高等学校专业英语系列教材

土建专业英语

ENGLISH IN INFRASTRUCTURE

王 鹰 编

西南交通大学出版社
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前　　言

土建行业是我国经济的重要支柱产业，对于拉动内需，繁荣市场，促进就业，保持国民经济快速、持续、健康地发展具有显著的作用。随着我国对外开放的不断扩大，特别是加入 WTO 以后，我国土建工程技术界同世界各国的人员来往、学术交流以及国际工程承包等日益频繁。例如，随着我国招商引资范围的扩大，许多工程项目都是由世界银行或亚洲银行贷款建设，国际工程咨询公司介入要求中方的工程技术人员和项目管理人员具备较高的英语水平。新形势下人才的培养的要求是既懂专业知识又懂国际惯例，更要掌握英语。为适应我国土建行业市场国际化和我国建筑承包商参与国际竞争的趋势，本教材遵照大学英语教学大纲的教学内容，广泛介绍了岩土工程、土木工程、地质工程以及工程项目管理等土建相关专业的英语知识；所选用的专业文献、基础专业词汇都是来自有影响的经典著作或新近出版的文献，在专业上具有一定深度和学习参考价值。与课文对应的词汇学习反映不同专业的基本词汇和术语，所附练习题，针对课文而设计，让学习者能够进一步运用和掌握课文的词汇和标准的英文表达。教材也专门论述了土木工程、地质工程专业英语翻译的主要方法和技巧。所举构词法及英语翻译全部都是土木建筑工程专业或者科技英语方面的内容；大多数例句是在各种文献中选出或经过简化改造。目的是通过专业英语课程的学习，培养学生阅读和翻译英文专业文献的能力，提高阅读和翻译专业文献资料的质量和速度，熟悉科技论文写作的基本知识。为扩大学生的专业词汇量，教材对科技英语中的一些重要的拉丁文和希腊文词根进行了详细注解。

教材所选的英文文献涵盖了基础工程、工程地质、岩土工程、道路结构、桥梁工程、地下工程等。每一篇课文中都有一定的练习题或者专业英语的翻译知识和技巧。附录中选编的专业词汇覆盖了土木工程、地质工程、岩土工程以及环境工程许多常见的专业词汇。

教材可以供交通土建专业、地质工程专业和土木工程各个专业高年级本科生和研究生学习和参考之用。

在教材的编写过程中得到西南交通大学出版基金的大力支持，西南交通大学谢强教授和成都大学前校长吴光教授提出了大量建设性的建议，在此一并致谢！

由于编者水平有限，时间仓促，书中难免有疏漏和不妥之处，恳请广大读者和同行批评指正。同时也对本书所引用的参考文献的作者们表示诚挚的感谢。

作者

2008 年 7 月

目　　录

Lesson 1

The Civil Engineer and Geology

Every branch of *civil engineering* deals in some way with the surface of the earth, since the works designed by *civil engineer* are supported by or located in some part of the earth's *crust*. The practice of civil engineering includes the design of these works and the control and direction of their construction. *Geology* is the name given to that wide sphere of scientific inquiry which studies the composition and arrangement of the earth's crust.

At the start of the 19th century, before engineering had become the highly specialized practice it is today, many civil engineers were also active geologists. William Smith is the outstanding example of these pioneers. Robert Stephenson combined geological study with his early work in railway construction, and other well-known figures in the annals of civil engineering history were also distinguished in geology.

Today there is widespread recognition of the vital importance of the science of geology to those who practise the art of civil engineering. Geology is commonly included as a basic subject in courses of training for civil engineering; civil engineering papers contain frequent references to the geological features of the sites of works described; and *soil mechanics*, the generally accepted scientific approach to soil studies, provides a common meeting ground for civil engineer and geologist and a mean of fostering their cooperation.

In the past, geological considerations frequently have been featured prominently in the study and discussion of failures of civil engineering works. In fact, to some engineers, geology may still be thought of as merely a scientific aid to the correct determination of the reasons for some of the major troubles that develop during or subsequent to construction operations. Although the assistance rendered by geologists and by the study of geological features in such "*postmortem*" considerations is valuable, the very fact that the geological features may have had something to do with these failures suggests with abundant clarity that the best time to consult a geologist or study geological features is before design and construction begin. In this way, the science can serve the art in a constructive rather than merely a *pathological* manner. It will later be seen, as applications of geology are considered in some detail, that this constructive service of the science can not only prevent possible future troubles, but it can also suggest new solutions to engineering problems and can often reveal information of utility and economic value, even in preliminary work.

