTS◆

目 录

CHAPTER	1. FORESTS AND WATER -----	1
	森林和水	
CHAPTER	2. MORE CYCLES -----	17
	更多循环	
CHAPTER	3. EVOLVING SYSTEMS, STRUGGLING INDIVIDUALS -----	31
	进化的系统, 挣扎的个体	
CHAPTER	4. COMMUNITIES WET... -----	46
	水生生物	
CHAPTER	5. ...AND DRY -----	59
	陆生生物	
CHAPTER	6. LET'S EAT! -----	81
	开饭喽!	
CHAPTER	7. FROM HUNTING TO PLANTING -----	100
	从捕猎到种植	
CHAPTER	8. WHAT LIMITING FACTORS? -----	121
	有什么限制因子啊?	
CHAPTER	9. BYE, BYE, BIOME! -----	145
	再见了, 生物群系!	

CHAPTER	10. ENERGY WEBS	162
	能源网	

CHAPTER	11. LET'S EAT AGAIN!	188
	让我们继续开饭!	

CHAPTER	12. BRIGHT LIGHTS, BIG CITY	208
	光影大都市	

CHAPTER	13. POLLUTION	226
	污染	

CHAPTER	14. EARTH ISLAND	247
	地球岛	

INDEX		
索引		267

◆ CHAPTER 1 ◆

FORESTS AND WATER

◆ 第一章 ◆

森林和水

OUR STORY BEGINS IN A PLACE THAT'S BEEN CALLED THE MOST FAR-FLUNG INHABITED ISLAND IN THE WORLD: **EASTER ISLAND**, A 64-SQUARE-MILE SPECK IN THE PACIFIC OCEAN, 2300 MILES FROM ANYWHERE.

在世界上有人居住的最偏远的地方，有一个名叫复活节岛的小岛，我们的故事便从这个小岛讲起。复活节岛面积只有64平方英里（1英里=1609.344米，下同），在浩瀚的太平洋上就像一个斑点，它距离最近的陆地有2300英里。



"HOW INAPPROPRIATE TO CALL THIS PLANET EARTH, WHEN CLEARLY IT IS OCEAN."

—ARTHUR C. CLARKE

“把这个星球叫作地球真不合适，这明明是一个水球！”

——阿瑟·C·克拉克*

*阿瑟·C·克拉克是英国著名科幻作家，未来学家。

REMOTE, BUT NOT
DESERTED... FROM TIME
TO TIME VISITORS DROPPED
BY... LIKE THE DUTCH
ADMIRAL ROGGEVEEN IN
1722. ARRIVING ON EASTER
SUNDAY, HE NAMED THE
ISLAND AFTER THE DATE OF
ARRIVAL, AND LEFT THE
FIRST WRITTEN ACCOUNT OF
THE PLACE AND THE PEOPLE
WHO LIVE THERE.

复活节岛虽然偏远，但并非荒无人烟……时常会有游客光顾……如1722年，荷兰海军上将罗格文就率领探险队来过这里。由于到达的那天正好是复活节，因此，罗格文便把这个岛命名为复活节岛，并留下了关于这个小岛及其居民的最早文字记录。



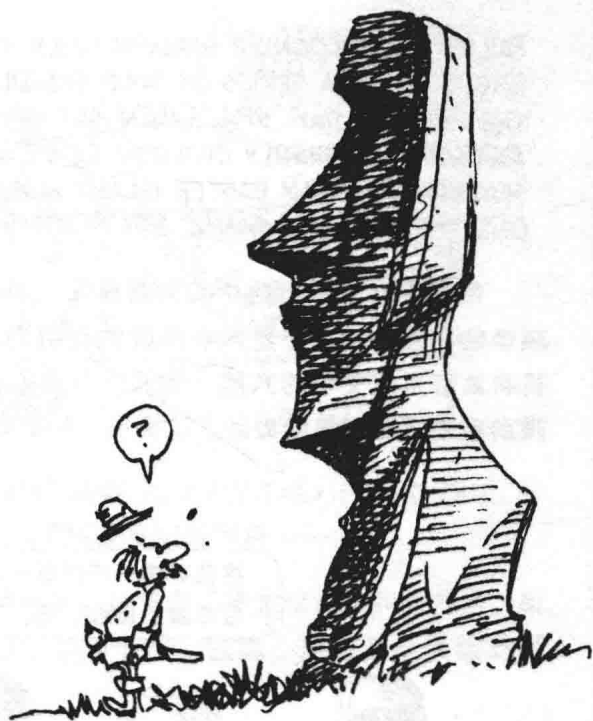
ACCORDING TO ROGGEVEEN AND OTHER 18TH-CENTURY REPORTS, SOME 3000 ISLANDERS EKED OUT A WRETCHED EXISTENCE BY FARMING BANANAS, SUGAR CANE, AND SWEET POTATOES FROM POOR, ROCKY SOIL. THE ONLY FRESH WATER CAME FROM MURKY LAKES INSIDE VOLCANIC CRATERS. THERE WAS SCARCELY A TREE ON THE ISLAND, AND THE PEOPLE WERE "SMALL, LEAN, TIMID, AND MISERABLE."

