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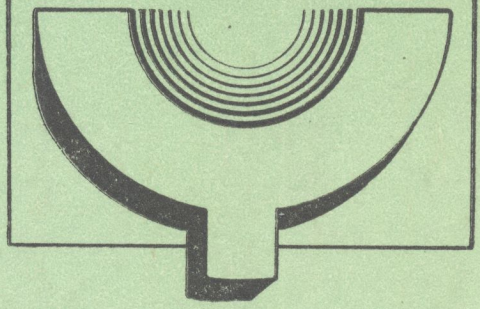
SENIOR English FOR TECHNICAL STUDENTS



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АНГЛІЙСЬКА МОВА

(ПОГЛИБЛЕНИЙ КУРС)

ДЛЯ СТУДЕНТІВ ТЕХНІЧНИХ ВУЗІВ

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ЗМІСТ

ПЕРЕДМОВА

Підручник англійської мови розрахований на 140 годин аудиторних занять і 140 годин самостійної роботи студентів. Він є логічним продовженням підручника англійської мови для студентів технічних вузів (Г. П. Ятель, Б. М. Князевський, Ф. К. Кузик. English for Technical Students.— К. : Вища шк., 1993).

У цьому підручнику основну увагу звернено на розуміння специфіки лексико-граматичних та лінгвостилістичних засобів науково-технічного мовного стилю, а також вироблення вміння передати їх адекватно під час перекладу українською мовою. Отже метою підручника є вдосконалення навичок ознайомлювального, переглядового і вивчального читання оригінальної науково-технічної літератури, а також підготовка студентів до практичної мовленнєвої діяльності англійською мовою — ведення бесіди (диспуту) на наукові теми, складання наукового повідомлення, анотування та реферування оригінальної технічної літератури тощо.

Для досягнення цієї мети тексти, вміщені до підручника, добиралися з монографій і журнальних статей англійських та американських авторів. Усі тексти зазнали деяких змін і скорочень. Вони охоплюють актуальні проблеми сучасної науки й техніки (комп'ютерна техніка й інформатика та програмування, робототехніка й електроніка, лазерна техніка й технологія, будівництво та архітектура та ін.). Тематика текстів не тільки забезпечує багатий лексико-граматичний навчальний матеріал, а й має велике пізнавально-виховне значення. Студенти ознайомлюються з досягненнями українських вчених у різних галузях науки і техніки, їх внеском у світовий науково-технічний прогрес. Тексти уроків 1, 3, 17 і 18 мають на меті привернути увагу студентів до гуманітарних проблем сучасності, зокрема ролі мови в суспільстві, взаємозв'язку результатів науково-технічного розвитку з проблемами екології, важливості морально-етичної відповідальності вчених за наслідки від впровадження їхніх розробок у життя.

У кожному уроці, крім 18-го, оглядового, даються два тематично пов'язані тексти (А і В). Текст А призначений

для аудиторного та самостійного вивчального читання (деталізоване і точне розуміння прочитаного на основі глибокого засвоєння лексико-граматичних і мовно-стилістичних особливостей тексту, а також уміння передати їх адекватно при перекладі українською мовою). Система лексико-граматичних і комунікативних вправ спрямована на свідоме практичне засвоєння мовних елементів технічного стилю, розвиток навичок усного мовлення.

Текст В призначено для ознайомлювального і переглядового читання. Вправи та завдання мають комунікативну спрямованість: розкриття основного змісту тексту, визначення теми, новизни та значущості інформації в стислому вигляді (резюме, анотація). На основі цього тексту рекомендується проводити проблемно-тематичні дискусії та бесіди під час аудиторних занять.

Текстам А і В передують дотекстові вправи на подолання фонетичних та лексико-фразеологічних труднощів, а також докладний коментар. Вони роблять зайвим вокабуляр у кінці підручника.

Для полегшення самостійної роботи студентів над збагаченням їхнього словникового запасу, свідомого і систематичного засвоєння мовних елементів різного порядку в підручнику подано короткий лексико-граматичний довідник. У ньому мовні засоби текстів коментуються з точки зору особливостей передачі їх засобами української мови.

Підручник містить такі додатки:

1. Короткий лексико-граматичний довідник.
2. Найуживаніші суфікси та префікси.
3. Найуживаніші прийменники.
4. Список прикладів «зрадливих друзів» перекладача.
5. Запозичені форми множини іменників.
6. Найуживаніші американізми.
7. Деякі математичні символи і вирази.
8. Англійські одиниці виміру.

Підручник можна використовувати для аудиторної і самостійної роботи як на ступені бакалаврату, так і у відповідних групах магістерського ступеня.

LESSON ONE

Grammar: 1. The Participle: Forms, Functions, Translation.
2. Terminology.

Text A. EVERYDAY ENGLISH AND TECHNICAL ENGLISH

1. Read aloud and memorize the following words:

enhance [ɪn'hɑ:ns] — підвищувати, підносити; uneven [(')ʌn'i:vn] — нерівний; extreme [ɪks'tri:m] — протилежність, крайність; value ['vælju:] — цінність, значення; status ['steɪtəs] — становище, стан; peculiarity [pɪˌkju:lɪ'ærɪtɪ] — (індивідуальна) особливість; quark [kwɑ:k] — кварк *(фундаментальна частинка)*; approximate [ə'prɔksɪmɪt] — приблизний; occur [ə'kə:] — траплятися, мати місце; primarily ['praɪmərɪlɪ] — у першу чергу.

2. Words and expressions for the text comprehension:

to take into consideration (account) — брати до уваги, враховувати; the matter is that... — справа в тому, що...; reference books — довідкова література; on the other hand — з іншого боку; embodiment — втілення; native speaker — носій мови; to spare no efforts — не жаліти зусиль; at first sight — на перший погляд; familiar pattern (model) — знайома модель; concise — стислий, короткий; to acquire (a thorough) knowledge — набути (грунтовних) знань; everyday (literary) English — розмовна (літературна) англійська мова.

At present, the contacts between people of different countries are increasing. This enhances the importance of the study of foreign languages. However, sometimes we don't even know which of the world's languages we should take into consideration. The matter is that the total number of languages in the world is very large. In different reference books it varies from five to eight thousands. The numerical distribution of people speaking different languages is extre-

mely uneven. There are not many languages in the world each of which has more than 50 million people. On the other hand, there are languages spoken by only several thousands of people.

To the first group belong such languages as English, Chinese, French, Russian, Ukrainian, etc. At the opposite extreme stand languages like Chitimacha, an American Indian language which in the late 1930's[1] had only two speakers left.

Everyone should understand that for the linguist there are no *big* or *small* languages. For each people the language is not only a means of communication, but also an embodiment of national and cultural values. Nevertheless, when we have to decide which of the world's languages to study, we take into consideration the differences in the social and functional status of each language.

When we consider English, we cannot misregard the fact that the English language is spoken by more native speakers than any other language except, presumably, North Chinese. English is native or the first language for the most population of Great Britain, USA, Canada, Australia, New Zealand. Besides, there are many areas, former British colonies (India, Nigeria, Ghana) where English is not a native language, but a second language with official status in education and administration, and for communication between speakers of other languages. If we take into account the important factor of speakers of English as a foreign language, it is most widely spread of the world's languages.

English is one of the five official languages of the UNO[2] (alongside of French, Russian, Spanish and Chinese). It is the working language during the meetings of the General Assembly[3] and Security Council of the UNO[4]. No wonder that so many people in various countries spare no efforts to acquire English for communication.

In Ukraine, higher schools students and postgraduates are trained to have a good knowledge of English, to read and use professional literature in their practical activity. As this textbook is for technical students, let us dwell on some peculiarities of technical English.

Technical English is often said to be difficult to understand. At first sight this may seem true[5]. There are a number of reasons why technical writing is rather difficult. It concerns first of all its vocabulary.

The scientific and technological progress has enriched the vocabulary with a great deal of new words, new meanings

and new word-combinations. Who today does not know such words as *computer, transistor, laser,* etc? Scientists and technologists also use many ordinary, everyday words to denote new terminological meanings. For example, the words *aroma,* and *charm* with the meaning *attractiveness* are used to denote the physical characteristics of the quark, a fundamental physical particle.

Each branch of science and technology has its own vocabulary (terminology). Many of them are formed on the basis of Greek or Latin words and are often international.

Some technical words, such as *power, roll, stress, strain, movement,* etc. borrowed from everyday English sometimes cause much greater difficulty than terminology. In addition to terms, a text on some special problem usually contains so-called learned words, such as *approximate, compute, feasible, exclude, indicate, initial, respectively,* etc.

As to the familiar grammatical patterns and models, they are the same as in everyday English. There is, certainly, a difference in the frequency with which certain grammatical forms occur.

Scientific and technical writing is usually about things, matter, natural processes, and it is impersonal in style. The Passive Voice of verb forms, the constructions Subject and Complex Object are frequently used. The first person singular is not generally used.

Simple sentences are rarely used, for isolated facts or events are seldom dealt with by the engineer. He has to show what the connection is, not only what happens, but also how it happens, when it happens, why it happens, and what is being effected.

The style of most scientific texts, besides being impersonal, is also very concise. It is because the author-scientist is writing primarily for other scientists.

In order to master technical English the learner must first acquire a thorough knowledge of everyday literary English with its grammar, vocabulary and rules of word formation. Then it will be easy for him to learn, step by step, the peculiarities of technical English. It should be born in mind [6], however, that understanding and translation of scientific-technical literature requires an additional training connected with knowledge of specific terminology.

VOCABULARY NOTES

[1] **in the late 1930's** — наприкінці 1930-х років
[2] **UNO (United Nations Organization)** — ООН (Організація Об'єднаних Націй)
[3] **General Assembly (of the UNO)** — Генеральна Асамблея (ООН)
[4] **Security Council of the UNO** — Рада Безпеки ООН
[5] **this may seem (to be) true** — це може видатися правильним
[6] **it should be born in mind** — слід (необхідно) пам'ятати

EXERCISES

I. Name the word-building elements (suffixes, prefixes) and the part of speech of each word. Translate them into Ukrainian:

importance — important — unimportant; consider — consideration — considerable; refer — referable — reference — referential; oppose — opposite — opposition; even — uneven; regard — misregard; know — knowledge; practice — practical — unpractical; rich — enrich — enrichment; add — addition — additional; frequence — frequency — frequent — frequently; person — personal — impersonal.

II. Read the following word-combinations and translate them into Ukrainian:

total number; numerical distribution; cultural values; official status; technical English; literary English; learned words.

III. Finish the sentences according to the text:

1. The total number of languages ... . 2. The numerical distribution of people speaking different languages ... . 3. For each people the language is not only ... . 4. The English language is spoken by more ... . 5. English is the working language during ... . 6. Each branch of science and technology has ... . 7. The scientific and technological progress has enriched the vocabulary with ... . 8. In order to master technical English the learner must... .

IV. Translate the following sentences taking into account the Participle in different functions:

1. There are languages spoken by only several thousands of people. 2. The data obtained should be carefully analysed. 3. If given opportunity our economy will rapidly develop. 4. Do you know the man speaking English? 5. Having finished his experiment the researcher began to analyse the data

obtained. 6. Being a very industrious pupil he worked hard, managed to make great progress in English. 7. Having returned to Oakland, Martin Eden lived in poverty, devoting every minute of his time to literary work. 8. We know Byron as the author of many lyrical poems devoted to nature and love.

V. Find in the text terminological words which came from everyday English.

VI. Comprehension questions:

1. What enhances the importance of the study of foreign languages? 2. Do we know the total number of languages in the world? 3. Are there *big* and *small* languages? 4. What factors determine the choice of foreign language to study? 5. What can you say about the social and functional status of English? 6. Is technical English completely different from literary English? 7. What distinguishes technical English from everyday English? 8. How can you master technical English?

VII. Make a summary of the text and discuss it.

VIII. Speak about:

a) the importance of learning foreign languages at present;

b) the social and functional status of English, Ukrainian and other languages;

c) your work at learning English (or any other foreign language).

IX. Render the following text in English:

Національні мови і культурна самобутність

Греки називають людину Zoon phonanta («тварина, яка розмовляє»). Відмінність людини від тварини полягає в здатності будувати систему звукових сигналів, які представляють не тільки її почуття і думки про навколишній світ, а й сам цей навколишній світ.

Ми не знаємо, якою була мова, наприклад людини кам'яного віку. Проте нам відомо дещо про менш давню мову, що називається індоєвропейською, або арійською. Її структура і частково лексика в суттєво зміненій формі збереглись у більшості європейських мов.

Граматична будова, прислів'я та приказки, а також ідіоматика тієї чи іншої мови дають чітке уявлення про думки й почуття її носіїв. Словниковий склад мови — це сума

предметів, дій, ідей, які або впливають на них, або необхідні їм у спілкуванні з навколишнім світом.

Саме тому мова є вираженням самобутності тієї чи іншої етнічної групи людей, об'єднаних спільною культурою. Коли ми кажемо: «Я — українець» або «Я — англієць», ми зараховуємо себе до конкретної культурної групи, що розмовляє певною мовою.

З цього випливає необхідність навчати рідної мови, літератури й традицій. Оскільки людина найкраще володіє рідною мовою, найточніше виражаючи нею свої думки, почуття, то навчання буде найефективнішим саме рідною мовою. Тому принцип навчання рідною мовою визначається психологією й педагогікою. Вивчення іноземних мов збагачує людину духовно, розширює можливості її життєвої діяльності.

X. Write a composition about English as a language for your professional career.

Text B. BRITISH ENGLISH AND AMERICAN ENGLISH

1. Read aloud and memorize the following words:

throughout [θru:'aut] — скрізь; nevertheless [ˌnevəðə'les] — але, незважаючи на; usage ['ju:zɪdʒ] — вживання; foreigner ['fɔrɪnə] — іноземець; variety [və'raɪətɪ] — різноманітність; comparable ['kɔmprəbl] — порівнюваний, гідний порівняння; draught [drɑ:ft] — протяг, тяга; auxiliary [ɔ:g'zɪljərɪ] — допоміжний; catalogue ['kætəlɔg] — каталог; diverge [daɪ'və:dʒ] — розходитися, відхилятися.

2. Words and expressions for the text comprehension:

English-speaking world — англомовний світ; uniform — однорідний; to tend — прагнути, мати тенденцію; Standard English (R. P. English) — літературна англійська мова; recent usage — найновіше вживання; to observe differences — зважати на розбіжності; to be consistent — бути послідовним; to the extent that — до такої міри (межі), що; throughout the world — в усьому світі; it is to be hoped — треба сподіватися; to impend — загрожувати; come to be widely used — широко вживаються.

English, or Standard (R. P.— Received Pronunciation) English is the type of English that is used by educated people throughout the English-speaking world. Nevertheless, it is not completely uniform. There are differences between the na-

tional standards (e. g. in Britain, America, and Australia) and also variants within each English-speaking country. For example, within the Northern English, Scotland, and Northern Ireland. The most firmly established national standards are British (B. E.) and American English (A. E.), the others tending to follow the usage of these two. It is this English that is taught in the education system of English-speaking countries and is also taught to foreigners. It is this variety that appears in print and in the spoken language of the mass media.

The Americans have developed their own particular style in various aspects of the language.

Even with comparable education and social position, a present-day New-Yorker and a present-day Londoner can find themselves using forms of English which are equally correct but which are quite distinct in vocabulary, in grammar, in pronunciation and in spelling. In other words, there are rules and norms for A. E. which are independent of the corresponding rules and norms for B. E.

Differences in spelling, pronunciation and in grammar between B. E. and A. E. are relatively minor. More differences occur in vocabulary. They are called Americanisms.

When we speak of Americanisms in language we mean words or other language features that are characteristic of the English used in the USA. Many usages that were originally Americanisms have been fully integrated into B. E. and their origin is no longer recognized: radio, immigrant, teenager, to locate, live wire, hot air, cold war, mass meeting, etc.

Americanisms of recent usages that are thought to originate in the United States are resistered by some British writers and speakers: O. K., I guess, to check up on, to win out, to lose out, etc.

The first American spelling reformer was Benjamin Franklin, the second was Noah Webster. Here are some peculiarities of American spelling: *honor, color* for B. E. *honour, colour; theater, meter* for B. E. *theatre, metre; defense, offense* for B. E. *defence, offence,* etc.

A single consonant is used for the double one in B. E. in such words as *traveler, traveled, wagon,* etc. In American texts you find *check* for *cheque* in B. E.; *draft* for *draught; program* for *programme,* etc.

We must remember, though, that many British writers use some American spellings and that certain American authors occasionally prefer British usage.

Particularly numerous are Americanisms in scientific and technical literature. For instance, in A. E. *a tram* is *a freight-car, the underground* is *a subway, petrol* is *gasoline, a pavement* is *a sidewalk.* In America a man wears pants (trousers), drawers (pants), an undershirt (vest), suspenders (braces), and halfshoes (shoes).

Though less in number, there are important differences in grammar as well. Englishmen today no longer use the form *gotten* as the Past Participle of the verb *get,* but it is the form commonly accepted in America. Americans use the auxiliary *do* with the verb *have* in many cases where the English would not do so.

The numerous differences between these two standards create some difficulties for the language learner, who naturally wonders whether he should try to use English or American grammar, British or American words. Some learners hesitate which of the two forms is more correct. Perhaps the best attitude for the learner to take is not one of judging whether British English or American English is more correct, but rather to observe differences between them carefully and catalogue them in his mind. When speaking or writing, he should try to be consistent, that is, he should try to use British grammar and words, or American grammar and words throughout and avoid a mixture of the two.

The great number of differences that exist between B. E. and A. E. caused the question of whether they can be considered the same language at all.

It is to be hoped that the varieties of English will not diverge to the extent of impending international communication in English. This hope is based on the fact that in the course of time with the development of the modern means of communication the lexical differences between the two variants show a tendency to decrease. Americanisms penetrate into Standard English and Britishisms come to be widely used in American speech.

ASSIGNMENTS

Read the text and do the following assignments:

I. Comprehension questions:

1. What type of English do the educated people use? 2. Are there any differences between British English and American English? 3. What are the English-speaking countries? 4. Are there any differences between B. E. and A. E. in spelling, pronunciation, grammar and vocabulary? 5. Do

British authors and speakers resist the use of Americanisms? 6. Are Americanisms numerous in scientific and technical literature? 7. Are B. E. and A. E. the same language?

II. Discussion questions:

1. How can Standard English be defined? 2. When did the American variant of the English language arise? 3. Are there any differences within the Standard English? 4. What are the chief differences between B. E. and A. E.? 5. Do the teachers pay attention to Americanisms at school? 6. Is it possible to consider the A. E. as a variant of the English language? 7. Give some examples of Americanisms in pronunciation, vocabulary and grammar. 8. Do you prefer to study B. E. or A. E. and why?

III. Express the main idea of the text in the shortest possible way.

IV. Do you know anything about Noah Webster's famous lexicographical work?

V. Group activities:

a) Language is given to man to conceal his thoughts.

b) If you want to know English well, you must study two English languages: spoken English and writen English. *(J.-J. Rousseau)*

c) Point out the main peculiarities of technical English.

VI. Enumerate divergences of A. E. in pronunciation, spelling, grammar, and vocabulary.

LESSON TWO

Grammar: 1. Sentences with **it** (Functions and Translation).
2. **Should/Would** + **Perfect Infinitive** Construction (Translation).
3. Terminology.

Text A. SCIENCE HELPS MAN TO SURVIVE

1. Read aloud and memorize the following words:

millenium [mɪ'lenɪəm] — тисячоліття; survival [sə:'vaɪvəl] — виживання; antiquity [æn'tɪkwɪtɪ] — старовина, античність; neighbourhood ['neɪbəhud] — сусідство; environment [ɪn'vaɪərənmənt] — оточення, середовище; surround [sə'raund] — оточувати, обступати; ancient ['eɪnʃnt] —

давній, античний; acquire [ə'kwaɪə] — набувати, оволодівати; leisure ['leʒə] — дозвілля; executive [ɪg'zekjutɪv] — виконавчий; mosquito [məs'ki:tou] — москіт, комар; frequency ['fri:kwənsɪ] — частота; require [rɪ'kwaɪə] — потребувати, вимагати; severe [sɪ'vɪə] — суворий; depletion [dɪ'pli:ʃən] — виснаження.

2. Words and expressions for the text comprehension:

to be on the eve (of) — бути напередодні; existence — існування; long uphill struggle — тривала тяжка боротьба; severe environment — суворе оточення; to domesticate animals — одомашнювати тварин; to record and pass on (one's) knowledge — записувати і передавати знання; to disseminate knowledge — поширювати знання; prehistoric times — доісторичні часи; did not begin until ... — не почався аж поки ...; to be in full flourish — бути в повному розквіті; means of communication — засоби зв'язку; let alone (control) — не кажучи про (контроль); versatility — багатобічність, різноманіття; on one's way to — на шляху до; for the very survival — для самого виживання (життя); depletion — виснаження, спустошення.

The present civilization is on the eve of the third millenium of our era. According to some scientists, man has lived on the Earth for over 2,000,000 years. The development [1] of human life has been very rapid if we consider man's existence as one long uphill struggle for survival in the severe environment.

One of the greatest philosophers of antiquity Lucretius Carus [2], in his poem *On the Nature of Things,* described how human life changed: man learned to use fire, skins and dwellings and established the laws of marriage and good neighbourliness.

It took man some 20 thousand years to learn how to use the energy of fire and how to use clay for making pots, to domesticate animals and to be able to make the simple clothes for himself. It was some 10 thousand years ago that writing was invented, and it became possible for people to record and pass on their knowledge about the environment from generation to generation. It was practically not long ago (in 1454—55)) that the printing press was invented, and so books were used to disseminate knowledge.

A scientific explanation of the world surrounding man began in prehistoric times, probably in Egypt [3] and Babylonia [4], more than 2,000 years B. C. [5]. But true progress in science did not begin until the sixth century B. C., when

the Greek civilization was in full flourish. Any school student can name many contributions made to the development of science and technics in the period from the ancient Greeks to the Renaissance [6]. The scholars of ancient Greece and Rome say in their records that by the time they came on the scene humanity had gone a long way and had acquired many skills and a great deal of knowledge. From its first steps, the development of science and technology have influenced the growth of our civilization more and more.

Today we see the world in which social, industrial and even political order has been greatly influenced by science. The achievements of science and technology during the past hundred years have modified our homes, places of work, means of communications and even our enjoyment. In general, although not always, scientific progress has engendered technology and medicine. Solving the problem of the environment — such as global warming, or the depletion of the ozone layer is the task of technology.

Science now is radically changing the instruments of production, the objects of labour and the whole of technology and organization of production. It has become a productive force while production is becoming a technological branch of modern science.

Due to the progress of science and technology in our remarkable age we may speak of an entirely new era of supersonic speeds [7].

In the twinkling of an eye — which scientists say lasts about one sixth of a second — a modern supersonic plane covers a distance of nearly a quarter of a kilometre, and a space rocket — several kilometres. A special research camera can take more than 100 million shots a second; some very fine chemical reactions take only a thousandth or a ten thousandth of a second, while the fission of uranium nuclei lasts a few millionths of a second.

Man cannot follow, let alone control, such speeds by conventional levers, switches or relays. And so he adopted light for his speedometer. It is the fastest thing there is, and covers 300,000 kilometres a second. For his executive man chose the electron, the smallest and most mobile particle of the material world. Its speed and versatility has helped man to make a great number of electronic instruments and devices, the most important of them being the electronic amplifier. Having become the basis of a new field of science and technology known as electronics or radio electronics, it found a wide application.

Electronic devices help to amplify extremely weak electrical charges, oscillations and signals. They have enabled man to hear how grass grows, to amplify the whine of a mosquito to the proportions of a thunder crash, and to detect the electrical signals which arise in the human brain in the process of thinking. An electronic valve cas generate its own signals at the fantastic frequency of millions of oscillations a second. Mounted on radio waves they travel to the Moon, the Sun and other celestial bodies at the speed of 300,000 kilometres a second. These signals are reduced to less than a thosand millionth of their initial volume on their way to a planet, and as they are reflected from its surface and arrive back on Earth, electronic devices amplify them back to the required volume. Photoelements will record the flare of a match struck on the Moon.

Everybody can give many more examples of this kind. One might go on and on, describing many wonders that once would have been regarded as truly magical. The advance in the scientific and technical progress is the outcome, primarily of the talent, inventiveness and the efforts of man.

Scientific and technological inventions are beneficial only when they help to improve man's living and working conditions. However, recent developments in nuclear power engineering have proved that they can be very dangerous for the very survival of the human race.

The more complex and intricate are the innovations of man's intellectual activity, the higher is the responsibility of scientists for the outcomes of application and use of their innovations.

VOCABULARY NOTES

[1] **development** — розвиток, розробка
[2] **Lucretius Carus** [lu:'kri:ʃəs 'kɛərəs] — Лукрецій Кар
[3] **Egypt** ['i:dʒɪpt] — Єгипет
[4] **Babylonia** [ˌbæbɪ'lounjə] — Вавилонія
[5] **B. C. (before Christ — before our era)** — до нашої ери
[6] **Renaissance** [rə'neɪs (ə)ns] — Ренесанс, доба Відродження (суспільно-політичний і культурний рух, почався в Італії в XIV ст., в інших країнах Західної Європи в XV—XVI ст.)
[7] **supersonic speed** — надзвукова швидкість

EXERCISES

I. Name the word-building elements (suffixes, prefixes) and the part of speech of each word. Translate them into Ukrainian:

civil — civilian — civilize — civilized — uncivilized — civilization; establish — established — unestablished — establishment; possible — impossible — possibility; explain — explained — unexplained — explanation; organ — organize — organized — unorganized — organization — organizational.

II. Interpret the meaning of the following correlated terms and use them in sentences of your own:

a) technique, technology, technics, engineering;
b) science, knowledge, learning;
c) advance, progress.

III. Determine which of the following words and expressions are terms:

clay, pot, dwelling, energy, environment, generation, printing press, century, record, technology, medicine, ozone layer, supersonic plane, space rocket, camera, fission, uranium, nucleus, relay, speedometer, electron, radio electronics, charge, brain.

IV. Read the text carefully and pick out terminological words and word-combinations. Explain to which sphere of knowledge they belong.

V. Explain the function of *it* in the following sentences and translate each sentence into Ukrainian:

1. If we compress gas it becomes hotter. 2. The book is interesting. I advise you to read it. 3. It is our new lab. 4. It will take you a good deal of time to accomplish this experiment. 5. It often rains in our region. 6. It was getting dark when he was leaving our experimental site. 7. It is impossible to imagine our life without books. 8. We consider it necessary to take part in this scientific conference. 9. It was Newton who discovered the laws of gravity and the formula known as Newton's Binomal Theorem. 10. It is when an object is heated that the average speed of molecules is increased.

VI. Translate the following sentences with *Should/Would* + + *Perfect Infinitive* Construction:

1. It would be unwise to sell this invention abroad. 2. The scientist would have made a great deal of research but it was broken off suddenly. 3. Some years ago we shouldn't have

thought it possible to make such an operation. 4. If I had seen her I should have asked her to join our research work. 5. You should have taken into account his advice before starting your experiment. 6. You should have consulted our professor concerning this problem. He is an expert in this field. 7. He would have given you good ideas by all means.

VII. Comprehension questions:

1. What were the early stages of man's existence on the Earth? 2. How has man's life on our planet changed? 3. What innovations (inventions) influenced man's progress? 4. What is the role of science in human development? 5. What are the outstanding stages in the scientific and technical progress of mankind? 6. How have the achievements of supersonic speeds influenced the further advance of mankind in various aspects of life? 7. When are scientific and technological inventions beneficial? 8. Are scientific and technological inventions always for the good of man? 9. Are the scientists and technologists responsible for the consequences of their work? 10. What is your opinion about the ethics in the modern world of science?

VIII. Make a summary of the text and retell it.

IX. Speak about:

a) scientific and technological inventions useful for our everyday life;

b) an outstanding scientist (inventor) you admire;

c) tasks of science and technology to preserve life on Earth.

X. Write a composition about Ukrainian science (in any field of knowledge).

Text B. *COSMIC BRAIN*— PHANTOM OR REALITY?

1. Read aloud and use in your discussion the following words:

apparatus [æpə'reɪtəs] — прилад, апарат; biogenetic ['baɪo(u)dʒə'netɪk] — біогенетичний; occurrence [ə'kʌr(ə)ns] — випадок, явище; miniature ['mɪnjətʃə] — мініатюра, мініатюрний; utensils [ju:'tensɪlz] — посуд; appreciation [ə,pri:ʃɪ'eɪʃn] — оцінка, визнання; unprecedented [ʌn'presɪd(ə)ntɪd] — безприкладний; surge [sə:dʒ]— підніматися (до).

