# Further Scientific English Practice

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## Foreword

This book provides reading material of scientific interest that is harder than the pieces to be found in *Scientific English Practice*. The passages come from the writings of scientists in the forefront of modern thinking, and it is hoped that students will find them interesting.

### Vocabulary

More difficult words are needed in this book than in *Scientific English Practice*. At the end of each passage there is a glossary, which explains the words and phrases printed in *italics* in the texts. An important point to be noted is that the glossaries explain words as they are used in the particular passage; this may *not* always be the word's most common meaning. The words included are those that are not among the 5,000 most common English words, as well as more common words that are used with a special scientific meaning. At the end of the book, a word index lists the words from all the glossaries in alphabetical order, and shows in which glossary a word can be found.

### Pronunciation

The pronunciation of every word in the glossaries is given in a simple international transcription. British pronunciation is used, and the transcription is similar to that in, for example, *An International Reader's Dictionary* by Dr Michael West (Longman, 1965 and later reprints). The symbols used are as follows (in alphabetical order as far as possible):

VOWELS

| | | |
|---|---|---|
| [a] | as in b*a*d | [bad] |
| [aː] | as in f*a*r | [faː] |
| [ai] | as in m*i*ne | [main] |
| [au] | as in n*ow* | [nau] |
| [e] | as in b*e*d | [bed] |
| [ei] | as in s*ay* | [sei] |
| [eə] | as in wh*ere* | [weə] |
| [ə] | as in *a*bove | [ə'bʌv] |
| [əː] | as in h*er* | [həː] |
| [i] | as in h*i*t | [hit] |
| [iː] | as in m*ee*t | [miːt] |
| [iə] | as in h*ear* | [hiə] |
| [o] | as in n*o*t | [not] |
| [oː] | as in f*or* | [foː] |
| [oi] | as in b*oy* | [boi] |
| [ou] | as in g*o* | [gou] |
| [u] | as in p*u*t | [put] |
| [uː] | as in b*oo*t | [buːt] |
| [uə] | as in s*ure* | [ʃuə] |
| [ʌ] | as in c*u*t | [kʌt] |

CONSONANTS

| | | |
|---|---|---|
| [b] | as in *b*ig | [big] |
| [d] | as in *d*ay | [dei] |
| [dʒ] | as in *j*ump | [dʒʌmp] |
| [f] | as in *f*or | [foː] |
| [g] | as in *g*et | [get] |
| [h] | as in *h*im | [him] |
| [j] | as in *y*es | [jes] |
| [k] | as in *c*ome | [kʌm] |
| [l] | as in *l*ike | [laik] |
| [m] | as in *m*y | [mai] |
| [n] | as in *n*o | [nou] |
| [ŋ] | as in bri*ng* | [briŋ] |
| [p] | as in *p*ut | [put] |
| [r] | as in *r*un | [rʌn] |
| [s] | as in *s*o | [sou] |
| [t] | as in *t*op | [top] |
| [tʃ] | as in *ch*air | [tʃeə] |
| [v] | as in *v*ery | ['veri] |
| [w] | as in *w*e | [wiː] |
| [z] | as in i*s* | [iz] |
| [θ] | as in *th*rough | [θruː] |
| [ð] | as in *th*is | [ðis] |
| [ʃ] | as in *sh*e | [ʃiː] |
| [ʒ] | as in plea*s*ure | ['pleʒə] |

Syllabic consonants have the mark ̩ below them, as in tab*le* ['teibl̩]. The mark ' is written before the syllable that has the main stress, as in ['veri].

## Exercises

The exercises that follow each passage are probably harder than those in the earlier books, because more difficult words and structures are needed for these subjects. The Index to Language Questions, at the end of the book, shows where exercises on a particular structure can be found.

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# Contents

# 1 The Interior of the Earth
## Sir Fred Hoyle

Sir Fred Hoyle (born 1915) is one of the world's foremost *astronomers*. He is also a great mathematician, and was lecturer in mathematics at Cambridge University before he became a professor. One of his many books is *Frontiers of Astronomy* (1955), from which the piece below is taken.

