ENGLISH FOR MINING ENGINEERING

采矿工程英语

蒋国安　吕家立　主编

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内 容 简 介

本教材所有课文均选自近年来国外新出版的专业书刊，反映了当前煤炭工业的新技术和新发展。内容包括煤矿地质和测量；矿井设计和开拓；井巷工程；岩体结构；矿山压力和巷道支护；长壁采煤法及其装备；房柱采煤法及其装备；矿井运输、提升、通风、排水、供电、事故防治、通讯和照明；选煤；矿区环境保护；特殊条件下开采；露天开采；采矿系统工程和矿业管理等专业知识。每课均包括课文，生词和词组，语言难点注释，阅读练习。本书既可作为煤炭高等院校采矿工程专业的英语教材，也可供有一定英语基础的矿山工程管理及技术人员自学参考。

ENGLISH FOR MINING ENGINEERING
采 矿 工 程 英 语
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前　言

为了满足全国煤炭高等院校加强专业外语教学的需要，根据原煤炭部“八五”教材编写规划的要求，我们组织编写了这本《采矿工程英语》教材。考虑到采矿工程专业学生专业知识面需要拓宽的要求，本教材的内容，包括了煤矿地质和测量，矿井设计和开拓，井巷工程，岩体结构，矿山压力和巷道支护，长壁采煤法及其装备，房柱采煤法及其装备，矿井的运输、提升、通风、排水、供电和事故防治、通讯和照明，选煤，煤矿环境保护，特殊条件下开采，露天开采，采矿系统工程和矿业管理等专业知识。因此，教材相当于一本简明英文采煤概论。

在编写本教材的过程中，特别注意到其内容应能反映煤炭工业当前的新技术和新发展，故所有课文均选材于近年来国外新出版的专业书刊。全书选编成28课计44节。每课（节）课文的正文约5 000～5 500个印刷符号。为帮助读者更好地理解课文内容，在课文正文后有生词和词组、语言难点注释。每课（节）的最后还有2 500～3 000个印刷符号的英文原文（无生词、词组和注释），供读者阅读练习。拟另外出版与本教材配套使用的《采矿工程英语参考资料》供读者参考使用。该参考资料包括每课（节）的中文译文；专业英语的语法特点（文体结构的特点，词汇特点和语法特点）；科技论文中英文摘要的写作技巧及摘要示例。

在安排教学进度时，原则上每课（节）课文用两个学时，44节需88个学时，考虑到要安排一定份量的练习以及其他事宜，本课程共需安排90～110学时。

本书由蒋国安，吕家立任主编。参加编写工作的有蒋国安（第一、二、三、四、五、六、二十四、二十七、二十八课），吕家立（第七、十一、十二、二十、二十一、二十二），侯忠杰（第八、九、十、十八、十九课），马翼飞（第十三、十四、十七、二十三、二十五、二十六课）。

由于编者的水平有限，加之时间仓促，不足之处在所难免，恳请读者批评指正。

编　者

1998年4月

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LESSON 1

HISTORY OF COAL MINING

The exact date of man's first use of coal is lost in antiquity. The discovery that certain black rock would burn was undoubtely accidental and probably occurred independently and many times in the world over thousands of years[1]. It is quite likely that these independent discoveries were made when primitive man chanced to build camp fires on exposed ledges of a black rock, then was amazed when it caught fire.

The Chinese recorded the use of coal 1 100 years before the Christian Era and from the Bible we learn that King Solomon was familiar with coal in what is now Syria[2]. In Wales, there is evidence that the Bronze Age people used coal for funeral pyres, and it is known that the Romans used this fuel. There are other ancient references.

So the knowledge that coal would burn, and even some uses of that knowledge, go back thousands of years. However, practical and consistent use of coal seems to date to England in the Middle Ages.

In the Americas, there is evidence here and there of occasional use by the Indians. However, the first recorded discovery of coal, in what is now US, was by French explorers, who reported an outcrop exposure on the Illinois River in 1679. Following this, other discoveries were made by French and British explorers, but the first recorded actual usage was in Virginia in 1702, where a French settler was granted permission to use coal for his forge.

Earliest recorded commercial mining was in 1750, from the James River coalfield near Richmond, VA, a deposit now abandoned. Besides local consumption from this field, shipments were made to Philadelphia, New York, and Boston.

At first, all coal was hewed by hand from the solid bed by use of pick and bar. It was then shoveled into baskets, boxes, or wheelbarrows and dragged by men, or women, to the outside or to the foot of a shaft. Later, cars were developed but still drawn over wood plank by humans. As time went on[3], iron straps, then rails, were used for the cars while mules, ponies, or horses did the pulling.

