水利工程专业英语

PROFESSIONAL ENGLISH—FOR HYDRAULIC ENGINEERING

王兆印　［美］梅尔钦（C. S. Melching）　易雨君　王睿禹　著

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内容简介

本书内容包括水利科学及工程、河流动力学及地貌、流域水文及地质灾害、水环境及生态、河口海岸及河流管理等方面的专业词汇和用法，还有写作和在国际期刊发表学术论文的方法和步骤，以及中国作者写作科技英文的常见错误等。本书以若干实例说明如何修改中式英文，另外还提供了阅读材料和听力材料。为了帮助教师使用本教材，本书在各小节后面补充了中文注释，对专业词汇和词组的使用进行解释，指出了常见的中式英文写作习惯以及修改方法。

本书可以用作水利工程专业研究生、博士生的教材，也可作为水利工程师和研究者写作英文科技论文的参考书。

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前言

PREFACE

本人主编英文国际期刊 *International Journal of Sediment Research* 18 年，还兼任其他三家国际期刊副主编多年。收到的期刊稿件近半数为中国作者所贡献，有不少稿件内容不错，仅由于英文太差不得不拒稿。为了改进研究生和青年研究工作者的专业英文写作水平，我在清华大学开设了水利专业英语课 Professional English for Hydraulic Engineering，受到研究生、青年教师和水利研究院工程师的欢迎，学生们踊跃参加。中国水利水电科学研究院及有关水利院系多次邀请本人到场讲课。

本书是十多年来在教学和与听课师生交流中不断修改更新补充后的讲义，贡献出来供有关专业师生参考使用。本书第二作者 Charles Steven Melching 教授是多家国际期刊的副主编，具有很高的专业水平和丰富的编辑修改水利专业英文的经验。他为本书贡献了大量的资料并且审阅修改了全部英文。本书第三和第四作者也为本书的成稿与出版做出了重要贡献。

为了帮助教师在课堂上讲解专业词汇，特别是词典上难以查到或专业上有不同意义的单词和词组，在每小节后面增加了关键专业词汇的中文注释。在中国作者经常犯的错误（Common Habits of Chinese Writers）以及改进翻译两节，所有的实例都是来自本书作者们修改的稿件和教学实践。每一小节后面用中文解释了中文写作的习惯与英文的差异。本书的听力材料是国际广播电台（China Radio International）在舟曲泥石流灾害发生后的采访录音，在清华大学的专业英语教学中用作听力材料和听力测验。余在多年的教学实践中发现，学生们在课堂第一个小时之后会感到疲倦，用英文笑话解除疲倦效果很好，本书特选取几例供教师参考使用。

王兆印

2017 年 3 月于清华园

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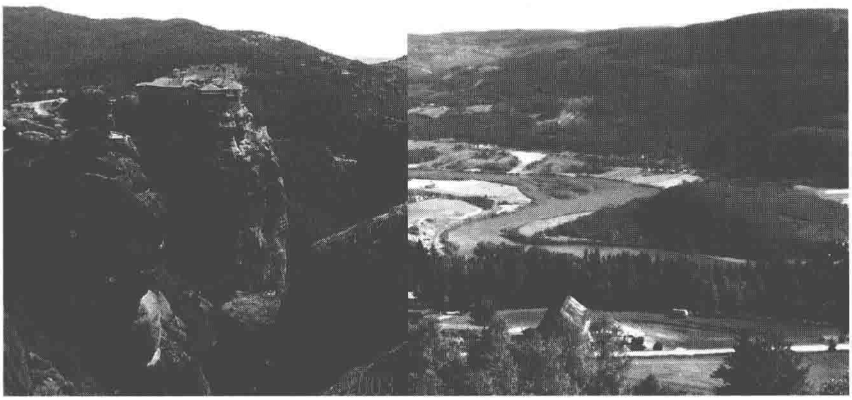
BASIC CONCEPTS

All land is part of a watershed or river basin. Figure 1 shows the landscape sculptured by erosion in Greece and the very dry land in Egypt. Indeed, rivers are such an integral part of the land that in many places it would be as appropriate to talk of riverscapes as it would be of landscapes. Rivers are much more than merely water flowing to the sea. Rivers carry downhill not just water, but just as importantly sediments, dissolved minerals, the nutrient-rich detritus of plants and animals. Their ever-shifting beds and banks and the groundwater below are all integral parts of rivers. Even the meadows, forests, marshes and backwaters of floodplain can be seen as part of the rivers—and the rivers as part of them.