从罗格文的记录及其他18世纪的文献可以得知，当时岛上大约有3000名居民，他们在贫瘠多石的土地上靠种植香蕉、甘蔗和甘薯勉强维生。唯一的淡水取自火山口内混浊的湖水。岛上几乎看不到一棵树，当地居民“个子矮小、瘦骨嶙峋、胆小羞怯，一副可怜巴巴的样子。”



BUT AMIDST THE SQUALOR
WERE SOME **SURPRISES...**
ESPECIALLY SOME 800
MASSIVE STONE
STATUES SCATTERED
ACROSS THE ISLAND,
SHOULDER TO SHOULDER,
THEIR BACKS TO THE SEA.
HOW WERE THEY CARVED?
HOW QUARRIED? HOW
MOVED? HOW ERECTED?
AND BY WHOM?

但在这片肮脏贫瘠的土地上，却
有着一些**神秘而奇异**的东西……最
为瞩目的是岛上矗立的800多尊**巨大**
石雕。它们肩并肩成行，背向大海而
立。石像是如何雕凿出来的？如何采
料？如何搬运？又如何竖立起来？这
一切都是谁做的呢？



WHEN THE EUROPEANS ASKED WHERE THE STATUES HAD COME FROM, THE
ISLANDERS GAVE THIS REPLY:

当欧洲来客问岛上居民石雕从何而来时，得到的回答是：



FAILING TO RECOGNIZE SARCASM WHEN THEY HEARD IT, THE EUROPEANS EMBARKED ON A SERIES OF WILD SPECULATIONS THAT HAVE CONTINUED TO THE PRESENT DAY: **SPACEMEN** SET UP THE STATUES WITH **ANTI-GRAVITY DEVICES**... A HIGHLY CIVILIZED **LOST CONTINENT** HAD SUNKEN INTO THE SEA, LEAVING ONLY EASTER ISLAND BEHIND... THEY WERE FLUNG INTO PLACE IN ONE PIECE BY **VOLCANIC ERUPTIONS**, ETC. ETC. ETC.

欧洲人并未听出话中的讽刺意味，因此开始了漫无边际的猜测，直到今天猜测依然在继续：是外星人利用反地心引力装置架起了这些石雕……这里曾是一块具有高度发达文明的大陆，但已沉入海底，唯有复活节岛残存下来……是火山喷发的威力将全部石雕抛到了这里……如此等等。

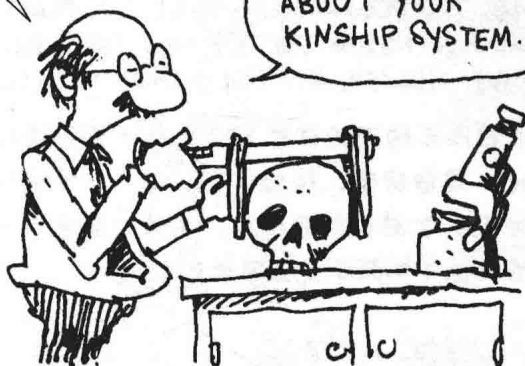
这些石雕只不过是一堆幻觉罢了，实际上根本就不存在。嗯，一定是这样。



嗯，现实就是社会想象的产物。

好吧，告诉我们你的亲缘关系……

SINCE THE ISLANDERS
HAD EITHER FORGOTTEN
WHAT HAPPENED OR
DIDN'T FEEL LIKE
SHARING, IT WAS LEFT
TO WESTERN SCIENTISTS
AND HISTORIANS TO
PIECE TOGETHER THE
STORY WITH **CALIPERS**,
SHOVELS, **MICRO-**
SCOPES, AND **ETHNO-**
GRAPHIC SURVEYS.