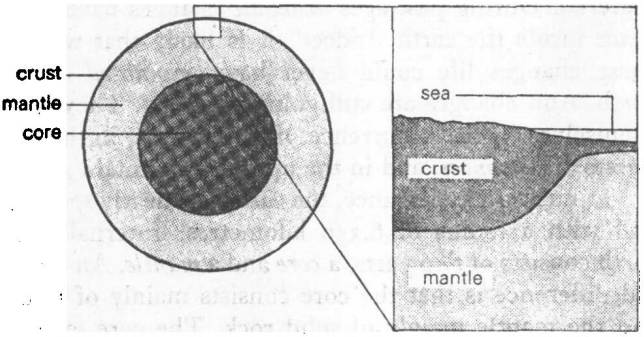
The planet we live on is not just a ball of *inert* material. During past ages *dramatic* changes have taken place inside the earth. Indeed, it is likely that without these changes life could never have *originated* on the earth. And changes are still going on today. They show themselves in the occurrence of *earthquakes*, in the outbursts of *volcanoes*, and in the uplift of mountain *ranges*.

In outward appearance, the earth is a nearly *spherical* ball with a radius of 6,350 kilometres. Internally the earth consists of two parts, a *core* and a *mantle*. An essential difference is that the core consists mainly of liquid and the mantle mainly of solid rock. The core extends outwards from the centre to a distance of some 3,450 kilometres. The mantle, as its name shows, is an outer covering extending from the core to the surface of the earth.

Judged by ordinary standards, the core is made of rather *dense* stuff. The material at the centre of the earth is at least thirteen times as heavy as ordinary water, while in the outer parts of the core the material is about ten times as heavy as ordinary water.

The mantle possesses a thin outer *crust* that is exceptional *in being composed of*[1] a particularly light kind of rock, with a *density* about 2·7 times that of water. (Compare this with a density of 13 at the centre of the earth.) Over

the continents of the world this crustal rock is about thirty-five kilometres thick, while over the oceans it is at most only two or three kilometres thick. Below the crustal *layer* comes a different, denser rock, probably *of a basic silicate variety.*[2] Indeed it seems likely that, apart from the thin outer crust, the rocks of the whole mantle are of a basic silicate variety right down to the *junction* with the core, at a depth below the surface of about 2,900 kilometres.




*Cross-section of the earth.*

We must now introduce the idea that the pressures occurring inside the earth are very considerable. It is well known that at sea level our atmosphere exerts a pressure of about fifteen pounds per square inch. This in itself is *no mean pressure*[3], as we all soon *come to realise*[4] if we have to pump up an automobile tyre. But the pressure inside the earth is vastly greater than this, amounting to tens of millions of pounds per square inch. At such enormous pressures, ordinary rock becomes *appreciably squashed.* Therefore, as we go inwards to greater and greater depths, the density of the rocks of the earth's

mantle increases. The density immediately below the outer crust is about 3·3 times that of water. We may compare this with a density of 4·0 at a depth of 500 kilometres, 4·5 at 1,000 kilometres, about 5·0 at 2,000 kilometres, and with about 5·6 at the surface of the core, which is at a depth of 2,900 kilometres.

The last of these *values* is important. We are now saying that in the part of the mantle immediately outside the core, the density is about 5·6 times that of water. On the other hand immediately inside the core the density is about 9·7. This means that at the surface of the core there is not only a change from liquid on the inside to solid on the outside, but there is also a very considerable change in the density of the material, from 9·7 on the inside to 5·6 on the outside. This change gives an important *clue* to *the nature of the material*[5] in the core.

## Explanation of words in italic

WORDS

*appreciably* [ə'pri:ʃiəbli] considerably
*astronomer* [ə'stronəmə] someone who studies the stars
*basic* ['beisik] (here) general
*clue* [klu:] something that helps one to find the answer to a problem
*core* [ko:] the most central part
*crust* [krʌst] the outer surface
*dense* [dens] thick
*density* ['densiti] how dense something is
*dramatic* [drə'matik] very exciting, as in a play or *drama*
*earthquake* ['ə:θkweik] movement of the earth's crust
*inert* [i'nə:t] not chemically active—does not combine with other chemicals
*junction* ['dʒʌŋkʃn] place where a *join* occurs
*layer* ['leiə] a thin covering
*mantle* ['mantl] a cover
*originate* [ə'ridʒineit] to begin
*range* [reindʒ] in *mountain range*, a chain of mountains

*silicate* ['silikit] like glass (adjective for a certain kind of rock); see phrases
*spherical* ['sferik]] round, like a ball or *sphere* [sfiə]
*squash* [skwoʃ] press together very hard
*value* ['valju:] (here) measurement, quantity
*variety* [və'raiəti] type
*volcano* [vol'keinou] a kind of mountain or hill that sometimes throws out hot liquid rock from the inside of the earth

PHRASES
[1] *in being composed of:* because it is composed of
[2] *of a basic silicate variety:* (rock) that belongs to the general silicate (glass-like) type
[3] *no mean pressure:* not at all a small (insignificant) pressure
[4] *come to realise:* to be made to realise (understand)
[5] *the nature of the material:* what the material is like

## 1 Exercises

COMPREHENSION

1 How do changes inside the earth show themselves?
2 What variations are there in the thickness of the crustal rock?
3 Give some examples of the densities of the material inside the earth.
4 What is the pressure of our atmosphere at sea level? What is the earth's diameter?
5 What great change takes place at the outer part of the core?

