

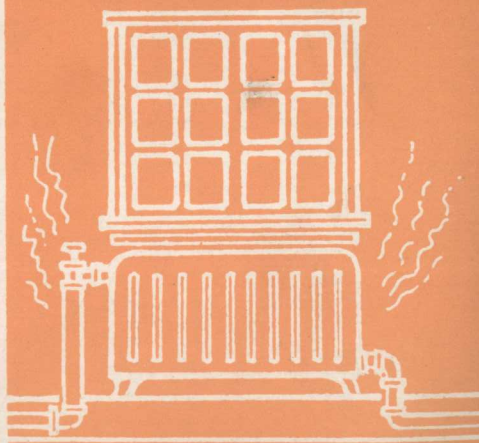
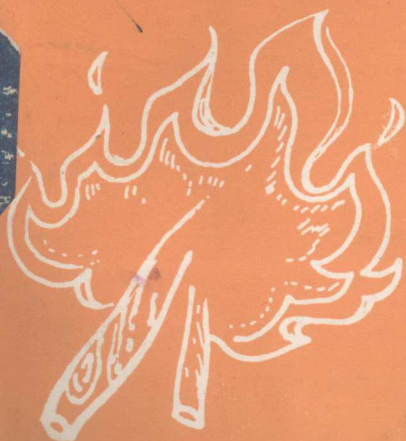


科普英语注释读物

# HEAT

## 热

[美] B. M. Parker 原著



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魏树德译注

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## 说 明

本书是供具有初步英语基础的中学生和大学低年级学生及其他读者阅读的英语科普读物,内容浅显,文字精练,有助于读者提高英语阅读能力及增长科学知识。对原书除个别词句和章节外,基本上未作删改。

本书介绍热的基本知识及其应用,包括热、热效应、测量温度和热量、热传导、对流、辐射、供暖、致冷、空气调节等方面的内容。为了使初学者也能顺利地进行阅读,每一篇短文后面都附有单词、词组和比较详细的注释。译文供读者在阅读某一短文后进行对照,以便检查是否理解正确。书末附有总词汇表,便于读者查阅和掌握科技基本词汇。

由于译注者水平、经验所限,本书肯定还存在不少缺点和错误,热烈欢迎读者批评指正。

本书译文承北京工业学院物理教研室教授郑联达同志校阅,谨此表示谢意。

译注者

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## 1. Heat

In what way do the glass roof and walls of a greenhouse act as a trap? Why must the builder of a steel bridge leave room for the steel to expand?<sup>①</sup> How can an electric current be used to freeze water? Why are many furnace pipes wrapped in asbestos? How can the same kind of thermos bottle keep coffee hot and lemonade cold?<sup>②</sup> To answer such questions, we must know about heat and its ways of traveling.

Heat plays a very important part in our lives. It is as important as air or food or water. If there is too little heat, we cannot live. On the other hand, too much heat kills us.

As you probably know, there are, circling around the sun, eight other planets somewhat like the earth.<sup>③</sup> You may have wondered whether these other planets are inhabited. They are all so far away that we cannot tell by looking at them.<sup>④</sup> But we can tell surely that no people like ourselves could live on most of them, because on most of them there is either far too much heat or far too little. For example, on Mercury, the planet closest to the sun, a piece of lead put out in the sunshine would melt. Pluto, the farthest planet we know of, is so cold that, if it has any water and air, not only the water but also the air must be frozen solid.<sup>⑤</sup>

The planets that are too cold for living things are too cold because too little heat, not too much coldness, reaches them. Coldness, or cold, cannot travel. It is absence of heat, just as darkness is absence of light. When we make a room dark, we do not put in darkness — we take away light. In the same

way, when we cool anything, we do not put coldness into it — we take away heat.

You have never seen or felt anything from which all the heat had been removed. Scientists have worked for many years trying to make some material absolutely cold, but so far they have not quite succeeded.⑥ There is some heat, probably a great deal, in even the coldest thing you have ever seen or felt.

