

Eugene J. Hall

English For Careers

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# The Language of Electrical and Electronic Engineering in English



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Illustrations by Bernie Case

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## FOREWORD

This book is one of a series of texts called *English for Careers*. The series is intended to introduce students of English as a foreign language to the particular language of different professional and vocational fields. The career areas covered are those in which English is widely used throughout the world—computer programming, air travel, international finance, the petroleum industry, and in this book, electrical and electronic engineering.

Each book in the series serves to give the student an introduction in English to the vocational area in which he or she is interested. *The Language of Electrical and Electronic Engineering* gives some of the theoretical background on which practical applications of electrical energy are based. There is also a discussion of the developments that are expected to take place in this field in the coming years.

The books in the series are intended for students at the high intermediate or advanced level, who are acquainted with a majority of the structural patterns of English. Thus, from the point of view of English as a foreign language, each book is designed to aid students in mastering the vocabulary of an area of specialization, and to give them practice using the vocabulary in conversational situations. The goal is for students to improve their ability to communicate in English, particularly with others in their field.

Each unit of this book begins with a glossary of special terms in which words and expressions used in electrical and electronic engineering are defined. The special terms are followed by a vocabulary practice section, which tests the student's comprehension of the terms and gives practice in their use. In the reading passage, these terms are used again within a contextual frame of reference. The reading passage is followed by questions for discussion, which give the student the opportunity to use in a communicative situation both the vocabulary items and the structural patterns that have occurred in the reading.

Each unit ends with a review section of one or two exercises. Some exercises test the student's ability to recall the special vocabulary. Other exercises pose problems the student might encounter in the field—he or she might be asked to identify some of the symbols used in diagrams of electric circuits, or to discuss the advantages or disadvantages of using certain kinds of equipment. In doing these exercises, the student will again be practicing the specialized vocabulary and the structural patterns used with them.

A great deal of successful language learning comes from experiences in which the learning is largely unconscious. In offering these books, we hope that the students' interest in the career information presented will facilitate their learning to communicate more easily in English.

EUGENE J. HALL  
Washington, D.C.

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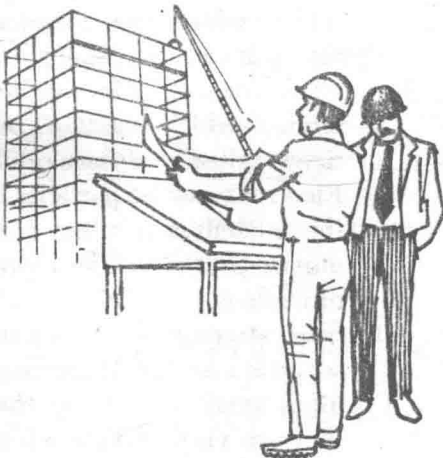
## UNIT ONE

# THE ENGINEERING PROFESSION

### Special Terms

**Engineering:** The practical application of the findings of theoretical science. An *engineer* is a member of the engineering profession. The term "engineer" is also used to refer to a person who operates or maintains certain kinds of equipment—a railroad locomotive engineer, for example. In that case, the person referred to is a technician rather than a professional engineer.

**Profession:** An occupation such as law, medicine, or engineering which requires specialized education of four or more years at the university level.



Civil engineers.

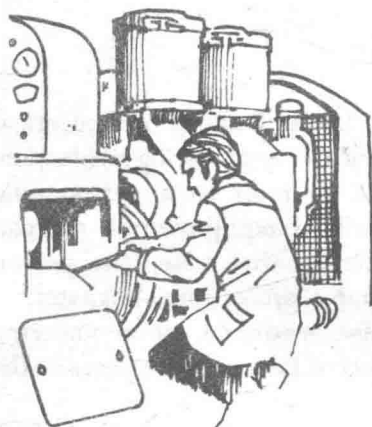
**Civil Engineering:** The branch of engineering that deals with planning structures for civilian use such as roads, buildings, bridges, and water supply and sewage systems. *Military engineering* is concerned with similar projects for military use.

**Mining and Metallurgy:** The branch of engineering that deals with extracting metal ores from the earth and refining them.





A mining engineer.



A mechanical engineer.



A chemical engineer.