AND HERE IS WHAT THEY FOUND OUT...
以下便是他们的发现……

岛上居民或许是已经忘了石雕从何而来，或许是不愿把这故事和人分享。既然如此，西方科学家和历史学家只好自己利用卡尺、铁锹、显微镜和民族志调查等科学手段来拼凑出这个故事。

AROUND THE YEAR 400,
EASTER ISLAND WAS
COLONIZED BY
POLYNESIANS.
VARIOUS FEATURES OF
THE ISLANDERS' SKULLS,
THEIR BLOOD TYPES,
SOCIAL SYSTEM,
LANGUAGE, AND CROPS
ARE ALL POLYNESIAN.



大约公元400年，波利尼西亚人移居到复活节岛。岛上居民的颅骨、血型、社会制度、语言和农作物都具有波利尼西亚人的特征。

POLLEN SAMPLES TAKEN FROM LAKE BEDS SHOW THAT THE ISLAND WAS THEN THICKLY COVERED WITH VEGETATION. HACKING OUT CLEARINGS FROM THE JUNGLE, THE POLYNESIANS BUILT AND PLANTED, AND SOON THEY ENJOYED A TYPICAL POLYNESIAN DIET OF YAM, TARO, BREADFRUIT, BANANA, SUGAR, COCONUT, CHICKEN, AND POLYNESIAN RAT (SMALL AND TASTY!).

取自湖床的花粉试样显示，岛上曾经植被茂密。波利尼西亚人在丛林中开辟空地，建造房屋，种植作物。不久，他们便过上了典型的波利尼西亚人的生活，他们的食谱中包括山药、芋头、面包果、香蕉、蔗糖、椰子、鸡肉以及波利尼西亚鼠（个头小、味道美！）。



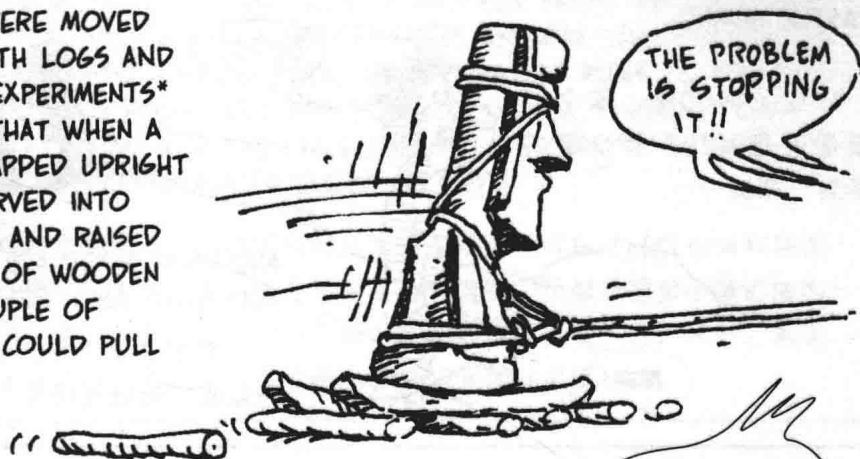
啊，这里简直就是天堂……与大自然如此和谐……来，加点柴火……把小鼠递过来……

THEIR LIFE WAS RICH... THEIR BABIES THRIVED... THEY POPULATED THE ISLAND WITH LITTLE EFFORT... AND IN THEIR COPIOUS SPARE TIME, THEY CARVED STONE MONUMENTS, ESPECIALLY **STATUES**.

这里的人们生活富足、人丁兴旺，在岛上悠闲自得地生活……他们把大量空闲时间用来雕刻纪念碑，尤其是**石雕**。



THE STATUES WERE MOVED AND SET UP WITH LOGS AND ROPE. RECENT EXPERIMENTS* HAVE PROVED THAT WHEN A STATUE IS STRAPPED UPRIGHT ONTO LOGS CARVED INTO SLED RUNNERS, AND RAISED ONTO A TRACK OF WOODEN ROLLERS, A COUPLE OF DOZEN PEOPLE COULD PULL IT EASILY!



*BY AMERICAN GEOLOGIST CHARLES LOVE.

*这些实验由美国地质学家查尔斯·洛夫完成。

这些石雕是用原木和绳索来搬运和放置的。最近的实验证明，如果将石雕竖立着绑在用原木雕成的雪橇状滑板上，地面上再用原木连起来铺成滑轨，只要几十个人便能轻松拉动这巨大的石雕！

SO THEY CUT DOWN A LOT OF TREES, NOT JUST FOR ROLLING STATUES, BUT ALSO FOR FIREWOOD AND BUILDING MATERIAL...