Gradually, black powder was introduced to blast down the coal, but undercutting, sidecutting, and drilling were still done by hand. During the late 1700s and 1800s, a number of basic developments greatly aided the mining of coal. The first steam engine was invented by James Watt in 1775 in Britain to pump water from coal mines, a very important application that made it possible for mines to go deeper[4]. The first rail transportation was for mining; the first steam locomotive was developed in 1814 by George Stephenson in England for a colliery, and the first electric locomotive was developed in 1883 in Germany for underground use.

Mechanization of operations at the face started before 1900 with development of punching machines and chain-type cutters for undermining the coal seam before blasting, of coal and rock drills, electric and compressed air locomotives, and even some early experiments with continuous mining machines.

Longwall mining was used here and there in the US until about 1910, particularly in Illinois, but then became noncompetitive with room-and-pillar methods in thicker seams that better lent themselves to mechanization. In the meantime, longwall continued to be dominant in Europe and Asia because of thin coal and depth of cover.

During World War Ⅱ, the Germans developed the longwall scraper for continuous loading onto a chain conveyor at the face. This was followed by various types of shearing machines developed in several countries. However, the most important development was in hydraulic, self

-propelled roof jacks and chocks that greatly reduced the manpower formerly required to set and reset individual jacks and to build cribs by hand.

With these developments, US coal companies again became interested in the longwall system. Numerous modifications and a general "beefing-up" were found necessary for US conditions but, after some failures and misapplications, longwall mining has become practical in this country, providing mining conditions are right, as attested by the gradually increasing number of units.

Surface mining was the earliest method of extracting coal. It consisted of recovering coal exposed in stream beds and visible outcrops with zero to a few feet of loose dirt cover. Under deeper cover and under rock the cheapest method-in fact the only means of recovery at first-was by underground mining, so surface developments were insignificant until about 1910, although, here and there, slip and cart scrapers drawn by mules were used to a very small extent.

NEW WORDS AND EXPRESSIONS

antiquity [æn'tikwiti] *n*.古代,古人们
discovery [dis'kʌvəri] *n*.发现,被发现的事物
undoubtedly ['ʌndautidli] *ad*. 毋庸置疑地,肯定地
accidental [æksi'dentl] *a*. 偶然的,意外的
likely [laikli] *a*. 很可能的,像是会的,
ad. 很可能,或许,大概
primitive ['primitiv] *a*. 原始的,远古的
chance [tʃa:ns] *vi*. 碰巧, 偶然发生
ledge [ledʒ] *n*. 架状突出物,矿脉,岩石的突出部
amaze [ə'meiz] *vt*. 使惊奇
n. 惊奇,惊愕
Syria [siriə] *n*. 叙利亚(亚洲)
Wales [weilz] *n*. 威尔士(英国)
the Bronze Age 青铜时代
funeral ['fju:nərəl] Pyres [paiəs] 火葬用柴堆
fuel [fju:əl] *n*. 燃料
the Middle Ages 中世纪
evidence ['evidens] *n*. 迹象,证据
reference ['refrens] *n*. 参考,出处,参考书目
consistent [kən'sistənt] *a*. 一贯的,始终如一的
here and there 各处
occasional [ə'keiʒənl] *a*. 偶然的
Indian [indjən] *n*. 印第安人
explorer [iks'plɔ:rə] *n*. 探险者,勘探者
outcrop ['autkrɔp] *n*. 露头
exposure [iks'pouʒə] *n*. 揭露,方位
Illinois [ili'nɔi, ili'nɔiz] *n*. 伊利诺斯[美国州名]
Virginia [və(:)'dʒiniə] *n*. 弗吉尼亚[美国州名]
settler ['setlə] *n*. 移居者,殖民者,开拓者
grant [gra:nt] *vt*.同意,准予(补助等),授予(权利等)
forge [fɔ:dʒ] *n*. 锻炉,铁匠炉
commercial [kə'mə:ʃəl] *a*. 商业的,品化的
coalfield ['koulfi:ld] *n*. 煤田,产煤区
VA = Virginia
deposit [di'pɔzit] *vt*. *vi*. 存放,沉积
n. 矿床,沉积,储藏量,存积
abandon [ə'bændən] *vt*. 抛弃,废弃
n. 放任,无拘无束
hew [hju:] *vt*. 砍,劈
solid ['sɔlid] *a*. 实体的,坚固的,立体的
pick and bar 镐和钎杆
shovel ['ʃʌvl] *n*. 铲,铁锹
vt. 铲,用铲子掘起,推,涌流
wheelbarrow *n*. 独轮小车,手推车
drag [dræg] *vt*. 拖,拉
drawn [drɔ:n] draw 的过去分词
plank [plæŋk] *n*. 板,厚板,支持物,板条
vt.铺以厚板,在……上铺板
strap [stræp] *n*. 铁皮,革,板
black powder *n*. 黑火药
undercutting *n*. 底部掏槽,拉底
sidecutting *n*. 侧面掏槽,侧面采掘
drilling [driling] *n*. 钻孔,钻眼
invent [in'vent] *vt*. 发明,创造
locomotive ['loukəˌmoutiv] *n*. 机车,火车头
a.有运转力的,移(机) 动的
colliery ['kɔljəri] *n*. 煤矿
mechanization [mekənai'zeiʃən] *n*. 机械化,变更,改进
operation [ɔp 'reiʃən] *n*. 操作,作业,运转
punching machine 冲床,冲压机,冲击式机械
chain-type cutter 链式截割机
undermining 底部掏槽,采动
compressed air 压缩空气,压气

