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Scientifically Speaking

An Introduction to the English of Science and Technology

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Preface

'*Scientifically Speaking*' is a short introduction to the English written and spoken by scientists and engineers. The book shows the specialized English of science and technology in use, and gives examples of many words which are frequently found in a number of scientific and technological fields.

After a general introduction on technical English, there are twelve chapters, each of which deals with a particular technological subject by means of written texts, diagrams and conversations. The most useful vocabulary items from the chapters are studied in detail. There is also a general vocabulary at the end of the book. A special appendix comments on some of the grammatical structures and sentence patterns commonly used by scientists and engineers which occur throughout the book.

The reader is not expected to be an expert in the subjects dealt with in the book. He needs to have a knowledge of elementary science and mathematics, but the technical subject matter of the book is presented in a way that will be of interest to the specialist and non-specialist alike. Since the technical and semi-technical words which occur in the English texts are studied in detail or appear in the general vocabulary, the book can be used without the help of a technical dictionary.

The Recordings

This book is intended to be used with recordings issued by the B.B.C. on 7″ LP discs (or tapes, or cassettes). They consist of the twelve conversations printed in the book and the equations and formulae on pages 125, 126 and 127. The principal characters in the conversations; the scientific journalist, Giles Newton and his wife Susan, will be familiar to audiences of the B.B.C. English by Radio series '*Scientifically Speaking*'.

A series of recorded drills and oral exercises based on the lessons for classroom and language laboratory use, is also on sale in many countries. Full particulars are available from English by Radio and Television, B.B.C., Queen's House, 28 Kingsway, London, W.C.2.

Introduction

I. Technical English

WHAT IS TECHNICAL ENGLISH?

When you read a piece of technical writing in English for the first time, or when you first hear scientists or engineers talking in English, you may find it very difficult to understand what is written or spoken, particularly if you have learned English as a language of everyday conversation and of literature. You may think that there is a special kind of English which is used only in science and technology and which has to be learned as a separate language. You may also feel that somehow the English of science and technology is much more difficult than everyday English. In fact, technical English does differ from everyday English, because of the specialized contexts in which it is used and because of the specialized interests of scientists and engineers. But the differences do not present any great problems once they have been recognized.

The following passage illustrates some of the features of technical English:

(Mr. Smith enters Dr. Brown's office. Dr. Brown is a consultant. Dr. Brown speaks.)

DR. BROWN **Good morning, Mr. Smith. Can I take your coat? Awful weather, isn't it? Do sit down. Cigarette?**

MR. SMITH **No, I don't smoke, thanks very much.**

DR. BROWN **Well, I've been looking into your enquiry about the corrosion trouble you've been getting in the control valve. I'm sorry you've had trouble—quite unexpected—but I think we have the answer. The most probable cause of corrosion at a metal-to-metal junction immersed in an ionized fluid is electrolytic.**

In this passage, Dr. Brown begins by talking informally to his visitor, but when he talks as an expert about his specialized subject—corrosion—his way of talking changes. His statements are impersonal, his style of speech is formal and he uses many technical terms.

Now here is an example of technical writing in English.

The main results obtained were:

(1) If an oscillatory motion was superimposed on steady shearing, the maximum torque on the top plate during the combined motion was scarcely more than the torque in steady shearing alone; the minimum was considerably less. The average torque was much less in the combined motion and it is possible that the average rate at which work was absorbed was less in the combined motion than in the steady shearing alone.

(A later analysis has shown an increase in these two cases.)

(2) The response of the material to oscillatory motion was non-linear below about 20 c/s in these experiments.

For a shear rate of the form:

$$s = s_0 \cos \omega t \qquad (1)$$

The stress was of the form:

$$= \sum_{n=1} A_{2n-1} \cos \{(2n-1)\omega t - \phi_{2n-1}\} \qquad (2)$$

The whole of this passage is in an impersonal, formal style, with a very high concentration of technical terms and a number of mathematical symbols (see also page 125). Some of these characteristics of technical English are examined in the sections which follow.

IMPERSONAL, OBJECTIVE STATEMENTS AND ATTITUDES

Scientists and engineers are interested in things and processes, in properties and characteristics. They are also trained to be objective. They endeavour to make statements or observations on which all observers would agree, and to make agreement easier they express many of their observations in numbers or by meter readings.

A non-scientist may be content to say that he can see a green light when he looks into an optical instrument. But 'green' is a subjective word and green is a colour of many possible shades. Verbal descriptions of colour given by different observers do not agree closely. So a scientist prefers to describe a colour by stating its wavelength, or its range of wavelengths and their intensities, because wavelengths and intensities can be read on the scales of suitable meters by anyone who is not blind. A scientist always invites others to verify his descriptions of what he observes. He accepts as facts only impersonal, objective statements about things which can be seen by any observers who choose to look.