The more obvious effects of geological features on major civil engineering works may be seen in the *underground railway* services in London and New York. In London, because the city is built on a great basin of *unconsolidated* material (including the well-known London clay), tube railways, located far below ground level and built in clay that was easily and economically excavated, have provided an admirable solution to one part of the city's transportation problems. In New York, on the other hand, the surface of Manhattan Island on which the city is located is underlain to a considerable extent to Manhattan schist. Underground railways had to be constructed in carefully excavated rock cuts just below surface level, as innocent visitors to that great city learn if they happen to stand on a ventilation grating when a train passes in the subway below. Many similar instances of the profound effect of local geological characteristics upon major civil engineering works could be cited, but all would serve to emphasize the same point: how closely the science of art are related and how dependent civil engineering work generally must be upon geology.

There is today increasing concern over the conservation of the natural environment, especially in relation to construction projects. Environmental impact statements are now often mandatory before construction can be started. The preparation of these important documents must start with a consideration of geology, since geological factors very largely determine the natural environment. Construction operation will inevitable disturb local geological formations and so affect the environment. With sound design, environmental conditions can be restored when construction is complete. In some cases, they are even improved from what they were before work started, yet this restoration must be assured before the necessary permits are granted.

Training in Geology

Geological training for civil engineers must be general; it must provide the student with a good grasp of principles and of the interrelation of various branches of geology. Attention has to be concentrated on the branches of geology which are of special importance in civil engineering practice—*physical geology*, *structural geology*, and petrology. Study of geologic maps and sections and examination of thin sections of rocks under the petrological microscope give special emphasis to lectures.

Field experience is of fundamental importance in all training. No course in geology for civil engineers can be regarded as complete without a reasonable period of time spent on geologic observation and survey. Local conditions will dictate how fieldwork will be arranged, but a continuous period of one or two weeks spent in a suitable locality will usually be more effective than any number of shorter periods fitted into a regular schedule.

The second part of geological training for civil engineers should be a study of geological lessons learned in actual engineering practice. The average students will have little experience with engineered construction. Courses on *foundation engineering* and construction methods present excellent opportunities for geologic lessons.

Conclusion

Geology has a vital part to play in all engineering operations which interact in any way with the ground, and thus the science is critical to the entire field of civil engineering.

Field geology is based entirely on such powers of observation, coupled with the ability to deduce the presence and orientation of three-dimensional geologic structures from surface features. The civil engineer is trained to think in terms of three dimensions in relation to structural design; equally important, if not more so, is the corresponding ability to visualize the special character of subsurface geologic conditions. Equally important is a full appreciation of the importance of water in rock and soil. Most engineers will have occasion to observe the remarkably diverse effects of water on many solid materials and especially on soils. Dry soils cause little trouble; wet soils can cause *havoc* on a job. Therefore, the civil engineer must not only learn to visualize subsurface conditions in spatial terms but must always realize added complications that the presence of varying amounts of *groundwater* may cause.

These concepts are basic to a full appreciation of the role that geology can and must play in design and construction of civil engineering works. The proper use of geology as the starting point of all civil engineering achievement will become ever more important with the passing years and the gradual utilization of more favorable site. Despite all the pressures that will come to bear on them through advancing technology and mounting demands, civil engineers should always remember the words of Francis Bacon, written as the modern world began to emerge:

Nature, to be commanded, must be obeyed.

词 汇

civil engineer 土木工程师

crust 地壳

geologist 地质学家
postmortem 死后的，事后的，解剖的，事后剖析
pathological 病理的，病理性的
geology 地质学
词根分析：*geo*，希腊词根，表示“地，地球”
例如：geography 地理
geochemistry 地球化学
geophysics 地球物理学
geothermal 地热的；地温的
-logy，希腊词根，science or study of，表示“……学，……论”
如：ecology 生态学
philology 语言学，文献学
comparative philology 比较语言［语文］学
psychology 心理学
underground railway 地下铁路
unconsolidated 松散的，未固结的
unconsolidated material 未固结材料，如松散沉积物
schist 片岩
Manhattan 曼哈顿区，美国纽约州东南部纽约市里的一个拥有自治权的区，主要位于曼哈顿岛上，即纽约湾的北头。据说荷兰西印度公司一名叫彼得·米纽伊特的职工在 1626 年用仅值约 24 美元的货物从居住于曼哈顿的印第安人手中购得此岛。始建时名为新阿姆斯特丹，1664 年英国人接管时改称纽约。这儿的定居点迅速发展到了该岛的南头，最终成为美国的金融、商业和文化中心。
ventilation 通风，换气，通风装置
subway 地铁（美语），地道
local geology 区域地质
physical geology 普通地质学，物理地质学
structural geology 构造地质学
foundation engineering 基础工程
petrology 岩石学
词根分析：*petro*-表示“石，岩”之意，也有“含石油的”之意。如：
petroleum 石油
petrochemical 石油化工产品，石油化工的
petrogram （史前洞穴中绘于岩石上的）岩画