continuous mining machine 连续采矿机械
longwall mining 长壁开采
noncompetitive [ˌnɔnkəmˈpetitiv] *a*. 不可竞争的
room-and-pillar method 房柱法
lent (lend 的过去式和过去分词) 提供,给予
dominant [ˈdɔminənt] *a*. 支配的,占优势的,主要的,显著的
vt. 统治,支配
n. 主要物,要素
scraper [ˈskreipə] *n*. 铲运机, 耙斗, 扒矿机
chain conveyer 链式运输机
shearing machine *n*. 剪机, 滚筒式采煤机
hydraulic [haiˈdrɔːlik] *a*. 液压的, 水力的
self-propelled roof jacks and chocks 自移式液压顶柱和垛式液压支架
individual jacks 单体支柱
crib [krib] *n*. 木垛, 支垛
modification [ˌmɔdifiˈkeiʃən] *n*. 更改,修改,改变
beef up 加强,充实
failure [ˈfeiljə] *n*. 失败,故障,失效,疏忽,缺少
misapplication [misˌæpliˈkeiʃən] *n*. 误用
attest [əˈtest] *vt*. 证实,证明,表明
surface mining 露天开采
slip scraper 刮土铲运机
cart scraper 铲运车
providing = provided conj. 以……为条件,假如

NOTES

〔1〕over thousands of years　在几千年中　over 在……期间, thousands of 许许多多, 无数, 几千

〔2〕in what is now Syria　在现在叫叙利亚的地方。what is now Syria 是介词 in 的宾语, 这里是宾语从句。如 in what follows 如下, 在下文中。

〔3〕As time went on　随着时间的推移　as 连词, 当……的时候。

〔4〕a very important application that made it possible for mines to go deeper　一种非常重要的作用, 使得矿井有可能开采更深的部分。it 是形式宾语。如 The invention of radio has made it possible for mankind to communicate with each other over a long distance. 无线电的发明使人类有可能进行远距离通讯联络。

EXERCISES

For many years the continually improving productivity in US coal mines was the envy of the world. Such steady improvement meant a fairly level, or even slightly declining, price to the consumer despite large increases in wages, materials, taxes, and other costs of production. However, this trend has drastically declined since 1968 because of the new stringent Federal safety regulations; rigid controls on surface water, and air pollution; and the mass of newly introduced, and constantly changing, bureaucratic reports. See Fig. 1.1.

The problem now is to not only meet the new safety and environmental requirements but, at the same time, to revive the steady progress of the past.

Reserves of all fossil fuels are limited, but the United States has more reserves in coal than in oil, gas, oil shale, and tar sands combined. Even if coal reserves are over estimated, as some in the industry believe, the relative dominance compared to other fossil fuels is apparent, Table 1.1. Reserves of all fossil fuels are finite, so for the long pull the world is fortunate in having nuclear energy. The distant future may see all fossil fuels consumed for higher uses than boiler fuel, for example, petrochemicals, lubricants, gasoline, chemicals, etc.

Table 1.1　US Reserves of Fossil Fuels Expressed in Heat Value

Reserves	Coal	Oil	Natural gas	Tar sands	Oil shale	Total
Quadrillions of Btu *	17 307	2 373	1 906	7	4 060	25 653

* Metric equivalent: 1 Btu × 1055.056 = J.