### New Words

roof [ru:f] *n.* 屋顶  
greenhouse ['gri:nhaʊs] *n.* 温室, 玻璃暖房  
trap [træp] *n.* 陷阱  
builder ['bildə] *n.* 建设者, 建筑工人  
room [ru:m] *n.* 地方, 空间(隙)  
expand [ɪks'pænd] *vt., vi.* (使)膨胀  
electric [i'lektrik] *a.* 电的, 电动的  
current ['kərənt] *n.* 流, (水、气、电)流  
freeze [fri:z] *vt., vi.* (使)结冰, (使)凝固  
furnace ['fə:nis] *n.* 炉子, 熔炉  
pipe [paip] *n.* 管子, 导管  
wrap [ræp] *vt., vi.* 缠绕, 包裹  
asbestos [æz'bestəs] *n.* 石棉  
coffee ['kɒfi] *n.* 咖啡  
lemonade [ˌlemə'neɪd] *n.* 柠檬水

travel ['trævl] *vi., vt.* 旅行, 传播, 传递  
food [fu:d] *n.* 食物  
kill [kɪl] *vt., vi.* 杀死, (被)弄死  
probably ['prɒbəbli] *ad.* 很可能, 或许  
circle ['sɜ:kl] *vi., vt.* 旋转, 环绕  
planet ['plænɪt] *n.* 行星  
somewhat ['sʌmhwɒt] *ad.* 有点, 稍微  
earth [ə:θ] *n.* 地球  
wonder ['wʌndə] *vt.* 对...感到惊奇, 想知道  
whether ['hweðə] *conj.* 是否  
inhabit [ɪn'hæbɪt] *vt.* 居住于, (动物)栖居于  
surely ['ʃʊəli] *ad.* 确实, 一定  
Mercury ['mɜ:kjʊəri] *n.* 水星  
piece [pi:s] *n.* 块, 片, 张  
lead [led] *n.* 铅  
sunshine ['sʌnʃaɪn] *n.* 阳光, 日

光  
melt [melt] *vi., vt.* (使) 熔化,  
(使) 融化, (使) 溶化  
Pluto ['plu:təu] *n.* 冥王星  
frozen ['frəuzn] *a.* 冰冻的, 冻  
结的  
solid ['solid] *n.* 固体  
coldness ['kəuldnis] *n.* 寒冷  
reach [ri:tʃ] *vt., vi.* 到达, 达到  
absence ['æbsəns] *n.* 不在, 缺  
席

cool [ku:l] *a., vt., vi.* 凉的;  
使冷却, 变冷  
remove [ri'mu:v] *vt., vi.* 移动,  
(使) 去掉, (使) 离开  
scientist ['saientist] *n.* 科学家  
absolutely ['æbsəljutli] *ad.* 绝  
对地  
quite [kwait] *ad.* 完全, 彻底,  
相当  
succeed [sək'si:d] *vi.* 成功

### Phrases and Expressions

act as 充当, 作为, 起... 作用  
leave room 留出空间(地方)  
electric current 电流  
furnace pipe 炉子的烟筒  
thermos bottle 热水瓶  
know about (of) 知道关于...  
的事情  
play ... part in ... 在... 中起...  
作用  
on the other hand 另一方面;  
相反, 反之  
either... or... 或者... 或者, 不

是... 就是  
far away 远离  
put out 放出, 摆出  
living things (beings) 生物  
put in (into) 把... 放进  
take away 把... 移开, 拿走  
for many years 许多年(来)  
try to (do) 设法 (...), 尽力  
(...), 试图(...)  
so far 迄今, 至此  
a great deal 大量的, 很多

### Notes

#### ① Why must ... leave room for the steel to expand?

“for + 名词(或代词宾格) + 不定式”构成不定式复合结构。从意义上说, 这种复合结构是一种主谓结构, 即其中的名词(或代词宾格)相当于主语, 又称逻辑主语, 不定式相当于谓语, 又称逻辑谓语。这种复合结构作为一个整体在句中可做主语、表语、宾语、定语或状语。上句中的不定式复合结构 for the steel to expand 说明名

词 room, 作定语。全句可译为:

为什么铁桥的建造者必须留出供钢架膨胀的空隙呢?