因此，岛上的居民砍伐了大量树木，不仅用来搬运石雕，也用来做柴火和建筑材料……

AND BY THE YEAR 1400, THERE WAS SCARCELY A TREE LEFT STANDING ON EASTER ISLAND...

到了1400年，整个复活节岛上几乎再也看不到一棵树……



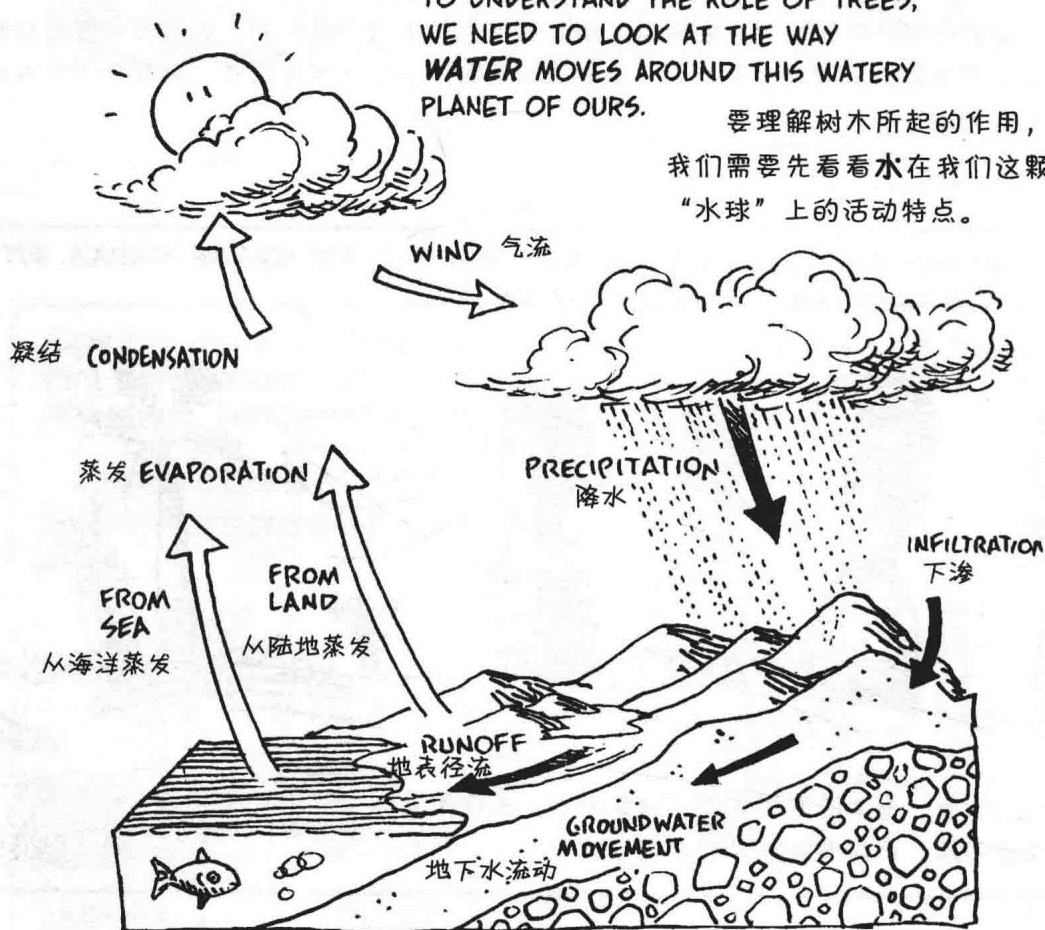
AND WHAT GOOD ARE TREES??
YOU MIGHT ASK... READ ON...

看到这里你也许会问，树木有什么好处呢？那就继续往下读吧……

THE WATER CYCLE 水循环

TO UNDERSTAND THE ROLE OF TREES,
WE NEED TO LOOK AT THE WAY
WATER MOVES AROUND THIS WATERY
PLANET OF OURS.