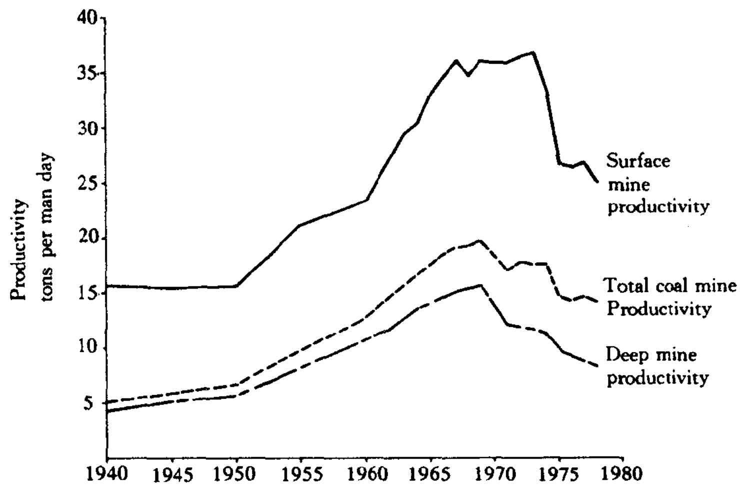

Fig. 1.1 Productivity per man day. Metric equivalent:
1 st × 0.907 184 7 = t.

Despite the tremendous importance of coal, the industry is faced with serious problems, such as:

1) Air and water pollution both at the mines and at the consuming end.

2) The onerous new Federal safety regulations.

3) Public outcry against surface mining and lack of satisfactory restoration in some cases.

4) A shortage of qualified supervisory and engineering personnel, as well as mine workers, to meet the growing demand for coal and the increasingly more difficult mining conditions.

5) A need to improve machinery, techniques, and managerial ability to resume the former yearly improvement in productivity and cost.

There are certainly solutions to all of these problems, which are challenges that a young person entering the industry should welcome as great opportunities.

LESSON 2

ORIGIN OF COAL

That coal has formed from accumulations of plant material has been well established. Estimates indicate that approximately 0.9 to 2.1 m (3 to 7 ft) of reasonably compacted plant material was required to form 0.3 m(1 ft) of bituminous coal. What were the conditions that so many times permitted the accumulation of great thickness of plant material that sometimes blanketed hundreds and even thousands of square miles[1]?

Conditions similar to at least some of those that must have prevailed in the geologic past exist today in a wide variety of swamp areas in different parts of world[2].

Accumulation of vegetal matter is now occurring in areas of the world ranging from subarctic to tropical resulting in formation of peat. Two major types of peat land can be recognized: (1) that developing on continental interior areas relatively elevated above sea level, and (2) that forming in low coastal areas close to sea level. In both types of areas, peat formation requires that growth of vegetation exceed that of decay and that the plant material be allowed to accumulate and not be removed by erosion[3]. Both types of peat land meet this condition because they are in poorly drained areas where high levels of ground water protect vegetable debris from normal rapid decay[4].

Small peat bogs also occur in a variety of small undrained depressions, both inland and on coastal areas. Originally in these bogs only water-dwelling plants grew, but as the shallow border areas of these depressions filled in, larger plants, including trees, gradually were able to grow and progressively fill the depression. In some places these bogs, commonly ranging from only a few acres up to a few hundred acres, are still unfilled, and the process of peat formation is continuing.

The character of most of the widespread coal seams that occur in the rock sequence indicates that they formed under conditions similar to those found in modern coastal or near-coastal swamps. The Everglades of Florida, the Okefenokee Swamp of Georgia, and the Dismal Swamp of North Carolina and Virginia are modern examples of such swamps. Extensive peat lands adjacent to the northwest coast of Europe also suggest conditions with many similar characteristics.

The accumulations of peat found on and in the sediments deposited as the delta of the Mississippi River have a somewhat different history but many similar characteristics. The several layers of peat and associated strata of the delta indicate conditions were much like those that prevailed during formation of the great coal deposits of Pennsylvanian age in the eastern United States and in similar strata in other parts of the world. Fig.2.1 diagrams the distribution of peat on a modern delta plain.

Coastal swamps are more likely to be preserved than inland swamps because they have a better chance of being covered by the sea and buried by sediments deposited on the sea floor.

The climate prevailing during the time the extensive coal swamps existed is believed to have been temperate to subtropical. It may have been much more uniform over broader areas of the earth than is true today.

In summary, conditions necessary for accumulation of peat that could be subsequently converted to coal are:

1) Swamp or marsh environment and climate favorable to plant growth.

2) Some subsidence (sinking) of the area during accumulation of vegetal debris, or compaction of deposited plant material, permitting further accumulation.

