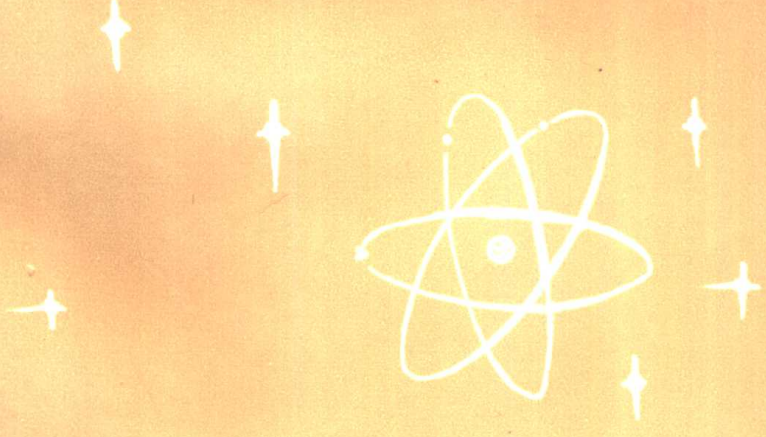
ENERGY AND
NUCLEAR ENERGY

能与原子能

英语科普对照注释读物



外语教学与研究出版社

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〔美〕 欧内斯特·施奈德 著
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内容简介

本书选自《今日自然科学》（*Physical Science for Today*）一书。作者欧内斯特·施奈德（Ernest E. Snyder）执教于美国亚利桑那大学。至一九七九年，《今日自然科学》一书已发行十版。

本书包括两个部分。第一部分就人类对能源的利用作了历史性的回顾和展望，着重介绍热能和热机，叙述电能对人类生活和生产的重要性和了解有关电能的知识的必要性，并探讨从太阳或地球内部获得能源的可能性和尚待解决的一些问题。第二部分介绍放射性的发现和本世纪对放射性同位素的研究和应用、核裂变和核聚变过程以及对核反应堆的控制，同时指出，核发电厂将提供世界上所需大部分能量的趋势等问题。

本书在每一节原文后都有语法注释和参考译文，书末附有注释和词汇表，可供大专院校和高级中学学生、知识青年和科技人员阅读，对理工科外语教师也有一定参考价值。

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Part I
Energy

Picture your community if a sudden and complete power failure has occurred one cold winter evening at about 6 PM. Electric and electrically controlled gas and oil furnaces have gone off. You go to light the gas stove in the kitchen to warm at least one room, only to discover that it will not light because the pumps that maintain pressure in the gas line into the city are powered with electricity.① Only those people who had the "foresight" to equip their homes with coal-fired furnaces are keeping cozy and warm tonight. The next day when you attempt to drive out to the country to cut some dead trees for firewood you discover that the car has only a few gallons of gasoline in the tank.② It is impossible to obtain gasoline because service station pumps are operated by electric motors.

The telephone company, hospitals, municipal water system, and a few radio stations are operating on an emergency basis with standby generators. But you do not have a battery powered radio so you have a problem trying to find out what is happening. You are eating cold soup from cans you opened with a hammer and screwdriver because the electric can opener does not operate. The community is almost completely paralyzed. Electric typewriters do not type, automatic doors

do not open, supermarket cash registers do not ring, escalators and elevators are motionless, traffic signals do not function, and crime accelerates in the darkened city. The evening of the second powerless night finds you and your family, wrapped in blankets, huddled in the living room, watching the last candle burn down. There isn't anything else to do. No newspapers were printed today. There is no TV and the theaters are all closed. Today you located a neighbor with a battery radio. The powerout extends over a wide area and was triggered by a malfunction in one of the system's nuclear power plants.

Perhaps the power will be back on tomorrow. But there are rumors of fuel shortages for the other power plants and the utility company is warning that the same thing can happen again within a very short time. Already there had been some power brownouts in your community the past summer. At least the lights and stoves kept working.