- ② How can the same kind of thermos bottle keep coffee hot and lemonade cold?

有的及物动词如 find, ask, make, keep 等后面常要求跟复合宾语, 即宾语+宾语补语。用作宾语补语的一般有名词、形容词、不定式、分词或介词短语。复合宾语中的宾语和它的补语之间在意义上也是主谓关系, 即宾语为逻辑主语, 补语为逻辑谓语。上句中 keep 后跟两个复合宾语即 coffee hot 和 lemonade cold。全句可译为:

相同的热水瓶怎么能使咖啡保持温热, 又能使柠檬水保持冰冷呢?

- ③ As you probably know, there are, circling around the sun, eight other planets somewhat like the earth.

句中现在分词短语 circling around the sun 说明 eight other planets, 起定语作用。

分词短语作定语一般都放在所说明的名词之后, 但上句中 eight other planets 后面已有介词短语 (somewhat) like the earth 作定语, 如果 circling around the sun 放在介词短语 (somewhat) like the earth 的后面, 则容易看成是 earth 的定语, 关系就不够清楚了。全句可译为:

你大概知道, 有另外八个多少有点象地球那样绕太阳旋转的行星。

- ④ They are all so far away that we cannot tell by looking at them.

句中 (so ...) that 引导结果状语从句; 介词短语 by looking at them 作方式状语, 说明谓语 cannot tell, 其中 looking 为动名词, 作 by 的宾语。全句可译为:

它们(这些行星)离地球都这样远, 以致我们不能凭观看来断定它们上面是否有人居住。

- ⑤ Pluto, the farthest planet we know of, is so cold that, if it has any water and air, not only the water but also the air must be frozen solid.

句中 the farthest planet 作 Pluto 的同位语, we know of 为定语从句, 前面省略了用作宾语的关系代词 that, 后面 (so ...)



that 引导的也是结果状语从句,其中又带有一个由 if 引导的条件状语从句。另外请注意 to know of (about) 与 to know 不同,例如: I don't know the worker, but I know of him. 我不认识这位工人,但我听说过(或知道)他。

- ⑥ Scientists have worked for many years trying to make some material absolutely cold, but so far they have not quite succeeded.

句中现在分词短语 trying to make ... 为伴随情况状语;它表示一个陪衬性的动作,说明谓语动词 have worked, 其中 some material absolutely cold 为 make 的复合宾语。

## 2. Heat, a Form of Energy

Air, food, water, and heat — these are the four requirements of all living things. Of these, air, food, and water are materials.<sup>①</sup> Heat is not a material. It is a form of energy.

People once thought that heat was a material. They thought that it was an invisible fluid which could flow in and out of other materials. It was spoken of as “caloric.” But the idea of heat as an invisible fluid was given up a little more than a hundred years ago.<sup>②</sup>

Every material takes up space. Every material has weight, too. Heat is not a material, because it does not take up any space and it does not weigh anything. No one could fill a bottle with heat or weight out a pound of it.

But what does it mean to say that heat is a form of energy? It simply means that heat can be used to do work. Anyone who has seen a great locomotive pulling a long train of loaded freight cars realizes that heat can do work, for it is the heat from burning fuel that makes the locomotive run.<sup>③</sup>

Heat is only one of several kinds of energy. Among the other kinds are electric energy, light, chemical energy — the energy that is stored up in such things as fuel and food — and mechanical energy — the energy which objects have because they are moving or because they are in a special position.

Other forms of energy can be changed to heat. We get much of the heat that we need by burning fuel. When we burn fuel, some of the chemical energy stored up in it is changed to heat. In electric stoves electric energy is changed to heat. Whenever

we strike a match, we are using friction to produce heat. Friction is caused by the rubbing together of two surfaces. The mechanical energy of the moving surfaces is changed partly to heat.