3) Sufficiently wet conditions to permit exclusion of air from much of the vegetal material

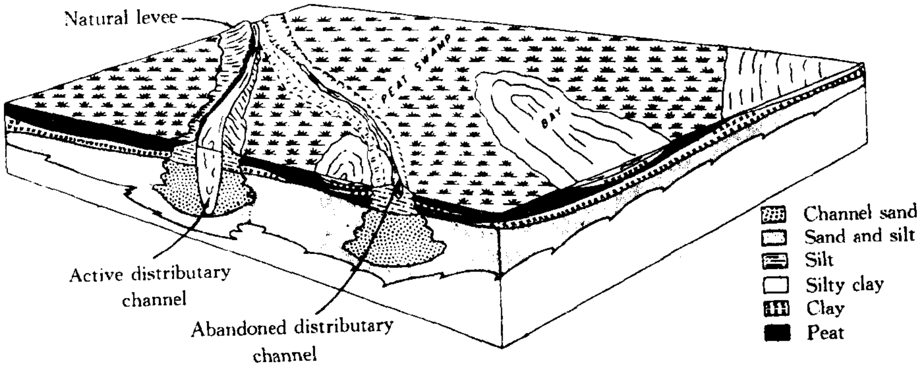

Fig. 2.1 Block diagram showing peat accumulation and related sediments on a portion of a large delta.

before it decays, and sufficiently rapid accumulation to thwart bacterial action, even in water of the swamp. Acidity of the swamp water normally prevents bacterial action at a few inches or a few feet below the water level in the swamp.

4) Proximity to the sea or a subsiding area so that vegetal material can be buried by sediments when the sea level rises or the land subsides.

5) Site of accumulation such that removal by erosion does not subsequently occur.

As peat accumulated, the weight of the top layers of peat compacted the lower layers, primarily by squeezing out large amounts of water. Variable chemical effects and bacterial action on the vegetable debris also took place in the swamp environment. Burial by sediments, physical - chemical effects associated with the changed environment, and loss of water and volatile materials resulted in formation of lignite, the earliest stage in the formation of coal.

With increasingly deeper burial, pressure continues to compress the lignite, and the increase in heat associated with the increasing depth of burial will further devolatilize the coal-forming materials. The rank of the coal became progressively higher, rising from lignite through subbituminous, bituminous, semianthracite, and anthracite to meta-anthracite.

NEW WORDS AND EXPRESSIONS

accumulation [əˌkjuːmju'leiʃən] *n*. 积累,积聚,堆积
establish [is'tæbliʃ] *vt*. 建立,使(风俗,先例等)被永久性地接受
estimate ['estimeit] *vt*. 估计,估价,预算,评价
indicate ['indikeit] *vt*. 指示,指出,表明,象征
approximately [ə'prɔksimitli] *ad*. 近似地,大约
reasonably ['riːznəbli] *ad*. 合理地,公道地,适当地
compact [kəm'pækt] *a*. 紧密的,结实的
vt. 使紧密,使结实
bituminous coal [bi'tjuːminəs koul] 烟煤
thickness [θiknis] *n*. 厚度,密(度),稠密,浓(度)
blanket [blæŋkit] *vt*. 覆盖
mile [mail] *n*. 英里,哩(1 哩 = 1.609 km)
prevail [pri'veil] *vi*. on (upon, with) 胜过,流行,普遍
geologic(al) [dʒiə'lɔdʒik(əl)] *a*. 地质(学) 的
variety [və'raiəti] *n*. 多样化,种类,[a~] 种种
swamp [swɔmp] *n*. 沼泽,煤层聚水洼
vegetal ['vedʒitl] *a*. 植物的
n. 植物,蔬菜
subarctic [sʌb'aːktik] *a*. 近北极的,亚北极的,副极带的
tropical ['trɔpikəl] *a*. 热带的,位于热带的
formation [fɔː'meiʃən] *n*. 形成,构成,层系,层
peat [piːt] *n*. 泥炭,泥煤
continental [kɔnti'nentl] *a*. 大陆的,大陆性的
interior [in'tiəriə] *a*. 内部的,内地的,国内的
n. 内部,内地,内务,内政
elevate ['eliveit] *vt*. 抬起,使升高
coastal [koustəl] *a*. 海岸的,沿海岸的
exceed [ik'siːd] *vt*. 超过,越过