This gloomy picture is presented to emphasize the degree to which we have come to depend upon convenient electrical energy and what happens when we are suddenly deprived of our servants. Power brownouts and blackouts have occurred and will become more frequent as our accelerating energy demands continue to outrun our resources for supplying the energy. Americans now use more than six times as much electrical power per capita as the world average, and our demand for more energy is doubling every 15 years. Within the next 15 years we will need twice as many power generating

plants as we have now plus the necessary distribution system to take care of the increase.

But simply building more power producers is not enough; there must be fuel to produce heat energy that can then be converted to electrical energy and we just do not have it. Already this country consumes 30% of the world production of coal and oil and 50% of the natural gas. We presently are importing one-third of the oil we consume and our production of natural gas lags our requirements by about 10%. Only in the areas of coal and nuclear fuel do we have an ample supply — at the moment.③ But these two energy sources are principal polluters of the environment and their indiscriminate use is of major concern and is being contested at every turn. It is something to be concerned about.

Grammatical Notes

① You go to light . . . with electricity: 句中动词不定式短语 to light . . . one room 作目的状语，说明谓语动词 go; 动词不定式短语 to warm at least one room 也作目的状语，说明非谓语动词 to light . . . 。only to discover . . . 为结果状语，说明谓语动词 go。句中第一个 that 为从属连词，引导宾语从句；第二个 that 为关系代词，引导定语从句。

② The next day . . . in the tank: when 为关系副词，引出定语从句，说明 the next day。to drive out . . . for firewood 在句中作目的状语，其中 to cut some dead trees for

firewood 也作目的状语，说明非谓语动词 to drive out。

that 为从属连词，引导宾语从句，作 discover 的宾语。

③ Only in the areas . . . at the moment: 这是一个倒装句，强调句中的状语部分 in the areas of coal and nuclear fuel。英语中以“only＋状语”开头的句子，要用倒装语序，表示强调。

Translation

第一部分　能

假如在一个寒冷的冬季傍晚，下午六时左右，突然发生了全面停电事故，请设想一下你们那个地区的居民会是什么样子。电炉和由电控制的煤气炉和煤油炉都熄灭了。你去点厨房里的的煤气灶，至少可以使一间屋子暖和一些，却发现点不着，因为通向市区的煤气管道的压力泵是用电发动的。唯独那些有“预见”的人，家里备有煤炉，才能在当晚过得温暖舒适。第二天，你打算驱车到乡下去砍些枯枝当柴烧时，又发现汽车油箱里只有几加仑汽油了。但又不可能买到汽油，因为加油站的油泵是用电动机开动的。

电话公司、医院、市自来水公司和几个电台采取紧急措施，开动备用发电机供电。你没有用电池做能源的收音机，所以不知道出了什么事。你只能用锤子和螺丝起子来开罐头，喝点冷汤，因为电动开罐刀不能用了。社会几乎完全瘫痪。电动打字机不能打字，自动门不能开，超级市场的现金收入记录机不响，自动楼梯和电梯不动，交通信号灯不亮，在这座黑暗城市里犯罪活动剧增。第二天夜里再没有电，你和你家里的人就

得裹着毯子，在起居室里缩作一团，注视着最后一根蜡烛点完。此外，就无事可做了。没有当天的报纸，没有电视，剧场全部停演。今天你找到一位有电池收音机的邻居，才知道由于核发电厂（核电站）电力系统发生故障，造成广大地区断电。

也许，明天就会恢复供电。但有谣言说，其他发电厂缺乏燃料，公用事业公司提出警告说，短期内可能再次发生同类事件。今年夏天，你所在的地区已经电力不足，但至少电灯和电炉还能用。

为了强调我们对于使用方便的电能依赖的程度，说明突然失去这一个有用的工具时会出什么事，才描绘出这样一幅暗淡的景象。电力不足，断电事件都已经发生过了，由于能的需要量不断增加，超过我们能够提供的能源，这类事件还会经常发生。目前，美国消耗的电力按人口平均为世界平均值的六倍多，我们对能源的消耗每15年增加一倍，所以今后15年内，我们的发电厂需要增加一倍，此外，还要加上相应的配电设备。