Our most important source of heat, however, is the sun. If the sun were blotted out, all our other ways of producing heat could not keep the earth warm enough to make life possible here.<sup>④</sup> The sun, most scientists agree, has been sending out enormous quantities of heat for hundreds of millions of years and will keep on doing so for hundreds of millions of years to come.<sup>⑤</sup> Until recently the source of the sun's heat was a puzzle. Now scientists believe that it is atomic energy produced much as atomic energy is produced in a hydrogen, or fusion, bomb.<sup>⑥</sup>

### New Words

requirement [ri'kwaɪəmənt] *n.*

需要(的东西), 要求

once [wʌns] *ad.* 曾经, 一旦

invisible [in'vɪzəbl] *a.* 看不见  
的, 无形的

fluid [flu(:)ɪd] *n., a.* 流体; 流  
体的

flow [fləʊ] *vi.* 流动

caloric [kə'lorɪk] *n.* 热(量), 热  
质

idea [ai'diə] *n.* 概念, 观念

weight [weɪt] *n.* 重量

weigh [wei] *vi., vt.* 重(若干);  
称分量

fill [fɪl] *vt.* 充满

pound [paʊnd] *n.* 磅

mean [mi:n] *vt.* 表示...意思,  
意指, 意味着

simply ['sɪmpli] *ad.* 简单地,  
仅仅

locomotive ['ləʊkə,məʊtɪv] *n.*  
火车头, 机车

pull [pul] *vt.* 拉, 牵引

loaded ['ləʊdɪd] *a.* 装着货的

freight [freɪt] *n.* 货物

car [kɑ:] *n.* (大车) 车厢

realize ['ri:əlaɪz] *vt.* 认识到, 了  
解

burn [bɜ:n] *vt.* 燃烧

fuel [fjuəl] *n.* 燃料

store [stɔ:] *vt., vi.* 贮藏, 贮存

mechanical [me'kænɪkəl] *a.* 机

械的  
 object ['ɒbdʒɪkt] *n.* 物体, 客  
 体  
 special ['speʃəl] *a.* 特殊的, 特  
 别的  
 position [pə'ziʃən] *n.* 位置  
 need [ni:d] *vt.* 需要  
 whenever [hwen'evə] *conj.* 每  
 当, 无论何时  
 strike [straɪk] *vt., vi.* 击撞, 擦  
 (打)  
 match [mætʃ] *n.* 火柴  
 friction ['frɪkʃən] *n.* 摩擦  
 rub [rʌb] *vt.* 摩擦  
 surface ['sɜ:fɪs] *n.* 面, 表面  
 partly ['pɑ:tlɪ] *ad.* 部分地  
 source [sɔ:s] *n.* 源, 来源  
 however [haʊ'evə] *ad., conj.*  
 无论如何, 不管怎样

blot [blɒt] *vt.* 涂污  
 possible ['pɒsəbl] *a.* 可能的,  
 可能存在(或发生, 做到)的  
 enormous [ɪ'nɔ:məs] *a.* 巨大  
 的, 庞大的  
 quantity ['kwɒntəti] *n.* 量, 数  
 量  
 million ['mɪljən] *num., n.* 百万,  
 百万个(人或物); 百万元  
 until [ən'tɪl, ʌn'tɪl] *prep., conj.*  
 直到...为止  
 recently ['ri:sntli] *ad.* 最近, 近  
 来  
 puzzle ['pʌzl] *n.* 难题, 谜, (单  
 数)困惑  
 believe [bi'li:v] *vt.* 相信, 认为  
 fusion ['fju:ʒən] *n.* 熔化; (核)  
 聚变

### Phrases and Expressions

flow in (into) 流入  
 flow out of 从...流出  
 speak of...as 把...说成是, 把...  
 作为...来讨论  
 give up 放弃  
 a little 一点(的), 少许(的), 略  
 微  
 more than 多于, 大于, 超过  
 a hundred years ago 一百年

前  
 take up 占有  
 fill ... with 用...充满...  
 weigh out 称出  
 freight car 货车  
 store up 贮存  
 electric stove 电炉  
 blot out 遮暗, 把...弄模糊

### Notes

① Of these, air, food, and water are materials.