decay [di'kei] v. *n*. 腐烂,衰败
remove [ri'muːv] *vt*. 移动,去掉,撤去,除掉
erosion [i'rouʒən] *n*. 腐蚀,侵蚀
drain [drein] *vt*. 排水,喝干,耗尽
protect [prə'tekt] *vt*. 保护,警戒
debris ['debriː] *n*. 碎片,岩屑,碎石,尾矿,废石
bog [bɔg] *n*. 泥塘,沼泽
originally [ə'ridʒənəli] *ad*. 最初,原先
water-dwelling 寓水性的
depression [dipreʃən] *n*. 降低,凹地,洼地,萧条
acre ['eikə] *n*. 英亩(1 英亩等于 40.47 公亩或 6.07 亩)
Florida, Georgia, North Carolina 美国州名
extensive [iks'tensiv] *a*. 广大的,广泛的,大面积的,大范围的
delta ['deltə] *n*. 三角洲,三角形物
Mississippi River 密西西比河
Pennsylvanian age 宾夕法尼亚纪
plain [plein] *n*. 平原
a. 清楚的,普遍的
preserve [pri'zəːv] *vt*. 保护,维护
n. 禁区,保护区
inland ['inlənd] *a*. 内地的,国内的
n. 内地
bury [beri] *vt*. 埋葬,埋藏,遮盖
sediment ['sedimənt] *n*. 沉积,沉积物
subtropical ['sʌb'trɔpikəl] *a*. 亚热带的
uniform ['juːnifɔːm] *a*. 一样的,均匀的
summary ['sʌməri] *a*. 概括的,扼要的
n. 摘要,概要,一览
subsequently ['sʌbsikwəntli] *ad*. 随后地,后来地
convert [kən'vəːt] *vt*. 转变,变换
favorable ['feivərəbl] *a*. 赞成的,有利的,讨人喜欢的,有促进作用的
subsidence [sʌb'saidəns, sʌbsidəns] *n*. 沉陷,下沉,下降
sinking [siŋkiŋ] *n*. 沉陷,下沉,凿井
exclusion [iks'kluːʒən] *n*. 排斥,排除在外
sufficiently [sə'fiʃəntli] *ad*. 足够地,充分地,能胜任地
thwart [θwɔːt] *vt*. 反对,阻挠,挫败
bacterial [bæk'tiəriəl] *a*. 细菌的
acidity [ə'siditi] *n*. 酸味,酸性
volatile ['vɔlətail] *a*. 易挥发的
n. 挥发物
lignite ['lignait] *n*. 褐煤(= brown coal)
anthracite ['ænθrəsait] *n*. 无烟煤,硬煤
meta-anthracite 变质无烟煤

NOTES

〔1〕What were the conditions that so many times permitted the accumulation of great thickness of plant material that sometimes blanketed hundreds and even thousands of square miles?

那么,允许很厚的植物材料堆积多次,这种植物材料有时覆盖几百甚至几千平方英里的条件是什么呢?

这里 what were the conditions 是一个简单句,后面跟着两个由 that 引导的定语从句. 第一个从句说明 conditions, 第二个从句说明 material。

〔2〕Conditions similar to at least some of those that must have prevailed in the geologic past exist today in a wide variety of swamp areas in different parts of the world.

类似于过去地质年代中普遍存在的条件,至少部分条件,今天也存在于世界上不同地区种类繁多的沼泽地中。

conditions……exist today…… 是一个简单句,其余都是修饰部分;similar to…… those 是形容词短语修饰 conditions, That 引导的定语从句说明 those; must 表示一种猜测。

〔3〕…… peat formation requires that growth of vegetation exceed that of decay and that the plant material be allowed to accumulate and not be removed by erosion*n*.

泥炭层要求植物生长超过腐烂,使植物材料得以积累而不被侵蚀掉。

第 1、3 个 that 是从句引导词,第 2 个 that 代替 growth。从句中三个动词 exceed, be, not be 前均省略了 should。

〔4〕…… protect vegetable debris from normal rapid decay.
……保护植物碎片不象往常那样快速腐烂。
protect …… from …… 保护……免遭……
〔5〕It may have been much more uniform over broader areas of the earth than is true today.
那时，地球较广泛范围内的气温要比现在实际气温均匀得多。
基本句型是 more …… than ……。此处 it 代表气温(climate) than 后面省略了 it，应该是 than it is true。

EXERCISES

Coal is defined as a combustible rock that originated in the accumulation and physical and chemical alteration of vegetation. Coal can be ignited and burned like the wood that was man's earliest fuel, but coal gives more heat than the same amount of wood and has many industrial uses. Unlike wood, coal is not generally found on the surface of the ground but is mined from the solid rock of the earth. Before taking up the occurrence, formation and the unique character of coal in the rock sequence, let us briefly consider the general character of all rocks in the crust of the earth.