(a) (b)

Figure 1 (a) The landscape sculptured by erosion (Greece); (b) river flow is the main drive for development of geomorphology (Norway)

The main **functions of rivers** are draining floods, supplying drinking water, maintaining ecology, irrigating farmland, transporting sediment, supplying power, providing habitat for fish, assimilating wastewater, and providing navigation. Humans exploit the resources of rivers by constructing dams and water-diverting channels, developing navigation channels, and harvesting fish, which result in changes in the river hydrology, runoff, sediment transport, riparian and stream habitats, and water quality.

Watersheds start at mountain peaks and hilltops. Snowmelt and rainfall wash over and through the high ground into rivulets which drain into fast-flowing mountain streams. As the streams descend, tributaries and groundwater add to their volume and they become rivers. As they leave the mountains, rivers flow and start to meander and braid, developing channels within the valleys with alluvial floors laid down by millennia of sediment-laden floods. Eventually rivers will flow into a lake or ocean. Where the river carries a heavy sediment load and the land is flat, the alluvial sediments may form a delta. Estuaries, the places where the fresh water of rivers mix with the ocean's salt, are among the most biologically productive parts of rivers and of seas. Most of the world's fish catch comes from species that are dependent for at least part of their lifecycle on a nutrient-rich estuarine habitat.

Figure 2 shows the components of a river system, materials transported, and the aspects affected by the rivers and transported materials. Rivers can be recognized as mountain rivers, alluvial rivers, and estuaries. A **mountain river** is the most upstream part of the river, including the river source and the upstream tributaries of the river, where the river system flows through mountainous areas and the flow is confined by mountains. Usually the channel bed of a mountain river is composed of gravel. Mountain rivers receive most of the sediment, nutrient-rich detritus of plants and animals, dissolved materials, and usually more than half of the water.

For a large river the upstream reaches compose the input-part of the river and are directly affected by the watershed or drainage area. Erosion control and vegetation development are the most challenging tasks for researchers and watershed managers. Erosion induced landslides and debris flows are disastrous in the upstream reaches. Mountain rivers are quite often

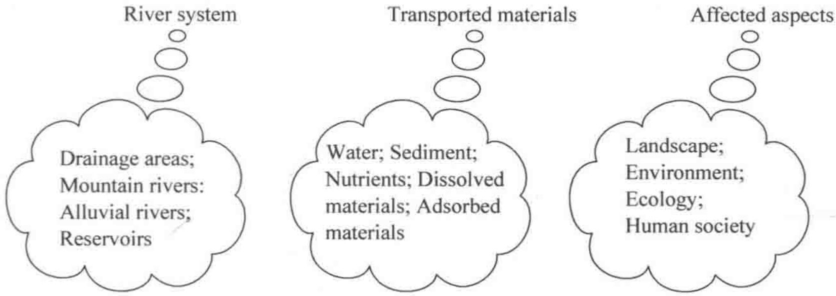


Figure 2 River system, transported materials, and aspects affected by rivers and the transported materials

incised rivers and degradation of the channel bed causes many problems. Therefore, erosion control and vegetation development over the watershed, landslides and debris flows, and control of channel bed incision are major topics of mountain river studies.

An **alluvial river** is defined as a river with its boundary composed of the sediment previously deposited in the valley, or a river with erodible boundaries flowing in self-formed channels. Over time the stream builds its channel with sediment it carries and continuously reshapes its cross section to obtain depths of flow and channel slopes that generate the sediment-transport capacity needed to maintain the stream channel. Alluvial rivers are mostly **perennial streams** and the channel bed is composed mainly of sand and silt. A large river usually originates from mountains and flows over floodplains before it pours into the ocean, therefore, it is a mountain river in its upper reaches and an alluvial river in its lower reaches.