2: Words and expressions for the text comprehension:

phantom (fantom) — фантом, привид; be created out of nothing — бути створеним з нічого; use laser spectroscopy — використовувати лазерну спектроскопію; optical laser probe — оптичний лазерний зонд; for ages — впродовж віків; biogenic (biogenetic) field — біополе; up to recent times — до недавнього часу; through lack of adequate detecting apparata — за браком відповідних приладів для реєстрації; from time immemorial — з вікопомних часів; plots of land — ділянки землі; people were in the know — людям було відомо; cult structures — культові споруди; create a distant influence upon a microbiological sensor — створити дистанційний вплив на мікробіологічний сенсор; enigmatic — загадковий; a solid stratum of orderly arranged nuclear substance — щільний шар упорядкованої ядерної речовини; one can't help coming to the conclusion — не можна не дійти висновку; to be lucky — бути везучим; braking — гальмування; and it is to be hoped now — а зараз треба сподіватися; beating the track into the unknown — прокладаючи шлях у незнане; the braking of high-power gamma-rays — гальмування високоенергетичних гама-променів.

Can matter be created out of nothing? The scientists of the Biochemistry Institute named after O. Palladin of the Academy of Sciences of Ukraine are trying to solve this unexpected, unusual problem. Using laser spectroscopy they have investigated psycho-physical phenomena by means of a laboratory apparatus whose authors are Ukrainian researchers.

Biofield of extrasensitives has been detected as well as their distant influence by a microbiological sensor under the control of optical laser probe. The computer system has proved the existence of biofield and measured its intensity though this phenomenon cannot be classified as truly physical in the traditional meaning of the word.

Biogenic, or biogenetic, field is known for ages to be generated out of the depths of the Earth, influencing biological objects. But up to recent times this occurrence could not be duly treated by men of science through lack of adequate detecting apparata. From time immemorial people were in the know about biogenic qualities of certain plots of land which they used as building sites for pyramids, churches, etc. These cult structures, it was noticed, concentrate biogenic field like a lens focusing sun rays at one point. Miniature concentrators of biogenetic field have turned

out to be hemispheres, cones, cubes, as well as utensils like vases, jugs, etc. These things were noticed to create a distant influence upon a microbiological sensor. The enigmatic biogenetic field is originated by the atomic nucleus producing alpha-, beta-, and gamma-rays.

A model can be suggested according to which *cosmic brain* is in existence at the centre of the Earth whose function is to manage various biological processes. This *cosmic brain* presents a solid stratum of orderly arranged nuclear substance. The vibrations of its structural parameters can be the source of the biogenetic field which surges to the surface and influences living nature, its phases being either positive or negative.

One can't help coming to the conclusion that to-day the science of biogenetic field is in a position hardly different from that of electromagnetic field of the end of the 19th century. O. Popov's invention of the radio — the wireless telegraph — found neither understanding nor appreciation in his homeland. And it is to be hoped now that to-day's scientists will be luckier in their unprecedented investigation beating the track into the unknown.

The Ukrainian scientists' idea of biogenetic field invariably leads to an important conception: materialization of this field is (and not only looks like) a reality whose effect is difficult to foresee. Literary, historical, and scientific sources state that the biogenetic field of the Earth can produce matter under certain, very definite, conditions. This can be well grounded by the modern science of physics: during the braking of high-power gamma-rays according to Einstein's formula, two material particles are formed — electron and positron.

A biogenic apparatus for producing matter that seems like a rosy dream of humanity to-day may become a reality tomorrow just as electricity, radio, television, automation, etc came into being,— the phenomena undreamed-of in the not very distant past, but hoped-for, expected and realized in the long run of endless scientific and technological progress.

ASSIGNMENTS

I. Comprehension questions:

1. What problems are the scientists of the Biochemistry Institute named after O. Palladin trying to solve? 2. What instruments are used in the research? 3. What has been

detected by a microbiological sensor under the control of optical laser probe? 4. Where is biogenetic field generated from? 5. Why wasn't it possible to treat duly this phenomenon up to recent times? 6. How is the enigmatic biogenetic field originated? 7. What does this *cosmic brain* present? 8. What does the idea of biogenetic field lead to?

II. Discussion questions:

1. How is it possible at present to detect biofield of extrasensitives? 2. What were people in the know from time immemorial about biogenetic field? 3. What specific phenomena did people notice about some cult structures? 4. What can be the source of the biogenetic field? 5. Why is the position of to-day's science of biogenetics compared with that of O. Popov's invention? 6. Is a biogenetic apparatus for producing matter a rosy dream of humanity?

III. Is the phenomenon named «cosmic brain» truly physical in the traditional meaning of the word?

IV. Suggest your own titles of the text.

V. Group activities:

a) What problems does the Biochemistry Institute named after O. Palladin solve?

b) Can to-day's science explain the phenomenon of biofield of extrasensitives?

c) What model can be suggested to explain the phenomenon of *cosmic brain?*

VI. Write a short summary of the text in English.

LESSON THREE

Grammar: 1. The Tense Forms in the Passive Voice: Meaning and Translation.
2. Terminology.

Text. A. THE ETHICS AND SOCIAL RESPONSIBILITY OF SCIENTISTS AND TECHNOLOGISTS

1. Read aloud and memorize the following words:

ethics ['eθɪks] — етика; acute [ə'kju:t] — гострий; research [rɪ'sə:tʃ] — (наукове) дослідження; threaten ['θretn] — загрожувати; adulterate [ə'dʌltəreɪt] — фальсифікувати,

підробляти; consciousness ['kɔnʃəsnɪs] — свідомість; thermonuclear ['θə:mou'nju:klɪə] — термоядерний; eternal [ɪ'tə:nl] — вічний; curiosity [ˌkjuərɪ'ɔsɪtɪ] — цікавість, допитливість; crucial ['kru:ʃɪəl] — вирішальний, критичний; extinguish [ɪks'tɪŋgwɪʃ] — нищити.

2. Words and expressions for the text comprehension:

self-contained and absolute value — самодостатня та абсолютна величина; unadulterated knowledge — справжні (несфальсифіковані) знання; from lack of knowledge (consciousness) — за браком знання (свідомості); in the event (of) — у разі; common sense — здоровий глузд; in effect — справді, насправді; with a view to — з наміром (метою); human predicament — нелегке (складне) становище людства; a life-and-death question — питання життя і смерті; to be aware of — розуміти, бути свідомим.

Modern scientific and technological progress has raised a complicated problem of the social responsibility of scientists. Here are some of them: How far are scientists responsible for the application of their work? If they are how can they best fulfil this responsibility? What is the ethics of scientific exploration, how is it related to the universal ethical values of mankind? Finally a number of scientists have raised the problem of the socio-ethical control of research referring to man, the justification for a moratorium [1] on some fields of research threatening man and the entire mankind. Is such control possible in whatever form? Will it not restrict the freedom of research? How is this freedom related to the social and humanistic responsibility of scientists and technologists?

The very fact that these specific problems are raised at all levels with increasing clarity shows the dissatisfaction with the idea that science is a self-contained and absolute value, a sphere of unadulterated knowledge independent of all other values of humanity and standing above them.

Scientists are realizing more and more clearly the indisputable fact that their social responsibility, the role of the ethical principle in science should grow in geometrical progression, if mankind and science itself are to develop at least in arithmetic progression. The ethics of science is being asserted as a *sine qua non* [2] of effective performance of humanistic-oriented scientific research. There is no alternative to this either for science or for humanity.

In mastering nuclear energy man has developed a power which, unless controlled by his intellect, could extinguish

life and snuff out our planet's blue glow [3]. This idea is convincingly proved by the disaster at the Chornobyl atomic power station in Ukraine. Such accidents take place from lack of knowledge in the fields of natural and technical sciences or from lack of consciousness about the negative consequences of the application of the scientific and technological innovations.

In the event of war, the last lines of civilization's history will be written in thermonuclear ink.

So it is not without reason that modern science is compared to Pandora's box [4]. Indeed, its eternal curiosity compels mankind to learn what is there beyond the Pillars of Hercules [5]. But has mankind enough common sense, social responsibility and self-control to resist the temptation of dangerous curiosity? This is, in effect, a life-and-death question for mankind.

Science and technology by themselves are not a source of ethics and values. They can tell you what will happen if you do this or that: for instance, how many people might be killed by a nuclear bomb. But the decision on whether to develop the bomb cannot be a scientific decision. This can only be judged by something outside science — ethics. Scientists and technologists should be aware of the consequences of their discoveries, projects.

Hence the crucial importance is attached to-day to the problem of socio-ethical control of science with a view to its humanistic orientation and development as a science for man. We need a new ethics and it must be many-sided. The belief that only one idea is true is tremendously dangerous. If you have only one way of looking at the world you abuse it. The new ethics must recognize that there are many ways out of the human predicament, which present different aspects of the same situation.

Only on the basis of such an ethical attitude can we solve the problems which threaten the world today — the destruction of the environment, drugs, AIDS [6], totalitarism. It is our duty to share a better world for all of us here on Earth.

VOCABULARY NOTES

[1] **moratorium** (on smth.) — мораторій, відстрочка
[2] **sine qua non** ['saɪnɪkweɪ 'nɔn] — обов'язкова умова
[3] **our planet's blue glow** — голубе світіння нашої планети
[4] **Pandora** [pən'dɔ:rə] — Пандора (у давньогрецькій міфології жінка, нібито створена Гефестом із землі й води)

Pandora's box — скринька Пандори — джерело всіх нещасть (Пандора з цікавості відчинила скриньку, де були сховані всі людські лиха, й випустила їх)

[5] **Hercules** ['hə:kjuli:z] — латинська назва грецького міфічного героя Геракла, який відзначався надзвичайною силою

Pillars of Hercules — Геркулесові стовпи (дві скелі поблизу Гібралтарської протоки на європейському та африканському берегах, згідно з античними міфами, споруджені Геркулесом)

[6] **AIDS (acquired immune deficiency syndrome)** СНІД (синдром набутого імунного дефіциту)

EXERCISES

I. Name the word-building elements (suffixes, prefixes) and the part of speech of each word. Translate them into Ukrainian:

adulterate — adulterated — unadulterated — adulterant — adulteration; apply — applied — appliance — applicable — applicant — application; value — valuable — invaluable — valuation — evaluation — valueless; relate — related — unrelated — relation — relationship; possible — impossible — possibility — impossibility; satisfy — satisfactory — unsatisfactory — satisfaction; believe — believable — unbelievable — belief — believer; destroy — destroyer — destruction — destructive.

II. Read the text and translate the following words into Ukrainian according to the text. State which of them are terms:

exploration, value, research, knowledge, progression, nuclear energy, power, thermonuclear, curiosity, bomb, predicament, environment, drug, AIDS, destruction, project, moratorium, (geometrical) progression.

III. Give English equivalents of the following words and expressions:

термоядерний, свідомість, знання, за браком знань, здоровий глузд, гостра проблема, наукове дослідження, питання життя і смерті, загрожувати, бути свідомим чогонебудь.

IV. Complete the following sentences using the word-combinations given below:

1. Problems of water and airpollution are obviously ... .
2. Problems of ethical responsibility of scientists and tech-

nologists are ... . 3. It is ... problem. 4. Ukrainian scientists tackle ... problems connected with nuclear radiation. 5. The possibility for minimizing negative effects of the scientific and technological progress is ... . 6. Productivity of natural resources outside and within the context of the scientific and technological progress is connected with a number of ... problems. 7. The construction and development of the independent sovereign Ukraine have faced a number of ... ... problems in economic and socio-political life.

(very complicated; most challenging; exceedingly difficult; of great importance; rather urgent; extremely important; very tempting; very peculiar)

V. Determine the tense forms in the following sentences and translate them into Ukrainian:

1. The engineer was asked to take part in the device tests. 2. Your invention has been spoken of for quite a long time. 3. This experiment is being carried on in our laboratory. 4. He had been taught over and over again about the purpose of this physics experiment. 5. He had been taught that modern physics involved the manipulation of minute quantities of matter, and that, to avoid mistakes, he would have to perform most of his experiments under vacuum. 6. The subject of elasticity will be discussed in details later on. 7. Radioactive isotopes are also being used successfully for this purpose. 8. The cell has always been considered the basic building block of FMS (Flexible manufacturing system).

VI. Read the text again and write out the sentences with the tense forms in the Passive Voice.

VII. Comprehension questions:

1. What problems appear in connection with the scientific and technological progress? 2. Are these problems easy to solve? 3. How is the freedom for research related to the social and humanistic responsibility of scientists and technologists? 4. Is science independent of all other values of humanity and does it stands above them? 5. Do all scientists and technologists realize their responsibility before mankind for the consequences of their activity? 6. Are there any proofs of the opposite? 7. What does the concept of new ethics mean in reference to the scientific and technological development of modern society? 8. What are the problems which threaten the world to-day?

VIII. Make a summary of the text and discuss it.

IX. Speak about:

a) the aspects of the scientific and technological progress which threaten the world to-day;

b) scientists and technologists who show responsible (irresponsible) attitude to the outcomes of their activity;

c) the ethics of scientists of the future.

X. Write a composition about scientists (engineers) of high social and ethical responsibility before humanity.

Text B. EINSTEIN'S TRIUMPH AND TRAGEDY

Einstein, as everyone knows, did something remarkable, but what exactly did he do? Even among educated men and women, few can answer. We are resigned to the importance of his theory, but we do not comprehend it. It is this circumstance which is largely responsible for the isolation of modern science. This is bad for us and bad for science; therefore more than curiosity is at stake in the desire to understand Einstein.

One of the cliches about Eienstein's theory is that it shows that everything is relative. The statement that everything is relative is as meaningful as the statement that everything is bigger. As Bertrand Russel pointed out, if everything were relative there would be nothing for it to be relative to. The name of relativity is misleading. Einstein was in fact concerned with finding something that is not relative, something that mathematicians call an invariant. With this as a fixed point, it might be possible to formulate physical laws which would incorporate the «objective residue» of an observer's experience; that is, that part of the space and time characteristics of a physical event which, though perceived by him, are independent of the observer and might therefore be expected to appear the same to all observers. The constancy principle of the velocity of light provided Einstein with invariant he needed. It could be maintained, however, only at the expense of the traditional notion of time. And even this offering was not enough. Space and time are intertwined. They are part of the same reality. Tinkering with the measure of time unavoidably affects the measure of space.

At the heart of the theory of relativity are questions connected with the velocity of light. The young Einstein began to brood about these while still a high-school student. Suppose, he asked himself, a person could run as fast as

a beam of light, how would things look to him? Imagine that he could ride astride the beam, holding a mirror just in front of him. Then, like a fictional vampire, he would cause no image; for since the light and the mirror are travelling in the same direction at the same velocity, and the mirror is a little ahead, the light can never catch up to the mirror and there can be no reflection.

But this applies only to his mirror. Imagine a stationary observer, also equipped with a mirror, who watches the rider flashing by. Obviously the observer's mirror will catch the rider's image. In other words, the optical phenomena surrounding this event are purely relative. They exist for the observer; they do not exist for the rider. This was a troublesome paradox, which flatly contradicted the accepted views of optical phenomena.

Step by step Einstein came to his fateful mass-energy equation. «The mass of a body is a measure of its energy content», he wrote in 1905, and gave his now-famous formula, $E = mc^2$, where E is energy content, m is mass (which varies according to speed) and c is the velocity of light.

When Einstein was twenty-six, he put forward an idea which changed the world. His idea revolutionized our conception of the physical universe; its consequences have shaken human society.

Einstein's achievement is one of the glories of man. Unfortunately, the scientist's great idea first was used not for the benefit of man, but for his distruction. When he realized the ominous consequences of his fatal equation and the responsibility he bore he vehemently protested against the military use of his discovery. But in vain. Besides, it became clear that the benefits of the so-called peaceful use of nuclear energy become also highly questionable.

Some great ideas may lead to still greater disasters. This was the triumph and tragedy of the genius.

ASSIGNMENTS

I. Comprehension questions:

1. Is Einstein's theory of relativity easy to understand? 2. What did B. Russel say about the name of relativity? 3. What lies at the heart of relativity? 4. Can you name Einstein's famous equation? 5. Did Einstein's great idea change the world? 6. What facts (events) produced a strong impact on Einstein's moral outlook?

II. Discussion questions:

1. Why don't a lot of educated people comprehend Einstein's theory of relativity? 2. Why is the term *relativity* misleading? 3 Which way are space and time intertwined? 4. What role did the velocity of light play in Einstein's theory? 5. How did the scientist come to his famous equation? 6. What was the cause of the scientist's moral suffering? 7. Did Einstein infringe the ethics of a scientist? 8. Could Einstein have foreseen the tragical consequences of his discovery?

III. Which of the five suggested titles of the text do you prefer?

1. Einstein's Fatal Equation.
2. The Theory of Relativity.
3. Einstein's Great Idea.
4. The Idea that Changed the World.
5. Triumph and Tragedy of the Genius.

IV. Render the text into Ukrainian.

V. Group activities:

a) There is a strong moral law within a man *(categorical imperative, E. Kant).*

b) Human history becomes more and more a race between education and catastrophe *(H. Wells).*

LESSON FOUR

Grammar: 1. Constructions with Emphatic it (Meaning and Translation).
2. Translation of Participle I (Depending on the Function).
3. Terminology (A + A + S Constructions).

Text A. UKRAINIAN NAMES IN WORLD SCIENCE

1. Read aloud and memorize the following words:

upsurge ['ʌpsə:dʒ] — швидке піднесення; descendant [dɪ'sendənt] — нащадок, потомок; surpass [sə:'pɑ:s] — перевищувати; restlessly ['restlɪslɪ] — невгамовно; academician [ə,kædə'mɪʃn] — академік; realm [relm] — галузь; alight [ə'laɪt] — спускатися, сідати, приземлятися; dirigible ['dɪrɪdʒəbl] — дирижабль; illustrious [ɪ'lʌstrɪəs] — славетний, відомий; reverence ['revrəns] — шанування; indomitable [ɪn'dɔmɪtəbl] — невгамовний.

2. Words and expressions for the text comprehension: blessed land — благословенна земля; to go down in history — увійти в історію; well-being — добробут; from time immemorial — з незапам'ятних часів; pave the way (into) — прокладати шлях (в, до); to stay away — залишатися; mode of life — спосіб життя; spare no efforts — не шкодувати зусиль; scientific exploit — науковий подвиг; to advance — рухатися вперед; to benefit — мати користь, вигоду, давати користь.

Rich is Ukraine in talented people, men of genius, devoted heart and soul [1] to their native land. Scientists and inventors, engineers and architects, singers and composers, writers and poets did their best to raise national science, culture, art to the highest world standards. They did it in and out of this country, within its borders [2] and far away — in many parts of the whole wide world.

The sons and daughters of this blessed land made an endless row of contributions to other people's civilizations, stimulating their growth, enriching their spiritual world, raising their life standards and well-being. The Ukrainian people's cultural and economic ties with other nations went down in history for many centuries, they existed from time immemorial, growing, developing, strengthening, now on the upsurge, now on the down-grade [3].

Yuri Kotermak — named Drohobych after his native land,— a well-known astronomer, philosopher and medicus [4], Rector of Bologna University in the 15th century, was one of the first to pave the way into world science.

Historical events, tragic, dramatic, unforeseen and unfavourable for the gifted people's descendants made many Ukrainians either leave their Homeland, or stay away in other countries. Absorbing other nations' culture and science, language and mode of life, Ukraine's intellectuals spared no effort to advance the peoples who sheltered them, gave them a chance to display their best natural qualities, let them contribute to the realm of knowledge and wisdom. America and Canada, Great Britain and Australia, Germany and France, Italy, as well as many other countries of East and West benefited and continue to benefit from Ukraine's descendants, from their strength of mind and intellect. Within their native land and outside its borders Ukrainian men of genius have been restlessly making contributions to world science.

To mention but a few we shall remember the names of Stepan Tymoshenko in the USA whose works *Strength of Ma-*

terials and *The History of the Strength of Materials* have become textbooks for the generations of students, Ivan Puluy in Austro-Hungary and Czechoslovakia [5] whose inventions preceded those of Wilhelm Roentgen, as well as many others.

There were such Ukrainians in our land whose discoveries paved the way into outer space, whose inventions promoted the further steps in space exploration: — a hero of the 1812 War General Olexandr Zassyadko, a freedom fighter, member of *Narodna Volya (People's Will)* Mykola Kybalchych, Kostyantyn Tsiolkovsky whose ancestor was Severyn Nalyvaiko.

Quite a special place belongs to the man of dramatic fate Yuri Kondratyuk (Olexandr Shargey) whose scientific exploit was duly appreciated by Academician Boris Rauschenbach. A man of tragic circumstances himself Rauschenbach wrote that it was Kondratyuk who suggested the idea of creating a base round the Moon and not on the Earth, to ensure the rocket starts for the Moon. Kondratyuk's idea was later realized in the *Appollo* flight programme many years after the author had been killed in action at the front.

Among other brilliant scientists who were working in this field and who gained breath-taking results [6] were Serhiy Korolyov, a constructor of cosmic systems, Academician Arkhyp Lyulka, a turbojet engines constructor, Lieutenant-General Mykola Dukhov, one of the creators of the atomic bomb.

Very near cosmic research stands another *flying* branch of scientific investigation — aviation and its affiliated domain hydronavigation. Most famous names here are Fedir Tereshchenko who constructed a monoplane with parameters far surpassing the existing models (as far back as 1913) and Dmytro Hryhorovych, a graduate of the Kyiv Polytechnic Institute, who constructed a seaplane (airplane rising from and alighting on water) for the first time in aeriel navigation.

And it was in Ukraine that such gigantic airplanes were brought into being [7] and use, as *Antey, Ruslan, Mriya (Dream)*. Quite unexpected is the turn at recent times to the long-forgotten kind of aviation — airships (dirigible balloons). Super-light (deltaplanes) and *wingless* aviation attracts Ukrainian plane-constructors' positive attitude and serious attention owing to such characteristic features of airships as practically unlimited weight-lifting ability, distance and time of flight, vertical start and landing. Today airships are built in such industrially developed countries as the USA, Canada, Great Britain, Germany, China and many others.

Among other illustrious personalities in Ukrainian science, Volodymyr Vernadsky's name deserves a special reverence for his indomitable scientific courage, for his abitity to foresee the development of human knowledge, for his efforts to foretell the future of mankind and its ways of progress.

The above mentioned names are only a few stars in the constellation of genius representing Ukrainian science in the world.

VOCABULARY NOTES

[1] **devoted heart and soul** — відданий (усім) серцем і душею
[2] **within its borders** — усередині, у межах (країни)
[3] **now on the upsurge, now on the down-grade** — то на піднесенні, то в занепаді
[4] **medicus** (*lat.* doctor) — лікар
[5] **Czechoslovakia** (now independent Czech and Slovak States) — Чехословаччина
[6] **breath-taking results** — гідні подиву результати
[7] **were brought into being** — були створені

EXERCISES

I. Name the structure (composition) of the following word-combinations and translate them into Ukrainian:

world standards, world science, life standards, space exploration, scientific exploit, aerial navigation, long-forgotten type, breath-taking results, freedom fighter.

II. Determine which of the following words and word-combinations are terms. Translate them into Ukrainian:

men of genius, native land, inventor, architect, composer, science, astronomer, historical event, strength of materials, discovery, space exploration, scientific exploit, rocket, aviation, hydronavigation, monoplane, dirigible, human knowledge.

III. Write out of the text and memorize the names of professions (specialities).

IV. Read the text carefully, find the sentences with Participle I in different functions and translate them into Ukrainian.

V. Finish the sentences according to the text:

1. The sons and daughters of Ukraine made contribution to ... . 2. Yuri Kotermak, named Drohobych was ... . 3. Many

Ukrainians had to leave their Homeland due to ... . 4. From Ukraine's descendants benefit such countries as ... . 5. It was Yuri Kondratyuk who suggested the idea of ... . 6. In the field of space research worked such brilliant Ukrainian scientists as ... .

VI. Find in the text and translate into Ukrainian the sentences with emphatic *it*-constructions.

VII. Comprehension questions:

1. In what talents is Ukraine rich? 2. Where did men of different talents do their best to raise national culture and science? 3. What is the contribution of the sons and daughters of Ukraine's land? 4. Are there many countries where Ukraine's descendants displayed their strength of mind and intellect? 5. What are the most outstanding Ukrainian names in world science and arts? 6. What is the fate of Yuri Kondratyuk? 7. What gigantic airplanes were brought into being in Ukraine? 8. What is the task of Ukrainian science at present?

VIII. Make a summary of the text and discuss it.

IX. Speak about:

a) Ukraine's scientific and technological achievements in and out of this country;

b) the struggle of Ukraine's people for their national independence;

c) the tasks facing Ukraine's people in the building-up our economy.

X. Write a short essay about the achievements of Ukrainian science and technology.

Text B. YURI KONDRATYUK AND THE MOON

1. Read aloud and memorize the following words:

technique [tek'ni:k] — техніка; illustrious [ı'lʌstrıəs] — славетний, відомий; huge [hju:d3] — велетенський; cosmonautics [ˌkɔzmə'nɔ:tıks] — космонавтика; trajectory ['træd3ıktərı] — траєкторія; righteousness ['raıtʃəsnıs] — справедливість, правильність; appreciate [ə'pri:ʃıeıt] — оцінювати, цінувати.

2. Words and expressions for the text comprehension:

have more than once surprised the world — неодноразово вражали світ; stands in the constellation of such outstanding scientific figures — входити до плеяди таких видатних

наукових особистостей; his indomitable spirit brought him world fame — його невгамовний дух приніс йому світову славу; had left the Earth for ever — назавжди залишив землю; the years 1918—1925 saw him working — у 1918—1925 рр. він працював; the Ukrainian Research Institute of Industrial Energetics — Український науково-дослідний інститут промислової енергетики; a huge Crimean wind-power station — велетенська кримська вітро-електростанція; workings out of reinforced towers construction and wind-power technique — розробки з питань будівництва залізобетонних веж та вітротехніки; he is often referred to — його часто називають; constructing interplanetary space-ships — будівництво міжпланетних кораблів; toiled independent of — працював незалежно від; the age-long dream of humanity — віковічна мрія людства; who was joined 20 minutes later — до якого приєднався через 20 хвилин; would have been impossible without — були б неможливими без; to overcome *stumbling-blocks* — подолати камені спотикання; to prove the righteousness of the theory of multi-stage space-rockets — довести вірність теорії багатоступінчастих космічних ракет; to suggest ... as rocket fuel — запропонувати як ракетне паливо; intermediate interplanetary rocket-bases — проміжні міжпланетні ракетні бази; landing with braking by atmosphere — посадка з гальмуванням атмосферою; celestial bodies gravitational field — гравітаційне поле небесних тіл; prevented ... from realizing his gift and talent to the full — завадили уповні реалізувати його хист і талант; a medal in his honour is to be conferred upon — медаль на його честь має присуджуватися; problems of distant probings of the Earth — проблеми дистанційного зондування Землі.

In the development of world science and technique, culture and craftsmanship a great role belongs to Ukraine's talented people. Inventors and scientists, investigators and researchers, engineers and designers, representatives of various professions have achieved breath-taking results. Their scientific and creative exploits have more than once surprised the world in the field of mathematics, physics, chemistry, mechanical and electrical engineering, cosmonautics and construction.

In the domain of cosmic research Ukraine's contribution is represented by many illustrious names among which one of the first belongs by right to Yuri Vasylyovych Kondratyuk (Shargey) (1897—1941). He stands in the constellation

of such outstanding scientific figures as K. Tsiolkovsky, V. Vernadsky, S. Korolyov, and others. His indomitable spirit brought him world fame, though, as it often happens, not in his life time.

The time and place of his birth are known: June 21, 1897, Poltava. The exact time of his death and his burial-place are unknown: early October 1941, or 1942, Kaluga district, are the official data on this man of genius whose real name was Shargey. The dramatic circumstances of his life made him live under an assumed name and world fame came to him many years after this pioneer in working out rocket engineering and the theory of cosmic flights had left the Earth for ever.

After finishing the 2-nd Poltava gymnasium he entered St. Petersburg University in 1916. The years 1918—1925 saw him working in Ukraine, in Poltava, Kyiv and some smaller towns, and since 1925 in the Northern Caucasus. In 1927 he moved to Novosibirsk where his occupation was projecting elevating gears. In the thirties he worked in Kharkiv at the Ukrainian Research Institute of Industrial Energetics. He stood at the head of the group of scientists whose task was designing and constructing a huge Crimean wind-power station. Working in Moscow before the war he devoted much of his time to energetics problems. It is a well-known fact that in building the Ostankino teletower, specialists used Y. Kondratyuk's workings out of reinforced towers construction and wind-power technique.

Y. Kondratyuk is often referred to as *Ukrainian Tsiolkovsky* for his main scientific interests lay in solving the problems of cosmonautics, cosmic flights and constructing interplanetary spaceships. In working at these problems as well as many others he toiled independent of K. Tsiolkovsky who knew Kondratyuk's works and approved of his ideas.