This objective attitude is naturally reflected in the way scientists and engineers express themselves and particularly in the kinds of grammatical structures and sentence patterns which they prefer, although the sentence patterns which occur in technical English are also found in non-technical English. Several of the patterns which occur most frequently in technical English are dealt with in the appendix at the end of this book.

II. Technical Vocabulary

SPECIALIZED VOCABULARIES

We have seen that technical English uses grammatical and syntactic forms and patterns which also occur regularly outside technical English. There are no new forms or patterns to be learned. However, the vocabulary of any technical discussions or piece of writing may include words which are never used outside the subject or field in question. If you do not know the subject, you will not understand what is said or written, even if English is your mother tongue. This is not surprising. Specialized vocabularies are not confined to science and technology. There is a specialized vocabulary of ballet and a specialized vocabulary of cricket. You are unlikely to understand a conversation between ballet enthusiasts or cricket enthusiasts unless you know something about ballet or about cricket. But the vocabularies used in science and technology are very large, and in English they include many semi-technical or non-technical words which are used in unfamiliar ways so that their new meanings must be learned.

TECHNICAL WORDS

As the range of knowledge and achievement increases in any scientific or technological field, new terms are needed to define new phenomena and to explain new things and processes. Often suitable terms have to be invented. Scientists have been extending the vocabularies of their subjects for centuries and each subject has its own store of terms with precise, narrow meanings (e.g. *bandwidth*, *flip-flop, semiconductor, solenoid*). Clearly it is not necessary to know *all* the separate technical vocabularies in order to deal with even very difficult technical reports or publications in one particular field. A physiologist will want to know one set of terms, an electrical engineer another. Moreover many of these highly technical terms are adopted internationally with only slight variations, usually to allow for differences in pronunciation or in word forms from one language to another. For example:

ENGLISH	FRENCH	GERMAN
electrolysis	electrolyse	Elektrolse
acetylene	acetylene	Azetylen
condenser	condensateur	Kondensator
magnesium	magnesium	Magnesium
pancreas	pancreas	Pankreas

There are of course many other technical words, particularly the well established names of substances, which differ from one language to another (e.g. English: *iron*, French: *fer*; English: *oxygen*, German: *Sauerstoff*).

Many technical terms are made up from Latin and Greek roots, prefixes and suffixes which soon become familiar (e.g. *ethylene*, *polyethylene*, *polytetrafluoroethylene*, *binomial*, *quadrinomial*). Other technical terms may be made up from existing words whose meaning is well known and is not substantially altered in the technical compound word (e.g. *feedback*, *hovercraft*. *overpass*, *undercarriage*). Sometimes words which are invented for use in one field are later added to the vocabularies of other fields.

Although there are good technical dictionaries which will solve most problems of technical vocabulary, you will find in this book notes on the way in which many technical words are formed, and each chapter contains a number of technical terms relevant to its subject.

SEMI-TECHNICAL WORDS

There are many words whose use is not confined to scientific and technological contexts and which are an essential part of technical English. Some of these are formed from Greek or Latin roots (e.g. *efficiency*, *energy*, *flux*, *moment*), but they are not usually the same in all languages. They include the basic words of the older sciences such as mechanics, and they have usually been taken from everyday language and given a precise definition for scientific use (e.g. *force*, *load*, *mass*, *matter*, *power*, *work*). As a result, the meanings of these words in their technical use are likely to differ from their non-technical meanings. Moreover, they may have different precise meanings in different technical fields. Thus the word *reaction* might in an everyday context refer to a man's *reaction* to hearing of the death of his wife, while in chemistry it might be used to refer to the *reaction* of ammonia with carbon dioxide to form urea. In nuclear physics it might refer to a nuclear chain *reaction* and in civil engineering it might refer to the *reaction* of a beam against the weight of a load placed on the beam. The wide technical use of words like *reaction* has also led to the introduction of many related forms of a single word (e.g. *to react, reaction, reactive, reagent, reactor, reactance*). Because these semi-technical words may present difficulties due to their several meanings and because many of them are general in their technical application, and therefore useful in a number of scientific and technological fields, this book will include as many of them as possible, giving examples of their related forms and comparing their different meanings in the word-study sections of the chapters.

FORMAL, NON-TECHNICAL WORDS AND EXPRESSIONS

There remains a class of strictly non-technical words and expressions which are seldom found outside technical English. They have been incorporated into the precise, impersonal, formal English of scientists and engineers partly because they seem to avoid the ambiguity or imprecision of more commonly used words with the same apparent meanings. Thus *to determine* is often used instead of *to find out, to convert* instead of *to change, appreciable* instead of *a lot of*. There are also expressions like *to be under construction, to come under load, to come into operation,* which are more common in technical English than in everyday English. There are many examples in this book from this class of words and expressions, and several are featured in the word-study sections.

WORD-STUDY SECTIONS AND VOCABULARY

The word-study sections after most chapters compare useful expressions and words which have similar forms and meanings. They also feature a number of terms from economic and sociological fields, which occur frequently in science and technology. At the end of the book, there is a full vocabulary of the technical and semi-technical terms which occur, with phonetic equivalents.