**Mechanical Engineering:** The branch of engineering that deals with machines and their uses.

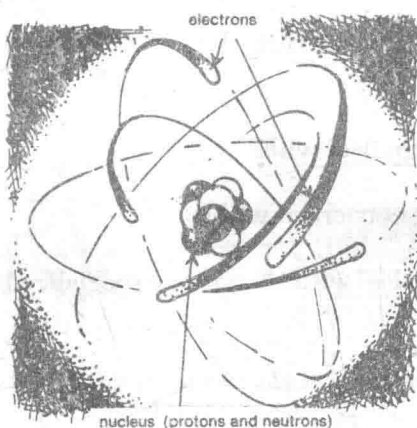
**Chemical Engineering:** The branch of engineering that deals with the processes involved in reactions among the elements, the basic natural substances. *Petroleum engineering* deals specifically with processes involving petroleum.

**Electrical and Electronic Engineering:** The branch of engineering that deals with the processes and devices derived from the movement of electrons.

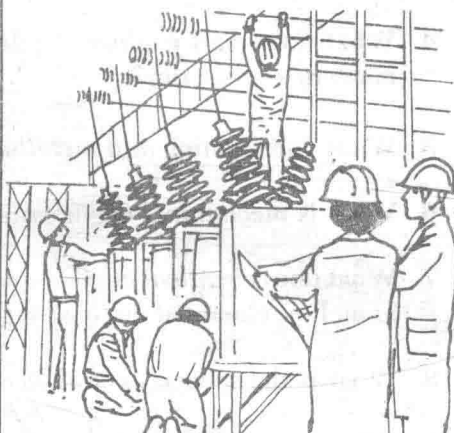
**Nuclear Engineering:** A modern branch of engineering that deals with finding practical uses for the processes that result from breaking up the nuclei of atoms.

**Atom:** The basic particle of matter of which the chemical elements are made up. An atom consists of a *nucleus* around which smaller particles called *electrons* orbit. Electrons and the particles in the nucleus are called *sub-atomic particles*. The plural of nucleus is *nuclei*.

**Electron Microscope:** A microscope is a device which magnifies small objects so that they are visible. An electron microscope uses a beam of



An atom.



Electrical engineers.

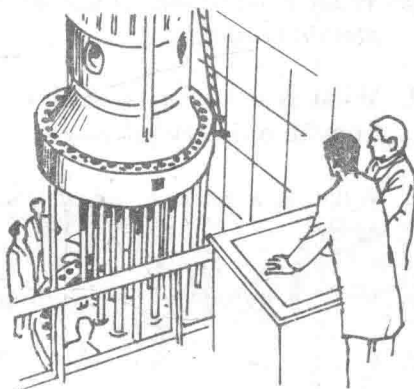
electrons instead of light to magnify images.

**Particle Accelerator:** A device that speeds up subatomic particles. It is used for research in atomic physics.

**Empirical Information:** Information based on observation and experience rather than on theoretical knowledge.

**Aqueduct:** A structure that is used to carry water over long distances.

**Quantification:** Putting data (pieces of information) into exact mathematical terms.



Nuclear engineers.