On July 21, 1969 the first flight to the Moon, the age-long dream of humanity, was realized by three American astronauts — Neil Armstrong, Michael Collins and Edwin Aldrin. The first steps on the surface of the Moon were made by Neil Armstrong who was joined 20 minutes later by Edwin Aldrin. This *Appollo* Moon flight and landing, as admitted by world's scientists, including Americans, would have been impossible without Y. Kondratyuk's solving a number of problems. These are such hard theoretical *stumbling-blocks* without overcoming which no moonlanding is possible: defining the optimal trajectory of cosmic flights, proving the righteousness of the theory of multi-stage space-rockets, suggesting some metals and non-metals and their hydrogen compounds as rocket

fuel. It was Kondratyuk's idea that intermediate interplanetary rocket-bases — planet satellites — be created as well as his was the thought of ensuring the return of cosmic spaceships to the Earth, their landing with braking by atmosphere and of the use of celestial bodies gravitational field for solving these problems.

In Y. Kondratyuk's works a number of new solutions was found pertaining to the development of cosmonautics: rocket dynamics, rocket building, cosmic systems creation. His scientific merits were not duly appreciated during his lifetime and his untimely death at the front prevented the great scientist and engineer from realizing his gift and talent to the full. His memory is dear to us, his descendants, and a medal in his honour is to be conferred upon those who make contributions to the study of cosmic space. A crater on the back side of the Moon was named after Yuri Kondratyuk.

In 1992 the National Cosmic Agency of Ukraine was established whose cosmic program has been worked out to further progress in cosmic studies and investigations. This program, among others, has brought into being Ukrainian rocket carriers *Zenith* and *Cyclon*, carried out fundamental works on problems of distant probings of the Earth, etc. Y. Kondratyuk's ideas have brought our country world fame, their influence has not been lost up to now and will serve generations to come.

ASSIGNMENTS

I. Comprehension questions:

1. Do the Ukrainian scientists play a great role in the development of world science and technique? 2. Who represents Ukraine's science in cosmic research? 3. What outstanding scientists carried out research on cosmic flights? 4. Where was Kondratyuk born? 5. Where did Kondratyuk get his education? 6. What problems was Kondratyuk concerned with in Kharkiv? 7. What did Tsiolkovsky think of Kondratyuk's ideas on cosmonautics? 8. When were the first steps on the Moon made? 9. Were Kondratyuk's merits appreciated during his life?

II. Discussion questions:

1. Representatives of what professions contributed to the development of world science and technique, culture and craftsmanship? 2. Does Ukraine play a great role in the domain of cosmic research? 3. Why was Kondratyuk forced to live under an assumed name? 4. What was Kondratyuk's

special merit in research of the Moon flights? 5. Why were Kondratyuk's merits not duly appreciated during his life time? 6. What task is set before the National Cosmic Agency of Ukraine?

III. Speak on Kondratyuk as a pride and glory of Ukraine's science.

IV. Give subtitles to each paragraph of the text.

V. Group activities:

a) Why is Ukrainian science and culture underestimated in the world?

b) What is V. Vernadsky famous for?

c) Why is Kondratyuk's burial place unknown?

d) Name outstanding Ukrainian figures in various fields of science and technique.

LESSON FIVE

Grammar: 1. Present and Past Perfect in the Passive Voice: Meaning and Translation.
2. Translation of **have + Passive Infinitive** Construction (have to be recorded).
3. **As ... as ...** Construction.
4. Terminology.

Text A. INFORMATION EXPLOSION AND DATA PROCESSING IN MODERN SOCIETY

1. Read aloud and memorize the following words:

purpose ['pə:pəs] — мета, ціль; (flying) vehicle ['vi:ɪkl] — (літальний) апарат; procure [prə'kjuə] — діставати, добувати; purchase ['pə:tʃəs] — купувати; issue ['ɪsju] — результат; completion [kəm'pli:ʃn] — завершення, виконання.

2. Words and expressions for the text comprehension:

data processing system — система обробки даних; issue notes — дані про випуск (продукції); stock and job records — матеріали та робочі місця; menu-driven press computer — перфокартковий комп'ютерний прес; setup information — задана інформація; to meet needs — забезпечити потреби; programmable press controller — прес з самопрограмним управлінням.

An outstanding characteristic of modern society is the powerful flow of knowledge and information in different fields of human activities. Information is often called the lifeblood of modern civilization. It plays an ever increasing part in everyday life, management of business, etc.

The scientific activity, with all its technical and economic outcomes and consequences, is today passing through a period of particularly rapid development. For instance, over the past 150 years the range of human knowledge has been doubled every twelve to fifteen years. In 1930, man knew four times as much as he did in 1900; by 1960 man's knowledge had grown sixfold [1], and by the year 2000 it can be expected to be a hundred times what it had been a century ago.

The present-day information explosion must be properly dealt with. To handle the information flow properly and instantly, to help specialists find immediately an information and data needed urgently a multiple of machines have been invented. They are now widely used for this purpose.

The computer, with its millionfold increase [2] in man's capacity to handle information, undoubtedly, holds the first place. Without the computer, data and information processing would be impossible, say, in space programs. It is the phenomenal speed of computers that makes them practically well suited to pursuing activities that require instant solution to complex dynamic problems. They are extensively used in the control and monitoring of space vehicles. Computers are ideal for high-volume computing tasks [3] such as the computation and analysis of statistical and mathematical data as well as scientific and engineering calculations.

For example, before production can be started in the factory, raw materials and parts have to be procured. This involves the data processing system in the preparation of purchase orders. When supplies are received they have to be recorded on appropriate stock or job records, which again involves data processing.

When production is due to begin [4] materials and parts have to be issued to the production centres and suitability recorded on issue notes which are subsequently recorded on stock and job records. The issues are often priced and extended. These are also data processing operations.

In the industry, for instance, one of the new generation of press control combines a menu-driven press computer with a programmable press controller. The press control

system monitors all vital functions of the stamping system. It provides an infinite capacity for storing all your setup information.

Total system diagnostics [5] are enhanced by the computer to provide on screen remedies for identifiable problems. Not only do you know why the press has stopped, but now you know where the problem is and how to remedy it.

On-line operating data [6] are automatically recorded. You can now call up a report to tell all about the job while it is running and how long to completion. The computerised control system has the flexibility to meet all production needs, its configuration can be expanded to meet new requirements [7] for more information.

Thus information and data processing is a special activity performed by the administrative organization for the business as a whole. It is concerned with the systematic recording, arranging, filing, processing and dissemination of facts relating to the phisical events occurring in business.

From the above said it can be concluded that data processing systems provide information and information provides the basis for managerial control of business operations to achieve corporate objectives [8] as effectively as possible. This means making the most suitable decisions based on the information provided.

A management information system therefore embraces the data processing systems, control systems (using information provided by the data processing system), and decision-making based on the facts indicated by the control systems.

A data processing system in its simplest form consists of three primary elements: input, processing and output. These elements apply whether the system is manual, mechanical or electronic.

A computer system consists of five elements, viz.[9] input, processing, output, storage and control.

It is absolutely necessary for every active member of modern society to be able to use the computer system in data (information) processing and management.

VOCABULARY NOTES

[1] **to grow sixfold** — зрости в шість разів
[2] **millionfold increase** — збільшення (ріст) в мільйон разів
[3] **high-volume computing tasks** — (завдання) обчислення великого обсягу
[4] **is due to begin** — має починатися

[5] **total system diagnostics** — повний системний діагноз
[6] **on-line operating data** — дані, що надходять безпосередньо до оператора
[7] **to meet requirements** — забезпечувати потреби
[8] **corporate objective** — корпоративна мета
[9] **viz.** (*лат.* **videlicet**) — а саме

EXERCISES

I. Define the models of the following expressions and translate into Ukrainian:

flow of knowledge; range of human knowledge; information explosion; data and information processing; production centres; press control; managerial control; press control system.

II. Use one of the words and expressions given below as an attribute of the word *information:*

1. At present we have ... information about the nature of this phenomenon. 2. There is lack of ... information about the mechanism of this process. 3. Is there any ... information on the processes concerned in cell differentiation? 4. Scientists now have ... information regarding the influence of the solar corpuscular fluxes on the Earth's atmosphere. 5. No ... information about the surface features of Mars is available. 6. There is still ... information of the nature of quantum phenomena. 7. The information ... is obviously incomplete and insufficient to allow any generalizations. 8. Can you say you possess ... information on the problem you are investigating?

(**sufficient, obtained, complete,** precise, a great deal of, detailed, **reliable, a lot of, valuable,** little, lack of, exact, unreliable, extensive)

III. Finish the following sentences according to the text:

1. An outstanding feature of modern society is ... . 2. The range of human knowledge has been doubled every ... . 3. Computers are ideal for ... . 4. Information and data processing is ... . 5. A management information system embraces ... . 6. A computer system consists of ... .

IV. Read the text again and write out terms (words and word-combinations).

V. Find in the text sentences with *Have + Passive Infinitive* Constructions and translate them into Ukrainian.

VI. Translate the following sentences paying attention to the meaning of the verbs in the Passive Voice:

1. The figures which have just been referred to were published in the last issue of the journal. 2. When the train had been lost sight of, we left the station. 3. The manufacture of electronic instruments for technical diagnostics of heavy diesel locomotives had been started by instrument makers in Ukraine. 4. In recent years many discoveries have been made in this branch of physics. 5. The practical uses of nuclear energy have been based on a knowledge of the structure of matter. 6. Electronic equipment has been applied in various aspects of our life.

VII. Comprehension questions:

1. Why is information often called the lifeblood of modern civilization? 2. How has the range of human knowledge grown over the past 150 years? 3. What helps man in storing and processing data and information? 4. In what domains of man's activity is the computer helpful? 5. How are computers used in industry? 6. What is data and information processing concerned with? 7. What does a management information system embrace? 8. What does a computer system consist of?

VIII. Make a summary of the text and discuss it.

IX. Speak about:

a) the importance of information in the life of man;

b) the processing of data and information at different periods of the life of society;

c) the modern systems of data and information processing.

X. Write a composition about the use of computers in our everyday life.

Text B. CODING AND DECODING MESSAGES

1. Read aloud and memorize the following words:

disguised [dɪs'gaɪzd] — замаскований; recepient [rɪ'sɪpɪənt] — одержувач; clue [klu:] — ключ *(до розгадки)*; yield [ji:ld] — давати; emperor ['empərə] — імператор; accomplices [ə'kɔmplɪsɪz] — співучасники *(злочину)*; message ['mesɪd3] — повідомлення; deciphering [dɪ'saɪfərɪŋ] — розшифровування; scramble ['skræmbl] — зашифровувати.

2. Words and expressions for the text comprehension:

the course of history — хід історії; nap — дрімати; through observation and reflection — за допомогою спостереження і розмірковування; might have been different — міг би бути відмінним; might have been added — можна було б до-

дати; sinister — поганий, зловісний; intelligible message — зрозуміле (ясне) повідомлення; to be baffled (for a clue) — бути в безвихідному стані (щодо ключа).

Trlx hoex erfa eetb mpel. This is the message that shook Europe for one hundred days. Had it been intercepted and read, the course of history might have been different. But this message reached its destination, and Napoleon Bonaparte was able to land safely in Marseille while his enemies were napping.

Naturally, such an important message had to be so disguised that only a few trusted persons could read it. Messages that are written in such a concealed manner are said to be *in code,* and the process of reading coded messages is known as *decoding.*

In order to decode a message the secret of its arrangement or the *key* of the code must be known. This is the same key which is used by a person when he translated his message into a coded one.

Generally, the key of a code is a secret which is closely guarded by the sender as well as the recipient of the coded message. However, sometimes the secret of the code may be discovered through observation and reflection. Let us take the above message: *Trlx hoex erfa eetb mpel.* We observe that the entire message was broken up into five groups of four letters each. This alone does not give us a clue. However, we note that the first letter of each group, if removed from the coded message and written all together T h e e m, may mean something. This may be an important clue. Consequently, we try the same thing with the second letters of the groups. We obtain r o r e p. If we examine the combination of these five letters closely we may observe that the reversal of their order yields p e r o r. Thus the first two trials yielded *the emperor.*

The third set of letters gives *lefte,* and the fourth set of letters, which is again written backwards, is x x a b l. Reversing the order of the fourth set of letters yields l b a x x. Now, assembling our findings, we have: *The emperor left Elba xx.*

What the x's at the and of the message mean is not clear to us. They may denote something very secret. On the other hand, they might have been added simply to bring the total number of letters in the message to twenty (which is a multiple of four, the number of letters in each group of the coded message). This is a common procedure as will be shown presently.

There are many reasons why people sent messages in concealed forms. In some cases the reason may be quite legitimate, in other cases sinister. Coded message may be used by spies to transmit reports to their employers or by criminals and plotters to communicate with their accomplices. On the other hand, governments use secret codes for communication between their legal agents so the message may be read only by those for whom they are intended. Armies and navies of all countries have secret codes. Telegraph companies are known to use special codes for transmitting commercial messages in order to save money; their codes are not secret and may be obtained or inspected in any office of these companies.

There are many methods for writing coded messages. Some of them are very simple and may be easily decoded. Others have now become extremely complex. The decoding of a secret message from some government agent, for instance, may be a tremendous task. The entire secret of a coded message lies in the manner an intelligible message is rewritten so that it becomes unintelligible. If the correct instructions for coding and decoding are available, deciphering may prove comparatively simple. But if the code key is not known, even a specialist may be baffled for a clue. Should the key be discovered, however, the entire code naturally becomes valueless. Because of this danger of discovery, governments are continually revising their codes.

There are two main methods of code writing. One consists of using the same letters as they appear in the original message, but changing their relative positions in a definitely prearranged manner. In other words, the letters of the message are carefully scrambled. The system used in this scrambling is the secret of the code. This method of code writing is known as transposition. The other method of code writing consists of the replacement of the letters of the original message by other letters (according to a certain definite system). This method is known as substitution.

ASSIGNMENTS

I. Comprehension questions:

1. What message shook Europe for one hundred days? 2. Whom was the message addressed to? 3. What is necessary for decoding a secret message? 4. How can the secret of a code be discovered? 5. What was the supposed clue in decoding the message? 6. Are the concealed forms of the message le-

gitimate? 7. What do the governments use secret messages for? 8. What methods of code writing are mentioned in the text?

II. Discussion questions:

1. Why might the secret message of Napoleon have changed the course of history? 2. What is *coding* and *decoding*? 3. What functions do *key* and *clue* play in decoding secret messages? 4. What method was applied in the case in question? 5. What are the reasons to send messages in concealed forms? 6. Can you tell the difference between the transposition and substitution methods?

III. Give the definitions of the terms:

spy — agent — intelligence officer.

IV. Suggest some other title of the text.

V. Group activities:

a) The role the secrecy plays in any government's policy.

b) Imagination is more important than knowledge. *(A. Einstein)*

c) Never write what you dare not sign. *(A. Saging)*

LESSON SIX

Grammar: 1. The Complex Subject Construction and its Translation into Ukrainian.
2. Terms of the Type: S + S + S (data storage device).

Text A. THE NEED FOR COMPUTER LITERACY IN MODERN SOCIETY

1. Read aloud and memorize the following words:

procedure [prə'si:dʒə] — процедура; awkward ['ɔ:kwəd] — незграбний, незручний; managerial [ˌmənɪ'dʒɪərɪəl] — управлінський; enjoyable [ɪn'dʒɔɪəbl] — втішний, приємний; acquaintance [ə'kweɪntəns] — знайомство; efficiency [ɪ'fɪʃənsɪ] — дієвість, ефективність; evolve [ɪ'vɔlv] — розгортати(ся), виявляти.

2. Words and expressions for the text comprehension:

disruptive — той, що руйнує (руйнівний); dumb — дурний, тупий; accounting calculations — бухгалтерські розрахунки; payroll (sheet) processing — обробка платіжної відомості; high-level function — функція високого рівня;

computer user — користувач комп'ютера; data base — база даних; to a greater or lesser extent — більшою чи меншою мірою; to shift away (from ... to) — переключатися (з ... на); computer service technician — технік, що обслуговує комп'ютери; to maintain and fix — обслуговувати (експлуатувати) і встановлювати.

The introduction of new procedures and new technology is said to be disruptive. Many people, particularly the older generation, cannot and do not want to change their ways of life [1]. They tend to be afraid [2] of the new systems. They believe that they won't be able to learn the new skills and will appear awkward and dumb. Nevertheless, changing technology tends to enforce [3] this on them.

The introduction of computers is said to follow that pattern. Slowly but surely, however, computers have crept into our life [4]. The microcomputer is now widely accepted as a very efficient device for performing many types of operation, such as the display of business and other information from a data base. It is used for performing computations of varying types at high speed including professional, scientific, engineering and accounting calculations. It is employed for mathematical calculations for the classroom as well as for word processing in typing and secretarial departments.

In business the computer is known to be a means increasing administrative efficiency, payroll processing, sales, etc.

Therefore the pressure on those who still are unfamiliar with computers and their use is ever greater. So almost everyone will need to become familiar with [5] data processing and computing, particilarly microcomputing, to a greater or lesser extent. No matter whether we need it in the home, office, school, college or factory, it will be almost as commonplace to use a computer as it is to drive a car.

Computers today are said to become more and more *user friendly* [6]. That is they are becoming much easier to use and understand. To use a computer in the past, one had to learn computer languages such as FORTRAN (FORmula TRANslation) or COBOL (COmmon Business-Oriented Language). The learning process was slow, errors were plentiful, and the whole process was difficult for many students.

Today's computers are much easier to use. Focus in many schools is shifting away from programming computers to using them for managerial decision making [7] a more enjoyable high-level function. Clerks do not need to become involved with the programming of computers as this is the prerogative

of the systems staff. Package programs may be used for the various applications in most instances.

Let's make acquaintance now with some of the terms and uses of computers, robots, and other high-tech equipment [8] in today's organizations.

Here are selected computer languages:

Ada: A goverment (especially military) computer language;
ALGOL (Algorithmic Language): math-oriented language used most often for larger computers;
APL (A Programming Language): IBM-devised language useful for math [9];
BASIC (Beginners All-purpose Symbolic Instructional Code); used mostly for math and statistics;
COBOL (Common Business-Oriented Language): used for business applications such as billing, payroll, or inventory;
FORTRAN (Formula Translation): used most often for scientific problems;
LISP: Advanced artificial intelligence language for programs that deal with human languages;
LOGO: Language useful for graphics; widely used in schools;
PASCAL: Language that teaches a structured approach to programming;
PL1 (Programming Language 1): similar to ALGOL, but handless business files better;
PROLOG (Programming in Logic): basic artificial intelligence program.

Due to computer application, a lot of new jobs have appeared. Some of the careers in computers, according to the government, will involve systems analysts [10]. Systems analysts have the challenging job [11] of analyzing the many functions of the firm and designing a computer system to perform those functions more efficiently. First the systems analysts study how the job is now being performed. Then they design a system to do the job better. To do that, they must learn what information must be collected and processed, what output is needed, what computer capacity is needed, and the costs involved. Systems analysts must explain the system to the various computer users and tell the programmers what the system needs to do.

The greatest increase in computer jobs in the future may be for computer service technicians. During the last decades, companies were busy installing computers. Someone has to maintain and fix those computers. This is a great opportunity for someone to start his or her own service business.

Dozens of careers have evolved because of computers and the information revolution. Someone, for example, must teach people how to use computers (computer trainers). There are computer consultants who advise firms which computer to buy. Computer librarians keep track of[12] all the tapes, disks, and other data storage devices. A data processing manager supervises the data processing center. Computer security specialists try to prevent computer crime [13]. Technical writers write the manuals that tell how to use the computer. Naturally, there are also computer engineers who design computers and manufacturers that produce computers.

There is a device that allows people to stay at home and work with a computer at work. It is called a modem. A modem converts data into a form that can be sent over phone lines so that one computer can «talk» to another.

Another major revolution is occurring in the use of computers to run machines, including robots, i. e. the use of computer-driven machines to do work formerly done by humans. Robot technology has improved dramatically in the last few years. Today, *intelligent* robots are being used in factories. Some robots can *see* and *read* using cameras. One robot, for example, detects irregularities in welded seams and corrects any mistakes. Another robot reads identifying numbers in nuclear fuel rods. The newest robots can *feel* the difference between an egg and a piece of steel and handle each of them accordingly. Some robots even respond to voice commands. Computers linked with robots can perform dirty, difficult, repetitive tasks faster, cheaper, and better than people.

VOCABULARY NOTES

[1] **way of life** — спосіб життя
[2] **they tend to be afraid** — вони схильні побоюватися
[3] **changing technology tends to enforce** — зміна технології має тенденцію нав'язувати
[4] **computers have crept into our life** — комп'ютери проникли в наше життя
[5] **to become familiar with** — познайомитися з
[6] ***user friendly*** — дружелюбний щодо користувача
[7] **managerial decision making** — прийняття рішення з питань управління
[8] **high-tech equipment** — високотехнологічне обладнання
[9] **math** — *розм. скор.* від **mathematics** — математика
[10] **analyst** — аналітик
[11] **challenging job** — заманлива, цікава робота

[12] **to keep track of** — стежити за
[13] **computer crime** — злочинність, пов'язана з комп'ютеризацією

EXERCISES

I. Explain the models and translate the following word-combinations:

data base, accounting calculations, payroll processing, data processing, computer language, managerial decision making, high-tech equipment, systems analyst, computer service technician, service business, information revolution, data storage device, data processing center.

II. Give full wording of the following abbreviations:

Ada, ALGOL, APL, BASIC, COBOL, FORTRAN, LISP, LOGO, PASCAL, PL1, PROLOG.

III. Which of the above listed programming languages are most widely used and which are obsolete?

IV. Read the text again, find the explanation of the meaning of the following terms and give their Ukrainian equivalents:

computer trainer, computer consultant, computer librarian, data processing manager, computer security specialist, technical writer, computer engineer, computer manufacturer, modem, *intelligent* robot.

V. Translate the following sentences, paying attention to the Complex Subject Construction:

1. A wide introduction of computers and robots is said to cause unemployment. 2. Robots are known to give little effect out of flexible production systems. 3. The Sun is known to represent a mass of condensed gases and vapours. 4. Certain properties of matter are considered to be always the same under definite conditions. 5. The cell is known to consist of two plates of conducting material put together and immersed in an electrolyte. 6. He is known to be a great expert in computer technology. 7. He is expected to make a good computer engineer. 8. English is known to be a language of international communication.

VI. Find in the text the sentences containing Complex Subject Construction and translate them into Ukrainian.

VII. Comprehension questions:

1. How do people of the older generation accept the new technologies? 2. Why do some people tend to be afraid of the new systems? 3. What technology is very efficient in process-

ing various kinds of information? 4. Where can computers, especially microcomputers, be efficiently appied? 5. Are all working people familiar with data processing and computing? 6. What is it necessary to know to be able to use a computer in one's work? 7. Why are today's computers easier to use? 8. What new computer careers have evolved because of computers and information revolution? 9. How are robots connected with the computer?

VIII. Make a summary of the text and discuss it.

IX. Speak about:

a) the history of computer technology;
b) computer use in various life situations;
c) the new computer careers.

X. Make a dialogue on *Importance of Computer Literacy for One's Career.*

Text B. YOUR HUMBLE SERVANTS: FINGERS AND ABACUS

1. Read and memorize the following words:

abacus ['æbəkəs] — рахівниця; pebble [pebl] — галька, камінець; limestone ['laimstoun] — вапняк; ingenuity [ˌindʒi'njuiti] — винахідливість; bead [bi:d] — намистина, кулька; horizon [hə'raizn] — горизонт; vexatious [vek'seiʃəs] — прикрий; subtraction [səb'trækʃn] — віднімання.

2. Words and expressions for the text comprehension:

slab — плита; biquinary notation system — система двоп'яткового позначення; vexatious problem — проблема, пов'язана з прикростями; digital computer—цифровий комп'ютер.

Nature thoughtfully provided our earliest ancestors with a simple aid of computation — a digital computer in the strictest sense of the word — copies of which may be seen in active use in any school-room where the youngest generation is counting on its fingers. In making this provision, nature unwittingly established the decimal base, with its 10 digit values as a natural mode in which the human race might express its numerical ideals.

In the beginning — to borrow a phrase — there was the abacus. This little device came into being some 2,000 years ago and still is the most widely used calculator on earth.

In some areas of the world it is the only known counting device.

The word *calculation* itself comes from the earliest form of abacus which consisted of lines drawn on the ground, with small limestone pebbles to represent numbers. The Latin word *calcis* means lime or limestone and the Latin word *calculus,* which grew out of it, first meant a small piece of limestone and later was expanded to mean any pebble used in counting.

The abacus (from *abax,* an ancient Greek word for slab) was a direct result of early efforts to count. When primitive man satisfied his need for food and shelter, he began seeking ways of expressing himself. His first *writings* were the rudimentary drawings on cave walls, the notches on the trees. The earliest were simply representations of what we find in nature — the sun, the moon, the animals he hunted. Soon, however, he wanted to express *how many* animals he had killed in a hunt, *how many* children he had, and so forth. Such was the development of symbols to indicate *one, several,* and *many.*

The next step was a big one — devising symbols to express specific quantities. The first two were, quite naturally, a *two* and a *five; two* because man had two hands, *five* because he had five fingers. And by combining the symbols for hands and fingers, he could express many different specific quantities. In such unprofessorial way man took his first plunge into the mathematical world and came up with a revolutionary concept — how to count. For then man acquired a scientific tool with which he could break up the universe into its component units and thus master the size and shape of things.

The numbers now in use are of comparatively recent origin, not more than a thousand years. They are known as Hindu-Arabic figures, because they originated in India and were introduced to Europe by the Arabs.

The abacus makes use of this two-five or biquinary notation system.

The abacus is a most remarkable instrument — a computer of great ingenuity capable of being made with the simplest tools.

But the abacus has its shortcomings — otherwise we'd all still be using it. It cannot carry over tens from one line to another and the counting of beads is the basis for addition and subtraction only. As man constantly expanded his mathematical horizons this became an increasingly vexatious problem.

Nevertheless, the elementary basis of operation of any digital computer, however complex, is the same as that of the old-fashioned abacus.

ASSIGNMENTS

I. Comprehension questions:

1. What is the simplest way of computation? 2. Is finger counting practised in our times? 3. Where does the decimal base of numeration come from? 4. What did the limestone pebbles represent in counting? 5. What is the etymology of the term *calculation?* 6. What is the origin of the word *abacus?* 7. What lies in the basis of two-five system of numeration? 8. Who invented numbers and introduced them to Europe?

II. Discussion questions:

1. Why do the people use the abacus in the time of scientific and technological progress? 2. Did nature provide man only with a decimal base of numeration? 3. How does the abacus function? 4. How did the first mathematical symbols come into existence? 5. What are the shortcomings of the abacus? 6. What have abacus and computer in common? 7. What do we call the abacus's native sister in Ukrainian?

III. Consult the dictionary and give the meaning of the following correlated terms:

figure — number — digit — integer — cipher.

IV. Give a short summary of the text.

V. Group activities:

a) The importance of Mr. Zero.

b) Prove that 12 (twelve) is the ancient's favourite number.

c) Why did the twenty-digits system fail?

d) Give linguistic explanation for the jocular saying that an Englishman has eight fingers only.

LESSON SEVEN

Grammar: 1. The Infinitive: Forms, Functions, Translation.
2. Conversion in Terminology.

Text A. BASIC COMPUTER SYSTEM ORGANIZATION

1. Read aloud and memorize the following words:

tight [taɪt] — тісний; within [wɪ'ðɪn] — у межах, всередині; circuitry ['sə:kɪtrɪ] — схема; execution [ˌeksɪ'kju:ʃn] — виконання, здійснення; majority [mə'dʒɔrɪtɪ] — більшість; area ['ɛəгɪə] — площа, дільниця; refer [rɪ'fə:] — стосуватися, торкатися; intermediate [ˌɪntə'mi:djət] — проміжний, перехідний; appropriate [ə'prouprɪɪt] — придатний, відповідний; utilize ['ju:tɪlaɪz] — використовувати.

2. Words and expressions for the text comprehension:

input/output (i/o) capability — здатність вводу-виводу; tight interconnection — тісний взаємозв'язок; memory chip — мікросхема пам'яті; to specify — визначати; under the control — під наглядом (контролем); depend upon — залежати від; outside world — зовнішній світ; to range (from ... to) — у межах (від ... до).

All computers, of whatever size [1], have four basic units: 1. an arithmetic/logic unit (ALU) [2], 2. a control unit, 3. a memory unit, 4. an input/output (I/0) unit [3].

There exists a tight interconnection of these units forming a basic computer system [4] within which data, information, or control signals are normally flowing.

Sometimes, the input and output units can be considered separately. The ALU and the control unit are often grouped together and referred to as the central processing unit (CPU) [5]. This is what the term *microprocessor* means. It is the ALU and control unit of a microcomputer. The microprocessor is usually one chip (IC) to which are added memory chips and I/0 chips to make a complete microcomputer.