“of ...”表示“在...中”或“其中”的意思，常常置于句首，material 有“材料”的意思，但这里译为“物质”较妥。

- ② But the idea of heat as an invisible fluid was given up a little more than a hundred years ago.

句中 idea 为名词，of heat 表示所属关系，介词 as 引导的 an invisible fluid 为 heat 的同位语，但在翻译中可把 idea 译作动词，把 heat 译作宾语，an invisible fluid 译作 heat 的补足语。全句可译为：

但把热当作(视为)一种看不见的流体这一观念(想法)在一百年稍微多一点的时间以前就被放弃了。

- ③ Anyone who has seen a great locomotive pulling a long train of loaded freight cars realizes that heat can do work, for it is the heat from burning fuel that makes the locomotive run. who has seen ... cars 为定语从句，说明句中主语 anyone；分词短语 pulling a long train of loaded freight cars 用作定语从句中的宾语 locomotive 的补语；并列连词 for 引导的句子说明前句谓语 realizes 的原因，it is ... that 是一个强调结构，此处强调主语 the heat from burning fuel；如不强调，则可改为：The heat from burning fuel makes the locomotive run. 又本句中不定式 run 作宾语 locomotive 的补语，因为在动词 make 后面，作宾语补语的不定式不用 to。

- ④ If the sun were blotted out, all our other ways of producing heat could not keep the earth warm enough to make life possible here.

本句为虚拟条件句，表示假设的情况与现在事实不符，条件从句的谓语动词 (were blotted out) 和主句的谓语动词 (could not keep) 都是用的虚拟语气；the earth warm 作 keep 的复合宾语，不定式短语 to make life possible here 为兼有程度意义的结果状语，其中 life possible 为 make 的复合宾语。

- ⑤ The sun, most scientists agree, has been sending out enormous quantities of heat for hundreds of millions of years and will keep on doing so for hundreds of millions of years to come.

most scientists agree 为插入句,前后用逗号隔开; has been sending out 为现在完成进行时态,在这里表示动作由过去某一时间开始继续到现在,并且还要继续进行下去; to keep on (doing) 表示“继续(…)”的意思; 不定式 to come 作定语,说明 hundreds of millions of years.

- ⑥ Now scientists believe that it is atomic energy produced much as atomic energy is produced in a hydrogen, or fusion, bomb.

句中代词 it 代替上句中的 the source of the sun's heat; 过去分词 produced 起定语作用,说明 atomic energy; 从属连词 as 引导方式状语从句; or 是“即”的意思,连接同位语 fusion bomb (热核弹)。

### 3. Three Effects of Heat

#### (1)

Heating materials brings about in them changes of many different kinds. Three of these kinds of changes are so common that we see examples of them almost every day.<sup>①</sup>

One of these kinds of changes we take for granted: the *rise in temperature* of a material that is heated.<sup>②</sup> We expect, for example, that a piece of iron held in a flame will get hot.

Another kind of change is *expansion*. Expansion means getting larger, or taking up more space. A bridge is sure to be a few inches longer on a hot summer day than on a cold winter day unless the bridge is built so that there is room between the separate parts for the steel of which they are made to expand.<sup>③</sup>

The third kind of change is the changing of a solid to a liquid or a gas, or of a liquid to a gas. For example, at the top of a lighted candle the solid paraffin, heated by the flame, becomes a liquid, or melts.<sup>④</sup> Some of the liquid paraffin rises in the wick and is changed to a gas at the center of the flame. Such changes in a material are called *changes of state*.<sup>⑤</sup>

The effects of heat on materials can be understood more easily if we know what scientists believe about the "building blocks" of which materials are made.<sup>⑥</sup>

Scientists believe that all materials, even the "solidest" solid, are made of little particles called molecules. These particles are unbelievably small — so small that, with only a few exceptions, separate ones cannot be seen even with a

powerful electron microscope.<sup>⑦</sup> A single thimbleful of air is made up of about 27 billion billion air molecules.<sup>⑧</sup> The molecules of a material attract one another. The attraction is greatest in solids and least in gases. In gases the molecules are much farther apart than in liquids or solids.