Relatively little is known about the very earliest history of the earth, although a number of geological theories have been developed. Manned exploration of the moon and the rocks returned to earth continue to provide some answers to questions concerning the earth's origin and history. The period of earth history with which we concern ourselves here begins after great areas of water had evolved on earth and substantial land areas of once molten (igneous) rock existed. Weathering and other processes that attacked the surface of the rocks reduced them to small particles. Water provided by rainfall transported this material, ultimately, to large bodies of water where it was deposited. Thus was initiated the geologic sequence of sedimentary rocks that lie above the once molten igneous rocks.

The crust and upper mantle of the earth are made up of several large plates along which differential movement (primarily horizontal) takes place. Such movements, although small, are occurring today. These horizontal movements are accompanied by vertical movements causing important changes in the relative position of the continents and oceans. Low-lying coastal swamps with favorable climates are ideal locations for coal accumulation and burial by river-borne sediments, and large areas are affected by relatively minor vertical movements of the shoreline. The large plates have continually or intermittently moved throughout the geologic past, resulting in various configurations of the continents and oceans, and coal-forming conditions have occurred at numerous times and places. Vast areas of our continents have been repeatedly inundated by shallow oceans and only relatively small parts of the present continents appear to have been above sea level throughout geologic time. Great forces acting principally along plate margins have folded and broken the crustal rocks, forming large belts of mountains.

LESSON 3

GEOLOGICAL AGE OF COAL

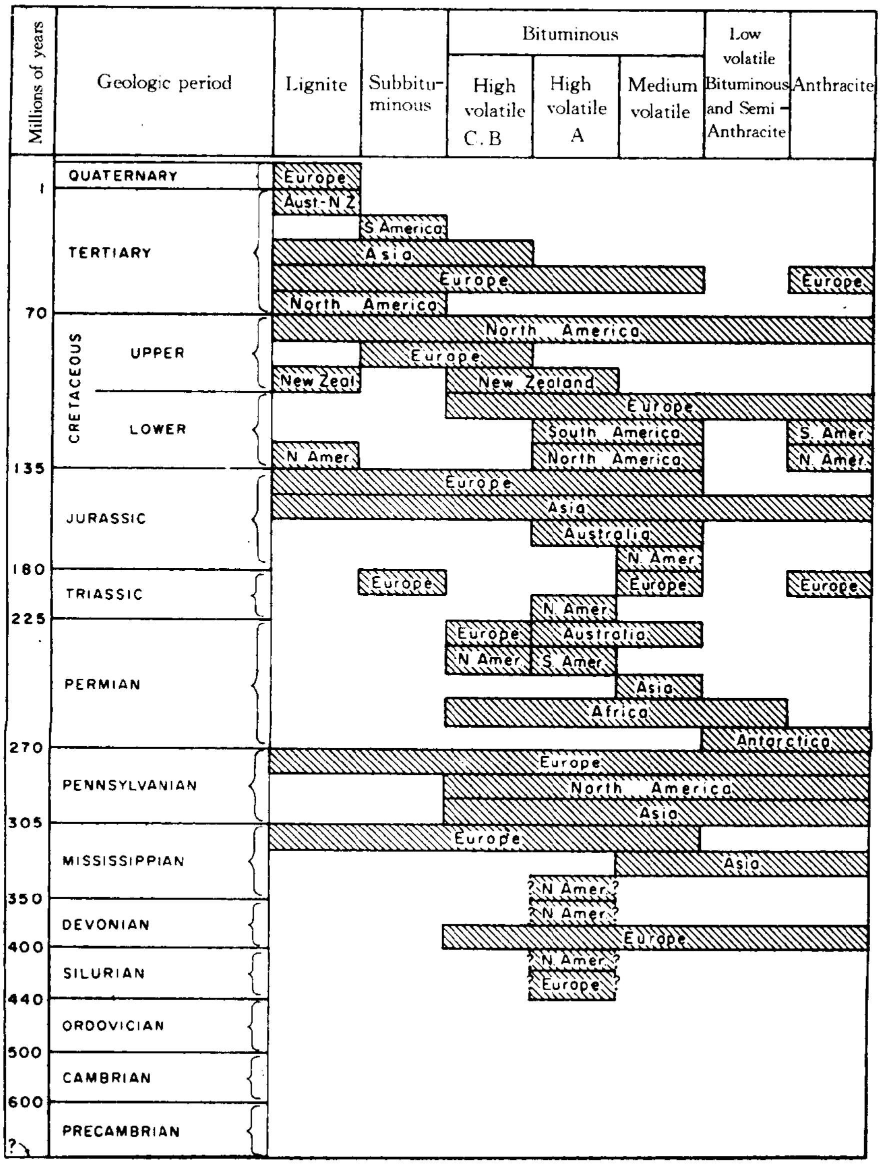

Fig. 3.1 Geologic age of various rocks of coal throughout the world.