The memory unit serves as an area to store instructions and data [6]. Instructions are the binary-coded pieces of information [7] that get decoded by the microprocessor and specify a particular operation that get operated on by the CPU [8]. The memory can also be used for storing intermediate

and final results of arithmetic operations [9] performed by the ALU. The control unit oversees the operation of the memory unit. By providing an appropriate address, information can be read from the memory unit and placed in the CPU or an output device. Information can also be written into memory from the CPU or an input device under the control of the control unit.

The CPU consists of the ALU and the control unit. The ALU is the area of the computer where arithmetic and logic operations are performed on data. The type of operation to be performed is determined by signals generated from the control unit. These signals are based on the decoding of an instruction that was read from memory. The data that get operated on [10] can come from memory or an input device based on the instruction for that operation. The result of the operation can be placed in memory or in an output device, again depending upon the instruction specified [11].

The control unit has the function of controlling [12] the functions performed by all the other components of the microcomputer. It must generate timing and control signals necessary to read (fetch) instructions from memory, decode these binary pieces of information utilizing the instruction decoder circuitry, and execute what is called for by the decoded instruction. It must also be able to communicate with I/O devices by performing read or write operations when called for by an instruction during the execution of a program.

The input/output unit consists of all the devices that allow the computer to communicate with the outside world. Some examples of input devices are keyboards, teletypewriters, punchcard and paper-tape readers [13], magnetic-tape readers, and analog-to-digital converters [14]. Some examples of output devices are indicator lights, teletypewriters, printers, punched-paper-tape, and digital-to-analog converters.

Since the computer is continually fetching and executing instructions, it must be operating on information in groups of bits [15]. These groups of bits that the computer operates on, either transferring or manipulating, are referred to as the computer word size [16]. The greatest majority of microcomputers use an eight-bit word size [17], indicating that the CPU deals with eight-bit transfers or manipulations of information. Each memory location holds an eight-bit piece of information, or one computer word. The grouping of eight-bits into one piece of information for transfer or manipulation occurs so frequently that it is given the name byte. Therefore,

eight bits is one byte and the computer used operates on one-byte words, so it can be described as an 8-bit microcomputer.

Larger computers, such as maxicomputers, generally operate with word sizes ranging from 16 to 64 bits, with 32 bits being the most common. These computers (32-bit) would then be described as having a word size of four bytes. Minicomputers operate with word sizes ranging from eight bits to 32 bits, with 16 bits being the most common.

Most microprocessors specify a 16-bit memory address[18] and, therefore, two bytes are necessary to define a specific memory location. Some microprocessors allow for storing data in specific areas of memory, in which case a special operation code for the operation to be performed is used and only eight bits of address are needed for the complete instruction.

VOCABULARY NOTES

[1] **of whatever size** — незалежно від розміру
[2] **arithmetic/logic unit (ALU)** — арифметично-логічний блок (АЛБ)
[3] **input/output (I/O) unit** — блок вводу-виводу
[4] **basic computer system** — основна система ЕОМ
[5] **central processing unit (CPU)** — центральний процесорний блок (ЦПБ)
[6] **to store instructions and data** — накопичувати запас команд і даних
[7] **binary-coded pieces of information** — масив інформації у двійковому коді
[8] **that get operated on by the CPU** — якими ЦПБ оперує
[9] **intermediate and final results of arithmetic operations** — проміжні та кінцеві результати арифметичних операцій
[10] **data that get operated on** — дані, над якими проводяться операції
[11] **depending upon the instruction specified** — залежно від конкретної команди
[12] **the control unit has the function of controlling** — блок управління виконує функцію контролю
[13] **punchcard and paper-tape reader** — зчитувач з перфокарт і паперової стрічки
[14] **analog-to-digital converter** — аналого-цифровий конвертер
[15] **to operate on information in groups of bits** — виконувати інформаційні операції в групах бітів

[16] **computer word size** — розмір слова ЕОМ
[17] **eight-bit word size** — розмір восьмибітового слова
[18] **16-bit memory address** — 16-бітова адреса пам'яті

EXERCISES

I. State which of the following words are terms:
tight, circuitry, computer, information, area, capability, range, keyboard, operation, storage, memory, device, control, execution, bit, byte, size, type.

II. Learn the Vocabulary Notes to the text and give Ukrainian equivalents of the following words and word-combinations:
input unit, digit, character, keyboard, digital computer, analog computer, output unit, code, decode, wire, trunk, drum, diode, chip, continuous paper tape, phosphorescent screen, hardware, software, magnetic core memory, buss, main trunk line, basic computer system, to store instruction and information, central processing unit, 16-bit memory address.

III. Read the text again and write out terminological words and word-combination related to:
a) input devices;
b) output devices;
c) microprocessors.

IV. Finish the following sentences according to the content of the text:
1. The memory unit serves as ... . 2. The control unit oversees ... . 3. The data that get operated on can come from ... . 4. The results of the operation can be placed ... . 5. The input/output unit consists of ... . 6. Larger computers generally operate with word size ranging from ... . 7. All computers have ... . 8. An automatic computer is a machine which is able ... .

V. Define the form and function of the Infinitive in the following sentences and translate them into Ukrainian:
1. One has to register the results of the experiments carefully. 2. Laws and theories are formulated from the results of the experiments and then used to predict the results of new experiments. 3. The researchers were glad to have obtained such results in their latest experiments. 4. Another important factor to have been referred to was that current strength was equal at all points of a series circuit. 5. I sup-

posed all the details of the experiment to have been explained to you long ago. 6. To fully comprehend the financial implications of investing in flexible, programmable manufacturing technologies, it is necessary to consider the three major elements of the factory-engineering, manufacturing, and information systems, as an inseparable, integrated whole. 7. This minimal representation of the hardware is sufficient to explain the software structure and functions. 8. Today engineers are trying to integrate the technologies of CAD, NC and IR (Industrial Robots).

VI. Find in the text sentences with the Infinitives, explain their forms, functions and translate them.

VII. Comprehension questions:

1. What basic units do all the computers consist of? 2. Is there any interconnection of these units? 3. What is the microcomputer? 4. What do we call instructions? 5. What is data? 6. What oversees the operation of the memory unit? 7. What does the CPU consist of? 8. What is the function of the control unit? 9. What word size do the majority of microcomputers use? 10. What does the word *byte* mean?

VIII. Make a plan of the text rendering.

IX. Speak about:

a) the principal parts of the computer;

b) types of computers;

c) the type of the computer and the computer language you use in your work.

X. Write a dialogue about the software and hardware of the computer.

Text B. MAJOR FUNCTIONAL PARTS OF THE AUTOMATIC COMPUTER

1. Read aloud and memorize the following words:

reasonable ['ri:znəbl] — розсудливий, поміркований, прийнятний; continuous [kən'tɪnjuəs] — безперервний, суцільний; variable ['vɛərɪəbl] — мінливий, змінний; acceptable [ək'septəbl] — прийнятний; energize ['enədʒaɪz] — живити енергією; oscilloscope [ɔ'sɪlɔskoup] — осцилоскоп; access ['ækses] — вибірка, доступ; coaxial [kou'æksɪəl] — коаксиальний; trunk [trʌŋk] — шина, магістраль; essentially [ɪ'senʃlɪ] — істотно, суттєво; phosphorescent [ˌfɔsfə'resnt] — фосфоресцентний.

2. Words and expressions for the text comprehension:

store information — накопичувати інформацію; to put out (answers) — (ви)давати відповіді; all in the proper sequence — усе в належній послідовності; to take in (information) — приймати (інформацію); human being — людина; physical variable — фізична змінна; electric typewriter — електрична друкарська машинка; access time — тривалість вибірки, тривалість доступу; coaxial cable — коаксиальний кабель; trunk line — лінія магістралі; general-purpose machine — універсальна машина (комп'ютер); phosphorescent screen — фосфоресцентний екран; diode-capacitor memory — діодний конденсаторний запам'ятовувальний пристрій.

An automatic computer is a machine which is able to take in and store information (problems, numbers, instructions etc.), perform reasonable operations on the information, and put out answers.

Now a question arises: How can a machine be arranged or constructed to do all the different kinds of reasonable operations that may be needed to work out the solution to a problem? And how does it perform them, all in the proper sequence, completely and accurately?

This is an important question, but the answer is rather long.

First, the machine must have a way of taking in information. The part of the computer that takes in information is called the input unit. For the machine to accept it, information for a digital computer has to be in the form of digits 0, 1, 2, 3, ...9 or characters A, B, C. Even these marks have to be translated by human beings into specially prepared symbols that the machine can accept: one example is punched holes in a card of standard size; another example is punched holes in continuous paper tape.

Information for an analog computer has to be in the form of distances or rotations, or voltages, or amounts of other physical variables.

Second, the machine must have a way of putting out information. The part of the computer that puts out information is called the output unit. The computer can easily put out information in a form acceptable to human beings. For example, the computer may give impulses to an electric typewriter, so that the keys are energized in the proper sequence to type out a message in ordinary typed characters which a human being can read. Or the computer may show a graph on a phosphorescent screen, such as the face of an oscilloscope.

Third, the machine must have a way of storing information. The part of a digital computer which stores information is called storage or memory. Information that is stored inside a computer is called locations or registers, units of hardware in which the positioning of physical objects stores information. Each register ordinarily holds one *machine word,* consisting usually of 10 to 20 decimal digits or characters, or their equivalents. The time required to transmit one computer word out of a specified register to where it will be used is called the access time; it usually amounts to a few millionths of a second or less in modern fast computers. The speed of modern computers is the speed of access to their memories. The capacity of a computer is the quantity of data that its memory unit can hold.

There are several types of storage media. Magnetic tapes and drums are used for the so-called *low-speed* memory of a computer: a magnetic core memory or diode-capacitor memory is used as the *high-speed* memory as well as a battery of *flip-flop* registers for the really high-speed work.

Fourth, the machine must have a way of performing reasonable operation on information. The part of a digital computer that does this is called the arithmetical unit. This unit is capable of performing automatically addition, subtraction, miltiplication, division as well as such logical operations as comparing, selecting, sorting and other mathematical and logical operations such as may be called for by the instructions given to the machine. Computers require from a few thousandths to a few millionths of a second to perform each arithmetic or logic operation.

Fifth, the machine must have one or more ways of allowing information to flow through it. In a digital computer there is a single channel along which all information flows, and it is usually called the buss; it consists of wires or coaxial cable running between all the registers, input, output, storage and calculating unit. It has a main trunk line running throughout the whole computer and a large number of sidings.

Sixth, and finally, the machine must have a control action. In a digital computer, this section of the machine connects sidings, registers into the buss and disconnects them. The control unit regularly takes care of carrying out the instructions given to the machine, of executing the sequence or program of instructions.

In all digital computers the control section takes in commands which are essentially or just exactly the same form in

each step: «Take the machine word from register ...; put it in register ...; and pick up the next order from register ...»

The control register in the control unit contains the current instructions for the machine at each cycle or step, saying what register to take information out of, what register to put information into, and what register contains the next instruction to be executed.

Once an automatic digital computer is organized in this way, it is a completely general-purpose machine. It can carry out any sequence of instruction, any program which can be expressed exactly and translated into its command code.

ASSIGNMENTS

I. Comprehension questions:

1. What is an automatic computer? 2. What do the input and output units do? 3. What kinds of computers are there? 4. Where does the computer store the information? 5. How many operations does the computer perform per second? 6. Is there an arithmetical unit in the computer? 7. What does the control unit take care of?

II. Discussion questions:

1. What can a computer do? 2. Why are two kinds of computers named *digital* and *analog* ones? 3. Can the computer accept any symbols? 4. What are the types of storage media? 5. What functions do the units of the computer perform? 6. Why do we call the computer a general-purpose machine?

III. Describe the binary system of numeration.

IV. Give a short summary of each of the computer's units.

V. Group activities:

a) Is the computer a thinking machine?

b) Give a short characterisic of the computer of the first and fifth generations.

c) Can a computer talk?

d) What can the computer do that a human being cannot?

LESSON EIGHT

Grammar: 1. The Gerund: Forms, Functions, Translation.
2. **One** — the Word-substitute.
3. Terminology.

Text A. MODERN ELECTRONICS (MICROPROCESSORS AND MICROCOMPUTERS)

1. Read aloud and memorize the following words:

sequential [sɪ'kwenʃəl] — послідовний; reside [rɪ'zaɪd] — перебувати; unique [ju:'nɪk] — унікальний, єдиний; otherwise ['ʌðəwaɪz] — інакше, по-іншому; peripheral [pə'rɪfərəl] — периферійний; inexpensive [ˌɪnɪks'pensɪv] — недорогий; varied ['veərɪd] — різноманітний; realm [relm] — сфера (діяльності); acquisition [ˌækwɪ'zɪʃn] — набуття, збирання (даних).

2. Words and expresions for the text comprehension:

daily life — повсякденне життя; set of instructions — набір команд; break down (into) — розділяти, групувати; over again — знову; business records — діловий облік; realm of data acquisition — сфера збирання даних; industrial process control — управління промисловим процесом; consumer electronics — електроніка у сфері споживання; computer market — ринок комп'ютерів.

A recent advance in electronics has had great impact [1] on both the electronics and our daily lives. With the arrival of the microprocessor [2], another evolutionary stage has taken place in the electronics field. What the introduction of the transistor did a number of years back [3], the microprocessor is doing now. Every day, more and more applications of this device affect our lives in many ways.

What are microprocessors and microcomputers? Why have they such impact on industry and our lives?

Before an understanding and appreciation of microprocessors and microcomputers can be achieved, one must know how a computer works in general and what components are involved [4]. A simplified description of how a computer works is to describe it as follows: the computer executes a sequential set of instructions [5]. The instructions are in a binary-coded form and reside in the computer's memory [6]. Each instruction has a unique code specifying a particular operation and has been placed in specific sequence by the computer programmer.

The complete set of instructions is referred to as a program [7], and the program allows the computer to perform a useful function.

The computer can perform this function by taking (fetching) the first instruction from memory and performing (executing) the operation called for by the code [8]. Then it goes back to the memory unit and takes the next instruction in sequence (unless directed otherwise) and performs the operation called for by its code. This sequential fetching of an instruction and execution of that instruction continues until the final instruction is executed. Thus, the computer has finished performing the function defined by the program and can either wait for a new set of instructions (program) or be directed to repeat the entire program over again.

Computers can be broken down into [9] three main categories based on their size. The biggest type are those that we see in large business corporations, banks and scientific laboratories. An entire large room may be devoted to these maxicomputers and their associated peripheral equipment [10], such as magnetic tape units, card punchers, card readers, and line printers. The function of these units can range from scientific computation and engineering problem solving [11] to large business-type operations, such as payroll, accounts keeping, inventory, and maintaining large files of data [12].

Minicomputers are much smaller in physical size and are used mostly for purposes such as industrial process control [13], scientific applications in research laboratories, and management of business records for small companies. These computers are in great demand because of their relatively inexpensive price compared to maxicomputers and their varied capabilities, making them very flexible and easy to package for a variety of applications [14].

The microcomputer is the least expensive and smallest of the three types of computers. Its greatest impact is the realm of data acquisition [15] and control in industrial process control, although many applications have been found in consumer electronics and the computer market. Microcomputers of the technology involved in manufacturing them will change many aspects of our daily lives.

VOCABULARY NOTES

[1] **to have great impact** — мати великий вплив

[2] **with the arrival of the microprocessor** — з появою мікропроцесора

[3] **a number of years back** — кілька років тому
[4] **what components are involved** — про які компоненти йдеться
[5] **a sequential set of instructions** — послідовність одержаних команд
[6] **reside in the computer's memory** — містяться в пам'яті ЕОМ
[7] **the complete set of instructions is referred to as a program** — повний комплект команд називається програмою
[8] **called for by the code** — передбачена кодом
[9] **computers can be broken down into** — ЕОМ можуть бути розподілені на
[10] **their associated peripheral equipment** — належне їм периферійне обладнання
[11] **engineering problem solving** — вирішення інженерної проблеми
[12] **maintaining large files of data** — запам'ятовування великих обсягів даних
[13] **industrial process control** — контроль промислового процесу
[14] **easy to package for a variety of applications** — легко перебудувати для різного вжитку
[15] **the realm of data acquisition** — сфера збирання даних

EXERCISES

I. Define the structure of the following terms and translate them into Ukrainian:

microprocessor, microcomputer, transistor, electronic device, computer, computer's memory, memory unit, magnetic tape, line printer, card puncher, card reader, files of data, maxicomputer. data acquisition.

II. Use terms from ex. I in the sentences of your own.

III. Find in the following sentences the words of terminological character, explain their structure, realm of use, and translate them into Ukrainian:

1. A revolution in data handling is taking place. 2. The process of accumulating information (knowledge) continues until we have a complex cross-indexed set of images and facts stored in our brain. This is what we call memory. 3. Electronic computers consist of three major components that might be schematically shown as an operation's register, a digital computer, and a memory unit. 4. There are such types of memory units: the rotating drum, the disk, and the solid

state or core storage. 5. The digital computer is controlled by the memory through an operation register that responds when receiving certain impulses from the memory. 6. Various computers can find solutions for linear equations, linear differential equations, matrices, partial differential equations, polynomials and so forth. 7. Because of its ability to store large amounts of information, a big computer can be and is used to translate from one language into another.

IV. Define the form and function of the Gerund in the following sentences and translate them into Ukrainian:

1. In such a short time he has made great progress in learning English. 2. By thoroughly preparing the experiment they obtained accurate data. 3. He was sorry for not having tested this device with the use of the computer. 4. On their having checked the temperature twice he decided to change conditions of the experiment. 5. On entering the lens the rays are bent toward the normal as before and on leaving they are bent away from the principal axis. 6. He remembered once having read that at very low temperatures some metals become superconducting, having practically zero specific resistance.

V. Read the text again and find the sentences with the Gerund. Explain its form and function.

VI. Write down 6—8 questions on the text.

VII. Compose a dialogue on the recent advance in electronics.

VIII. Speak about:

a) the types of computers;

b) the computer and its components;

c) the microcomputers, macrocomputers and microprocessors.

IX. Speak on the advances in modern microprocessor technology.

Text B. MICROPROCESSORS, MICROCOMPUTERS, MICROCONTROLLERS AND MINICOMPUTERS

1. Read aloud and memorize the following words:

circuit ['sə:kɪt] — схема; require [rɪ'kwaɪə] — вимагати (потребувати); compatible [kəm'pætəbl] — сумісний, сполучений; assembly [ə'sæmblɪ] — монтаж; cumbersome ['kʌmbəsəm] — незграбний, громіздкий; hexadecimal

['heksə'desiməl] — шістнадцятковий; alphanumeric ['ælfənjumerik] — початкове число; assign [ə'sain] — приписувати; ascending [ə'sendiŋ] — який іде по висхідній лінії; vice versa ['vaisi'və:sə] — навпаки.

2. Words and expressions for the text comprehension:

integrated circuit — інтегральна схема; to provide with — забезпечувати; read-only memory (ROM) — доступна тільки для читання пам'ять; interactive video computer terminal — інтерактивний комп'ютерний відеотермінал; line printer — пристрій рядкового друку; control element — елемент управління; number system — числова система; decimal number system — система десяткових чисел; microprocessor-based system — система на основі мікропроцесора; binary number system — двійкова система чисел; assembler language — мова асемблера; shorthand number system — стенографічна система чисел; octal — вісімковий; hexadecimal — шістнадцятковий; no matter how large or small — незважаючи на те, якої величини.

A microprocessor is an integrated circuit (IC) that performs many of the functions found in a digital computer. A single microprocessor IC is capable of performing all the arithmetic and control functions of a computer. By itself, a typical microprocessor IC does not contain the memories and input/output (I/O) functions of a computer. However, when these functions are provided with additional ICs, a microcomputer is formed.

Typically, a basic microcomputer requires a read-only memory (ROM) to store the computer program or instructions, a random-access memory (RAM) to store temporary data (the information to be acted upon by the computer program), and an I/O IC to make the system compatible with outside or (peripheral) equipment such as an interactive video computer terminal, teletype, or line printer. There are some ICs that contain some, or all, of these functions. In effect, when an IC contains all of the basic functions, the IC is *a computer on a chip*. However, this is not the typical case.

Microprocessors are sometimes referred to as microprocessor units (MPU) or control processor units (CPU) (CPU can sometimes mean central processor unit). A microprocessor is not always used in digital computer applications. Instead, the microprocessor is used as a controller. As a matter of interest, the microprocessor was originally developed as the control element for those applications where digital computer function (the ability to store and execute a complete program automatically) was too large or expensive. Sometimes, the

microprocessor is called *a microcontroller* when used in these control applications.

The term *minicomputer* can be applied to many relatively small and relatively simple computers. A minicomputer often contains many ICs, but not necessarily a microprocessor IC.

Number Systems in Microprocessors / Microcomputers

The decimal number system is generally used in the world outside the microprocessor. Inside a microprocessor-based system, the binary number system is used most often. This is because binary numbers are compatible with the electrical pulses used in digital or logic systems. Binary numbers use only two digits, 0 or 1. The zero can be represented by the absence of a pulse, with the 1 being represented by the presence of a pulse (vice versa in some systems). The pulses can be positive or negative without affecting the binary number system (as long as only two states exist). In any event, to understand the language of microprocessor-based systems (generally referred to as machine language), it becomes necessary to examine number systems in general and the binary number system in particular.

Although microprocessors use binary numbers in the form of pulses, most microcomputer systems use some other form of number system for assembly of computer programs (generally referred to as assembly language). This is because binary numbers (although compatible with pulses) are cumbersome when the values are beyond a few digits. Shorthand number systems are used to enter and read out programs and data in a microcomputer system. The most common shorthand number systems used for microcomputer programming are the octal, hexadecimal (or hex), binary-coded decimal (or BCD), and alphanumeric systems.

The binary number system uses only two digits, 0 and 1. The positional weights of the digits increase from right to left as in the familiar decimal system. In all number systems, digits are assigned positional weights, or values, so that numbers can be written to express all quantities, no matter how large or small. The real value of a digit depends on its position in the number. With binary, the increase of value is in ascending powers of 2.

ASSIGNMENTS

I. Comprehension questions:

1. What do we call a microcomputer? 2. What functions do some ICs contain? 3. What purpose was the microprocessor originally developed for? 4. How many digits does the binary system use? 5. Where are the electrical pulses used? 6. What is necessary for understanding the machine language? 7. Why must microcomputer systems use shorthand number systems? 8. What does the real value of a digit depend on?

II. Discussion questions:

1. What functions is a single microprocessor IC capable of performing? 2. How is a microcomputer formed? 3. What is *a microcomputer on a chip?* 4. Why is the microprocessor sometimes called a microcontroller? 5. What do the 0 and 1 digits represent? 6. What number systems are there? 7. What way does the positional weight of the digit increase?

III. Speak on the arithmetical operations by electrical means.

IV. Render the text into Ukrainian.

V. Group activities:

a) Large-scale integration (LSI) in electronics.

b) How many separate electronic components can a chip contain?

c) What have minicomputers, microcomputers, microprocessors and microcontrollers in common?

d) Define the computer's hardware and software.

LESSON NINE

Grammar: 1. Sentence Patterns with Modal Verbs.
2. Terminology.

Text A. COMPUTER-AIDED PRINTING

1. Read aloud and memorize the following words:

manual ['mænjuəl] — підручник, посібник; bulletin ['bulɪtɪn] — бюлетень; delete [di:'li:t] — викреслювати (у коректурі); visual ['vɪzjuəl] — зоровий; image ['ɪmɪd3] — зображення, образ; enormous ['inɔ:məs] — величезний; appropriate [ə'prouprɪɪt] — придатний, відповідний; galley ['gælɪ] — *полігр.* гранка; typography [taɪ'pɔgrəfɪ] — книгодрукування, друкарство; monotonous [mə'nɔtnəs] — монотонний.

2. Words and expressions for the text comprehension:

to fail to notice — бути неспроможним помітити; sophisticated — складний, ускладнений; to lay out text — робити макет тексту; news-letters — інформаційні бюлетені; laser printer — лазерний принтер; optical scanner — оптичний скануючий пристрій; artist — художник, ретушер; to typeset a book — набирати книжку; cutting — обрізка (книжки); pasting — нанесення клею; printing plates — друкарські форми; page format — сторінковий формат; composition — набір; mouse — маніпулятор «мишка»; in the making — у виробництві; floppy disk — гнучний диск.

The computer revolution is obvious to anyone who watches TV or reads any of business publications. He cannot fail to notice that personal computer users are becoming much more sophisticated.

As an example, let's discuss the use of computers for word processing in typing. Thanks to the development in 1984 of software programs that can lay out text on a page and combine it with high-resolution graphics [1], many personal computer (PC) users now create their own texts, manuals, bulletins and news-letters. Writers make use of computers and word processors, which allow them to revise easily what they write. They can insert, delete or move words and sentences, and see the results on a screen without having to type entire paragraphs or pages. This technology is termed *desktop printing* [2].

What exactly is desktop printing or publishing? It is the application of personal computers to the entire range of the printing process, from the typing in the author's original copy to the final printing of the publication. It is a means of producing documents, complete with graphics, ranging from one-page information to advertizing leaflets [3], magazines and even books, an equipment which can comfortably be housed [4] on a reasonably large desk.

The basic equipment, or *hardware*, consists of a computer, complete with a visual display unit (screen) [5], a keyboard and a movement sensing device [6] known as a mouse, an optical scanner and a laser printer. The programs, or *software,* needed to operate the equipment consists of a *page description language* [7] which translates the image on the computer screen into a set of digital instructions that the laser printer can follow, and a composition program to drive the entire system.

Desktop publishing, as its name suggests, allows a publishing house to be established on the top of a desk. It allows of an enormous saving of both time and money. With the use

of a personal computer system and the appropriate software, it is now possible to edit, design, illustrate, lay out, and typeset a book in a relatively short time and without a large staff and a staggering budget.

Desktop publishing eliminates the need for outside typesetters and artists. With the use of a relatively inexpensive computer, type can be set in the office. The results can be checked at once and corrections made easily and at no extra cost. Full page make up [8], too, can be done on the computer. Changes can be made on the screen, and there is no need for galleys, or for cutting and pasting.

With the use of painting and drawing programs, digitizers, image scanners, and other graphic tools, it is possible for artists to create images on the screen; this artwork combined on the same page with the text can be examined on the screen before printing. Once again, by this method, correction is simplified.

Finally, type and art, in page format, can be output in the office by means of a laser printer. Once the image has been transferred to the computer, it can be modified, saved and printed out like other data.

In recent years, the traditional composition has been rendered almost obsolete [9] by the introduction of computer generated and assisted typography. Metal typesetting has been gradually replaced by phototype setting [10] and, increasingly, by digitized typesetting and other direct image composition [11], which account for most of today's book typesetting.

As its name implies, phototypesetting is based on the principles of photography, the copy to be used in the making of the printing plates is created by exposing photosensitive paper or film to light formed into the shapes of type characters, and the paper or film is then processed like any other photograph.

All phototypesetting reguires 3 elements: a master character image [12], a light source, and the photosensitive material or film.

An operator sits down at an input device, a typewriter-like keyboard, and copies the manuscript, also giving codes, stored in a computer, dictates the type sizes, the space between letters, words and lines, as well as the width of lines, justified or unjustified. The material is then put into the type-setter system, which creates the type images on the paper or film directly by tape (paper or magnetic) or floppy disk.

That is how computers are used in printing. This technology gives the possibility to refuse from a hard and monotonous craftskills of the publishing process. Desktop publishing enables writer's words and ideas to reach a large number of readers more economically and efficiently than ever before.

VOCABULARY NOTES

[1] **high-resolution graphics** — графіки високої якості виконання
[2] **desktop printing** — настільний друк (книгодрукування)
[3] **advertizing leaflets** — рекламні листівки
[4] **to house (on a desk)** — розміщувати (на столі)
[5] **visual display unit (screen)** — візуальний дисплейний блок (екран)
[6] **movement sensing device** — датчик чутливості руху
[7] **page description language** — мова посторінкової пам'яті
[8] **full page make up** — посторінкова верстка
[9] **has been rendered almost obsolete** — став майже застарілим
[10] **phototype setting** — фотонабір
[11] **direct image composition** — безпосереднє формування образу
[12] **master character image** — зразок зображення літери

EXERCISES

I. Explain the structure and translate the following word-combinations:

personal computer user; software program; word processor; desktop printing; one-page information; visual desplay unit; movement sensing device; optical scanner; page description language; set of digital instructions; staggering budget; full page make up; computer generated typography; phototype setting; digitized typesetting; master character image; floppy disk.

II. Translate the following adjectives and their corresponding nouns:

a) wide — width, deep — depth, long — length, hot — heat, warm — warmth, high — height;

b) short — shortness, cold — coldness, cool — coolness, round — roundness, shallow — shallowness, soft — softness, hard — hardness, useful — usefulness, complete — completeness.