Molecules are always moving. In solids they do not move far — for the most part they merely vibrate back and forth. Each molecule keeps its position among the other molecules. In liquids the molecules move faster and more freely than in solids. The molecules of a gas move still faster and more freely.

Now let us see what molecules have to do with explaining the effects of heat. When a material is heated, the molecules of which it is made begin to move faster. The molecules in a hot iron rod are moving faster than in a cold iron rod. As the molecules of a material move faster, they move farther apart. The spreading apart of the molecules makes the material expand, or take up more space.<sup>⑨</sup> If a solid is heated a great deal, the molecules may move so fast and so far apart that the solid changes to a liquid or even to a gas. It *melts* in the first case and *evaporates* in the second case. If you heat a liquid, the molecules may move so fast and so far apart that the liquid evaporates, or changes to a gas.

### New Words

effect [i'fekt] *n.* 效应, 效果;

影响, 作用

common ['kɒmən] *a.* 普通的,

平常的

example [ig'zɑ:mpl] *n.* 例子,

范例

almost ['ɔ:lməʊst, 'ɔ:lməst] *ad.*

几乎, 差不多

rise [raɪz] *n.* 上升, 增长

temperature ['tempərɪtʃə] *n.* 温



# 度

heat [hi:t] *n., vt., vi.* 热; 把...

加热; 变热, 发热

expect [iks'pekt] *vt.* 期待, 期望, (料)想, 认为

hold [həʊld] (held [held]) *vt.* 握住, 支持

flame [fleim] *n.* 火焰, 光辉

expansion [iks'pænʃən] *n.* 膨胀, 扩张

sure [ʃuə] *a.* 一定的, 肯定的

inch [intʃ] *n.* 英寸

unless [ʌn'les] *conj.* 如果不, 除非

separate ['sepərit] *a.* 各别的, 独立的, 分开的

liquid ['likwid] *n., a.* 液体 (的); 液态的, 流动的

gas [gæs] *n.* 气体

top [tɒp] *n.* 顶, 盖, 顶端, 上面

light [lait] *vt.* 照明, 点着

candle ['kændl] *n.* 蜡烛

paraffin ['pærəfin] *n.* 石蜡

wick [wik] *n.* 烛芯, 灯芯

center ['sentə] *n.* 中心, 中央

state [steit] *n.* 状态

particle ['pɑ:tɪkl] *n.* 粒子, 微粒

molecule ['mɒlɪkjʊ:l] *n.* 分子

unbelievably [ʌnbi'li:vəbli] *ad.* 难以相信地

exception [ik'sepʃən] *n.* 例外

powerful ['paʊəfʊl] *a.* 强大的, 强有力的, 效力大的

electron [i'lektrɒn] *n.* 电子

microscope ['maɪkrəskəʊp] *n.* 显微镜

single ['sɪŋgl] *a.* 单一的, 单个的, 个别的

thimbleful ['θɪmbl,fʊl] *n.* 极少量, 些微

billion ['bɪljən] *num.* (英德) 万亿, (美法) 十亿

attract [ə'trækt] *vt.* 吸引

attraction [ə'trækʃən] *n.* 吸引 (力)

least [li:st] *a.* (little 的最高级) 最小的

father [fɑ:ðə] *ad., a.* (far 的比较级) 更远处; 更远的

apart [ə'pɑ:t] *ad.* 相隔, 相距

merely ['miəli] *ad.* 仅仅, 只不过

vibrate [vai'breit] *vi.* 振动, 摆动

forth [fɔ:θ] *ad.* 向前

freely ['fri:li] *ad.* 自由地

still [stil] *ad.* 还, 仍旧, (修饰比较级) 更

explain [iks'plein] *vt.* 解释, 说明

rod [rɒd] *n.* 杆, 棒

spread [spred] *vt., vi.* 展开, 扩展, 传播

even ['i:vən] *ad.* 甚至(...也), 连(...都), 甚至(比...) 更

evaporate [i'væpəreit] *vi.* 蒸发, 挥发