然而，只建造更多的发电厂是不够的；还必须有燃料，才能生产热能，随后再转变为电能，而我们恰恰缺少燃料。美国已消耗世界总产量中30％的煤和油、50％的天然气。美国消耗的油有三分之一是进口的，天然气产量与需要量相比，缺少10％左右。只有产煤区和生产核燃料的地区，目前供给充分。但这两种能源是污染环境的主要物质，人们反对不加区别地滥用这两种能源，从而经常发生争议。这是应该考虑的一个问题。

1. Historical Perspective

For the first 99.65% of the time that man has occupied the earth, he relied almost entirely upon his own muscles to perform whatever tasks were necessary or desirable. It was not until he succeeded in domesticating the beasts of burden that he was able to rid himself of some of the numbing drudgery that seemed to be his lot.① Domestication of animals was soon followed by the use of the wind to propel primitive vessels and flowing water to irrigate crops by means of crude water wheels that lifted the water from the canal or stream to the level of the field.

The next step was the utilization of wind and water power to grind grain and operate primitive machinery to perform a variety of tasks such as polishing, sawing, and turning. Waterpower soon was being used to operate a diversity of machinery to produce many products in demand by developing civilizations. This is the way it remained until the eighteenth century when Thomas Newcomen and James Watt developed the first practical devices that enabled man to free himself from dependence upon muscles, wind, and water to make his life a bit easier.②

The Industrial Revolution in England and central Europe

in the 1800's was powered by steam. While water powered industries clustered around advantageous areas along rivers, steam powered factories concentrated in regions close to fuel sources, mainly the coal fields of Europe and eastern United States. Thousands of people moved from rural areas to the industrial cities to work in the factories and created the problems unique to urbanization which are still with us.

With the invention of the electromagnetic generator in the latter part of the nineteenth century, it became possible to convert the energy of burning fuel to electricity which could then be transmitted to distant points for use.⑧ The first practical electric street railway (streetcar) went into operation in Germany, and Thomas Edison installed the first electric utility to supply 85 customers in New York City with incandescent electric lighting. Within a very short time, electric power was being generated and distributed at many places around the world and energy for everyone became a reality.

Grammatical Notes

① It was not until ... his lot: 后一个 that 引导的是定语从句，说明 the numbing drudgery。

② This is the way ... a bit easier: it remained until ... 为定语从句，修饰 the way。英语中修饰 time, way, direction, distance, moment 等名词的定语从句，可不用关系代词或关系副词。关系副词 when 引导的定语从句修饰 the eighteenth century。关系代词 that 引导的定语从句修饰

名词 devices。动词不定式短语 to free himself from... 是宾语补足语。动词不定式短语 to make his life a bit easier 为目的状语，修饰动词 enable。

③ With the invention ... for use: it 为形式主语，动词不定式短语 to convert ... to electricity 是真实主语。which 引导的定语从句修饰名词 electricity。

Translation

1. 历史的回顾

在人类占据地球最初的99.65%的时间里，几乎完全依赖自己的体力来做必要的或愿意做的一切工作。直到人类能够驯养驮兽后，才有可能摆脱似乎是人类命运注定非干不可的笨重单调的苦工。人类学会驯养动物之后，又利用风力来推动原始的小船，还借助简陋的水车从沟渠中汲水灌田。

下一步就是利用风力和水力来碾谷物、开动原始的机械，从事研磨、切割、旋转之类的工作。不久，水力被用来推动各种机器，制造多种产品以应日益发展的文明之需。直到十八世纪，在托马斯·纽科曼和詹姆斯·瓦特① 发明第一批有实用价值的设备以前，就是这样的。这些设备使人类从依赖体力、风力和水力的状况下摆脱出来，使生活有所改善。

十九世纪中，在英国和中欧，蒸汽推动了工业革命。以水为动力的工业集中在江河沿岸便于利用水力的地区，以蒸汽为动力的工厂集中在燃料产地，主要是欧洲和美国东部的煤矿附近。成千上万的人从农业区迁往工业城市，进入工厂工作，因此产生都市化过程中所特有的问题，这些问题迄今仍然存在。