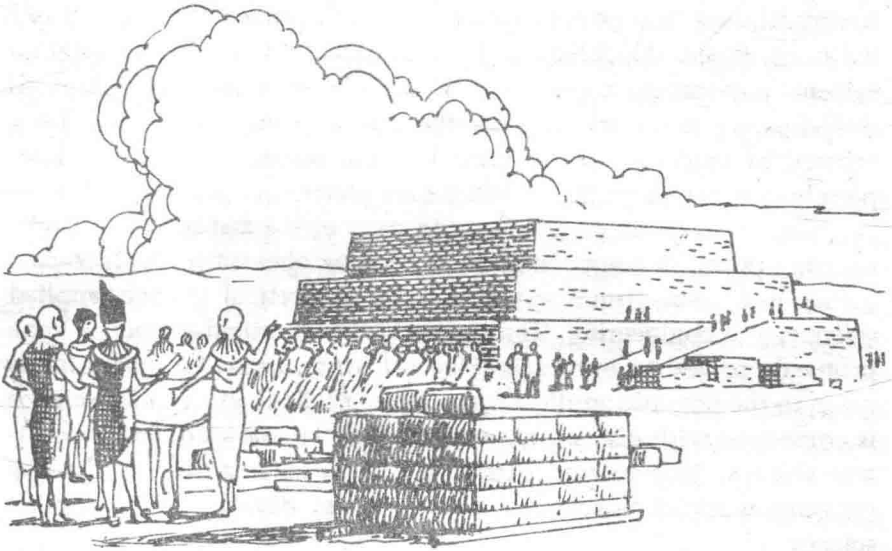
## Vocabulary Practice

1. What does *engineering* mean?
2. How does a railroad locomotive engineer differ from a professional engineer?

3. What is a *profession*? Give examples.
4. What does *civil engineering* deal with? How does it differ from *military engineering*?
5. What does *mining and metallurgy* deal with?
6. What is *mechanical engineering* concerned with?
7. What does *chemical engineering* deal with? Name one specialized branch of chemical engineering.
8. What is the special area of *electrical and electronic engineering*?
9. What is *nuclear engineering*?
10. What is an *atom*? What are its different parts? What is a *sub-atomic particle*?
11. What is a *microscope*? How does an *electron microscope* differ from an ordinary microscope?
12. What is a *particle accelerator*? In what kind of research is it used?
13. What is *empirical information*?
14. What is an *aqueduct* used for?
15. What is meant by *quantification*?

## ***The Engineering Profession***

*Engineering* is as old as history. One of the earliest engineers was Imhotep, who designed the stepped pyramid of Sakkhara in Egypt in the twenty-seventh century B.C. Mankind could not have emerged from a primitive hunting and gathering existence without the engineering skills needed to create tools, metal refining processes, buildings, roads, and irrigation and sanitation systems. As human society has grown more complex, the need for many different engineering skills



The construction of a pyramid in ancient Egypt.



Engineering has a great influence on our daily lives.

has multiplied. In our era, engineering has significantly changed our daily existence. Machines and communication and transportation systems not only do a great deal of our work but have also increased our capacity for work. Indeed, the social changes that have been created by engineers are so great that our society has not yet completely come to grips with all that they mean.

*Engineers* make practical application of the findings of theoretical, or "pure," sciences such as physics or chemistry. A three-part distinction is sometimes made between theoretical science, applied science, and engineering. The research of theoretical science is done primarily to add to our knowledge of nature. Little consideration is given to the possible applications of research findings. Applied science is concerned with discovering ways to use the knowledge of theoretical science. Engineering carries the research one step further by devising workable processes based on the discoveries of applied science.

An example of this three-part system is in the development of nuclear energy. Chemists and physicists studied the structure of the *atom* over a long period of time. They learned that atoms of uranium-235 could be split into two nearly equal parts, releasing a great deal of energy in the process. Then, under the pressures of World War II, applied science took over the research to find a military use for this release of energy. Applied scientists discovered that it was possible to create a chain reaction, a controlled release of energy that continued by itself. Then, engineers together with scientists began to work out the difficult and complex systems that made the atomic bomb a reality. After the war, scientists and engineers again worked as a team to find ways of putting atomic energy to work for peaceful purposes such as generating electric power.

This is a comparatively clear-cut example of the distinction between what might be called the "three sciences." However, as our knowledge of science has grown, engineers have begun to play a greater role in all phases of scientific work. Devices such as *electron microscopes* and *particle accelerators*, designed and built by engineers, are used in the search for basic information. At the same time, more and more engineers are members of scientific teams involved not only in the development of workable machines and systems, but in all aspects of research.

For thousands of years, engineers based their work on *empirical information*—information that depended on observation and experi-

ence rather than on theoretical knowledge. Many ancient structures, such as the *aqueducts* of Rome, have survived because they were built with greater strength than would be considered necessary by modern standards, which are based on scientific research and complex mathematical calculations.

The earliest engineering work was in the fields that we would now call civil and military engineering, and mining and metallurgy. *Civil engineering* is concerned with the construction of buildings, roads, bridges, and irrigation and sanitation systems for civil as opposed to military use. *Mining and metallurgy* involves finding deposits of metal-bearing ores and developing systems for refining them. So important is this branch of engineering that mankind's progress in civilization is marked by the names of the metals in use at different periods of history—the Bronze Age and the Iron Age.

The modern age, which began in the sixteenth and seventeenth centuries, has brought an explosion of science in every field—physics, chemistry, astronomy, and physiology—and has introduced new fields, such as nuclear physics. One of the reasons for this rapid increase in scientific knowledge has been the use of the experimental method to verify theories. At least as important has been the use of *quantification*—putting the data acquired through experimentation into exact mathematical terms. Mathematics is the language of modern engineering.