III. Finish the following sentences according to the content of the text:

1. Many personal computer users now create ... . 2. Writers make use of computers and word processors to .... 3. Desktop printing is ... . 4. Desktop publishing eliminates the need for ... . 5. Metal typesetting has been gradually replaced by ... . 6. All phototypesetting requires 3 elements: ... .

IV. Read the following extract, translate it into Ukrainian and explain the terminology:

Full-page scanners can transfer some images to the PC screen, but since pages have to be fed into them they are not able to handle material in bound books. Now comes a portable scanner that can.

The device is a hand-held optical scanner that *reads* line drawings and photographs from books, magazines and other sources and immediately delivers the image of desktop publishing programs. To operate the user moves the scanner over a drawing or photo. The device contains a programmable chip that has various light *values* embedded in it. The chip compares the darkness of the image being scanned with those values and reproduces the image. The scanner can read an image two and one-half inches wide by 10 inches long at one time. If the image being scanned is larger than that, more than one pass with the scanner is necessary.

V. Explain the use of modal verbs with different Infinitive forms and translate the sentences:

1. To be detected the electron must have an interaction with the detector. 2. He cannot have made such a serious mistake in his experiment. 3. All the preparations for the experiments used in air navigation have to be small and light in weight. 4. According to the law of conservation of energy, the energy spent in starting the body must be equal to that when it is stopped. 5. Surface tension may be expressed in any unit of energy per unit of area.

VI. Find the sentences with modal verbs in the text and explain their use.

VII. Comprehension questions:

1. Why are personal computer users becoming more sophisticated? 2. Since when has it become possible to use computer in typing? 3. Can you explain what desktop publishing is? 4. What are the main components of desktop printing? 5. What does desktop publishing serve? 6. What does desktop publishing eliminate? 7. What has metal typesetting been gra-

dually replaced by? 8. What components does phototype require?

VIII. Make a plan of the text and write a summary on the basis of this plan.

IX. Speak about:

a) modern computer revolution and its jobs;
b) desktop publishing in our country;
c) your personal experience in the use of a computer.

X. Retell the text.

Text B. ROBOTS AND THEIR JOBS

1. Read aloud and memorize the following words:

automata [ɔ:'tɔmətə] — автомати; playwright ['pleiraɪt] — драматург; cybernetics [ˌsaɪbə'netɪks] — кібернетика; enhance [ɪn'hɑ:ns] — підвищувати; stevedore ['sti:vɪdɔ:] — вантажний; hazardous ['hæzədəs] — небезпечний; ardous ['ɑ:djuəs] — важкий.

2. Words and expressions for the text comprehension:

overwhelming majority — переважна більшість; primary producer — головний виробник; by virtue (of) — з волі; to think up a word — придумувати слово; transfer line — лінія транспортування; management information system — система інформації для управління; to step up — установлювати; rigger — складач, монтажник; billet — заготовка; harmful fumes — шкідливі випари; piece-meal — частинами (окремо).

A characteristic feature of automation today is a rapid expansion of computers and robotics, rotor lines and rotor conveyers, and flexible automated production lines and systems which ensure high productivity.

According to some scientists, by the end of this century, the overwhelming majority of people will be occupied in science, education, administration and the service industry, while only 15 per cent of the labour force will remain directly in production. Machines and robots will be the primary producers of material wealth.

What do we refer to as robots?

Robots are automata with programmable control, which by virtue of their specific structures, designs or movement capabilities, can perform functions which until now seemed the exclusive domain of human labour.

The short, dynamic word *robot* was first coined back in the 20s by Karel Czapek, a Czech writer and playwright.

Finishing work on his play *R. U. R.*, the only thing left for Czapek was to think up a word to designate the play's characters — humanoid machines. True, Karel Czapek was thinking of calling them *labors* from the Latin word for work.

«Don't you think it might be a little too pretentious?» he asked his artist brother, Josef Czapek.

«But why not base it on the Czech language? Call them robots».

That was how the Czapek brothers coined the word *robot*, now included in practically all the world's languages.

The robots of our time resemble humans very little. According to specialists, the main thing is not for them to look like people, but to just do their work for them. Factories equipped with automatic machine tools, transfer lines and management information systems place a lot of hope in them.

Automation has stepped up the machining of the most sophisticated items, improving precision and quality of output, but it has demanded that the fulfilment of all the auxiliary operations be likewise as precise and quick. And this became the job for modern robots.

Automation sought out areas where a robot can operate as well as a person but where people are reluctant to work. In other words man has created the robot so as not to become a robot himself.

Robotics incorporates the latest achievements of mechanics metallurgy, radio-electronics, engineering, cybernetics and basic sciences.

As compared with the new sensational break throughs, for instance, robots created by Japanese engineers, our manipulators may seem rather modest.

Our robots service presses and hammers in the factory shops. They feed blanks, measuring their temperature in passing, if this is required by the technology, remove the finished parts and pass them on along the technological chain. Even now these modest toilers have released thousands of people from monotonous and sometimes very hard work.

«Robots that process blanks not only free workers from hard monotonous labour, but also sharply enhance the efficiency of production in forge and press shops.»

One of the first-generation robots could perform operations of the type «take off — put on» or «pick up — bring».

It replaced several stevedores and riggers. However, it could pick up billets or other items only from definite positions determined by a rigid programme.

Today, to avoid errors, robots are supplied with vision (TV camera) and hearing (microphone). Man entrusts to second-generation robots the performance of more complex production operations — painting, soldering, welding and assembly work.

A more complex task lies ahead — to remove people completely from production areas where there are harmful fumes, excessively high or low temperatures and pressure. People should not work in conditions that are hazardous. Let the robot replace them there — and the sooner, the better. That is how scientists understand one of the main humanistic tasks of robotics of our time.

Does this mean that first-generation robots have done what they could and can leave the production scene? The experts say not at all. There is a great need for such machines, especially during loading — unloading operations.

Variations are possible, too — robots of several generations operate together, within a single team. And the machine of the higher class secures the necessary working conditions for the other, rigidly-programmed robots.

Generally speaking, a single robot by itself is hardly of any use in production. It must be coupled in design with other equipment — with a system of machines, machine tools and other devices. The task is to set up robotized complexes and flexible productions capable of transferring easily and quickly to an output of new goods.

Robots are needed not only to spare man power, especially on arduous, monotonous and harmful jobs. Many production processes are unthinkable without them.

Single-handed, even the *cleverest* and most skilful robot is not yet a soldier in the field. Nor are many if they are introduced piece-meal, unless they are united into a technological chain.

It is different when mechanical helpers work as parts of robot-technical complexes, flexible production systems. For all its promising nature, a robot is one component of a complete automation system.

Flexible production systems (FPS) consist, as a rule, of several machine tools with numerical programmed control (NPC), or of processing centres — machine tools equipped with microprocessors. The FPS also include robot loaders, which deliver and take off items, and transport robots. An

all-purpose computer controls the entire cycle, including the facilities.

One hundred per cent automated production is no longer a dream. The ideal, towards which people in various countries are now aspiring, is to automate the entire chain of the birth of new output beginning with electronic design. That's why robots production enterprises are being reoriented from the production of industrial robots by piece towards the manufacture of complete systems and robotized complexes.

ASSIGNMENTS

I. Comprehension questions:

1. What, do you think, will be the main occupation of the people by the end of the century? 2. What per cent of labour force will remain directly in production by the end of the century? 3. Who do you think, will be the primary producer of the material wealth in the future? 4. Who coined the word *robot*? 5. Do modern robots resemble humans? 6. Can robots perform complex production operations? 7. Is one hundred per cent automated production a dream of the distant future?

II. Discussion questions:

1. What are robots? 2. What are the movement capabilities of a robot? 3. Achievements of what sciences does robotics incorporate now? 4. What kinds of work a robot performs a man is reluctant to do? 5. Can a robot perform the work a man cannot do? 6. Can robots produce cars? 7. What does *a flexible production system* mean?

III. What do you understand under the term *humanoid machine?*

IV. Suggest some other titles of the text.

V. Group activities:

a) Automation and technical progress.
b) What makes robot different from an ordinary machine?
c) Name automated enterprises in our country.
d) Will robots help to solve the ecological problems?

LESSON TEN

Grammar: 1. The Passive Voice: Peculiarities of Translation.
2. Terminology.

Text A. LASER SERVES MEN

1. Read aloud and memorize the following words:

mature [mə'tjuə] — (до)зрілий; torch [tɔ:tʃ] — зварювальний паяльник; depreciation [dɪˌpri:ʃɪ'eɪʃn] — знецінювання; yttrium ['ɪtrɪəm] — ітрій; divergence [daɪ'və:dʒəns] — відхилення, розходження; cylinder ['sɪlɪndə] — циліндр; maintain [men'teɪn] — підтримувати; impair [ɪm'pɛə] — пошкоджувати, погіршувати; apparent [ə'pærnt] — очевидний.

2. Words and expressions for the text comprehension:

production line — виробнича лінія; flux of energy — потік енергії; conventional heat source — традиційне джерело теплоти; depreciation cost — зменшення вартості; reduced outlays — зменшені витрати; continuous-wave mode — режим безперервної хвилі; collimation — колімація; large diesel engine — великий дизельний двигун; heat-treating — теплова обробка; outer layer — верхній шар; conventional system — традиційна система; to accomodate — пристосовуватися; short response time — короткий час реагування; jet-engine turbine blades — лопаті турбіни реактивного двигуна; cooling holes — отвори охолодження.

One of the main characteristics of laser radiation is its intensity. From the invention of the laser in the 1950's it was recognized that [1] intense laser beams might be a good way to deposit [2] large quantities of energy in materials for manufacturing purposes. That potentiality has now become a mature technology. Over the past decade high-power lasers have been used in [3] many manufacturing processes: the welding of automobile parts, electronic devices and medical instruments; the heat-treating of automobile and airplane parts to improve their surface properties; the cutting of sheet metal in the punch and die industry, and the drilling of small cooling holes (.007 to .05 inch) in airplane parts. In all these operations laser systems have made production lines more efficient and have reduced costs.

In manufacturing lasers serve basically as devices capable of applying an extremely high flux of energy to the surface of a workpiece. In this role they have significant advantages

over such conventional heat sources as flames, torches, electric arcs and plasma jets. Among those advantages are a product of higher quality (in terms of better performance and a reduction in the number of parts that have to be reworked or scrapped); reduced outlays for materials, labor and processing; high productivity (with resulting reductions in floor space and depreciation costs); a better working environment, and the flexibility and versatility of the laser and the production system based on it.

It is becoming common to speak of two classes of high-power lasers, light and heavy. The classification depends mainly on the power. The light lasers operate in the range from a few tens of watts to [4] a few hundred. They serve in such work as cutting and drilling ceramic substrates in the electronics industry, drilling rubies in the watchmaking industry and cutting not only metal but also cloth, plastics and wood in a variety of other industries. Many of the lasers are fairly small solid-state devices: ruby laser (with a wavelength of 69 micrometers), neodymium-doped glass lasers and neodymium-doped yttrium aluminium garnet lasers (both with a wavelength of 1.06 micrometers in the infrared). These wavelengths couple well with most metals, making it possible to apply them in welding, drilling, cutting and heat-treating.

The light class of lasers also includes certain gas lasers (argon and carbon dioxide), which are operated mostly in the continuous-wave mode. The beam emitted by a gas laser has almost total collimation, meaning that it shows little of the divergence that characterized the beam of, say, a flashlight. Hence the beam can be concentrated in a small spot (ranging in size from micrometers to a fraction of a millimeter), and it delivers power of great intensity [5]. These characteristics are important, particularly in welding by the deep-penetration process [6].

The heavy lasers range in power from a few kilowatts to a few tens of kilowatts. The heavy lasers in manifacturing serve in heavy-duty processing [7] such as the welding of pipelines, the welding of automobile parts and the heat-treating of the surface of such parts as crankshafts and the cylinder walls of large diesel engines. The treatment hardens the surface, increasing the resistance of the part to wear. Most of the heavy-duty lasers are carbon dioxide lasers operating in the continuous mode.

The high flux of electromagnetic energy appied to the surface of the workpiece by a laser is absorbed in an outer

layer about 10 nanometers (.000001 millimeter) thick. In that thin layer a heat source of very great intensity is thereby established. An advantage of the laser is that the heat energy is maintained and made to work [8] in the region where the work has to be done. For this reason the energy efficiency is high, ranging from 10 to 1,000 times higher than it is in conventional systems that heat proportionately larger volumes of the workpiece. Laser systems thus achieve notably fast processing times and unique processing properties[9].

Another important advantage of the laser is that it does not damage parts, since it delivers heat in less time than a conventational source because of the high power density of the beam. Therefore the heat has no time to flow into the part. Conventional sources heat far more of the workpiece than is necessary, giving rise to thermally induced distortion [10], cracks or stresses that can damage the part, making it necessary to rework or scrap it or impairing its performance. The economic implications are obvious for costly semifinished parts such as gears whose teeth need to be hardened, jet-engine turbine blades in which cooling holes must be drilled and engine blocks whose cylinder bores need to be hardened on the inside [11].

All these advantages result from the extremely high power density of the laser beam. Certain other advantages make the laser beam a highly flexible tool and explain why lasers can often be employed with good results even at the level of power obtainable from conventional sources. The beam has no mass and can be easily moved and controlled with short response times. It is easily accommodated in automatic processes. It acts from a distance, eliminating or reducing problems of mechanical interference. By the same token [12] it does not generate mechanical responses, so that the workpiece does not vibrate and does not need to be clamped. Finally, laser technology makes for clean and fast processing that is compatible with work stations along production lines. As a result the technology has significant implications for the logistics and compactness of the production system.

These advantages become apparent in the specific things lasers can accomplish in manufacturing, such as drilling, deburring, cutting, welding and heat-treating. The present achievements in laser technology are impressive but they represent only a beginning of the contributions laser systems can be expected to make to industry.

VOCABULARY NOTES

[1] **it was recognized that** — визнавалося, що
[2] **might be a good way to deposit** — можна було б добре вкласти
[3] **lasers have been used in ...** — лазери застосовуються в...
[4] **in the range from ... to ...** — у діапазоні від ... до ...
[5] **it delivers power of great intensity** — він (лазер) посилає енергію великої сили
[6] **welding by the deep-penetration process** — зварювання методом глибокого проникнення
[7] **heavy-duty processing** — обробка важкого типу
[8] **the heat energy is maintained and made to work** — теплову енергію підтримують і змушують працювати
[9] **unique processing properties** — унікальні властивості обробки
[10] **giving rise to thermally induced distortion** — породжуючи термічно зумовлені дефекти
[11] **on the inside** — зсередини
[12] **by the same token** — до того ж

EXERCISES

I. Give Ukrainian equivalents of the following word-combinations:

laser radiation, manufacturing purposes, electronic device, heat-treating, surface properties, die industry, working environment, solid-state devices, power density, automatic processes, mechanical responses, laser technology.

II. Group the terms given below into the following types: a) physics; b) mechanics; c) electronics; d) engineering; e) chemistry:

laser, radiation, welding, automobile, airplane, punch, die, drilling, workpiece, electric arc, ceramic substrates, ruby laser, micrometer, heat-treating, neodymium, yttrium, cutting, argon, carbon dioxide, gas laser, collimation, micrometer, aluminium, kilowatt, crankshaft, cylinder, engine, resistance, nanometer, millimeter, heat, gas, jet-engine, turbine, mechanical responses.

III. Use the following words and word-combinations in the sentences of your own:

invention, manufacturing processes, conventional heat sources, advantage, beam, laser technology, achievement, light lasers, heavy lasers.

IV. Put questions to the words in bold type in the following sentences:

1. **In drilling and deburring** lasers function as a means removing material. 2. Drilling is most often done **with solid-state lasers.** 3. Drilling by laser remains **a costly process.** 4. A laser beam put to work in cutting can easily be made fully automatic **by computerized numerical control.** 5. It has been estimated that **more than 100 laser cutting systems** are installed per year throughout the world. 6. In welding laser tools can operate in two ways: **by conduction and by deep penetration.** 7. Laser welding offers **many practical advantages.** 8. Laser welding demands **a more accurate positioning of the workpieces.** 9. **In the aerospace industry** a number of welding operations have been conducted with electron beams. 10. Conduction welding serves **mainly for joining thin sheets or plates.**

V. Find the verbs in the Passive Voice, explain their use and translate the sentences into Ukrainian:

1. The greatest success has been achieved in drilling rubies in the watchmaking industry. 2. Lasers are also widely used in drilling the diamonds employed as dies for drawing wire. 3. The liquid is then removed by a jet of covering gas. 4. The drawbacks are overcome with deep-penetration welding. 5. With a well-focused beam of high intensity a keyhole can be established in milliseconds. 6. The molten material is lifted above the outer surface by the pressure of the superheated vapor. 7. The refining and purifying effects of laser welding have been demonstrated in shipbuilding steel, arctic-pipeline steel, nickel steels and the new HSLA (high-strength, low-alloy) steel. 8. This valve seat is made of cast iron; it is being alloyed with a powder of many elements.

VI. Look through the text again, find the sentences containing Passive Voice and translate them.

VII. Comprehension questions:

1. What are the main characteristics of laser radiation? 2. Why has laser technology found its way to manufacturing? 3. In what manufacturing processes have laser devices been used? 4. Are lasers used only in manufacturing? 5. What classes of high-power lasers can we speak of? 6. What materials are used in lasers? 7. What are important advantages of the laser? 8. What do the advantages of the laser result from? 9. How does laser technology make for a clean and fast processing? 10. What are lasers expected to make in future?

VIII. Discuss the content of the text in the form of a dialogue.

IX. Speak about:

a) the use of laser technology in various manufacturing processes;

b) the classes of high-power lasers;

c) some important advantages of the laser.

X. Describe laser applications in electronics industry.

Text B. IVAN PULUY — ROENTGEN'S PREDECESSOR

1. Read aloud and memorize the following words:

humanitarian [hju,mænɪ'teərɪən] — гуманіст; illustrious [ɪ'lʌstrɪəs] — славетний; musician [mju:'zɪʃn] — музикант; mannerism ['mænərɪzm] — манера; appreciate [ə'pri:ʃɪeɪt] — оцінювати, поважати; Psalter ['sɔ:ltə] — Псалтир; priority [praɪ'ɔrɪtɪ] — пріоритет, передування (в часі); roentgen (röntgen) ['rɔntjən] — рентген; Vienna [vɪ'enə] — Відень; exhibition [,eksɪ'bɪʃn] — виставка.

2. Words and expressions for the text comprehension:

to tear away from — відірвати від; under most unfavourable conditions — у найнесприятливіших умовах; did their utmost — робили все, що тільки від них залежить; as early as the 17th century — ще в XVII столітті; incandescent lamp — лампочка розжарювання; and now for — а тепер стосовно; a stroke of good luck — дарунок долі; (they) owe a great lot to (him) — (вони) дуже зобов'язані (йому); the pioneer ideas — новаторські думки; though his data had not been properly recorded — хоча його дані не були зафіксовані належним чином; beside being a writer, investigator, experimenter — крім того, він був письменником, дослідником, експериментатором; owe a great lot to the famous scientist — багато чим завдячують славетному вченому; allotted stipends (to poor students) — виділяв стипендії (бідним студентам); did his best to contribute to the science — вкладав усі свої сили в розвиток науки; have given their due to the memory — віддали належну шану пам'яті.

Among illustrious names in Ukrainian scientific research one of the least known is that of Ivan Puluy (1845—1918), whose valuable contribution to world science has not been duly appreciated up to this day. Like many other prominent scientific figures whose tragic fate had torn them away from

native soil, he lived and toiled abroad, among strangers, under most unfavourable conditions.

Such men of science working far away from their Motherland did their utmost both for their country-men and mankind as a whole. Thousands of scientists and research workers, of Ukrainian origin, played an outstanding role in many branches of the world's civilization, culture, and science. In Ukraine's tragic history the *brain drain* of her best cultural figures and scientific minds began as early as the 17th century. Leaving for Moscow and St. Peterburg were numerous humanitarians who made their significant contribution to Russian science — among them linguists, philosophers, musicians, architects, painters, and all sorts of craftsmen. Their influence found its reflection in science, literature, music, art, construction, even in language and mannerisms.

Ukrainian professors contributed largely to research carried out at the Universities of the USA and Canada, Berlin and Paris, Prague and Bratislava, Warsaw and Sofia. Their scientific gains went down in history, their inventions and discoveries are appreciated and remembered nowadays by thankful humanity.

The greatest scientist of the Austro-Hungarian Empire of the second half of the 19th century, Ivan Puluy, investigated unseen X-rays, later known as Roentgen rays. His incandescent lamps were far more perfect than those invented by T. Edison. Puluy contributed, to some extent, to the invention of miners' lamps, telephone networks, neon signs, etc. Together with P. Kulish he effected the first Ukrainian translation of the Bible, and was the first to translate into Ukrainian *Prayer-book, Psalter* as well as a geometry text-book.

And now for the priority of investigating X-rays. Traditionally Roentgen's name is associated with these invisible rays penetrating through wood, metals, paper, leather, etc. Prof. Wilhelm Roentgen began to investigate X-rays on November 8, 1885, his discovery being to a great extent, a stroke of good luck. And on January 23, 1896 W. Roentgen made a public report in Würzburg informing the scientific world about his invention which was then at an early stage of development. Five years later Roentgen's work was awarded the Nobel Prize.

To tell the truth, Puluy's investigation of the mysterious X-rays began, however, much earlier, at least a dozen years before. As far back as 1877, on his own conception, Puluy worked out cathode ray-tubes and their protographs (as well as the results of investigation) were published in sci-

entific papers of the Vienna Academy of Sciences. For the invention and construction of the Vacuum lamp *(Puluy's tube)* he was awarded the Silver Medal at the World Electrotechnical Exhibition in Paris in 1881. Photoprints by means of unknown rays were received in 1886, but Puluy's indecision prevented him from publishing scientific results and the pioneer ideas were unrealized through the scientist's own negligence.

Puluy's priority in the study and investigation of X-rays was undoubted though his data had not been properly recorded. By the time Roentgen made his tests, Prof. Puluy had published 100 pages of his own works on the subject of cathode lamps and invisible rays.

Puluy's whole life was completely devoted to science — he was physicist, mathematician, philosopher, electrotechnician, architect, pedagogue, linguist (he knew 15 foreign languages), beside being a writer, investigator, experimenter. In his youth he studied physics, mathematics, astronomy, and later on he taught these and other exact sciences. Generations of young people of his time owe a great lot to the famous scientist. *Puluy's Fund* which existed up to 1939 allotted stipends to poor students from Ukraine. Living in Prague since the autumn of 1884 till his death on January 31, 1918, Ivan Puluy did his best to contribute to the science of the country whose sons and daughters have given their due to the memory of the great Ukrainian scientist.

ASSIGNMENTS

I. Comprehension questions:

1. Who is Roentgen's predecessor? 2. Was Ivan Puluy's contribution to world science duly appreciated? 3. When did the *brain drain* from Ukraine begin? 4. Where did Ukrainian humanitarians go to work to? 5. What physical phenomenon did Puluy investigate? 6. When did Puluy begin investigating X-rays? 7. What field of knowledge was Puluy competent in?

II. Discussion questions:

1. What professionals left Ukraine for Moscow in the 17th century? 2. Why did Ukrainian professionals leave their native country? 3. What foreign Universities did Ukrainian scientists work at? 4. What inventions did Puluy contribute to? 5. What are the properties of X-rays? 6. What prevented Puluy's scientific results from realization? 7. What was the score of Puluy's erudition?

III. What do you understand under the *brain drain*?

IV. Retell the text.

V. Group activities:

a) Speak about the tragic fate of Ukrainian scientists.

b) Who was Puluy's co-author in the translation of the Bible?

c) The role of indecision and negligence in a man's life.

LESSON ELEVEN

Grammar: 1. Gerundial Construction (Translation).
2. Causal Prepositions.
3. Terminology.

Text A. MODERN URBAN PLANNING (A MULTIFUNCTIONAL CENTER)

1. Read aloud and memorize the following words:

guideline ['gaɪdlaɪn] — вказівка, вимога; goal [goul] — мета; thoughtfully ['θɔ:tfulɪ] — вдумливо; merchandise ['mə:tʃəndaɪz] — товари; entertainment [ˌentə'teɪnmənt] — розвага, забава; urban ['ə:bən] — міський; framework ['freɪmwə:k] — рамки, межі; cohesive [kou'hi:sɪv] — зв'язаний; restaurant ['restrɔ:ŋ] — ресторан; terrace ['terəs] — тераса; cafe ['kæfeɪ] — кафе; utilization [ˌju:tɪlaɪ'zeɪʃn] — використовування; perimeter [pə'rɪmɪtə] — периметр; aperture ['æpətjuə] — отвір, щілина; threshold ['θreʃould] — поріг; freight [freɪt] — вантаж, вантаження.

2. Words and expressions for the text comprehension:

human settlements — поселення людей; realm of life — ділянка (галузь) життя; to acknowledge — визнавати; urban organization — організація міста; inventiveness — винахідливість; for reasons of — через; boundary — межа; to assume the role — брати на себе роль; tourist attractions — привабливі для туристів місця; their very existence is threatened — загроза самому їхньому існуванню; the city core — середина міста; in accordance with — відповідно до; freight elevator — вантажний елеватор.

The *multifunctional center* represents a new building type which will attain a world-wide significance [1]. The concept of the multifunctional center does not come out of a vacuum.

It represents, in fact, the natural and organic organization pattern [2] which has existed since the founding of human settlements and has expressed itself everywhere as the nomadic hunter turned to the pursuit of agriculture [3], the activities of craftmanship and of trade.

Thus, in every realm of life, we have to acknowledge the old saying that «nothing is really new in this world». Having acknowledged this undeniable fact, we should not be hesitant about [4] studying and learning from the experiences of urban organization as expressed in the past.

For reasons of changing sociological conditions and because of the impact of scientific and technological inventiveness, many of the old, organically grown multifunctional centers have assumed the role of tourist attractions because they satisfy a strong underlying human desire for certain *old* ways of life. In other cases, their very existence is threatened, because they do not respond to certain real — and a few imagined — needs of twentieth-century man. In spite of these difficulties, multifunctionality remains operative [5] in central areas of many settlements: in villages and town squares and in centers of cities.

Because of historic development many of the old city cores grew not just as *multifunctional centers* but as *omnifunctional centers*. This was due to the fact that within the confines of the old cities, formerly protected by fortifications, all urban requirements had to be satisfied. This *omnifunctionality* is no longer necessary or attainable.

The new-type multifunctional center cannot be developed with the goal of creating omnifunctional centers. The goal should be rather to combine as wany urban functions of the *center-conforming* type [6] as possible in a concentrated and land-conserving manner, counteracting the tendencies toward fragmentation, sterility, and waste of time and energy.

There are various reasons for the difficulties with which the planning and implementation of the multifunctional centers are beset.

One of the tasks connected with the creating and shaping of the multifunctional center [7] is to employ the tools which science and technology have given us, to the highest degree using them to eliminate the conflicts between man and his mechanical slaves.

There emerge a number of practical guidelines for the planning of multifunctional centers. We must obviously invent methods which enable us to place a maximum amount of enclosed space [8] serving human activities on a minimum

of land. If we achieve this goal, we will shorten the distances between the various functions to such a degree that we will minimize the waste created by enforced mobility [9]. The tools of modern technology — if thoughtfully employed — can be of greatest assistance. The task of creating a multifunctional center is an infinitely more difficult and complex one than that of creating a unifunctional one.

The boundary line between the unifunctional and the multifunctional center cannot be sharply drawn. Some centers contain accessory activities [10] which are not directly connected with the buying and selling of merchandise. We find in most of them eating facilities [11], in some entertainment or even cultural activities, certain public services, for example, post offices, and in rare cases, offices and some other functions. Even in a unifuctional office center there are usually some facilities catering to immediate shopping needs and personal services. Thus it appears that the division line must be drawn in accordance with the consideration of whether a center is, as its productive space is concerned, devoted to the highest degree to only one specific function or whether various functions are combined with each other in such a manner that each is strongly represented [12].

Multifunctionality is already established when just two different urban functions are combined (for example shopping facilities with employment facilities in offices), but the meaningfulness of multifunctionality grows when one succeeds in combining a large number of urban functions within one physical framework.

The problem which faces the center team [13] is that of inventing methods which make possible the most intensive use of land, avoiding, however, the disadvantages and dangers commonly associated with the term *high density*.

If it is our aim to create cohesive and concentrated multifunctional centers [14], then we will have to succeed in changing the relationship between productive surface and land surface considerably. In regional shopping centers, even the largest and best planned ones, the structures containing all productive functions are rarely higher than two floors above ground. In organically grown cities, on the other hand, we find that each structure is multifunctional. In basements, on the ground floors, and often one floor above, there can be found stores, shops, and various institutions. Above them, there are additional floors, varying in number which contain residences, offices, restaurants, terrace cafes, and other enterprises.