Many alluvial rivers are large rivers or flat-land sections of large rivers, such as the lower reaches of the Yellow River and the middle and lower reaches of the Yangtze River. These alluvial rivers are confined within the valley defined by human constructed or artificially reinforced **levees.** The river morphology and river patterns depend mainly on the sediment transportation and deposition. Rivers are the main source of water resources for agriculture, urban use, and industry.

River flood are major natural disasters accounting for 1/3 of the total loss due to natural hazards. The quality of river water is important for human health. Flood and sediment transportation are natural processes in these rivers and water diversion, channelization, and navigation are human disturbance, to the rivers. Thus, sediment transportation, watèr resources development, and **flood defense** are the most important issues in the alluvial river management.

The **estuary** is the connection part of a river with the sea or the ocean into which it flows, including the river mouth, a river section affected by the tide, and the water body area affected by the river flow. Sediment is deposited for land creation and very often a delta develops in the area. In recent years, the need for sustainable development of coastal cities and marine resources has given rise to challenging environmental problems. Examples include the environmental impact assessment of dredging and sludge/spoil dumping and the transport and transformation of nutrients and heavy metals at the sediment-water interface. Urban development including large-scale land reclamation and population growth induced increase in sewage discharge puts the estuary ecosystem under stress.

Red Tide is a phenomenon in which the seawater is discolored by high algal biomass. Some algal species produce potent toxins, which accumulate in shellfish that feed on those algae, resulting in poisoning in human consumers. There has been a significant expansion of red tide episodes and impacts throughout the world over the last several decades. Very unusual red tides have occurred in the Bohai Sea, East China sea, and South China sea in the past decades. Delta and coastal processes, **eutrophication**, and **algal blooms** are the major challenges for the management of estuaries.

A variety of **river-uses** was the driving force of societal development in the past and now is even more important in economic and cultural development. Rivers, and the rich variety of plants and animals which they sustain, provided hunter-gatherer societies with water for drinking and washing, and with food, drugs and medicines, dyes, fibers, and wood. Farmers reap similar benefits as well as, where needed, irrigation for their crops. For pastoral societies, who graze their herds over wide areas of often parched plains and mountains, perennial vegetation along the banks of rivers provides life-sustaining food and fodder during dry seasons and droughts. Towns and cities use and misuse rivers to carry away their wastes. Rivers also served as roadways for commerce, exploration, and conquest. The role of rivers as the sustainers of life and fertility is reflected in the myths and beliefs of a multitude of cultures.

Many countries have taken an increasing interest in **integrated river management** coordinating various sectors of river issues. A developing country, like China, now strongly emphasizes the goal of flood control, water resources development, and protecting environment in addition to reducing poverty by supporting efficient and sustainable development of agriculture and light industries.

Water is acknowledged to have a significant impact on the economic development potential of individuals through agriculture, water supply and sanitation, public health, power generation, flood mitigation, etc. In addition, water sustains ecological systems, which also have economic value, and in turn generate a healthy hydraulic system. Poor people can improve their welfare by having access to water. In turn, people who are wealthier and better educated are better able under stress conditions to make cautious use of water, thus, not pre-empting the next generation from having similar benefits from the same water system.

Integrated river management aims at reconciling the provision of safety to the people dwelling by the river, sustainable use of the land and water, and limit impairment of the pristine bio-communities and improvement of aquatic and terrestrial ecology (Wang et al., 2014). It also aims at making water use economically productive, socially equitable, and environmentally sustainable. These goals can be achieved in principle in many ways, but the fact that the water system is characterized by important externalities and unusually high transaction costs (as compared to the power sector, for instance) limits the options for workable institutional arrangements. It is attractive to concentrate on a hydrographically coherent region such as a river basin, catchment, or drainage or **polder** area, as all key actors and all **decision-making** can be brought under one purview.

Where water users have managed to put their common long-term interest ahead of their desire for quick personal gain, and, thus, engaged in collective action, **catchment-based water management** has been practiced in many places around the world. For integrated river management, one has to understand the entire river system very well, including all issues of a river, and all aspects of the natural and human-impacted system and their interconnections.