As scientific knowledge increased, so did its practical applications. The eighteenth century witnessed the beginning of the Industrial Revolution, when machines began to take over more of the work that had previously been done manually. In the nineteenth century scientific research and the practical application of its results progressed rapidly. This brought a greater understanding of natural forces as well as substantial changes in the way people lived.

Another result of the growth of knowledge was an increase in the number of scientific and engineering specialties. By the end of the nineteenth century, civil engineering, *mechanical engineering*, and mining and metallurgy had been established, and courses were being offered in the newer specialties of *electrical* and *chemical engineering*. The number of specialties has continued to grow right up to the present, with the establishment of such disciplines as aerospace, *nuclear*, *petroleum*, industrial, and *electronic engineering*. Some of these have developed from older disciplines—petroleum from chemical engineering, and electronic from electrical engineering.

Because of the variety and number of engineering fields today, there are often many different kinds of engineers working on large projects such as space exploration and nuclear power development. On such projects, the engineer is usually a member of a team headed by a systems engineer, a person who coordinates the contributions made by all the different disciplines. Because teamwork enters into so many engineering projects, being able to work easily with others is an important qualification for engineers.

A final result of the increase in scientific knowledge is that engineering has become a *profession*. A profession is an occupation like law or medicine that requires specialized advanced education; they are often called the "learned professions." Until the nineteenth century, engineers were for the most part craftsmen who learned their skills through apprenticeship, or on-the-job training. Today, becoming an engineer requires at least a four- or five-year university course leading to a Bachelor of Science or an engineering degree. More and more engineers, especially those engaged in research, go on to get a master's or doctor's degree. Even those engineers who do not study for advanced degrees must keep up with changes in their own field and related areas. All of this means that an engineer's education is never really finished; he or she must be willing to be involved in a constant learning process.

The word "engineer" has two uses in English. One, as we have indicated, refers to the professional engineer who has a university degree and an education in mathematics, science, and one of the engineering specialties. "Engineer," however, is also used to describe a person who operates or maintains an engine or a machine. A good example of this is the railroad locomotive engineer who runs our trains. These engineers are essentially technicians rather than professional engineers, the kind we will refer to in this book.

There are two other important considerations for today's engineers. First, they work with management and government officials who are very cost-conscious and demand that engineering systems be workable not only from a technical, but also from an economic point of view. Therefore, an engineer must be able to develop his or her ideas within the financial realities of a particular project.

Second, the general public has become much more aware in recent years of the social and environmental consequences of engineering projects. For much of the nineteenth and twentieth centuries, engineering was the most visible part of science, and since the general

attitude was that all science was good, engineering progress was usually accepted without reservation. Today, people are showing greater concern about possible dangers resulting from advances in engineering. Generating electric power by means of nuclear energy has not progressed as rapidly as many scientists and engineers predicted, partially because of the public's new awareness of the human and environmental dangers involved. Engineers cannot work in a scientific vacuum but must also take into account the social consequences of their work. We have, after all, described engineering as a profession which makes practical application of the findings of theoretical science. A successful engineer must include in a definition of "practical" the idea that the work should be desirable to society and safe for human beings.

## ***Discussion***

1. What is one piece of evidence that we have about how old engineering is?
2. What were some of the products of engineering skills that were necessary in order for mankind to emerge from a primitive existence?
3. How has engineering changed our daily existence?
4. What three-part distinction is often made concerning science? What is the function of each of these parts of science?
5. What example is given of this division of scientific effort into three parts? Can you think of any other examples?
6. Why is the distinction between the three aspects of science no longer so clear-cut?
7. What are two devices often used in basic scientific research?
8. On what kind of information did engineers base their work for thousands of years?



9. Why are many structures from ancient times still in existence?
10. What were the earliest fields of engineering? What kinds of things did each field deal with?
11. What has happened to science since the beginning of the modern age?
12. What are two of the reasons for this rapid increase in scientific knowledge?
13. What effect did the increase in scientific knowledge have in the eighteenth century?
14. What happened to science and engineering in the nineteenth century?
15. In what engineering specialties were courses being offered by the end of the nineteenth century?
16. What are some of the specialties that have developed since then?
17. Why are many engineers members of teams nowadays?
18. Who usually heads a team of engineers?
19. What are some of the "learned professions?" Why has engineering become one of them?
20. What kind of training did most engineers have up until the nineteenth century?
21. What is the minimum education required of an engineer?
22. Why must an engineer be willing to be involved in a constant learning process?
23. What meaning of the term "engineer" will be used in this book? What meaning will not be used?