Technology has supplied us with certain tools which have changed the design of certain types of structures from an engineering and architectural point of view. Outstanding in this respect is the progress [15] made in creating conditions of controlled light and air [16] and that made in the field of vertical transportation.

Conditions of controlled air and light can be applied to a large number of utilizations of inner space. It certainly applies to large assembly rooms where natural light infiltrating through even the largest of window apertures can penetrate into only a small strip around the perimeter. This category includes also meeting rooms, conference rooms, cinemas (which of course have to be dark in order to operate), lecture halls, storage rooms (whether for goods or automobiles), restaurants, etc. It is thus possible to establish a listing of urban functions [17] for which conditions of controlled light and air are definitely preferable.

The full recognition of the importance of our technological ability to provide conditions of controlled light and air will assist us in utilizing land in a highly intensified manner.

The second tool is the development of vertical transportation. Whereas in the field of horizontal movement, all that our «progress» has brought us is a vast increase of individual transportation by motor car, and a decrease of public transportation, the opposite is the case in the field of vertical transportation [18]. Here, technology has to a large degree replaced the individual transportation medium, the climbing of stairs, through highly efficient and speedy public transportation, by means of electronic elevators, escalations, freight elevators, inclined moving ramps, vertical conveyer belt systems, etc. These inventions have made possible the construction of miltistoried department stores, multilevel shopping centers and, of course, high-rise apartment buildings [19], office buildings, hospitals, etc. The vertical public transportation has increased a thousandfold. There is no doubt that we are on the threshold of new technological development concerning horizontal public transportation. Dozens of meaningful inventions have been made in this respect, and it is only in their application that we lag behind. In connection with the concept of the multifunctional center, both the already applied technology concerning vertical transportation and the already available [20] but not yet applied technology concerning horizontal transportation will have to play a role.

[1] **to attain a world-wide significance** — стати всесвітньовідомим
[2] **the natural and organic organization pattern** — зразок природної і органічної організації
[3] **the nomadic hunter turned to the pursuit of agriculture** — мисливець-кочівник перейшов до заняття землеробством
[4] **we should not be hesitant about** — ми не повинні сумніватися щодо (стосовно)
[5] **multifunctionality remains operative** — багатофункціональність залишається дійовою
[6] **the *center-conforming* type** — тип, якому властиво виявляти *тяжіння до центру*
[7] **connected with the creating and shaping of the multinational center** — що полягає у творенні й формуванні багатофункціонального центру
[8] **to place a maximum amount of enclosed space** — розташувати максимальний обсяг замкненого простору
[9] **enforced mobility** — зростаюча мобільність
[10] **accessory activities** — додаткові послуги
[11] **eating facilities** — підприємства громадського харчування
[12] **each is strongly represented** — кожна з них жорстко обмежена
[13] **the center team** — група, що працює над розробкою центру
[14] **to create cohesive and concentrated multifunctional centers** — створювати компактні й концентровані багатофункціональні центри
[15] **oustanding in this respect is the progress** — у цьому відношенні значне місце належить прогресу
[16] **to create conditions of controlled light and air** — створювати умови для контролю за освітленням і вентиляцією
[17] **to establish a listing of urban functions** — встановити перелік функцій використання в міському господарстві
[18] **the opposite is the case in the field of vertical transportation** — зовсім навпаки стоїть справа, коли йдеться про вертикальне транспортування
[19] **high-rise apartment buildings** — багатоповерхові житлові будинки
[20] **the already available (technology)** — вже наявна (техніка)

EXERCISES

I. Define which of the following words and expressions are terms, give their Ukrainian equivalents:

world-wide significance, human settlement, nomadic hunter, urban organization, tourist attractions, town square, city core, fortifications, land-conserving manner, enclosed space, accessory activities, urban functions, productive surface, land surface, basement, ground floor, store, residences, storage room, vertical transportation, stairs, elevator, escalator, inclined moving ramp, vertical conveyer belt system, apartment building, multifunctional center.

II. Pair the prefix with the proper group of words:

il-: go, stand, take, estimate;
un-: mature, mutable, personal;
im-: legal, literate, legitimate;
under-: usual, popular, equal, written.

III. Explain the difference between the terms *multifunctional center* and *unifunctional center*, *productive surface* and *land surface*.

IV. Look through the text again, write out the sentences containing the Gerund and translate them into Ukrainian.

V. Read and translate the sentences describing the organically grown city centers; the unifunctional and the multifunctional center.

VI. Put questions to the words in bold type:

1. Many of the old, organically grown multifunctional centers have assumed the role of tourist attractions **because they satisfy a strong human desire for certain *old* ways of life.** 2. **Because of historic development** many of the old city cores grew not just as *multifunctional centers* but as *omnifunctional centers*. 3. **The boundary line between the unifunctional and the multifunctional center** cannot be sharply drawn. 4. Multifunctionality is already established **when just two different urban functions are combined.** 5. We classify cities **according to function.** 6. The *type* of cities is derived **from the predominating function.**

VII. Comprehension questions:

1. What does the concept the *multifunctional center* represent? 2. Why have many of the old multifunctional centers assumed the role of tourist attractions? 3. Due to what facts did many of the old city cores grow not just as *multi-*

functional centers but as *omnifunctional centers*? 4. What is the goal of creating omnifunctional centers? 5. Is the task of creating a multifunctional center more difficult and complex than that of creating a unifunctional center? 6. When is multifunctionality established? 7. What are the urban functions of the city core? 8. What are the individual transportation means and those of public use?

VIII. Write down 6—8 questions on the text and answer them.

IX. Speak about:
a) old city planning;
b) modern city planning;
c) advantages of a small town and a large city.

X. Render the text into English using the words and expressions given below it:

Космодром на Хрещатику?

У кабіні літального апарата, що був знайдений свого часу в районі Хрещатика, було виявлено написи санскритом. Це свідчить про те, що давні космонавти належали до праіндоєвропейців, тобто того кореня, що й ми.

Нині це здається легендою, але факти свідчать про те, що ще на початку XX століття видатний археолог Вікентій Хвойка під час розкопок трипільського поселення неподалік від місця, де тепер стоїть консерваторія ім. П. Чайковського, виявив незвичайний, сріблястий апарат величезних розмірів. Учений розпорядився, щоб цю знахідку обкопали якомога глибше. Землю насипали у відра і витягали нагору цілий тиждень.

Важка це була робота. І навіть коли опустилися на глибину 50 метрів, кінця-краю отому апаратові не було видно. На місце розкопок запросили губернатора. Він усе уважно оглянув і розпорядився засипати знахідку. А була вона неабиякою: діаметр — три метри і понад півсотні метрів завдовжки. Копачі засипали таємничу знахідку.

У 1946 році, коли робітники розбирали руїни на Хрещатику, вони натрапили на цю ракету. Ракета була дуже складною. Про неї говорив славетний вчений С. П. Корольов: «Бачить око, але зуб не бере». Наші науковці ще не мали достатніх знань, аби осягнути цю техніку. Таємнича зна-

хідка, можливо, належить до трипільської культури, яка існувала на нашій землі багато тисячоліть тому.

У XX столітті на українській землі народилися великі творці космічних ракет — Кибальчич, Корольов, Кондратюк, які зробили величезний внесок у вітчизняну ракетотехніку. Прокладаючи шлях у Космос, до нових незбагненних світів, вони присвятили своє життя пошукам незвіданих космічних доріг, розкриттю віковічних таємниць всесвіту.

(flying apparatus — літальний апарат; inscription — напис; belong to — належати; root — корінь; testify (to the fact) — свідчити (про той факт, що); outstanding archaeologist — видатний археолог; excavations — розкопки; a find(ing) — знахідка; there was no end to it — цьому не було кінця; to bury — закопати (засипати); complex — складний; to comprehend — зрозуміти (осягнути); mystery (secret) — таємниця; universe — всесвіт)

Text B. TYPES OF MODERN CITIES

1. Read aloud and memorize the following words:

dawn [dɔ:n] — світанок; surplus ['sə:pləs] — лишок; church [tʃə:tʃ] — церква; merchant ['mə:tʃənt] — купець, торговець; climax ['klaimæks] — кульмінаційний пункт; commerce ['kɔmәs] — торгівля, комерція; pursuit [pə'sju:t] — переслідування, пошук; indigenous [in'didʒinәs] — місцевий, природний; warehouse ['wɛəhaus] — товарний склад, великий магазин; accessibility [æk,sesi'biliti] — доступність.

2. Words and expressions for the text comprehension:

overlapping functions — функції, що частково збігаються; one-industry towns — міста однотипної промисловості; agricultural trading center — центр торгівлі сільгосппродуктами; dawn of urban history — світанок історії містобудування; immediate hinterland — місцевість, що прилягає безпосередньо до міста; religious worship — релігійне поклоніння (культ); secular homage — почесті світського характеру; recuperation — відновлення; prerequisite — передумова; historical continuum — історичний континуум; are prone to move (into) — схильні рухатися (в); agglomeration — скупчення, нагромадження.

Any classification of cities is somewhat arbitrary. The criteria of classification are a matter of choice. We classify cities according to function, but we recognize that most cities are dedicated to a plurality of overlapping functions. The *type* is derived from the predominating function. Some

cities, of course, are distinct types, such as college towns, one-industry towns, or agricultural trading centers. But such clear distinction is the exception rather than the rule.

To establish a system of classification, we arrange function according to the manner in which it occurred in urban history. There are cities that function as seats of insititutions, trading centers, industrial centers, metropolitan centers, and resort towns.

The first mentioned city type, characterized as the seat of one or several institutions, reaches back into the dawn of urban history when city life was centered around the temple or the palace of the ruler. There were economic reasons, of course, that made the foundation and growth of such cities possible. They were dependent upon an agricultural surplus in the immediate hinterland. Yet the economic function of these early cities was subsidiary to religious worship or secular homage.

In the contemporary environment, the college town, the county seat, the seat of the state government, the agricultural experiment station and towns devoted to a variety of such purposes, containing schools, governmental institutions, churches, and libraries fall into this same category.

The city as a center exclusively for trade and commerce was prominent at another phase of urban development. Such singleness of purpose is unusual for the large city in the contemporary scene. The cities at the shores of the Mediterranean Sea in antiquity, however, could be considered primarily centers of trade and commerce. Upon these cities the products of a vast rural hinterland converged. Between these cities, products of the hinterland were exchanged. From the urban centers, these products were distributed to the country population in the region.

In the Middle Ages, urban commerce developed before urban industry. Trade gave a livelihood to merchants and to those engaged in transportation before it stimulated the development of crafts and industries which were later to replace the commercial activities in importance. In the contemporary scene, we have to look to our agricultural trading centers for a similar type of town.

The industrial city reaches its full development during the industrialization process itself. It is dependent, in both location and growth, upon the availability of raw materials within a favorable range of transportation. It is also dependent upon a supply of labour, and not unconcerned with the distance at which the product can be marketed.

In the metropolitan center, the process of urbanization reaches its climax. The metropolitan center is characterized by a multiplicity of functions. It contains industry as well as commerce, educational as well as governmental institutions. The metropolitan center feeds on the cumulative processes of urban growth.

The metropolis may start its development from any of the above mentioned types. Let us assume a trading center favorably located near existing means of transportation. Large masses of consumers will be attracted by commercial activities and provide a sufficient market for the development of consumer goods industries. Nearby sources of raw materials may give further impulse to industrial development. The labour supply so collected induces an ever widening range of diversified industrial enterprise to locate within the metropolitan area. Educational and governmental institutions are prone to move into the already established large urban settlement where they will be close to the people they intend to serve.

The process may proceed along different lines. The metropolis may start as a center of industry which — at a certain point of development — begins to attract banks, warehouses and other establishments to promote commerce in either raw materials or finished products. The metropolis may have its origin in a seat of government or an educational center. The beginning, however, is not very important once the metropolis has come into its own.

In its full bloom, the metropolitan center becomes an end in itself, gaining increasing advantage as an agglomeration of a large resident population. It fulfills regional as well as national and worldwide services in the pursuit of governmental, educational, commercial, and industrial activities.

We place the resort town at the very end of our historical continuum. The resort town appears as the outgrowth of a metropolitan way of life that requires specialized services for purposes of human recuperation. We need not elaborate upon its function. Suffice it to say that the resort town is economically dependent upon the existence of large urban settlements at a reasonable distance.

The resort is most frequently tied to small urban settlements which function simultaneously as agricultural trading centers. Accessibility to metropolitan travelers and a site which appeals through natural features such as lakes and meadows and mountains are important prerequisites.

Such conditions establish for the indigenous population the opportunity of additional income through boarding houses, hotels, cabins, and artificial recreational facilities.

ASSIGNMENTS

I. Comprehension questions:

1. What is the *type* of the city derived from? 2. When did the cities as seats of institutions appear? 3. What type of the city do the college towns belong to? 4. Did the cities as trading centers exist in antiquity? 5. What is the industrial city dependent upon? 6. What kind of a city expresses the idea of urbanization as its climax? 7. Where are the resort towns located?

II. Discussion questions:

1. What groups are the cities classified into according to their functions? 2. What were the reasons for building cities as seats of institutions? 3. What kinds of cities as seats of institutions are there now? 4. Where were the cities as centers of trade situated in ancient times? 5. Why are the industrial centers dependent upon transport and supply of labour? 6. What is the multiplicity of functions of the modern metropolitan centre? 7. What are the opportunities of additional income for the people in the resort towns?

III. Give a linguo-historical explanation of such interconnected pairs of words:

city — urban, village — rural, man — human.

IV. Retell the text according to the functional system of city classification.

V. Group activities:

a) Is there a limit in the continuous growth of the metropolitan centres?

b) What are the advantages and disadvantages of a metropolis centre?

c) Are Englishmen fond of living in towns and cities?

LESSON TWELVE

Grammar: 1. Complex Subject Construction (Translation).
2. Word-building in Terminology.

Text A. WHAT IS ARCHITECTURE?

1. Read aloud and memorize the following words:

thence [ðens] — звідси; survive [sə:'vaɪv] — вижити, зберегтися (в часі); apparent [ə'pærnt] — очевидний, inevitably [ɪ'nevɪtəblɪ] — неминуче, amateur ['æmətə:] — аматор, любитель; conscious ['kɔnʃəs] — свідомий; prudential [pru:'denʃl] — продиктований розважливістю; aquedict ['ækwɪdʌkt] — водогін; mediaeval [ˌmedɪ'i:vl] — середньовічний; draughtsmanship ['drɑ:ftsmənʃɪp] — креслення; awareness [ə'wɛənɪs] — свідомість; aesthetics [i:s'θetɪks] — естетика.

2. Words and expressions for the text comprehension:

master-builder — кваліфікований робітник-будівельник; to derive one's living (from) — отримувати засоби на життя (від); to undergo training — проходити (діставати) підготовку; in advance — наперед, заздалегідь; in relation to — стосовно (відносно).

The view of architecture taken here [1] is that it is primarily a certain kind of activity, not a kind of building; it is a process and not a product. This is given some support by the derivation of the word [2]: *architect* after all means master-builder, and *architecture* might therefore be expected to mean the activity of such people and thence, by the kind of extension usual in the development of language [3], the buildings which they oversee.

As against this view, we have the history of architecture, which characteristically deals with products rather than processes. Architectural history, insofar as it has concentrated on products [4], has frequently encountered the question. What is to count as architecture? This difficulty is not too acute for periods before, let us say, the eighteenth century: the customary method is simply to include all buildings of any size which survive, giving special emphasis to those that have attracted the most admiration.

As we more through history and across cultures the education and social position, the class in fact from which architects so defined are drawn [5], inevitably varies; but it does so within certain surprisingly apparent limits [6]. The range

extends from the man of general culture, at one end, whose technical background may be limited and who may even be an amateur, to, at the other end, the man whose background is in the crafts and trades, the building technology of the period.

The introduction of formal education and legal status has restricted the range of distribution and increased the proportion of architects in the «modal» category. Yet degrees, diplomas and certificates of registration are not essential to the activity of architecture: nor is the ideology or the formal social structure of professionalism. We may say that the architect is a fulltime designer of buildings, professional in the sense of deriving his living from such work, and having undergone some kind of specific training for his task, and that architecture is building designed by such men. This does distinguish architecture from building in general [7], but tells us nothing about the characteristics of the result, or about whether it is good or bad.

The need for the prefessional designer arises because design becomes self-conscious; design becomes self-conscious because a demand has arisen, no matter how, for something special or unusual. Self-conscious design would not have arisen [8], architects would not have been identified by activity and name, architecture schools would not have been established, had there not first of all been wish and will [9] to achieve something exceptional, to do something which differed sufficiently from the established types to require exceptional care and thought, something the form and execution of which must he planned in advance. Until the relatively modern separation of architecture and engineering it is hardly possible to draw a line between symbolic and prudential building considered as activities. Roman aqueducts and bridges and mediaeval castles appear in the histories of architecture, and rightly so. The *art* of architecture and the *science* of engineering are not really separate even today, as the work of the artist engineers.

Self-consicious design not only arises from some special social demand; it requires large resources, at least in relation to the scale of the work. Building of any kind has always been expensive. Exceptional building has been proportionately more expensive, though its relative cost has declined greatly in modern times. It is the unusually large or unusually elaborate building which both demands the skill of an architect and can absorb the cost of his services within its budget without gross distortion.

Summarizing, then, architecture, for the present purpose, will be taken to be the design, by a full-time professional designer trained for his work, of structures of some social importance to which, whether because of their large scale or their complexity, considerable resources must be devoted.

The historical development of models or homomorphs is a development of method. The nature and power of the conceptual tools available to the designer determine in no small measure what he can conceive and accomplish. And conversely, the limitations of method will be expressed as limitations of the design. This is as apparent in architectural schools and offices today as it is in the history of architecture. The student or young architect who cannot draw freely or confidently will design within the limits of his power of representation [10]. He is the victim of *analogue take-over* [11]: his tools and models constrain his thinking. This is obvious enough, but the more general point that the architecture of any period is limited by its stock of models and methods has not been generally grasped. The recent revival of interest in architectural drawing [12] has, however, been accompanied by, or perhaps has stimulated, a recognition that the particular drawing styles encouraged by the Modern Movement, the *neutral* draughtsmanship of the engineering drawing [13], and the preference for models over drawings, were themselves part of the attempt to eliminate other kinds of architecture for which other kinds of drawing had been developed.

Drawing is only a limited and partial model for architectural activity. It concentrates attention on appearance, arrangement and the means of construction; generally, on physical relationship. It is a static model, and limited in its capacity for representing dynamic situations; complex social relationships, for example. While construction remained conventional and the physical environment produced by a given design correspondingly predictable, visual representation was enough. Increasingly from the mid nineteenth century [14], however, new building types, new materials, and perhaps above all the new mass clientele have undermined these conditions.

The much debated crisis of architecture today can be seen as a crisis of method. The conflicting voices call, on the one hand [15], for a more humane architecture, for an architecture that is once again decorated and ornamented, for a revival of drawing and a new and more inclusive awareness of architectural quality, and, on the other hand [16], for a more practical architecture, physically comfortable, free of technical

defects, and better adapted to the life and aspirations of its users. This exactly reflects the existing dichotomy of approach of method [17]; each *side* in the debate is demanding more of the same. A new account of method is needed, an inclusive account, which will contain the new aesthetics and the new pragmatics, just as they themselves seek to include [18] a wider range of aesthetic possibilities and a wider range of practical conditions.

VOCABULARY NOTES

[1] **the view of architecture taken here** — викладений тут погляд на архітектуру

[2] **this is given some support by the derivation of the word** — це деякою мірою підкріплюється походженням слова

[3] **and thence, by the kind of extension usual in the development of language** — а звідси, шляхом деякого поширення (значення слова), як це звичайно буває в розвитку мови

[4] **insofar as it has concentrated on products** — оскільки вона зосереджена на результатах

[5] **from which architects so defined are drawn** — з якого вийшли так звані архітектори

[6] **it does so within certain surprisingly apparent limits** — це відбувається в межах напрочуд явних обмежень

[7] **this does distinguish architecture from building in general** — це справді відрізняє архітектуру від будівництва взагалі

[8] **self-conscious design would not have arisen** — свідоме проектування не виникло б

[9] **had there not first of all been wish and will** — якби передусім не було бажання й волі

[10] **will design within the limits of his power of representation** — виконуватиме проекти в межах своїх образотворчих можливостей

[11] **he is the victim of *analogue take-over*** — він є жертвою *запозичення аналогії*

[12] **the recent revival of interest in architectural drawing** — сучасне відродження інтересу до архітектурного проектування

[13] **the *neutral* draughtsmanship of the engineering drawing** — *нейтральне* мистецтво зображення в технічному кресленні

[14] **increasingly from the mid nineteenth century** — починаючи з середини XIX сторіччя

[15] **on the one hand** — з одного боку

[16] **on the other hand** — з іншого боку

[17] this exactly reflects the existing dichotomy of approach of method — це точно відбивае існуючу двоїстість підходу
[18] just as they themselves seek to include — так само, як вони намагаються самі включити

EXERCISES

I. Give Ukrainian equivalents of the following international words:

activity, architecture, process, product, master, concentrate, period, method, special, history, culture, limit, amateur, technology, formal, proportion, legal, category, registration, structure, designer, resource, dynamic, crisis, ornament, practical.

II. Explain the morphological structure of the following words and translate them into Ukrainian:

building, architectural, development, characteristically, surprisingly, proportionately, unusually, representation, correspondingly, interaction, structural, survival.

III. Give appropriate suffixes to each verb to form nouns:

to build, to decorate, to imitate, to separate, to develop, to introduce, to distribute, to construct, to present, to recognize.

IV. Fill in the blanks with the words *entails, design, decorate, architect, plan, produce, evolve:*

1. Thus architectural ... ... the study of solutions for convenience, for structure, and for appearance. 2. The ... does not first ... the building from the point of view of convenience, then ... a strong construction to shelter it, and finally ... the whole to make it pretty. 3. Any ... that ... from such a procedure will ... only a confused and unsatisfactory building.

V. Put questions to the words in bold type:

1. Architecture **is the art and science of building.** 2. Three basic factors in architecture — **convenience, strength and beauty** — are always present and interrelated in **the best** structures. 3. **The designer must have a sufficient knowledge of engineering and of building materials.** 4. The architect must always study **each** detail from the viewpoints **of both use and apprearance.** 5. **The architect** has the task of being **an artist** as well as an inventive engineer. 6. The value of true architecture lies **in the direct effect of the structure itself and of the actual elements of which it is constructed.**

VI. Use the Complex Subject Construction in the following sentences according to the model:

M o d e l: We know that each type of atom has a name and symbol.—Each type of atom is known to have a name and symbol.

1. People consider him as the best qualified architect. 2. We may say that architecture is the art and science of building. 3. When the designer has a sufficient knowledge of engineering and building materials and possesses the creative imagination we say that he is a good specialist. 4. It is considered that the Roman architect M. Pollio listed three basic factors in architecture. 5. Specialists consider that convenience, strength and beauty are the basic factors in architecture. 6. They consider this building a masterpiece of architecture.

VII. Find sentences in the text with the Complex Subject Construction and translate them.

VIII. Comprehension questions:

1. Is architecture considered to be rather a process or a product? 2. When do architects deal with products rather than processes? 3. What factors are essential for the activity of an architect? 4. Under what conditions is the architect considered a full-time designer of buildings? 5. When is the architect spoken of as a good one? 6. Are the *art* of architecture and the *science* of engineering really separate today? 7. Why are the limitations of method expressed as limitations of the design? 8. How are architectural drawing and construction interrelated? 9. Why do some architects speak of the crisis in architecture today? 10. What kind of a new method in architecture is needed?

IX. Write a short summary of the text.

X. Speak about:

a) the interrelation of architecture and building;
b) the forms and functions of architecture;
c) the tasks of architecture in Ukraine today.

Text B. MODERN ARCHITECTURE

1. Read correctly and use in your discussion the following words:

environment [ɪn'vaɪərənmənt] — оточення, середовище, equilibrium [ˌi:kwɪ'lɪbrɪəm] — рівновага; exhibition [ˌeksɪ'bɪʃn] — виставка; horizon [hɔ'raɪzn] — горизонт; transpa-

rent [træns'pɛər(ə)nt] — прозорий; simultaneity [ˌsɪm(ə)l-tə'nɪətɪ] — одночасність; futile ['fju:taɪl] — марний, даремний; spatiality ['speɪʃəltɪ] — просторовість; existentially [ˌegzɪs'tenʃəlɪ] — що належить до існування; baroque [bə'rouk] — бароко; Renaissance [rə'neɪsns] — Відродження (Ренесанс); Enlightenment [ɪn'laɪtnmənt] — доба Просвітительства; transient ['trænzɪənt] — швидкоплинний, минущий; decennium [dɪ'senɪəm] — десятиліття.

2. **Expressions for the text comprehension:**

came into existence — здобула право на існування; it means to identify with a physical and social environment — йдеться про ототожнення з матеріальним і соціальним оточенням; that of bringing about a revision of values — здійснити переоцінку цінностей; its forms seemed to have been invented from scratch — здається, що її форми були вигадані на голому (порожньому) місці; all these words refer to spacio-temporal structures — усі ці слова мають відношення до просторово-часових структур; a vertical reference is expedient to make it appear as a focal point — доцільно надати йому вигляду вертикального орієнтиру, що виявляється як точка у фокусі; implied that a new language of forms were necessary — мало на увазі, що нова мова форм є необхідною; a refusal of any kind of a priori dogma — відмова від будь-якої заздалегідь прийнятої догми; by different means man has to understand and *keep* the transient world of phenomena — за допомогою різних засобів людина повинна зрозуміти світ і керувати його швидкоплинними процесами; which enable him to handle situations — які дають йому змогу керувати ситуаціями; to keep the vision of how things *are,* of their *true nature* — проникати в сутність *природи речей,* в їх *справжню суть:* a *visual revolution* took place in the plastic arts — у скульптурному мистецтві відбулася *помітна революція:* the traditional *figure* is thus disposed of — таким чином, традиційний *символ* відкидається; it visualizes different ways of being between earth and sky — вона висвітлює різні шляхи існування між землею й небом.

Modern architecture came into existence to help man feel at home in a new world. *To feel at home* means something more than shelter, clothing and food. Primarily it means to identify with a physical and social environment. It implies a sense of belonging and participation, that is, the possession of a known and understood world. Man has to feel that he *stands under,* among, known and meaningful things. We are all aware that such an identification has become problematic in the modern world. The closed and secure environments of

the past have disintegrated, and new social and physical structures demand new forms of understanding.

Modern architecture is one of these forms. Its general aim is to provide man with a new dwelling. The new dwelling should satisfy the need for identification and thus be an expression of a renewed *friendship* between man and his environment. «The problem of the house is the problem of the epoch,» Le Corbusier wrote in 1923, «The equilibrium of society depends upon it. Architecture has for its first duty, in this period of renewal, that of bringing about a revision of values, a revision of the constituent elements of the house.»

The first great international manifestation of the new architecture, the Weissenhofsiedlung in Stuttgart from 1927, was in fact organized as an exhibition called *The Dwelling.*

Over and over again the pioneers of modern architecture refer to the newness of the modern world, and insist that it cannot be served by the forms of the past. Le Corbusier's battle-cry is well known: «A great epoch has begun. There exists a new spirit ... Architecture is stifled by custom. Our own epoch is determining, day by day, its own style.»

Modern architecture in fact appeared as something radically new. Its forms seemed to have been invented from scratch, as embodiments of a new vision of the world. Hector Horeau's project for the World's Fair in Paris 1867 already illustrates that. Here the massive and enclosed forms of past building are abolished; space extends infinitely in all directions, as indicated by a limitless horizon, and the building appears as a trasparent and open volume which is an integral part of total space. To understand the aims and results of modern architecture, we therefore have to consider the *newness* of the modern world, and ask how architecture serves to make it manifest.

The new *things* are certainly interesting in themselves, but more important are the general changes in the relationship between man and his environment which they express. Thus we talk about openness, mobility, interaction and simultaneity. All these words refer to spatio-temporal structures, and suggest that the newness of the modern world primarily has to be understood in terms of such. To many this understanding appears impossible. Being a world of *complexity and contradition,* it seems futile to look for common denominators or structural properties. And still, the pioneers evidently believed that such properties exist, and took the understanding of them as their point of departure. In particular they concentrated their attention on the *new concep-*

tion of space, assuming that architecture is the art which expresses the *spatiality* of the world.

The spatiality of the new world is particularly well indicated by the world *simultaneity.* Thanks to media and potential mobility, we are so to speak in several places simultaneously. Physically we are of course in one place at a time, but existentially we experience a *simultaneity of places.* This is the basic property of the new spatiality, and the content of the *new vision.*

In general, the new conception of space gives primary importance to openness and continuity, in contrast to the isolated, semi-independent *places* which made up the spatial structure of past worlds. This openness is however primarily horizontal; a global situation implies that the surface of the earth is integrated, whereas the vertical direction correspondingly loses in importance. The relationship to the sky, the *sacred dimension* of past cultures, tends to be forgotten when the earth is opened up as horizontal extension.