WRITE A SHORT DESCRIPTION, in your own words, of the interior of the earth.

ESSAY

1 The results of earthquakes.
2 Will men ever go to the centre of the earth? (Give reasons for your answer.)

LANGUAGE

1 Fill each space with one of these words in its right form: inert; spherical; radius; dense; outer; crust; considerable; tyre; occur; clue.

## 1 The Interior of the Earth

*a.* The material inside the earth is ..... near the core than near the surface.
*b.* The detective found a ..... which showed him who the thief was.
*c.* The diameter of a circle is twice its .....
*d.* Argon is a gas that does not combine with other chemicals; it is .....
*e.* No one ever pumps up the spare ..... of my car.
*f.* Accidents rarely ..... when one is careful.
*g.* I still have a ..... amount of work to do.
*h.* A ball is ..... in shape.
*i.* You need good teeth to bite a hard ..... of bread.
*j.* The ..... walls of the building were not strong enough, and it fell down.

2 Give the adjectives formed from the following nouns:
sphere; crust; drama; exception; importance.
Give the nouns formed from the following adjectives and verbs:
occur; dense; vary; deep; press.

3 Rewrite the following sentences. Start in each case with the words given in brackets:
*a.* Compare this with a density of 13 at the centre. (This should be .....)
*b.* We soon realise this if we have to pump up an automobile tyre. (If an automobile tyre .....)
*c.* This change gives an important clue to the nature of the material in the core. (An important clue .....)
*d.* We must now introduce a new idea. (A new idea .....)
*e.* They show themselves in the occurrence of earthquakes. (They are .....)

4 *a.* Change the phrase in italics to one that begins with *If*, and make any other necessary changes: *Without these changes*, life could never have originated on the earth.
*b.* Use other words for the phrase in italics without changing the meaning: *Apart from* the outer crust the rocks of the whole mantle are of a basic silicate variety.
*c.* Put WHICH in the following and make any necessary changes: The pressures occurring inside the earth are very considerable.

*d.* How do we pronounce the dot in 3·3? What is ·3 of 100?
*e.* What is a *junction* on a railway?

5 The word *kilometre* has two parts. *Kilo-* is a Greek prefix that means 1,000, and a *metre* is a certain length. Many other prefixes from Greek and Latin are used in scientific words. Here are some:
*centi-*: one hundredth. A *centimetre* is one hundredth of a metre. *milli-*: one thousandth. What is a *millimetre*?
These two prefixes may also be used for *having a hundred*, *having a thousand*. What is a centipede and what is a millipede? What is a centigrade thermometer scale?

*Dec-* (from the Latin DECEM = ten) is also used. A *decade* is ten years. *December* used to be the tenth month. *Decapoda* are creatures with ten legs, such as crabs. A *decagon* is a geometrical figure having ten angles and ten sides.

Some more prefixes are: *Tri-* 3 (triangle). *Quadr-* 4 (quadrangle). *Pent-* 5 (pentagon). *Hex-* 6 (hexagon). *Hept-* or *Sept-* 7 (heptagon). *Oct-* 8 (octagon). *Non-* or *Novem-* 9 (nonane; November).

Give some other scientific words starting with such prefixes and say what the words mean.

6 Notice *10 times as heavy as water*. Write sentences containing the following:
*a.* ten times as long as;
*b.* three times as dense as;
*c.* half as difficult as.

## 2 Radioactivity
Albert Schweitzer

Albert Schweitzer was born on January 14th, 1875, at Kayserberg, Alsace. He spent eight years in the Lycée at Mulhouse, where he learnt to play the organ extremely well. At the age of eighteen, in 1893, he left the Lycée and went to study at Strasbourg. He was unusually clever, and he was already well known when he decided, at the age of thirty, to add medicine to his subjects of study. In that year he became a medical student at Strasbourg, and he remained there for six more years. He married in 1912. On 20th March, 1913, he set out for Africa, where he became world-famous as a doctor and a *humanitarian*. He died in 1965.