翻译练习

1. 英译汉

(1) Geology has a vital part to play in all engineering operations which interact in any way with the ground, and thus the science is critical to the entire field of civil engineering.

(2) Environmental impact statements are now often mandatory before construction can be started.

(3) In London, because the city is built on a great basin of unconsolidated material (including the well-known London clay), tube railways, located far below ground level and built in clay that was easily and economically excavated, have provided an admirable solution to one part of the city's transportation problems.

(4) Courses on foundation engineering and construction methods present excellent opportunities for geologic lessons.

(5) Every branch of civil engineering deals in some way with the surface of the earth, since the works designed by civil engineer are supported by or located in some part of the earth's crust.

2. 汉译英

（1）地下铁道是城市交通系统的重要组成部分。

（2）土木工程师在设计之前必须对建筑场地进行勘察。

（3）施工方案有时取决于场地的工程地质条件。

专业英语知识

专业英语基础知识

专业英语与普通英语相比，有许多独特之处。因为专业英语与专业知识紧密联系，除了包含一些数据、公式、符号、图表和程序外，在语言、语法、修辞、词汇以及体裁方面都有其独特之处。下面从语言、语法、词汇和结构上对专业英语的特点做简单的介绍。

1. 专业英语语言特点

专业英语在语言上具有准确性和简洁性。所谓准确性就是要表达准确，正确理解和分析英语的语法特点和句型，表达上不使用模棱两可的词汇。

【例句 1】Civil engineering offers a particular challenge because *almost* every structure or system that is designed and built by civil engineers is unique. One structure *rarely* duplicates another *exactly*.

译文：土木工程面临特殊的挑战，因为由土木工程师设计建造的每个结构或体系都是唯一的。一个结构几乎不能完全复制另一个。

专业英语的内容通常包括理论分析，公式推导和研究目的、范围、方法、步骤和结论等。在不影响表达的前提下，语言应尽可能简洁，避免不必要的润饰和重复，但并不排除使用复杂句或长句。

【例句 2】The yield criterion for a material is a mathematical description of the combinations of stresses which would cause yield of the material. In other words, it is a relationship between applied stresses and strength.

译文：材料的屈服准则指能够导致材料屈服的应力组合的数学表达式。换言之，它表示作用应力与强度之间的关系。

另外，专业英语强调逻辑严谨、概念清晰、关系分明、句子连贯。

【例句 3】Discontinuities affect not only the application of rock mechanics theory but they will, in most cases, lead to problems with water. Some discontinuities show tight contacts between their surfaces, but most surfaces will be open to some degree, they will permit entry of rainwater.

译文：结构面（不连续面）不但影响岩石力学的应用，大多数情形下，结构面还带来

了与水有关的问题。有些结构面紧密接触，但大多数结构面都有一定的张开，从而允许雨水的进入。

2. 专业英语的语法特点

专业英语多描述客观事物、现象和规律。这一特点决定了科技人员在撰写论文时要采用客观和准确的手法陈述被描述对象的特性和规律、研究方法和研究成果等。因此，专业英语常常使用非人称的语气进行客观叙述。

【例句 4】It should be emphasized that underground exploratory work must always be considered supplementary to and conditioned by previous studies of local geologic structure.

译文：应该强调的是地下勘探工作通常应该被认为是先前对区域地质构造研究的补充且必须受其限制。

由于专业英语的客观性，决定了非人称的表达方式，因此，被动语态在专业英语中用得较多。

【例句 5】Before the construction of a bridge is undertaken, for example , a statistical study is made of the amount of traffic the bridge will be expected to handle.