Baroque architecture prepared for the conquest of the horizontal. The plans for cities such as Versailles are typical examples of the open but centralized Baroque conception of space.

The new space conception which came to the fore during the second half of the nineteenth century, took over the notions of extension and mobility, but abolished the symbolic center. In the modern world human understanding is no longer administered by some centrally placed authority, but is set free and, at least in theory, put within the reach of everybody. The *loss of the center,* however, makes our understanding of the world extremely difficult. How is human orientation and identification possible in a dynamic world of interaction and change? To solve this problem is the task of architecture.

When the pioneers of modern architecture rejected the *forms of the past,* they did not only intend particular motifs, but also general space conceptions such as the linear perspective of the Renaissance, or the totalitarian patterns of the Baroque. In particular they turned against the *academic* compositions of the official architecture of the nineteenth century, where the meaningful centers and axes of Baroque planning degenerated into a play with formalistic figures. During the nineteenth century the parts were taken out of their context, and history was reduced to a *department store,* where forms could be borrowed when *needed.*

The rejection of the styles implied that a new language of forms were necessary to set the new conception of space

into work. Contemporary architecture had to take the hard way. As with painting and sculpture, it had to begin anew. It had to reconquer the most primitive things, as if nothing had ever been done before. It could not return to Greece, to Rome, or to the Baroque, to be comforted by their experience. In certain crises man must live in seclusion, to become aware of his own inner feelings and thoughts. The new architecture aimed at helping man to gain an existential foothold and make him feel safe with openness and mobility. Modern architecture is part of the new art, and developed in accordance with the evolution of modern art in general, in particular with modern painting and sculpture.

To modern man it might not seem obvious that a new art is needed in a world dominated by science and technology. Do we not believe today that understanding is a matter of reason alone? Do we not believe that all problems may be solved by technical means? The faith in reason stems from the Enlightenment. In general it implies a refusal of any kind of a priori dogma, and a belief in the study of the phenomena as such.

What is the purpose of art in general, and particularly in an epoch of scientific understanding and industrial production? By different means man has to understand and *keep* the transient world of phenomena to which he belongs. Thus he abstracts similarities, classifies and arrives at *natural laws.* Or he constructs practical tools which enable him to handle situations according to his purposes. But this is not enough. Understanding means something more than theory and practice. It also means to keep the vision of how things *are,* of their *true nature,* which includes their interrelationships.

During the first decennium of the twentieth century *a visual revolution* took place in the plastic arts. Basically it consisted in a departure from the realistic representation of the objects of everyday life, which had been the norm in past epochs. In cubism this was achieved through the use of a number of simultaneous viewpoints, whereby several aspects of the thing were unified into one image. Thus pictorial art left perspective behind, and became *abstract* or *nonfigurative.* The traditional *figure* is thus disposed of, and a new kind of *open form* comes into existence. This revolution happened about the same time as some architects abolished the historical styles, and the pioneers of modern music moved away from tonality. All these experiments may be understood as parallel attempts at developing a *modern* art which could

express the new open world. In general it aimed at a return to the *things themselves,* and thus represented a complement to the quantitative abstractions of scientific thinking.

Modern art and modern architecture belong together. Both aim at helping man to find an existential foothold in the new world through the visualization of its qualities. The artistic character of modern architecture was recognized by the pioneers. Already Louis Sullivan said: «... a building which is truly a work of art (and I consider none other) is in its nature, essence and physical being an emotional expression». Le Corbusier gave particular emphasis to this view, introducing all the three chapters on *Architecture* in his book *Towards a New Architecture* with the same statement: «You employ stone, wood and concrete, and with these materials you build houses and palaces. This is construction. Ingenuity is at work. But suddenly you touch my heart, you do me good, I am happy and I say: «This is beautiful. That is Architecture. Art enters in.»

Le Corbusier went on saying: «By the use of inert materials and starting from conditions more or less utilitarian, you have established certain relationships which have aroused my emotions. They are a mathematical creation of your mind. This is architecture.»

As an art, architecture makes a world visible. Evidenty this world does not correspond to that of the plastic arts. A work of architecture does not present to us the essences or interrelations of human beings, animals or other things. In general, it does not portray anything. What, then, does architecture do? Rather than representing something else, it visualizes different ways of being between earth and sky. All things are of course related to earth and sky, and this relationship is part of their world. In buildings this aspect gains primary importance, or in other words, the buildings reveal what we have called the *spatiality* of the world.

ASSIGNMENTS

I. Comprehension questions:

1. What is the purpose of modern architecture? 2. What was the first duty of modern architecture? 3. Where did the first great manifestation of the new architecture take place? 4. What terms express the *newness* of the modern world? 5. Are openness and continuity the new conceptions of space? 6. Did the nineteenth century space conception abolish the symbolic center? 7. When did the Baroque planning degenerate into

a play with formalistic figures? 8. Was a new language of forms necessary for modern architecture? 9. Is a new art needed in the world of science and technology? 10. Can a modern building arouse emotions?

II. Discussion questions:

1. What does the expression *to feel at home* mean? 2. Why is the problem of the house the problem of the epoch? 3. Can the newness of the modern world be expressed by the terms of openness, mobility, interaction and simultaneity? 4. What does the term *simultaneity* express? 5. Why is the city of Versailles a typical example of a centralized conception of space? 6. Does *the loss of the center* make the world easier to understand? 7. What did the devaluation of symbols in the nineteenth century express? 8. Why cannot all problems be solved by technical means in the world dominated by modern technology? 9. Are the constructions of modern architecture always *beautiful*? 10. Which way does the builder reveal the *spatiality* of the world?

III. Why was the relationship to the sky considered as the *sacred dimension* in past cultures?

IV. Make a plan of the text. Discuss the text according to this plan.

V. Group activities:

a) What role did Le Corbusier play in the development of modern architecture?

b) What changes in the man's world outlook lead to the new conceptions in architecture?

c) Do the modern plastic art, music and architecture express the open world?

LESSON THIRTEEN

Grammar: 1. The Adverbial Modifier of Purpose (Translation).
2. **S/Pr. + proved + Infinitive** Construction.
3. Adjectives of the Type: city — urban.

Text A. GROWTH OF CITIES (PRINCIPLE OF CITY LOCATION)

1. Read aloud and memorize the following words:

freighter ['freɪtə] — вантажне судно; pier [pɪə] — пристань; warehouse ['wɛəhaus] — товарний склад; terminate

['tə:mɪneɪt] — закінчуватися; personnel [ˌpə:sə'nel] — особовий склад; necessitate [nɪ'sesɪteɪt] — робити необхідним; furnish ['fə:nɪʃ] — постачати, приставляти; harbour ['hɑ:bə] — гавань; barge [bɑ:dʒ] — баржа; truck [trʌk] — ваговоз, товарна платформа; cause [kɔ:z] — викликати; ferry ['ferɪ] — пором; exclusively [ɪks'klu:sɪvlɪ] — винятково; inaccessible [ˌɪnæk'sesəbl] — недоступний; estuary ['estjuərɪ] — морський рукав (гирло); perch [pə:tʃ] — розташувати високо; hover ['hɔvə] — нависати; cease [si:s] — припиняти.

2. **Words and expressions for the text comprehension:** urban developments — зростання (розвиток) міст; ocean-going freighter — океанське вантажне судно; highway — тракт, магістраль; seacoast shipping center — морський торговельний центр; inland trading center — торговельний центр, віддалений від моря; remnants — залишки; inaccessible hillside — недосяжний бік гори; estuary of river — гирло ріки; bulky raw materials — великі об'еми сировинних матеріалів; pottery industry — гончарне виробництво.

Cities, that is, large and dense population settlements, tend to be located at breaks of transportation lines [1]. The crowding of urban developments is undoubtedly due to the need for unloading facilities [2] for ocean-going freighters. In addition to docks and piers, and to ware-houses for temporary storage, there must be facilities for inland transportation [3]. Thus, cities are located where the inland waterways connect with the open sea, or where highways and, later, railroad lines terminate at the edge of the continent, providing coast-to-coast distribution [4] of all incoming goods.

It takes both personnel and equipment to transfer goods [5] from one means of transportation to another. There are opportunities for work as well as commercial gain where the boats come in. Harbour facilities must be provided, and the final distribution of incoming goods must be decided upon. Manpower is needed for the operation of physical as well as commercial processes in demand at such locations. Thus a sufficient population is attracted and retained to provide for the first foundation and further growth of an urban settlement.

The seacoast shipping centers furnish only the most obvious example of a principle of city location that has much wider application. There are urban settlements at river crossings which in earlier days necessitated reloading activities [6]. There are urban settlements along the indand waterways where goods were transferred from barges to wagon trains,

railroads, or trucks. There are urban settlements at the edges of mountain ranges [7] that formerly made necessary the shifting from one means of transportation to another.

Wherever railroad construction came temporarily to an end, urban settlements developed to accommodate the transfer of goods from freight train to some other means. Today, the break of transportation which caused original city location has in many instances been replaced by further extensions of the rail system [8]. Railroad construction was continued with devastating effect upon inland trading centers. Bridges were thrown over rivers to eliminate the need for reloading to and from ferries [9]. In this process, many urban communities came to outlive their usefulness [10]. The location of new communities and their development changed continuously with the improvement of our means of transportation.

In addition to the reason for city location, there are many other reasons for city growth. The function of the city as a trading center is emphasized by the theory that points exclusively to location at breaks of transportation lines.

In the early Middle Ages, city location was determined primarily by the needs of defence. We find remnants of these ancient cities on almost inaccessible hillsides, on the estuaries of rivers, or perched on peninsulas. With the development of trade and commerce, many of these cities lost importance, ceased to grow, and drifted into stagnation [11]. Nor is urban growth entirely explainable anymore by location to transportation facilities. Most modern cities have developed from centers of commerce and trade to centers of industry. Under the circumstances, new economic considerations have to be added to the explanation of urban growth and development.

Modern industry needs bulky raw materials. The distance these raw materials have to travel from their place of origin (for example, from the mines) to the place of industrial transformation enters heavily into industrial cost calculations [12]. Quite often several raw materials are required in the process of production.

Location of industry and location of urban settlement are attracted to the places where raw materials are extracted. On top of the mines, obviously, the cost of cross-country transportation is reduced to nothing [13].

Coal proves to be more effective in [14] attracting the steel industry than iron. More coal than iron ore — in weight and bulk — is used and lost in the production of any given amount of steel. For this reason, the steel industries of Wes-

tern Europe are located in the Ruhr valley where coal is found, rather than in France where the iron ore is mined.

The relationship of industrial and urban location to coal and iron ore is, of course, only a striking example of a more general principle. Location is determined by the attempt to reduce the total cost for transportation to the lowest possible level. The pottery industry moves to deposits of suitable clay; oil refineries hover over the most productive wells; and paper mills cluster around our resources of timber. Urban settlements provide the necessary manpower for industrial and commercial activities in such locations.

VOCABULARY NOTES

[1] **tend to be located at breaks of transportation lines** — мають тенденцію до розміщення на розривах транспортних ліній

[2] **the need for unloading facilities** — потреба у створенні можливостей для розвантаження

[3] **inland transportation** — внутрішні перевезення

[4] **coast-to-coast distribution** — розподіл, що простягається від берега до берега (від Атлантичного до Тихого океану)

[5] **it takes both personnel and equipment to transfer goods** — існує потреба як у людях, так і в обладнанні для транспортування товарів

[6] **which in earlier days necessitated reloading activities** — які в період виникнення потребували можливостей для перевантаження

[7] **at the edges of mountain ranges** — на краях гірських пасм

[8] **rail system = railway system** — система залізничних доріг

[9] **the need for reloading to and from ferries** — необхідність перевантаження на пороми (туди й назад)

[10] **urban communities came to outlive their usefulness** — міські поселення почали відживати (втрачати свою корисність)

[11] **drifted into stagnation** — занепали

[12] **enters heavily into industrial cost calculation** — становить значну частину при підрахунках промислових видатків

[13] **the cost of cross-country transportation is reduced to nothing** — вартість транспортування через усю країну зменшується до мінімуму

[14] **coal proves to be more effective in** — вугілля, виявляється, має перевагу в

EXERCISES

I. Find the following word-combinations in the text and translate the sentences into Ukrainian:

urban development, inland transportation, inland waterways, open sea, incoming goods, commercial gain, harbour facilities, river crossing, transfer of goods, freight train, railroad construction, ancient city, railroad line, pottery industry.

II. Read the text again and write out terminological words and word-combinations.

III. Give Ukrainian equivalents of the following international words:

transportation, continent, commercial, process, principle, construction, theory, industry, distance, total, resources.

IV. Construct sentences to illustrate the difference between the following pairs of words:

construction — building; modern — contemporary; old — ancient; bank — coast; mountain — hill; people — population; manpower — labour force.

V. Put as many questions as possible to each of the following sentences:

1. Each culture characterizes in the city the unifying idea that runs through its activities. 2. Cities are located where the inland waterways connect with the open sea, or where highways, railroad lines terminate, providing distribution of all incoming goods. 3. In the early Middle Ages, city location was determined primarily by the needs of defence. 4. The modern city should be planned with reference to biological, social and personal needs of the community, its cultural and educational purposes. 5. Location of industry and location of urban settlements are attracted to the places where raw materials are extracted. 6. Urban settlements provide the necessary manpower for industrial and commercial activities in such locations.

VI. Define the function of the Infinitive in the following sentences by putting questions to each of them:

1. We have come here to build a new town. 2. I have entered the institute to become a highly qualified engineer. 3. To build a house one must have a plan, necessary materials and manpower. 4. To learn a foreign language it is necessary to read, write and speak every day. 5. To become a good construction designer one should know fundamentals of

many sciences. 6. To find the state of a mass of a gas, we must know its volume, its pressure and its temperature.

VII. Analyse the use of the Infinitives in the text, translate the sentences into Ukrainian.

VIII. Comprehension questions:

1. What is a city and what is a town? 2. Where do cities tend to be located? 3. Why were urban settlements located along the inland waterways or at breaks of transportation lines? 4. What determined city location in the early Middle Ages? 5. What factors determine modern city location? 6. Why are urban settlements attracted to the places where raw materials are available? 7. What factors determine city location nowadays? 8. Do you know the history of the appearance of your city (town)?

IX. Speak about:

a) the principles of urban location;
b) the factors determining modern city growth;
c) the industrial transformation of modern cities.

X. Render the following text into English. Make use of the words and expressions given below the text.

Трипільська культура — феномен часу

Трипільська культура — повноцінна складова української духовної і мистецької традиції. Вона існувала як історична реальність за тисячі років перед християнством, як явище первісної високорозвиненої культури.

Це не тільки археологічне відкриття кінця минулого століття, це — феномен національної культури, наша давня історія, ключ до цілої духовної епохи. В ній можна знайти вічну мистецьку національну традицію, свій код до розуміння дійсності, релігії, естетики. Неолітична культура, яка дістала назву трипільської, знайшла відображення в працях таких видатних археологів, як наш земляк Вікентій Хвойка або англійський дослідник Гордон Чайлд.

Київщина дала світові культуру, яка ще за два тисячоліття до єгипетських пірамід, індійських храмів і шумерських пам'яток налічувала вже вісім тисяч років. У прадавніх трипільських містах археологи знайшли астрономічні обсерваторії, храми, календарі, знаряддя праці, речі домашнього вжитку, прикраси з дорогоцінних металів. Серед знахідок були й скульптури людей, дуже схожих на сучасних космонавтів. Археолог Вікентій Хвой-

ка натрапив на глечик, на якому зображено літальні апарати з реверсивним слідом, смугою відпрацьованих газів, ніби від реактивного літака.

У результаті багаторічних розкопок вчених-археологів було відтворено й описано трипільські знахідки — прадавні міста з двоповерховими, розписаними червоною вохрою, оселями, капища, дивовижні керамічні вироби, тарілки, глеки, жбани, на яких відображені міфічні уявлення наших предків про світобудову, статуетки, що являли собою релігійні скульптури.

Трипільська культура, як повноцінна складова, входить до скарбниці світової культури; вона відображає українську духовну й мистецьку традицію, споріднену з давніми культурами шумерів, індійців, єгиптян, тібетців, монголів. Глибоке й ретельне вивчення її принесе нові знахідки, нові відкриття, нові несподіванки в галузі мистецтва, культури, а також науки й техніки.

(трипільська (неолітична) культура — neolithic culture; повноцінна складова — a full-fledged constituent part; первісний — primordial; духовна епоха — spiritual epoch; вічна мистецька традиція — the everlasting art tradition; храм — temple; прадавній — ancient; знаряддя праці — labour implements; речі домашнього вжитку — domestic utensils; дорогоцінні метали — precious metals; глечик — jug; розкопки — excavation; предки — predecessors)

Text B. CITY OF MIDDLE AGES

1. Read aloud and use in your discussion the following words:

medieval [ˌmedɪ'i:vel] — середньовічний; moat [mout] — рів з водою; apparent [ə'pærnt] — видимий; sprawl [sprɔ:l] — розповзатися в різні боки; thoroughfare ['θʌrəfɛə] — пожвавлена вулиця; subservient [səb'sə:vjənt] — сприятливий; siege [si:dʒ] — облога; suburbanite [sə'bɔ:bənaɪt] — приміський житель; burgh ['bʌrə] — місто із самоуправлінням; hierarchical [ˌhaɪə'rɑ:kɪkəl] — ієрархічний; pretentious [prɪ'tenʃəs] — претензійний; squeeze [skwi:z] — видавлювати, притискувати; ordinance ['ɔ:dɪnəns] — указ, постанова.

2. Words and expressions for the text comprehension:

air views — огляд з повітря (літака); protective shelter — захисне укриття; in the course of centuries — протягом століть; market place — ринкова площа; city gates — міські ворота; purposeful planning — цілеспрямоване планування; symbolic reference — символічне згадування (по-

силання); interurban traffic — внутрішньоміський транспорт; generous lay out — щедре витрачання (чого-небудь); to encompass tillable land — оточувати орну землю; hierarchical arrangement — ієрархічне розташування; guild-halls — зали гільдії; ballhouses — будинки для балів (з танцями); wholesale market — ринок оптової торгівлі; scramble for space — боротися за простір; plumbing system — система водогону.

The cities of the Middle Ages were planned cities. Present air views make the ruins of medieval cities appear as random agglomerations of dwellings crowded like the chicks of a hen into the protective shelfer of walls and moat, with a minimum of rational internal organization. The original structure of the city is no longer apparent. In the later phases of the Middle Ages, the city outgrew its original design. In the course of centuries, it filled up and, unable to sprawl beyond the limits of its fortifications, developed differently from the metropolis of the industrialization period.

The main streets and thoroughfares of the medieval cities were deliberately and rationally planned. They led directly — and frequently in a straight line — from the central market place to the city gates.

At times, an element foreign to our conception of purposeful planning entered into the picture. The street system was occasionnally determined by symbolic references, dividing the city area, for example, into 12 sections representing the 12 apostles of Christ. A straight north-south and east-west direction was frequently preferred to arrangements more convenient to interurban traffic. But plans there were; although subservient to values different from ours.

Originally, the medieval cities were planned with a generous layout, leaving room for additional expansion. The belt of fortifications was wide enough to encompass tillable land for food supplies in case of prolonged siege. The gardenland of the urban residents was also enclosed within the city walls.

City location, of course, was determined by defence purposes. A variety of strong defence positions were exploited. Cities were located on the tops of cliffs and mountains; we also find them on islands, and at river deltas and peninsulas. The winding course of a river offered many opportunities for well protected urban locations.

Yet what was an advantageous position in the beginning later often turned into an embarassing restriction to further growth. Neither the hill-top nor the island could be extended to allow for unlimited population increase. Many urban set-

tlements thus fell by the wayside due to geographical obstructions. They fell into a state of stagnation from which they never recovered. Others extended in suburban settlements beyond their natural borders. They continued to grow at the foot of the hill-side or overflowed the river line behind which the early settlement had sought protection.

From the 12th to the 16th century, not only were these cities filled up, but most of them were repeatedly extended beyond earlier ranges of fortification. As the medieval city filled up, additional populations settled in clusters outside the city walls. By the concerted efforts of these peripheral settlers, something like a stockade was thrown around their dwelling units to hold the site against the enemy at least long enough to permit the suburbanites to withdraw to the inner ring of fortifications.

Sooner or later, the city walls proper were extended to embrace all the outlying settlements in a widened ring of defensive construction. Successive rings of abandoned protective belts are still clearly visible in the street system of cities that have survived from Middle Ages.

Inside, the medieval city pattern expressed the class structure of a feudal society and that of the urban community itself. Not all, but many of the earlier cities nestled at the feet of burghs. As the city spread in a circle or semicircle, it retained a hierarchical arrangement of residential construction according to status. Advanced status pre-empted the grounds in the center of town. Members of the nobility had their city residences close to the central market place. As the nobility declined in power and numerical importance, their place was taken by the family residences of wealthy merchants or craftsmen with seats in the city council.

Unlike our modern cities, these cities had no slums close to their centers; instead there were pretentious stone structures, palaces, and stately mansions. Here was the place also for the numerous public buildings. Many of these have since been converted to residential use, thus obscuring their original function. Cathedrals and city halls, to be sure, still stand out as such. In addition the innermost ring of urban construction contained the guildhalls and the ballhouses, the public baths, and the wholesale markets with indoor as well as outdoor space for commercial activities.

At the periphery of the medieval city, we find the residences of the poorer members of the community, squeezed close to the wall and crowded together in a frantic scramble for space. The modest dwellings of the early Middle Ages, as

a matter of fact, have not endured to the present times. These one-story and one-room structures were later replaced by more elaborate three-floor structures protruding over the street front to increase the amount of dwelling space.

If the main streets of the medieval city were laid out according to a uniform plan, the same cannot be said for the side streets and alleys. The winding network of sidestreets often leaves us with an esthetically pleasing impression.

These side streets of the Middle Ages were never laid out with a view to purposes of communication. They were spaces left over in the built-up area of the city, as farm and garden land, vineyards, barns, and stables were gradually cut up into lots for residential construction. There were no premeditated plans for as much as a single city block. As a matter of fact, there were no city blocks.

Sanitary conditions in the medieval city were such as to endanger by either plague or fire its very survival. There was progress, but the growing population pressure continuously made obsolete the water system and the sewerage system, as well as the protective measures designed to forestall the devastating fires that annihilated entire cities.

City ordinances determined the distance between individual structures in order to limit the spread of possible fires. Streets were paved, restrictions were imposed upon the elimination of waste products, public toilets were installed. The pigsties had to disappear from the street system and, in the late Middle Ages, many cities installed plumbing systems that piped running water into the individual dwelling units.

To permit a minimum of sunlight to penetrate into the side alleys, building ordinances restricted the custom of letting the upper floors of residential construction protrude to the point where the houses almost touched at the top-level. Street-lighting helped to improve the citizen's safety from robbery by night, and the organization of the fire brigade was improved as these cities grew and filled up into dense clusters of humanity within the confines of the city wall.

ASSIGNMENTS

I. Comprehension questions:

1. Were the cities of the Middle Ages planned? 2. What happened to the cities in the later phases of the Middle Ages? 3. What was the street system occasionally determined by? 4. How were the medieval cities planned? 5. Why did the medieval cities fall into a state of stagnation? 6. How did

the medieval city pattern express the class structure of that time society? 7. Who lived at the periphery of the medieval city? 8. What community conveniences did the medieval city offer? 9. How was order kept in the medieval city? 10. What helped to support the citizen's safety by night?

II. Discussion questions:

1. Why is the original structure of the medieval city no longer apparent? 2. How can you prove that the medieval cities were planned? 3. What enabled cities to fulfil the function of defence? 4. What hindered the further growth of the medieval cities? 5. What can you see in the street system of cities that have survived? 6. How can you prove that the medieval city pattern expressed the class structure of society? 7. Were there city blocks in the medieval cities? 8. What can you say about sanitary conditions in the medieval city?

III. Explain the difference between the words of similar semantic group:

a) house — building — residence — dwelling;
b) city — town — settlement — village;
c) land — soil — earth — ground.

IV. Find in the text sentences describing:

a) the main streets of the medieval cities;
b) that city location was determined by defence purposes;
c) numerous public buildings in the medieval city.

V. Retell the text in short according to your own plan.

LESSON FOURTEEN

Grammar: 1. **Should/Would + Infinitive** Construction.
2. Polycomponential Terms and Ways of Translating Them.

Text A. SPECIAL FEATURES OF FOUNDATION AND SOIL ENGINEERING

1. Read aloud and memorize the following words:

designate ['dezɪgneɪt] — визначати; therefore ['ðeəfɔ:] — ось чому, тому; load [loud] — вантаж, навантаження; ex-

cessive [ɪk'sesɪv] — надмірний; obviously ['ɔbvɪəslɪ] — безсумнівно; occurrence [ə'kʌrəns] — випадок, явище; failure ['feɪljə] — обвал; rupture ['rʌptʃə] — розрив; caisson ['keɪsən] — кесон; negligible ['neglɪdʒəbl] — незначний, нехтуваний; naturally ['nætʃrəlɪ] — природно, звичайно.

2. Words and expressions for the text comprehension:

contact surface — поверхня контакту; roadbed — полотно дороги; rupture — розрив; failure — обвал, сповзання; strain — напруга, навантаження; slide — зсув; cumulative action — кумулятивна дія; excessive stresses — надмірні навантаження; elastic and plastic properties — еластичні та пластичні властивості; stress distribution — розподіл навантаження; engineering properties — технічні властивості; soilmass — грунтова маса; field conditions — польові умови; three-phase system — трифазова система.

What is the purpose and the importance of a foundation? The term *foundation* is used to designate the part of a structure which serves to transmit to the soil beneath its own weight, the weight of the superstructure above it, and any forces which may act upon them. A foundation is therefore the connecting link between the superstructure and the soil.

The function of a properly designed foundation is to support the loads resting on it and to distribute them in a satisfactory manner over the contact surfaces of the soil layer on which it rests. In order to be satisfactory [1], this distribution must not produce excessive stresses within the soil mass at any depth beneath the foundation. One must obviously consider [2] as excessive stresses which would cause a complete rupture within the supporting soil mass and a noticeable tilting and sinking of the structure as a whole [3]. This is not a frequent occurrence [4] where buildings are concerned, but it is not unkown. Damages to roadbeds or earth dams due to rupture failures and slides of the soil or supporting embankments also happen occasionally.

Stresses are also to be rated as excessive [5] if the cumulative action of the strains they produce causes a settlement of the supporting soil surface so uneven that the structure above it would be cracked or otherwise damaged while undergoing deformations [6] required to adapt it to this uneven settlement. The importance of foundations is self-evident, since no structure can endure without an adequate foundation.

When the surface soil layers are too weak, the foundation has to be carried down to more resisting layers if such are present within easy reach. According to circumstances, this can be done by open excavation, by driving piles, or by

sinking caissons to the desired depth. But, whatever may be the type of foundation [7] or the depth below the soil surface to which the foundation reaches, the loads that it will transmit to these layers will always cause stresses and therefore strains in the supporting soil mass [8]. As in all other materials, the magnitude of the unit strains will depend on the magnitude of the corresponding unit stresses and on the elastic and plastic properties of the supporting soil. These strains will always be present and their sum will always produce some deformation and settlement of the contact surfaces between the foundation and the supporting soil.

What is the interaction between the superstructure, the foundation, and the soil beneath it? A foundation will naturally tend to follow any settlement of the soil on which it rests. In turn, the superstructure will follow the settlement of the foundation which supports it. Both will tend to equalize uneven settlements [9] by resisting deformation and thereby transmitting more load to those parts of the soil surface which have settled least. No deformation of the soil surface beneath a structure can take place without a corresponding deformation of both the foundation and the superstructure above it. This remains true for any type of structure, be it a building, a bridge, a road, or a dam.

The supporting soil, the foundation, and the superstructure form one single unit and should therefore always be considered as a whole. The interaction between them is very complicated. However, it is most important to bear in mind [10] the fact of such interaction from the very start of studies in this field. It has been too often disregarded in the past, largely because of the complexity of the problem, analysis of which was not even attempted with the more limited knowledge available in earlier periods in the history of engineering. As a result of this complexity of foundation problems the scientific development of foundation engineering has remained far behind that of structural engineering. For the same reason even present-day foundation work requires methods of approach which differ from those usual in structural engineering.

And now let's dwell on the scientific development of foundation engineering. As compared with the structural engineer [11], the foundation engineer was, and still is, in a much less favourable position.