The piece given below is from a talk which he made from Oslo radio station on April 24th, 1957. It may be found complete in Norman Cousins' book, *Dr Schweitzer of Lambaréné* (published in 1961). Its subject is the danger to everyone in the world from radiation.

My thanks to the radio station in Oslo, the city of the Nobel Peace Prize, for making it possible for me to speak to far-off places.

What is *radioactivity*?

Radioactivity consists of rays differing from those of light *in being invisible*,[1] and able to pass not only through glass but also through thin metal discs and layers of *cell tissue* in human and animal bodies. Rays of this kind were first discovered in 1895 by the *physicist*, Wilhelm Roentgen of Munich, and named after him.

In 1896 the French physicist Henri Becquerel *demonstrated* that rays of this kind occur in nature. They are *emitted* from *uranium*, an *element* known since 1786.

In 1898 Pierre Curie and his wife discovered in the *mineral* pitchblende, which is a uranium *ore*, the strongly radioactive element *radium*.

The joy that such rays were *at the disposal of humanity*[2] was at first *unmixed*[3]. For the rays appeared to destroy the fast-growing cells of terrible *growths* in the body. But after a time it was found that the destruction of these cells does not always mean a cure, and that the normal cells of the body may be seriously damaged if they are exposed to radioactivity for a long time.

When Mme Curie, after handling uranium ore for four years, finally held the first gramme of radium in her hand, *abrasions* that no treatment could cure appeared in her skin. With the years, she grew more and more ill from a disease caused by radioactive rays. They damaged her bone *marrow* and, through this, her blood. In 1934 death ended her suffering.

Even so, for many years we were not aware of the grave risks *involved* in *X-rays* to those who are constantly *exposed* to them. Through *operating* X-ray *apparatus*, thousands of doctors and nurses have *incurred* incurable diseases.

Radioactive rays are *material things.*[4] Through these rays, the radioactive element constantly emits tiny *particles* of itself. These are of three kinds, named after the first three letters of *the Greek alphabet*:[5] *alpha*, *beta*, *gamma*. The gamma rays have the strongest effect.

The reason why elements emit radioactive rays is that they are constantly *decaying*, and radioactivity is the energy they liberate *little by little.*[6] There are other elements that are radioactive, besides uranium and radium. Some *radiation* from space is added to the radiation from the elements in the earth; fortunately, the air mass, 250 miles high, that surrounds our earth protects us against this radiation. Only a very small *fraction* of it reaches us.

We are, then, constantly being exposed to radioactive radiation coming from the earth and from space. It is so

weak, however, that it does not hurt us. Stronger sources of radiation, as for instance X-ray machines and *exposed* radium, have harmful effects if one is exposed to them for some time. These rays are invisible. How can we tell that they are there, or how strong they are?

Thanks to the German physicist Hans Geiger, who died in 1945 as a victim of X-rays, we have an instrument which makes that possible.

## Explanation of words in italic

WORDS

*abrasion* [ə'breiʒn] sore, painful skin where the surface has been rubbed off
*alpha* ['alfə] see GREEK ALPHABET in phrases
*apparatus* [apə'reitəs] equipment: scientific instruments and machines
*beta* ['bi:tə] see GREEK ALPHABET in phrases
*cell* [sel] (here) a small piece of living matter: see *tissue*
*decay* [di'kei] to rot away, die
*demonstrate* ['demənstreit] to show, prove
*disposal* [di'spouzl] (see phrases below)
*element* ['elimənt] something that cannot be split into simpler things but is part of other matter: for example, water contains the *elements* hydrogen and oxygen
*emit* [i'mit] to send out
*expose* [ik'spouz] to uncover; *be exposed to*, to have no protection against
*fraction* ['frakʃn] (see Exercise 6, Language)
*gamma* ['gamə] see GREEK ALPHABET in phrases
*growth* [grouθ] a diseased mass (of *cells*) growing in the body
*humanity* [hju:'maniti] people: the human race; *humanitarian* [hju:mani'teəriən] someone who loves and works for humanity
*incur* [in'kə:] to bring something bad upon oneself
*involve* [in'volv]: *be involved in*, (here) to be associated with
*marrow* ['marou] the fat that is inside the bones of the body
*material* [mə'tiəriəl] (see phrases below)
*mineral* ['minərəl] a metal, etc., that comes from the ground: see ORE