◎名词注释

algae 藻类。algal bloom 藻华；red tide 赤潮，是严重的藻华。

alluvial 和 fluvial 都指冲积的：alluvial river 冲积河流，alluvial delta 冲积三角洲；fluvial process 冲积过程。

decision-making 决策过程，decision-maker 决策者。

delta 三角洲，来自希腊字母 Δ，指河口形成的三角状的岛屿，目前多指河口泥沙淤积影响的大片区域，例如长江三角洲泛指上海、江苏、浙江靠近长江口的大片区域。

ever-shifting bed 不断变动的河床。类似的词组有 ever-present 总是存在的；ever-young 永葆青春的；ever-bubbling 不断涌出的。

flood control 和 flood defense 都指防洪。近年来多用 flood defense 或 flood management，因为 flood 不能 control。

incised river 下切的河流，指通过河流侵蚀，河床不断下降的河流。类似的词：degradation 河床下切，aggradation 淤积抬升，二者指河流地貌变化，多为地貌学界采用；riverbed erosion 和 incision 河床侵蚀下切，sedimentation 和 siltation 河流淤积抬升，两者指挟沙水流造成的河床侵蚀下切或淤积抬升，多为水利工程界采用。

integrated river management 河流综合管理。

land creation 造陆。河流输沙到河口会造陆，现在通常发生 land loss，指河口海岸侵蚀造成的土地损失。

mountain river 山区河流；mountainous area 山区。

natural hazards 自然灾害。hazards 和 disasters 都指灾害，disasters 指已经发生的灾害，hazard 表示灾害性，所以减灾是 hazard mitigation，而不能用 disaster mitigation。例如联合国人道主义事务署 the United Nations Department of Humanitarian Affairs (UNDHA, 1992) 定义，Disaster: A serious disruption of the functioning of a society, causing widespread human, material, or environmental losses which exceed the ability of affected society to cope using only its own resources. Disasters are often classified according to their speed of onset (sudden or slow), or according to their cause (natural or man-made). Hazard: A threatening event, or the probability of occurrence of a potentially damaging phenomenon within a given time period and area. Risk:

Expected losses (of lives, person injured, property damaged and economic activity disrupted) due to a particular hazard for a given area and reference period. Based on mathematical calculations, risk is the product of hazard and vulnerability. **Vulnerability**: Degree of loss (from 0 to 100 percent) resulting from a potentially damaging phenomenon.

parched plain 非常干旱的平原。

perennial 常年的。perennial vegetation 一年四季常绿的植被；perennial flow 一年四季都流水。

polder 围垦区，来自荷兰语。

riparian 滨河的。例如 riparian forest 滨河植被，riparian wetland 滨河湿地。

river training 和 river harnessing：河流治理，多用前者。

river use 河流利用，包括饮用、发电、航运、娱乐、灌溉等。类似的 land use 土地利用。

river 河流。与 river 意思相近的词汇还有很多：valley 指河谷，如 v-shaped valley 指 v 形河谷；stream 指河流中的流水部分；channel 指河槽，如 open channel hydraulics 明渠水力学；canal 人工运河；creek 专指山溪；rivulet 小河；gully 沟谷；ravine 常年流水的山沟。

sanitation 卫生。

sediment-laden floods 挟沙洪水；Sediment-laden flow 挟沙水流。

sediment-transport capacity 水流挟沙能力，是水流的一种属性，不能用 transport capacity of sediment。

sewage 和 wastewater 都是污水。sewage 指城市污水或居民排放的污水；wastewater 指所有污水，多指工业废水。

tributary 支流，指水汇进主干的支流；dis-tributary 指从干流流出的支流。

watershed 流域，意思相近的词汇还有 basin，catchment。watershed 更偏重指河流的上游部分；basin 更强调流域的整体，如 drainage basin；catchment 指集水区，catchment area 流域。

1.1 HYDROLOGICAL CYCLE

Precipitation is the water falling over the land from the atmosphere primarily in the form of rain and snow. Precipitation can return to the atmosphere; move into the soil; or run off the earth's surface into a stream, lake, wetland, or other water body. More than half of the precipitation falling over the land evaporates to the atmosphere rather than being discharged as stream flow to the oceans. This "short-circuiting" of the hydrologic cycle occurs because of the two processes, interception and transpiration. A portion of precipitation never reaches the ground because it is intercepted by vegetation and other natural and constructed surfaces. The amount of water intercepted in this manner is determined by the amount of interception storage available on the above-ground surfaces.