译文：例如，在桥梁建造之前，对于桥梁的交通量要做统计性的研究。

专业英语中大量使用不定式、动名词、分词，多数情况下是为了让句子简洁和精练。

【例句 6】The total weight *being* less, it is possible *to build* much taller buildings.

译文：总重量减轻，才有可能建造更高的建筑。

【例句 7】Consequently, the detailed estimate is often used as the budget estimate since it is sufficient definitive to reflect the project scope and is available long before the engineer's estimate.

由于施工图预算足以明确反映施工范围，并且早在施工预算之前就可以采用，因而施工图预算经常被用作概算。

专业英语在理论分析和公式推导中常采用 assume that...，suppose that... 等祈使语气的表达方式。

【例句 8】Suppose that safety factor of the slope is 1.5, internal friction angle of the soil is 25°.

译文：假定边坡的安全系数是 1.5，土的内摩擦角是 25°。

在专业英语中，条件句多用于条件论述、理论分析和公式推导中，最常用的是 if 引导的条件句。

【例句 9】The huge investment in the infrastructure will be erased quickly if proper maintenance and rehabilitation procedures are enforced and funded.

译文：如果合理的养护和修复计划得以资助并实施，就可以迅速取消用于基础建设的巨大投资。

专业英语中长句较多，但一般比较简洁清晰。在阐述定义、定律、生产工艺过程和技术等复杂概念时必须严谨、精确而完整，逻辑严密，一气呵成。

【例句 10】Using computers, structural engineers determine the forces a structure must resist, its own weight, wind and hurricane forces, temperature changes that expand or contract construction materials and earthquakes.

译文：结构工程师使用计算机确定结构所必须抵抗的力，即结构本身的重量、风力与飓风力、温度变化引起建筑材料的膨胀或收缩以及地震。

3. 专业英语词汇的特点

在普通英语或文学英语中，一词多义或一义多词的现象非常普遍，如 get，do，take，have ，make 的多解性相当惊人。而专业英语中，尤其是专业词汇的词义要专一得多，能用来表达确切的含义，体现了专业英语的严谨性。专业英语的词形越长，词义就越专一，如 permeability（渗透性）。

每个专业都有一定数量的专业词汇和术语。专业文献中的专业词汇一般有三类。第一类是纯专业词汇。纯专业词汇的意义很单纯，只有一种专业含义，有时候甚至根据需要造出来。如 T-beam（T 梁），fire-proof brick（耐火砖），prestressed concrete（预应力混凝土），reversed fold（倒转褶皱）等。

第二类是半专业词汇。它大多数是各个专业通用的，在不同的专业领域有不同的含义，如 foundation（基础、基金、创立、根据）。“fault” 一词，普通英汉词典中的意义是“缺点，缺陷；瑕疵”；在地质学、地理学里，是“断层”；在机械领域是“故障，裂纹”；在体育领域是“发球失误和传球失误”。

第三类是非专业词汇，这类词汇是指在非专业英语中使用不多，但却严格属于非专业英语性质的词汇。如 application（应用、用途、作用、申请等）。

专业英语也较多使用词性的转换。转换后词义往往与原来的词义相关。常见的词性转换类型有：名词→动词、形容词→动词、动词→名词、形容词→名词等。这里有两种情况，一种是词本身可以在句子中充当另一种词类；另一种是在译文中被转换成另一种词类。例如：standard（n. 标准）→standardize（v. 标准化）；former（adj. 前面的）→the former（n. 前者）；wide（adj. 宽的）→widen（v. 加宽）。

专业英语中也有许多词汇属于外来词，如希腊语、拉丁语、法语词汇等。有些词是日常生活中常用的，例如：economical，immigrate，foreword 等。有的则用于某些专门的领域。例如在土木工程领域，如：hydraulics，infrastructure，reliability，specification。据统计，现代科技英语中，有 50%以上的词汇源于希腊语、拉丁语等外来语，而这些外来语