In the general distribution of coal through the sedimentary rock sequence, only relatively rare occurrences of coal-like material, altered almost to graphite, have been reported from Precambrian (Fig. 3. 1) sedimentary rocks. These are believed to be local concentrations of algal or fungal material.

The principal organisms found in the oldest rocks in which fossils are common, the Cambrian (Fig.3.1), are algal deposits and remains of shells of sea animals. They are found principally in limestones or other limy strata. The earliest known occurrence of fossils of land plants is reported in Silurian rocks, and minor occurrences of coal have been found in Silurian and overlying Devonian rocks in various parts of the world, including North America.

The first extensive coal seams are reported from rocks of Mississippian and Pennsylvanian age in North America and the equivalent Carboniferous strata in Europe. Most coal mining in North America in the past has been from coal seams of Pennylvanian age in the eastern United States and Canada. Rapidly growing production of the past few years from western states is principally from coals of Cretaceous and Tertiary age. The general character of coal sequences in the Appalachian Coal Field[1] and the Interior Coal Province is shown in Figs. 3.2 and 3.3.

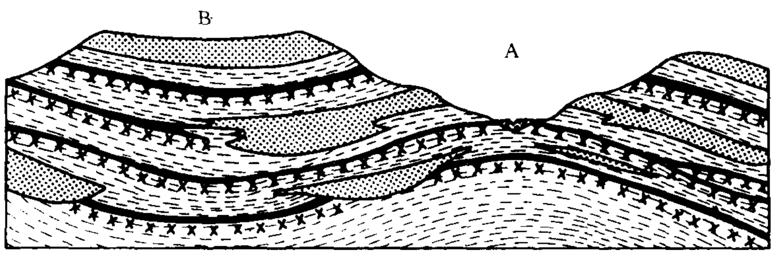

Fig. 3.2 Simplified cross section of coal-bearing sequence in parts of the Appalachian coalfields. Rocks have been gently folded into anticline (upfold) at A and syncline (downfold) at B.

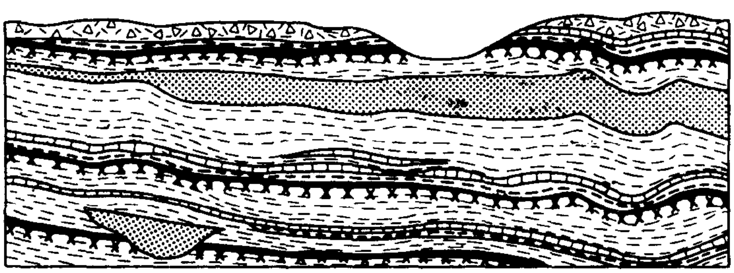

Fig. 3.3 Simplified cross section of coal-bearing sequence representative of the Interior Coal Province. A layer of glacial drift overlies the rocks in most of this area.

Coals are found in all geologic periods from Silurian through Quaternary time (Fig. 3.1) in various parts of the world. No commercially important coals have been found in strata older than Mississippian age, although Devonian coals have been mined locally in Europe. Some Permian coals are mined in the United States, but coals of that age have much more important reserves in other parts of the world, particularly the USSR and Australia. Coals of Triassic age are known and have been mined locally in Europe but they are relatively minor deposits. Jurassic coals also are in relatively minor deposits in most of the world, although they have been mined in some areas in Europe and Asia; however, the Jurassic contains important coal reserves in Siberia and western Canada. Large reserves of coals of Cretaceous and Tertiary ages are found in the western United States, western Canada, and other parts of the world, and are the bases for development of a number of very large surface mines in the western United States.

Coal-forming conditions have existed several hundred times, particularly since late Mississippian time, and some of the areas affected were tens of thousands of square miles in size.

Individual coal seams range in thickness from a fraction of an inch up to several tens of feet, and are reported up to as much as 91 m (300 ft[2]) in some areas. Most of the bituminous coal seams are less 6.1 m (20 ft) thick, and most mining in such seams has been in coal from 0.9 to 3 m (3 to 10 ft) thick. Much of the great expansion of mining in the western United States has