要理解树木所起的作用，
我们需要先看看水在我们这颗
“水球”上的活动特点。



CLOUDS HOLD MOISTURE, WHICH FALLS AS RAIN (OR SNOW, BUT NOT IN POLYNESIA!). IT FALLS WITHIN A **WATERSHED**, AN AREA THAT COLLECTS SMALL STREAMS INTO A MAJOR RIVER, AND ULTIMATELY RUNS TO THE SEA. WATER EVAPORATES FROM LAND AND SEA INTO THE AIR, WHERE IT CONDENSES INTO CLOUDS, AND THE CYCLE IS COMPLETED. WATER IN THE ATMOSPHERE IS FULLY REPLACED EVERY **12 DAYS**.

云层中含有大量水汽，水汽凝结后降落下来形成雨或雪（不过在波利尼西亚是绝不会下雪的哦）。降雨的地方会形成一个**流域**，也就是很多小溪汇成大河的地方。河水最终流入大海。水分不断从陆地和海洋蒸发，进入大气，再次凝结成云，水循环便完成了。大气中的水每隔12天循环更新一次。

WHEN PRECIPITATION FALLS IN A FOREST, THE WATER HAS MANY OPTIONS: SOME BARELY PENETRATES THE GROUND BEFORE IT IS TAKEN UP BY ROOTS AND PASSED BACK TO THE AIR BY TRANSPIRATION (PLANT BREATHING). SOME GOES DEEPER, ALL THE WAY TO THE GROUNDWATER.

落到森林里的雨水去哪里了呢？这有很多种可能：有的还没等渗入地下，便被植物根系吸收，然后又通过蒸腾作用（植物也需要呼吸！）进入大气。有的渗到地下较深处，一直渗到地下水水中。

(WHAT'S GROUNDWATER? DIG A DEEP ENOUGH HOLE IN THE GROUND, AND YOU'LL HIT WATER. THAT'S GROUNDWATER. THE TOP OF THE GROUNDWATER IS THE **WATER TABLE**.)

WATER TABLE 地下水位 →

GROUNDWATER 地下水 →



（什么是地下水呢？如果在地上挖一个深坑，就会有水渗出来，这就是地下水。地下水水面也称**地下水位**。）

FOREST SOIL HOLDS A LOT OF WATER BECAUSE IT'S SO **POROUS**: A MIXTURE OF CLAY, SAND, AND DECAYING ORGANIC MATTER, THE SOIL IS HONEYCOMBED BY CHANNELS MADE BY ROOTS, BURROWING ANIMALS, AND FUNGI. THE TOP LAYERS TEEM WITH BACTERIA, WHICH BREAK DOWN ORGANIC COMPOUNDS INTO CHEMICAL NUTRIENTS THAT DISSOLVE IN WATER, DRIP DOWN, AND ARE TAKEN UP BY ROOT SYSTEMS.

AROUND HALF THE TOTAL VOLUME OF FOREST SOIL IS EMPTY SPACE!

将近一半的森林土壤竟然是空的！



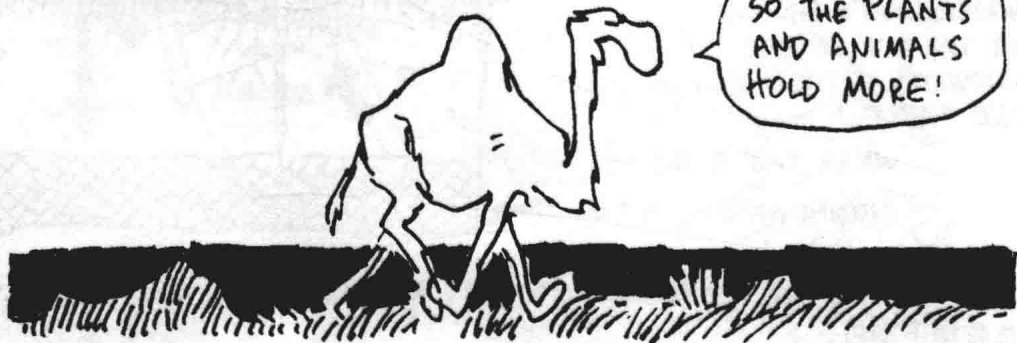
森林里的土壤含有大量水分，因为这种土壤含有黏土、沙砾和腐烂的有机物质，土质疏松，有很多孔隙。土壤里的树根、穴居动物、菌类等纵横交错，犹如蜂窝。土壤表层含有大量细菌，将有机化合物分解成化学营养素，溶入水中，再渗入深层，被根系吸收。