Transpiration is the diffusion of water vapor from plant leaves to the atmosphere. Unlike intercepted water, which originates from precipitation, transpired water originates from water taken in by the roots of plants. **Evaporation** of soil moisture is, however, a much slower process due to capillary and osmotic forces that keep the moisture in the soil and the fact that vapor must diffuse upward through soil pores to reach surface air at a lower vapor pressure. When calculating the **hydrologic budget** of a watershed the transpiration from vegetation and the evaporation from the soil typically are considered together as **evapotranspiration**.

Infiltration. Close examination of the soil surface reveals millions of particles of sand, silt, and clay separated by channels of different sizes. The macro pores include cracks, "pipes" left by decayed roots and wormholes, and pore spaces between lumps and particles of soil. Water is drawn into the pores by gravity and capillary action. Gravity is the dominant force for water moving into the largest openings, such as worm or root holes. **Capillary action** is the dominant force for water moving into soils with very fine pores. Infiltration is the term used to describe the movement of water into soil pores. The infiltration rate is the amount of water that soaks into soil over a given length of time. The maximum rate at which water infiltrates into a soil is known as the soil's **infiltration capacity**.

Ground Water. The size and quantity of pore openings also determines the movement of water within the soil profile. Gravity causes water to move vertically downward. This movement occurs easily through larger pores. As pores reduce in size capillary forces eventually take over and cause water to move in any direction. Water will continue to move downward until it reaches an area completely saturated with water, the phreatic zone or zone of saturation. The top of the phreatic zone defines the **ground water table** or **phreatic surface**. In mountainous area the channels are incised very deep and lower than the phreatic surface of the neighboring hills, ground water flows through rock pores and the channel banks into the river, as shown in Figure 3. This part of ground water returning to the rivers keeps the stream flow perennial and relatively stable.

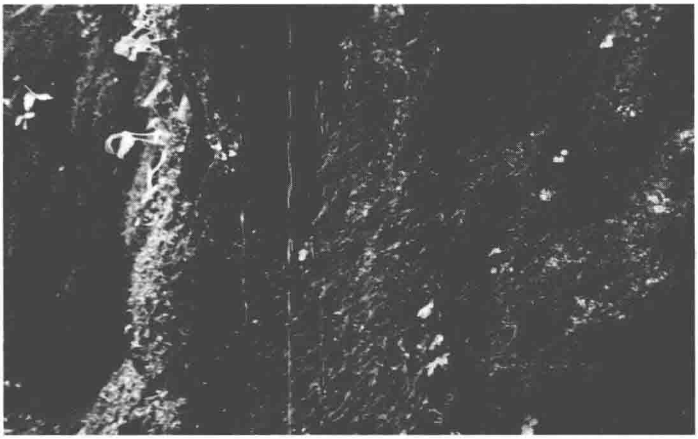


Figure 3 Ground water flows through rock pores and channel banks into the stream

If rainfall intensity is less than infiltration capacity, water infiltrates into the soil at a rate equal to the rate of rainfall. If the rainfall rate exceeds the infiltration capacity, the excess water either is detained in small depressions on the soil surface or travels down slope as **surface runoff** (Figure 4). Factors that affect runoff processes include climate, geology, topography, soil characteristics, and vegetation. Average annual runoff ranges from zero (desert) to more than 2 meters in China. The surface runoff gathers and flows in streams or rivers, and finally pours into the ocean. Runoff discharge (or discharge) is the volume of water flowing across a section of the stream per time and usually the unit of discharge is cubic meters per second (m^3/s or cms in some literature).