词汇构成的一个主要特征就是广泛使用词缀（包括前缀 prefix 和后缀 suffix）和词根。因此适当掌握一些词缀和词根有助于扩大词汇量。

另外，在专业英语中往往大量出现缩写（abbreviation）、数学符号（mathematical symbol）及其表达式（expression）。

在阅读和撰写专业文献时，常常遇到一些专业词汇或术语、物理量、单位的缩写或政府机构、学术团体、科技期刊和文献的简称。例如：

Fig.（figure）图，图件；

Eq.（equation）方程；

m/s（meter/second）米/秒

in.（inch）英寸；

Eng.（engineering）工程，master of Eng. 工程硕士；

i. e.（拉丁语 id est）也就是，即；

etc.（拉丁语 et cetera）等等；

Psi.（pounds per square inch）磅/平方英寸；

QC（quality control）质量控制；

CAD（Computer Aided Design）计算机辅助设计；

ASCE（American Society of Civil Engineers）美国土木工程师学会；

FIDIC（International Federation of Consulting Engineers）国际咨询工程师联合会；

EI（Engineering Index）（美）工程索引。

4. 专业英语的结构特征

以上专业英语在语言、语法和词汇的特点构成了专业英语的基础，更进一步，还需要了解专业英语在段落及文章层面上的结构特征，了解隐含在语言运用中的逻辑思维过程，这样，才有助于把握文章要点和重点，提高阅读和理解能力。

一般，在每一自然段落中，总有一个语句概括出段落的重点。这个语句或在段落之首，或在段落之尾。若干自然段落形成一个逻辑段落，从不同角度来阐述某一层面的核心内容。全篇则由若干个逻辑段落组成，从不同层面来阐述文章标题所表明的中心思想。

Lesson 2

Earth and Its Structure

The earth is not a rigid and static body, but is in a continual state of change, both inside and on the surface. Forces are acting to create new rock material and on the surface other forces are destroying the rock which has been formed in the past. The product of these destructive processes is known as soil, itself a new form of the material, so the forces of destruction may also be thought of as constructive forces. The word soil in geotechnical engineering means any unconsolidated material in the ground and is not used in the same sense as that used in pedologists who study soil as a life-supporting material. The age of the Earth is at present believed to be at least 4 600 million years.

The interior of the Earth is believed to be built of *concentric* shells of rock material, named the *crust* and *mantle*, which surround a central *core*. Movement of material within the Earth is believed to be the cause of some of the surface processes which we experience. This movement may be the last phases of the turbulence associated with the creation of the planets in the *solar system*.

The average *specific gravity* of the Earth as determined by mathematics of planetary motion is 5. 5, but the specific gravity of the rock found on the surface is only about half this value, 2. 7. Therefore the interior must be denser. The evidence for the existence of a structure consisting of distinct shells of shells of different specific gravities come from measurements on the rates at which shock waves from earthquakes travel through the Earth. There are different types of waves and the move in complicated paths through the interior. Results obtained from the study of these waves (*seismology*) have shown that there are relatively rapid changes in specific gravity at depths of 35 700, and 2 900 km. These changes are called discontinuities by *geophysicists*; this word is also used in *geotechnics*, but is a different sense, to indicate fractures and open spaces within rocks. These relatively rapid changes in specific gravity caused earthquakes waves to be reflected and refracted; the subsequent paths followed by the waves can be detected and their study forms the basis of our knowledge of the interior of the Earth. Geotechnical exploration methods can determine the specific gravities of the rock below the surface as part of a site investigation program to predict the behavior of the rock below a construction site.

The study of the continents, their structure and histories, have led geologists to believe that the continents and oceans are not permanently fixed in position but are moving extremely slowly across the surface of the Earth, a process known as *continental drift*. The ocean beds are not permanent. The evidence for this belief is that studies of the ages of rocks dredged from ocean beds show that the youngest rocks tend to be found in a world-encircling mid-ocean ridge system in the North and South Atlantic Oceans, Pacific Ocean, and between the Indian Ocean and Antarctica. The rocks further away from ridges are older than those within the ridges, from which it is inferred that rock is rising and being pushed sideways as more comes to the surface from the mantle. To maintain balance in the shape of the Earth there must be regions where rocks are descending into the mantle. Thus the ocean bed is slowly expanding outwards and this process is known as *ocean-floor spreading*.

Rock material is therefore continually moving and during this movement undergoes changes. The movements which form mountains are not continuous constant rate processes, but occur at irregular time intervals. Stresses build up in the rock and cause deformation and increase in strain energy. When the rock reaches the *elastic limit* a fracture occurs and there is a sudden release of energy in the form of earthquake waves. The fracture in the rock is called a *fault*. The movement during a single earthquake may be of a centimeter, but in a severe earthquake it may be as much as a meter.