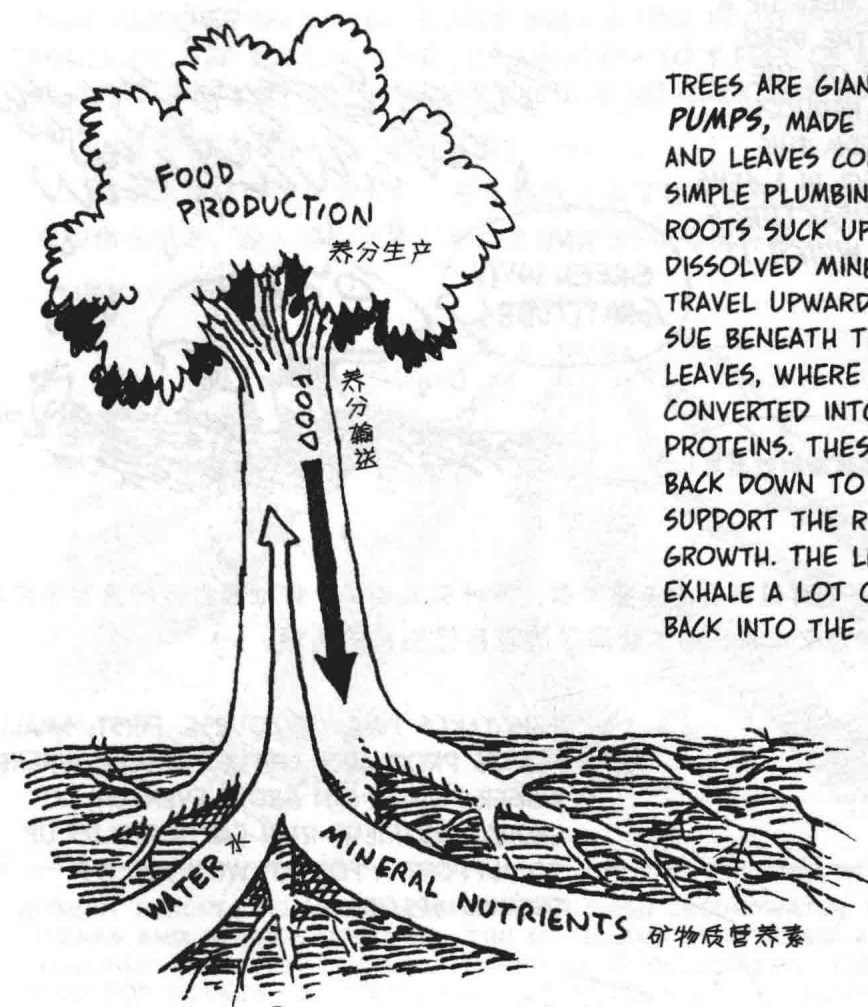
BY CONTRAST, OPEN LAND HAS LESS BIOLOGICAL ACTIVITY AND SO HOLDS LESS WATER.

相比之下，因为空旷的陆地上生物活动较少，所以这里储存的水分也就更少。

原来是动植物储存了更多的水分！

SO THE PLANTS AND ANIMALS HOLD MORE!





TREES ARE GIANT **WATER PUMPS**, MADE UP OF ROOTS AND LEAVES CONNECTED BY A SIMPLE PLUMBING SYSTEM. THE ROOTS SUCK UP WATER AND DISSOLVED MINERALS, WHICH TRAVEL UPWARD THROUGH TISSUE BENEATH THE BARK TO THE LEAVES, WHERE THEY ARE CONVERTED INTO SUGAR AND PROTEINS. THESE FOODS TRAVEL BACK DOWN TO THE ROOTS TO SUPPORT THE ROOTS' FURTHER GROWTH. THE LEAVES ALSO EXHALE A LOT OF WATER VAPOR BACK INTO THE ATMOSPHERE.

每棵树都像一台巨型抽水机，其组成部分树根和树叶由一个简单的管道系统连接。树根吸收水分和溶解了的矿物质，水分和矿物质由树皮下的组织向上输送给树叶，然后转化为糖分和蛋白质，成为树木的养分。这些养料又向下重新回到树根，为树根提供继续生长的养分。树叶也会呼出大量水汽，散发到大气中。

UNDERGROUND, HUNDREDS OF MILES OF TREE ROOTS ANCHOR THE TREE TO THE GROUND AND HOLD THE SOIL IN PLACE. MARVELOUS THING, A TREE!

在地下，总长达数百英里之多的树根使大树牢牢固定在土壤中。仅仅是一颗树，却如此神奇！