1. Plastics

The journalist, Giles Newton, and his wife, Susan, are at home after spending the day at a plastics exhibition.

SUSAN NEWTON **I just can't help thinking of things made from plastics as imitations, as cheap substitutes.**

GILES NEWTON **If by 'cheap' you mean less expensive, then you're quite right. For example, that new watering can we bought for the garden.**

SUSAN **Yes, it did cost less than a metal one.**

GILES **Do you remember why we bought it?**

SUSAN **I liked the nice bright yellow colour. But you can buy coloured metal ones, too.**

GILES **Ah! But with plastics, the colour goes all the way through, because the pigments are mixed in with the raw materials. They don't have to be painted like metal.**

SUSAN **What does it matter? The result's the same!**

GILES **No, it isn't. Take a watering can, or a child's toy, or even something you use in the kitchen, like your washing-up bowl. What happens when they're knocked against something hard?**

SUSAN **You mean if they're metal?**

GILES **Yes.**

SUSAN **I suppose, after a while the paint becomes chipped. All right, I see the point. With plastics the colours won't chip off.**

GILES **But do you remember another reason why we decided to buy a new watering can?**

SUSAN **Of course. The old one was so rusty. There were holes in the bottom . . . I see. Plastics don't rust like metal.**

GILES **Exactly. Are you beginning to feel more kindly towards plastics?**

SUSAN **I've nothing against them, Giles, but they are used instead of the original materials, so that makes them substitutes, doesn't it.**

GILES **Do you remember what Mr. Harvey said?**

SUSAN **Who?**

GILES **The plastics expert, you know, the chemist, in the recording I made at the exhibition.**

SUSAN **Oh yes, of course.**

GILES **And, incidentally, my tape recorder wouldn't be so small or so light if it weren't for the fact——**

SUSAN **I know, if it wasn't made of plastics.**

GILES **You're learning. I'll just run the tape back to the right place. I think this is where it is. Listen.**

(*On tape recorder*)

GILES **. . . people who call them substitutes.**

MR. HARVEY **Oh, yes, some still do but they're quite wrong, Mr. Newton. Plastics are materials in their own right. Cheapness is not the only factor that makes them acceptable to industry. Before it can replace any other material—like wood, metal or a natural fabric—a plastics material must have a performance that is at least comparable to whatever was previously used.**

SUSAN **And I suppose sometimes they're even better.**

MR. HARVEY **Frequently, particularly when the properties of the material are adjusted, or even created, to suit the specific requirements of the end product.**

GILES **What sort of properties?**

MR. HARVEY **The degree of rigidity or flexibility, for example; resistance to acids, insulating qualities, ability to withstand sudden changes of temperature. Oh, the list is endless because the plastics industry is being asked continually to recommend or develop materials for such a wide variety of new uses.**

GILES **Do they succeed?**

MR. HARVEY **More often than not. In fact, there are so many types of plastics with so many unique properties, they frequently provide answers to unsolved engineering problems.**

(*Giles Newton stops the tape recorder*)

GILES **Well, Susan?**

SUSAN **He talks so easily about unsolved engineering problems. I'd be more impressed with an example—but a simple one, of course.**

GILES **As simple, perhaps, as your habit of leaving the refrigerator door partly open?**

SUSAN **Well, the catch is broken.**

GILES Susan! It was repaired two months ago.

SUSAN Oh, all right! I sometimes give it a push with my elbow and it doesn't quite close. So?

GILES Well, somebody thought of making refrigerators without door-catches. Have you heard of polyvinylchloride—better known as PVC?

SUSAN Of course! The upholstery in the car, the kitchen floor tiles, the shower-curtains in our bathroom, they're all different types of PVC.

GILES Well, that's what was used to solve this particular engineering problem: PVC, with a magnetic filler.

SUSAN So, when the door is almost closed, magnetic attraction pulls it, keeps it tightly shut. That's very clever.

GILES And it's cheaper to make.

SUSAN And the refrigerator has a better door. Marvellous!

Plastics are Polymers

Plastics are organic materials which at some stage can be moulded or shaped as required. They are synthetic—man-made, not natural materials, and are composed of long chain-like molecules called polymers. Each of these polymer molecules is formed by joining together many thousands of small molecules called monomers. The monomer molecule is an arrangement of atoms which can be made to react with similar monomer molecules to form a chain. The reaction is known as polymerization.

The monomers from which plastics are made are generally produced by separation from natural gases or from oil. These substances are sometimes combined with other chemicals, such as chlorine. By means of pressure and heat, and often with the aid of catalysts, the monomer molecules of the gas or liquid react and, as they combine, form the polymer molecules of the raw plastics, which is generally in the form of a powder or of granules. By careful control of the polymerization, the monomer molecules may be arranged and joined in a number of ways. Thus the properties of each of the many plastics materials can be modified to suit a wide range of products and applications.