All these processes of rock formation, movement and decay have caused rock found at the surface (*outcrop*) to consist of many different types and to have definite physical properties. The important properties are specific gravity, *permeability*, strength, *compressibility*, and state of *weathering*. The last is very important because the other properties are dependent on it. Measurements of these properties are made at proposed construction sites (in situ tests), and on samples taken to a geotechnical laboratory, in the hope that the mechanical behavior of the rock or soil can be predicted and suitable construction designs made.

1 Weathering and decay of the Earth's surface

The natural tendency of rock near the surface to break into small pieces causes it to have a greater surface area per unit volume, and water can enter the *discontinuities*. In humid climates this accelerates the rate of decomposition of rock at the surface. Weathering in humid climates is chiefly a chemical process. Rainwater is very slightly acid because of dissolved *carbon dioxide* from the atmosphere; plants emit carbon dioxide from their roots, which also manufacture humic acids, and the interaction of these with rock releases solutions of plant nutrients, phosphorous, potassium, calcium, and trace elements, that are necessary to the plants. Water acts as solvent in these processes by which plants decompose rocks and break them down into soil. The removal of these elements from the body of the rock leaves very small spaces into which water enters and the decay process accelerates. The rock first becomes porous, and then breaks into small pieces which become progressively smaller as the rock is changed into soil. The chemical processes are complex and depend on the various minerals of which the rock is composed. Silica (SiO_2) in the form of the mineral *quartz* is stable in temperate climates, but in equatorial climates the high temperatures help it to decompose. Minerals that contain iron decompose to form iron hydroxides, which give the rock a brown color, an indicator of weathering when fresh, unaffected rock is not naturally brown. Plant roots enlarge discontinuities by forcing the rock surfaces apart, helping the weathering process.

Wind forces may be strong enough to blow away pieces of rocks that have become loose because other weathering processes. The greatest wind erosion effects are seen in dry climates where the wind can blow strongly enough to carry with it tiny pieces of rock, grains of sand or dust. This has an abrasive effect, sand blasting, which carries away large quantities of rock as more dust. Wind erosion produces some spectacular rock shapes in desert climates, for example, Monument Valley in the United States of America.

The total effect of all these processes is to build up a mass of loose rock material above a more solid body of rock below (*bedrock*). The boundary between the two different masses is called rockhead. The top layer is called the weathered or superficial zone, or overburden. The depth of the weathered zone may be very important in construction works.

2 Earth history

The history of the Earth goes back over a very long period of time, of the order of thousand of millions of years, and during that time certain events occurred which left their mark on the structure of the upper parts of the crust, which we see today. This structure includes the present-day distribution of continents, mountains, relics of old mountains that have been worn down by erosion, unconformities, and the record of the evolution and extinction of certain forms of animal life preserved in the rocks as *fossils*.

3 Geological period and time scale

Geologists divide Earth history into *eras*, divisions of which are known as *periods*. The names used for the periods are based on names for rocks, place or area names, and the kinds of fossils found in the rocks. The sequence of all the evolutionary stages in life, and the sequence of rocks formation has been compiled by geologists working over more than a hundred years in all parts of the world, firstly in Europe, then in North America, and the other continents. The internationally recognized periods are given in the form of vertical sequence, the *geological column*, with the oldest rocks at the bottom. This is the standard way of presenting rock formation. This column can be compared with a core of rocks extracted from a borehole, where the earliest formed rocks are lower down, and the more recently formed rocks are above the older. It is possible during Earth disturbance for whole sequences of rock groups to be turned over and inverted, so it is not an invariable rule that the rock at the bottom of a borehole is older than the rock at the top. The geological column is a model of Earth history in terms of rock groups, which are known as formations.

Table 2 - 1 Geological period and time scale

Era	Period		Age/Ma
Cainozoic	Quaternary	Recent Pleistocene	2
	Tertiary	Pliocene Miocene Oligocene Eocene Paleocene	66
Mesozoic	Cretaceous Jurassic Triassic		226
Paleozoic	Permian Carboniferous Devonian Silurian Ordovician Cambrian		570

Study of Earth movements or disturbances, uplift of mountains, or intrusions of great masses of *igneous rock* under them, shows that the intensities of these movements build up to peaks and then decay and disappear, leaving mountain ranges and relics of volcanoes which are then eroded down to sea level. The geological column given here states the approximate ages of the time boundaries between the periods. The eras are known as *Pre-Cambrian*, *Paleozoic* (ancient life), *Mesozoic* (medium life) and *Cainozoic* (recent life).