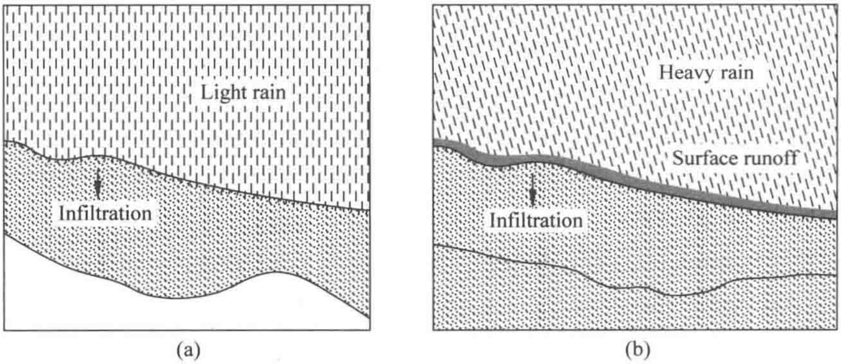


Figure 4 (a) No surface runoff for light rain; (b) surface runoff occurs when rainfall intensity exceeds the infiltration capacity

◎名词注释

capillary 毛细的；capillary action 毛细作用。

ground water table 地下水位。ground water 与 soil water 土壤水有本质不同。soil water 是土壤中受毛细管力作用的水，不能在重力下流动，只能被植物利用。

ground water 地下水，指重力作用下在土壤间隙中可以流动的水，不能翻译成 underground water。

hydrologic budget 水文概算，类似的还有 sediment budget 泥沙概算。

hydrological cycle 水文循环。

interception 截留。

osmosis 和 infiltration 中文翻译都是渗透，但是完全不同的过程。osmosis 指水透过膜从高浓度向低浓度的渗透，如 osmotic force 渗透力。infiltration 是水由表及里渗入土里，主要在重力和毛细管作用下从上往下渗透，如 infiltration capacity 渗透率。与 infiltration 意思相近的词还有 soak into 渗进，seepage 渗漏，leakage 淋滤，sink 渗下。

phreatic zone 地下水层。

runoff 径流；surface runoff 地表径流；annual runoff 年径流量。

topography 地形，比 morphology 地貌更局部更细节。

transpiration 蒸腾；evaporation 蒸发，从土地直接进入空气中；evapotranspiration 蒸散发。

1.2 DRAINAGE NETWORK

The drainage network occupies only a small part of a drainage basin, but it has been the subject of great geomorphic and hydrologic interest, especially since the publication of Robert Horton's paper on drainage network. The techniques developed by Horton for quantitative description of a drainage network opened the study and understanding of this complex geomorphic system. Horton's approach to network description was applied and expanded by the "Columbia School" of Strahler and his students, and many studies of drainage basins and stream networks have followed the lead of Horton and Strahler.

Stream Ordering. Horton developed a method of classifying, or ordering, the hierarchy of natural channels within a watershed, but the modified system by Strahler (1957) is probably the most popular today. Strahler's stream ordering system is portrayed in Figure 5(a). The uppermost channels in a drainage network (i.e., headwater channels with no upstream tributaries) are designated as first-order streams down to their first confluence. A second-order stream is formed below the confluence of two first-order channels. Third-order streams are created when two second-order channels join, and so on. Note in the figure that the intersection of a channel with another channel of lower order does not raise the order of the stream below the intersection (e.g., a fourth-order stream intersecting with a second-order stream is still a fourth-order stream below the intersection). Within a given drainage basin, stream order correlates well with other basin parameters, such as drainage area or channel length. Consequently, knowing what order a stream is can provide clues concerning other characteristics such as which longitudinal zone it resides in and relative channel size and depth.

The stream ordering method by Horton and Straheler is very useful for theoretical analysis but not convenient for engineering studies because one has difficulty to identify the first-order streams in a watershed, which depends on the map used for the stream ordering. In engineering practice the channels are ordered in the following method as shown in Figure 5(b): the channels flowing into the stem river, which flows into the ocean, are the first order tributary of the river; the channels flowing into one of the first-order