十九世纪中叶以后，发明了电磁发电机，从而有可能把燃

烧燃料而产生的能，转化为电能，并输送到远处使用。第一条实用有轨电车道在德国正式运行。托马斯·爱迪生② 在纽约建立了第一家电力公司，为85个用户的白炽电灯提供电力。在很短的时间内，世界各地有许多地方都已发出和输送电力，为每个人提供电能已成为现实。

2. Energy—What It Is

Energy is one of those fundamental terms in science that are impossible to define in the usual manner. If we resort to the dictionary definition, "energy is the ability to do work," then we are confronted with the necessity for defining the word *work*. The physicist regards work as a force acting through a distance.* Which is quite understandable except for the fact the term *force* also defies ordinary definition. If we say that force is a "push or a pull," we are now required to explain what we mean when we use these two words and about all we can say is that we exert energy when something is pushed or pulled.①

We must resort to operational definitions which describe something in terms of what it does rather than what it is. We have already defined force as that which can change the state of motion or configuration (shape) of an object. Thus, energy is that which can cause a force to act to do work.

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* In the English system of measurement, the common unit for work is the foot-pound — the product of pounds force acting through distances measured in feet. Thus, if your weight is 160 lb and you climb a flight of stairs a vertical distance of 30 ft, you have done 30 ft × 160 lb = 4800 ft-lb of work.

Science has been able to identify only three kinds of basic energy to power the universe: 1) Gravitational energy exists between all material things and is responsible for the gravitational force that provides the power to operate the massive turbines in our hydroelectric generating plants.② Gravitational energy also acts between very small particles such as atoms and molecules but the force is not very effective unless the particles are very close together. 2) Nuclear energy binds together the particles that make up the nuclei of atoms. Man has learned to release and utilize some of this energy under very specific conditions. 3) Electromagnetic energy is that which is associated with the subatomic particles that carry net electrical charges, principally the electrons and protons found in the atoms of all normal matter.

All kinds of energy can be classed as either potential or kinetic. Kinetic energy is the energy of motion; anything that is moving is capable of striking something else and exerting a force against it or doing work on it, or both.

Potential energy is the energy of position or configuration. The water stored behind the dam in Figure 1 possesses the ability or potential to move through the penstocks and do work. A woundup watch or clock spring is an example of potential energy of shape or configuration. The food (chemical) energy stored by plants is potential energy of configuration because the pattern of molecular structures has been altered by the radiant (electromagnetic) solar energy utilized by the plants. This potential energy can be released when

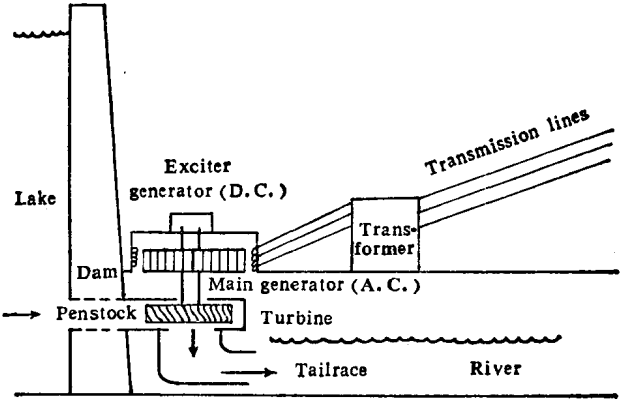

FIGURE 1 *Hydroelectric power installation.*

the food molecules are oxidized within the cells of living organisms.* Certain atoms possess the capacity for converting part of their potential nuclear energy to kinetic energy. The uranium "fuel" atoms in a nuclear reactor designed to produce electrical energy undergo a fission (splitting) action that changes a tiny portion of their nuclear potential energy to the kinetic energy of moving particles and radiation.

It should be apparent by now that potential energy can be converted to kinetic energy and vice versa. An excellent

* You can demonstrate for yourself the conversion of this potential chemical energy to kinetic energy [heat and light]. Simply stick a shelled peanut on a pin and set it afire with a match. The rather surprising amount of energy produced is the same amount you would realize for your body if you ate the nut instead of burning it. The process that goes on in your body cells is chemically the same but proceeds at a slower rate and at many different places at once.