The analysis of stress distribution in soil masses is a complicated problem of a highly indeterminate nature requiring a thorough knowledge of advanced higher mathematics and

of the theories of elasticity and plasticity. For new problems the help of specialists in these fields has to be resorted to [13]. Their solutions for idealized conditions then have to be critically examined by the engineer in order to be adapted as closely as possible to the actual and generally much more complicated field conditions.

The main difficulty lies in the much more complicated engineering properties of soils as compared with other building materials. Most soils are three-phase systems; that is, they are composed of solid matter, of water, and of air. Their behaviour under stress is strongly affected by their density and by the relative proportions of water and of air filling their voids. These properties may vary with time and depend to a limited extent on a number of other factors. The time element becomes very important in the study of the stress-stain relationship of soils [13].

Other factors which are relatively negligible [14] in the study of these relationships for other building materials, such as the rate and the manner of application of loads, may become of cardinal importance where some soils are concerned. Changes in the moisture content of most soils may greatly alter many of their important engineering properties. These properties may also be strongly affected by vibrations and by changes in the condition of lateral confinement of the soil. All the above is true [15] both for undisturbed natural soil deposits supporting foundations and for artificially selected and compacted soils used as a construction material for earth structures such as dams and embankments.

In the case of undisturbed natural soil deposits which support structures erected on them, the difficulties of the determination of their engineering properties are still further increased by their frequent lack of uniformity due to the erratic processes of their formation by nature. It is therefore not always possible to proceed in a manner identical with that used for other building materials and to judge accurately the average engineering properties of a large soil mass on the strength of tests on a few samples. Further, it is extremely difficult to extract for testing small samples from the depth of a natural deposit without changing their properties. Under the circumstances it is not surprising that the scientific development of foundation engineering lagged far behind that of structural engineering [16].

VOCABULARY NOTES

[1] **in order to be satisfactory** — для того щоб задовольнити ці вимоги
[2] **one must obviously consider** — напевне, треба враховувати
[3] **a noticeable tilting and sinking of the structure as a whole** — різні перекоси й просадки споруди в цілому
[4] **this is not a frequent occurrence** — не часто трапляється
[5] **to be rated as excessive** — вважатися надмірними
[6] **while undergoing deformations** — під час виникнення деформацій
[7] **whatever may be the type of foundation** — яким би не був тип фундаменту
[8] **strains in the supporting soil mass** — деформації в грунтовій товщі під навантаженням
[9] **to equalize uneven settlements** — вирівняти нерівномірну осадку грунту
[10] **to bear in mind** — мати на увазі
[11] **as compared with the structural engineer** — якщо порівняти з інженером-будівельником
[12] **the help ... has to be resorted to** — треба звернутися за допомогою до ...
[13] **stress-strain relationship of soils** — взаємозалежність між напругою і деформацією грунтів
[14] **are relatively negligible** — мають відносно невелике значення
[15] **all the above is true** — усі перераховані вище обставини відповідають
[16] **lagged far behind that of structural engineering** — набагато відстало від розвитку самого будівництва

EXERCISES

I. Find the following words in the text and give their contextual meaning in Ukrainian:

foundation, act, manner, mass, deformation, adapt, adequate, caisson, material, plastic, contact, naturally, analysis, theory, idealized, examine, proportion, factor, cardinal, vibration, identical, accurately.

II. Write out of the text terminological word-combinations according to: a) two components, b) three components. Translate them into Ukrainian:

M o d e l: a) soil layer → layer of soil — шар грунту;
b) surface soil layer → soil layer of the surface — шар грунту поверхні.

III. Finish the following sentences according to the text:

1. The term *foundation* is used ... . 2. A foundation is the connecting link between ... . 3. The importance of foundations is self-evident, since ... . 4. Most soils are three-phase system; that is, they are composed of ... . 5. Changes in the moisture content of most soils may greatly alter ... . 6. Damages to roadbeds or earth dams happen due to ... .

IV. Read the text again and find sentences describing: a) the function of the foundation; b) the importance of an adequate foundation; c) the interaction between the superstructure, the foundation, and the soil beneath it.

V. Put as many questions as you can to the following sentences:

1. The civil engineer must consider many factors when selecting the material for construction. 2. The designer must be able to select and adapt such materials of construction that will give the most effective result by the most economical means. 3. In many cases bricks are very satisfactory too for use in the construction. 4. In respect of physical and mechanical properties, construction materials are divided into rigid, semi-rigid and soft.

VI. Explain the meaning of *Should/Would + Infinitive* Constructions in the following sentences and translate them into Ukrainian:

1. The masterplan of the town should show the agricultural areas that should be left for passive recreation. 2. A town should be a nice place to live, to work and to rest in. 3. City growth should be controlled. 4. Therefore, parameters must be determined which would dictate the need for the whole of industry to produce only high-quality commodities. 5. We decided that in selecting the most suitable materials in the construction of this machine he would consult materials engineers.

VII. Find the sentences with *Should/Would + Infinitive* Constructions in the text and translate them into Ukrainian.

VIII. Comprehension questions:

1. What does the term *foundation* designate? 2. Can you name the functions of a designed foundation? 3. What stresses are to be rated as excessive? 4. What must be done to the foundation when the surface soil layers are too weak? 5. What is the interaction between the superstructure, the foundation, and the soil beneath it? 6. What can you say about the scientific development of foundation engineering? 7. What should

we take into account when analysing stress distribution in soil masses? 8. What can greatly alter engineering properties?

IX. Write a short summary of the text.

X. Speak about:

a) the important parts of the building;

b) the role of the foundation in the construction of the building;

c) the scientific development of foundation engineering and structural engineering.

Text B. FOUNDATION SOILS AND SUBSTRUCTURES

1. Read correctly and use the following words in your discussion:

crosswise ['krɔswaɪz] — навхрест, впоперек; sheath [ʃi:θ] — обшивка; massif ['mæsɪf] — гірський масив; aperture ['æpətjuə] — отвір, щілина; masonry ['meɪsnrɪ] — кам'яна або цегляна кладка; diverse [daɪ'və:s] — різний; external [ɪks'tə:nl] — зовнішній; armouring ['ɑ:mərɪŋ] — обшивка (покриття); expenditure [ɪks'pendɪtʃə] — витрата; intermittently [ˌɪntə'mɪtəntlɪ] — з проміжками.

2. Words and expressions for the text comprehension:

in conjunction with — у поєднанні (разом) з; strip — прокладка; footing — основа (фундаменту); reinforced concrete slab — залізобетонна плита; basement premises — підвальні приміщення; pre-eminently — винятково; socket-type foundation — фундамент цокольного типу; backfilling — засипка виїмки; subgrading — основа, земляне полотно; masonry voids — пори в цегляній кладці; rubble concrete — бутобетон; quarry stones — бутове каміння, плитняк; foundation pad block — грунтовочний блок; intermittently cushioned — підкладка (подушка) з проміжками; load-lifting capacity — здатність нести навантаження; prefabricated concrete plant — завод з виготовлення бетону.

I. Types of Foundations. Distinction is made among the following basic types of foundations.

1. Individual footings arranged under columns and walls in conjunction with marginal foundation beams; these foundations are extended cross- and lengthwise.

2. Strip footings under columns which carry a pressure transmitted from a row of columns; the strips are made to run

in two directions, i. e., the footings are arranged of crossed strips.

3. Wall footings extending all along the walls. The wall footings can be extended only crosswise, their length being conditioned by that of the walls or of the row of columns.

4. Mat or continuous foundations in the form of reinforced concrete slabs, particularly under a network of columns and under walls, sheaths or shells, or box-shaped (coffered foundations). The dimensions of the mat foundation base depend on those of the structure in plan or of its part resting upon the foundation.

5. Solid foundations in the form of a rigid massif underlying the whole of the structure. In plan (horizontally) these foundations may extend in two mutually perpendicular directions.

Individual foundations do not enhance the rigidity of the structure. They find application when differential settlements do not exceed the permissible values. To keep down the irregular settlements of the columns use is made of strip footings, crossed strips and mat foundations. Wall footings modify the stiffness of the structure but insignificantly. In walls with large apertures the wall footings tend to redistribute the pressure lengthwise and serve as a link for partitions between posts. Wall footings are sometimes constructed with a view to fencing off the basement premises and cellars arranged for technical needs.

With the individual, solid and wall footings having a not too great horizontal spread their masonry is pre-eminently in compression. In this case their projecting parts are made either stepped or inclined. To economize on the masonry material the bottom part of the foundation is made in the shape of a reinforced concrete slab. Such foundations are arranged both as individual footings under columns and as wall footings.

The foundation top is made so as to match the structural members that are to rest upon it. In case of metal columns the foundation cut or edge is made to lie at a depth of 0.5 to 1 m so as to place the metal heel of the column below the level of the building's floor. Precast reinforced concrete columns are supported by the socket-type foundations with an elevated socket. This enables the backfilling and subgrading for the arrangement of the floors to be done prior to the installation of the columns.

II. Materials for foundations. The foundation materials undergo deformations under the effect of diverse external

forces, the action of surface water, freezing and defrosting of the moisture in masonry voids. To ensure a long useful life of the foundations, materials are selected that resist well these effects, such as reinforced concrete, concrete, rubble concrete, rubble masonry. The latter involves the use of manual labour and for this reason finds little application.

The concrete is a better material for foundations. Quarry stones in an amount of 25—30 per cent of the masonry volume are embedded into the concrete (rubble concrete) to reduce the consumption of cement. Of concrete and rubble concrete are made wall blocks for build-up foundations and foundation pad blocks of limiting width.

The reinforced concrete is the most universal material for foundations of any structural form or design. Especially indispensable is reinforced concrete in strip footings under columns and mat foundations, for it resists well the bending forces. Reinforced concrete and concrete foundations are often made of prefabricated members, this permitting their erection on the spot by the industrial method.

III. Prefabricated reinforced concrete foundations. The use of precast members is most effective in constructing wall footings. Here the footing consists of reinforced concrete pad-blocks undergoing bending and of wall blocks subject pre-eminently to compression. Above the ground water table application find hollow wall blocks. In wall footings use is made of standard pad-blocks. To save the material and reduce the number of types and sizes of pad-blocks gaps are left between them, an intermittently cushioned wall footing is arranged. The clearances between the pads are filled with compacted sand.

In erecting large-panel buildings special foundation slabs and wall block panels are sometimes employed.

Sometimes individual footings too are of precast members. Under columns such footings are better to consist of single blocks. Column footings built up of several blocks demand an additional consumption of armouring to be arranged at several levels. The dimensions of the blocks are set depending upon the load-lifting capacity of the erecting crane. Installation under columns of individual footings built-up of two and more blocks is effective only when foundation work is to be accomplished against time.

The costruction of built-up foundations may help achieve a minimum consumption of concrete, cut down the foundation weight and the time needed for its erection, and reduce the expenditure of labour at the construction site. This, however,

usually involves an increased consumption of steel, higher manpower quotas at the prefabricated concrete plant and, sometimes, higher transportation cost as well.

ASSIGNMENTS

I. Comprehension questions:

1. How many types of foundations are there? 2. When are strip footings, crossed strips and mat foundations used? 3. What way is the foundation to be made? 4. Under what effect do the foundation materials undergo deformation? 5. Is manual labour still applied in masonry? 6. What is employed for erecting large-panel buildings? 7. What foundations involve an increased consumption of steel, higher manpower quotas and higher transportation cost?

II. Discussion questions:

1. What distinctions are made among the basic types of foundations? 2. What purpose are wall footings constructed for? 3. Under what conditions can the arrangement of the floors be done prior to the installation of the columns? 4. What ensures a long useful life of the foundations? 5. Why is reinforced concrete the most universal material for foundations? 6. What are the gaps between the pad-blocks left for? 7. What are the advantages of the constructions with built-up foundations?

III. Define the term *manpower quota*.

IV. Express the main idea of each of the subtitles of the text.

V. Group activities:

a) Can you give any examples of neglecting the requirements in building practice?

b) Is economy on the masonry materials always justified?

c) What problems do the surface and ground water present?

LESSON FIFTEEN

Grammar 1. Tense Forms in Active and Passive (Review).
2. Terminology: Word-combinations of A + S Type.

Text A. GEODESY: DEFINITION, CLASSIFICATION, PROBLEMS

1. Read aloud and memorize the following words:

geodesy [dʒi(:)'ɔdɪsɪ] — геодезія; ocean [ouʃn] — океан; external [eks'tə:nl] — зовнішній; selenodesy [sɪ'li:nɔdɪsɪ] — селенодезія; coordinate [kou'ɔ:dnɪt] — координатний; curvature ['kə:vətʃə] — кривизна, вигин; surveying [sə:'veɪɪŋ] — зйомка; series ['sɪəri:z] — серія, ряд; fluid [fluɪd] — рідкий, текучий, рідина; assumption [ə'sʌmpʃn] — припущення; equipotential [ˌi:kwɪpə'tenʃ(ə)l] — рівнопотенційний; geoid ['dʒi:ɔɪd] — геоїд; exterior [eks'tɪərɪə] — зовнішній; ellipsoid [ɪ'lɪpsɔɪd] — еліпсоїд; ascertain [ˌæsə'teɪn] — пересвідчитися; variable ['veərɪəbl] — мінливий, змінний.

2. Words and expressions for the text comprehension:

validity — обґрунтованість; earth's surface — поверхня землі; space exploration — дослідження космосу; heavenly body — небесне тіло; planetary geodesy — планетна геодезія; reference surface — еталонна поверхня; estate cadastre — майновий кадастр; terrestrial body — земне тіло; marine geodesy — морська геодезія; artificial satellite — штучний супутник; ocean surface — поверхня океану; bounding surface — гранична поверхня.

According to the classical definition geodesy is the «science of the measurement and mapping of the earth's surface». This definition has to this day retained its validity; it includes the determination of the earth's external gravity field [1] as well as the surface of the ocean floor. With this definition, geodesy may be included in the geosciences, and also in the engineering sciences.

Triggered by the development of space exploration [2], geodesy turned in collaboration with other sciences toward the determination of the surfaces of other heavenly bodies (moon, other planets). The corresponding disciplines are called selenodesy and planetary geodesy.

Geodesy may be divided into the areas of global geodesy [3], geodetic surveying [4], and plane surveying [5]. Global geodesy

is responsible for the determination of the figure of the earth including the complete external gravity field. A geodetic survey defines the surface of a country by the coordinates of a sufficiently large number of control points. In this fundamental work, the overall curvature of the earth [6] must be considered. In plane surveying (topographic surveying, cadastral surveying, engineering surveying [7]), the details of the land surface are obtained; the horizontal plane is in general sufficient as a reference surface.

There is close interaction between global geodesy, geodetic surveying and plane surveying. The geodetic survey adopts the parameters determined by measurements of the earth, and its own results are available to those who measure the earth. The plane surveys, in turn, are generally tied to the control points of the geodetic surveys [8] and serve then particularly in the development of national map series and in the formation of real estate [9] cadastres.

The problem of geodesy is to determine the figure and the external gravity field of the earth and of other heavenly bodies as functions of time; as well as, to determine the mean earth ellipsoid from parameters observed on and exterior to the earth's surface. This geodetic boundary-value problem [10] incorporates a geometric (figure of the earth) and a physical (gravity field) formulation of the problem; both are closely related. By the figure of the earth we mean the physical and the mathematical surface of the earth.

The physical surface of the earth is the border between the solid or fluid masses and the atmosphere. Recently, the ocean floor has also been included in the formulation of the geodetic problem, being the bounding surface between the solid terrestrial body and the oceanic water masses. The extension of the problem to the oceans is designated marine geodesy. The irregular surface of the solid earth (continents and ocean floor) is incapable of being represented by a simple mathematical relation; it is therefore described point wise by the use of coordinates [11] of the control points. On the other hand, the ocean surfaces (70 % of the earth's surface) possess a simpler principle of formation. Under certain assumptions, they form a part of a level (equipotential) surface (surface of constant gravity potential) of the earth's gravity field. We may think of this surface as being extended under the continents and then identify it as the mathematical figure of the earth.

What we call the surface of the earth in the geometrical sense is nothing more than that surface which intersects

everywhere the direction of gravity at right angles, and part of which coincides with the surface of the oceans.

The majority of the observed parameters used in geodesy refers to the earth's external gravity field, whose study thereby becomes a concern of geodesy. The upper limit of space that is of interest is governed by the geodetic usage of artificial satellites and space probes, as well as the earth's moon. The physical aspect of the problem of geodesy follows from the consideration of the earth's surface and the geoid as bounding surface in the earth's gravity field. The external gravity field may be described by the countless level surfaces[12] extending completely or partially exterior to the earth's surface.

Reference systems with a defined metric and curvature are required for the computations in global geodesy and geodetic surveying. Because of its simple equation, a rotational ellipsoid flattened at the poles is better suited as a geodetic reference surface than the geoid, which is determined by the uneven distribution of the earth's masses. Particular significance is given to the mean earth ellipsoid [13], which is the optimal ellipsoid approximating the geoid.

The body of the earth and its gravity field are subject to temporal variations of secular, periodic, and singular nature, which can occur globally, regionally, and locally. The geodetic measurement and evaluation techniques today have advanced to the extent that they can detect a part of this change. Should average conditions be ascertained, observations must be corrected for these changes. With the detection of a part of the variations, geodesy also contributes to the investigation of the dynamics of the terrestrial body. The figure of the earth and the external gravity field are accordingly conceived as time dependent variables.

VOCABULARY NOTES

[1] **the earth's external gravity field** — зовнішнє гравітаційне поле Землі
[2] **triggered by the development of space exploration** — під впливом інтенсивного розвитку космічних досліджень
[3] **global geodesy** — вища геодезія
[4] **geodetic surveying** — геодезична зйомка
[5] **plane surveying** — інженерна геодезія
[6] **the overall curvature of the earth** — загальна кривизна Землі

[7] **topographic surveying, cadastral surveying, engineering surveying** — топографічні, кадастрові, інженерні зйомки
[8] **the control points of the geodetic surveys** — вихідні пункти геодезичної зйомки
[9] **real estate** — нерухоме майно
[10] **geodetic boundary-value problem** — геодезична гранична (за значенням) задача
[11] **it is therefore described point wise by the use of coordinates** — тому вона описується за допомогою координат
[12] **the countless level surfaces** — незліченні рівневі поверхні
[13] **the mean earth ellipsoid** — середній еліпсоїд Землі

EXERCISES

I. Give Ukrainian equivalents of the following words from the text:

classical, global, figure, coordinate, fundamental, detail, formation, function, mass, control, principle, sense, interest, limit, regionally, locally.

II. Group the following word-combinations according to the models and translate them into Ukrainian:

Models: S + S — space exploration — дослідження космосу
A + S — planetary geodesy — планетарна геодезія

gravity field, control points, cadastral surveying, plane surveying, reference surface, estate cadastre, heavenly body, marine geodesy, artificial satellite, topographic surveying, fluid masses, terestrial body, ocean surface.

III. Read the text again and write out all terminological words and word-combinations according to their models; give their Ukrainian equivalents.

IV. Give English equivalents of the following words and word-combinations:

гранична поверхня, океан, поверхня океану, рідкий, зовнішній, морська геодезія, крива, топографічні зйомки, інженерна геодезія, вища геодезія, гравітаційне поле Землі, припущення, штучний супутник, земне тіло.

V. Read and translate the following sentences paying attention to the tense forms of the verbs:

1. The formulation of the problem of geodesy first developed in the course of the nineteenth century. 2. The question of the figure of the Earth had already been raised in anti-

quity. 3. In the sixteenth and seventeenth centuries, new observations and ideas from astronomy and physics decisively influenced the perception of the figure of the Earth and its position in space. 4. After the rotational ellipsoid had asserted itself as a model for the Earth, numerous arc measurements were conducted until the middle of the nineteenth century to determine the dimension of the Earth ellipsoid. 5. Polar motion has been determined since 1899. 6. The terrestrial geodetic measurements with the exception of spatial distances are tied to the direction of the plumb line at the point of observation, and thereby, to the earth's gravity field.

VI. Read the text again, write out sentences with verbs in the Passive Voice and translate the sentences.

VII. Put questions to the Subject and Predicate in the sentences from ex. V.

VIII. Comprehension questions:

1. What is the classical definition of geodesy? 2. What sciences may geodesy be included in? 3. What is the object of modern geodesy? 4. What areas may geodesy be divided into? 5. Why is there close interaction between global geodesy, geodetic surveying and plane surveying? 6. What are the problems of geodesy? 7. What do the majority of the observed parameters used in geodesy refer to? 8. What can you say about the advance of the geodetic measurement and evaluation technique today?

IX. Formulate 5—6 questions of your own on the text and find answers in the text.

X. Speak about:

a) geodesy as a science;
b) the object of geodesy today;
c) the branches of geodesy today and their interrelation with other sciences.

Text B. LIFE DEVOTED TO MINERALOGY

1. Read aloud and memorize the following words:

mineralogist [ˌmɪnə'rælədʒɪst] — мінералог; rearing ['rɪərɪŋ] — виховання; academician [əˌkædə'mɪʃn] — академік; geochemistry [ˌdʒɪo(u)'kemɪstrɪ] — геохімія; initiative [ɪ'nɪʃɪətɪv] — ініціатива; renowned [rɪ'naund] — славетний, знаменитий; urgent ['ə:dʒənt] — терміновий; honorary ['ɔnərərɪ] — почесний; suburbs ['sʌbə:bz] — околиці; heritage ['herɪtɪdʒ] — спадщина.

2. Words and expressions for the text comprehension:

went down into the history — увійшов в історію; outstanding — видатний; did his best for — зробив усе від нього залежне для; to make an important contribution — зробити важливий внесок; to defend a candidate's (doctor's) thesis — захистити кандидатську (докторську) дисертацію; senior research worker — старший науковий співробітник; on his initiative and by his active participation — з його ініціативи та його активної підтримки; carrying out a wide range of duties — виконуючи багато обов'язків; it was on this basis that — саме на цій основі; annual scientific conferences — щорічні наукові конференції; remained to his dying day — залишався до самої своєї смерті; neighbouring sciences — суміжні науки; cherished the idea — плекав ідею; experiencing great hardships — зазнаючи великих труднощів.

Yevhen Kostyantynovych Lazarenko (1912—1979) whose life was an example of service to his native land went down into the history of Ukrainian science as an outstanding mineralogist, a gifted pedagogue and a talented organizer of scientific research. All his life he studied minerals, their formation, structure and properties, did his best for their practical application, thus making an important contribution to world mineralogical science.

The famous Ukrainian scientist was born on December 26, 1912 in Kharkiv. On graduating from the faculty of geology and geography at Kharkiv University in 1934 he entered post-graduation devoting these fruitful years to the deep study of the science of minerals.

In 1937 he defended his candidate's thesis and later on worked as a docent, dean of the geological faculty at Voronizh University. In the war years he worked in the Urals as a senior research worker.

His real scientific career began in 1944 at Lviv University where he organized and headed the chair of mineralogy, became one of organizers and the first dean of the geological faculty. In 1947 he defended his doctor's thesis and in 1951 he was elected a corresponding member of the Academy of Sciences of Ukraine and appointed Rector of University.

The following twelve years, up to 1963, was Prof. Y. Lazarenko's brightest period in establishing the national University's principles, in rearing talented youth. In 1963 he was dismissed from his high position and the following six years were given to the teaching activity and scientific work as head of the chair of geology.

Since 1969 till his dying day on January 1, 1979, he lived and worked in Kyiv. Here he headed the Institute of geological sciences in 1969 carrying out a wide range of duties in scientific and organizational, editing and social activities, and the same year he was elected Academician of the Ukraine's Academy of Sciences. In 1972 he continued his investigations in the field of Ukraine's mineralogy as well as of general mineralogy problems. This was already done in the Institute of geochemistry and physics of minerals to which the scientist was transferred together with his department.

On his initiative and by his active participation, the Ukrainian Mineralogical Society was organized whose first President was the renowned geologist. It was on this basis that Academician Y. Lazarenko held annual scientific conferences discussing urgent problems of mineralogy as well as its connection with neighbouring sciences, organized a wide-spread publishing activity. He was an honorary member of the Bulgarian geological society, Honorary Doctor of natural sciences at Lublin University and an active member of the Mineralogical Society of Great Britain and Ireland, the Society of Mineralogy and Geology of the Czechoslovak Academy of Sciences.

The great scientist loved his native land, thought of its natural resources, he cherished the idea of transforming its waste-lands into mineralogical reservations. The Academician was one of initiators of creating the Podilsk Park of Nature including the picturesque suburbs of the town of Kamyanets-Podilsk. In 1977 the corresponding decision was taken and directed to the Ukrainian Government.

Y. Lazarenko was the author of a three-volume textbook on mineralogy in Ukrainian as well as the Ukrainian-Russian-English mineralogical dictionary (in co-operation with O. M. Vinar).

Living under very hard circumstances experiencing great hardships in his life and creative work, Y. Lazarenko remained to his dying day a true patriot of his native land, the defender of her science, culture and historical heritage.

ASSIGNMENTS

I. Comprehension questions:

1. What science was Yevhen Lazarenko's life devoted to? 2. When was Lazarenko born? 3. When did he die? 4. What University did he study at? 5. When and where did Lazarenko's real career begin? 6. Did Lazarenko establish the national

University's principles? 7. When was Prof. Y. Lazarenko dismissed from rectorship? 8. What problems did Lazarenko investigate in Kyiv? 9. What scientific establishments awarded Lazarenko with honorary titles and degrees?

II. Discussion questions:

1. What had Lazarenko devoted all his life to? 2. What was his scientific, social and pedagogical activity at the University? 3. When was Lazarenko dismissed from his position? 4. What was Lazarenko engaged in when in Kyiv? 5. What problems did the Ukrainian Mineralogical Society work out? 6. What dictionary did Lazarenko publish?

III. What are the ties among geology, geodesy and mineralogy?

IV. Retell the text according to the landmarks of Academician Lazarenko's life.

V. Group activities:

a) Isn't the title of the text too narrow in your opinion?

b) What is more important — patriotism or professionalism?

c) Why were such scientists as Lazarenko dismissed from their high positions?

d) What is your ideal of a real scientist?

LESSON SIXTEEN

Grammar: 1. Translation of the Complex Object Construction.
2. Terminology (Models and Translation).

Text A. BASIC PRINCIPLES OF PHOTOGRAMMETRY

1. Read aloud and memorize the following words:

photogrammetry [ˌfoutə'græmɪtrɪ] — фотограметрія; environment [ɪn'vaɪər(ə)nmənt] — середовище; measurement ['meʒəmənt] — вимірювання, вимір; perspective [pə'spektɪv] — перспективний; inherent [ɪn'hɪərənt] — властивий, притаманний; procedure [prə'si:dʒə] — процедура; duplicate ['dju:plɪkeɪt] — розмножувати, робити копію; missile ['mɪsaɪl] — ракета; emulsion [ɪ'mʌlʃən] — емульсія; inertial [ɪ'nə:ʃɪəl] — інерційний; mensural ['mensjurəl] — мірний, мірчий; override [ˌouvə'raɪd] — відкинути; worth [wə:θ] — цінність; pertinent ['pə:tɪnənt] — доречний, підходящий.

2. Words and expressions for the text comprehension:

reliable information — надійна інформація; precision dimensional measurements — точні просторові виміри; mathematical computations — математичні обчислення; projective geometry — проективна геометрія; analog instrument — аналоговий інструмент; accurate results — точні результати; ballistic missile — балістична ракета; tracking — спостереження; panoramic photography systems — панорамні фотографічні системи; electron micrography systems — електронні мікрографічні системи; auxiliary information data — допоміжні інформаційні дані; comprehensive knowledge — всебічні знання.

Scientists consider photogrammetry to be the art, science and technology of obtaining reliable information about physical objects and the environment through process of recording, measuring and interpreting [1] photographic images and patterns of electromagnetic radiant energy and other phenomena.

Included within the above definition [2] are two distinct aspects of photogrammetry: 1) *Quantitative* (or, metric), which involves precision dimensional measurements [3] to obtain direct information related to size and shape of objects or derived information such as change (e. g., velocity, volume change, etc.), statistical (e. g., area distribution, time variation, etc.), or associated (e. g., stress, force, etc.) parameters; 2) *Qualitative* (or, interpretative), which deals with the recognition and interpretation of objects.

Within the scope of Quantitative photogrammetry *Analytical Photogrammetry* deals with the Solution of problems by mathematical computations, using measurements made on the photographs as input data [4]. In general, a mathematical model is constructed to represent relations between points in the object space and their corresponding images on the photographs. The principle of perspective and projective geometry is inherent in this.

During the recent developments of the analytical (computational) procedures the interest of numerous photogrammetrists has been to somewhat duplicate the performance of the analog instruments [5] for standard mapping problems. For such applications, analytical approaches have demonstrated efficiency (in terms of accuracy, time and cost), such as are comparable [6] to the instrumental approaches without any great improvement.

The analytical photogrammetrists have always tried to justify their efforts on the basis that they should be able to obtain [7] more accurate results in less time than in the

instrumental approaches. The real strength of analytical photogrammetry justifies its continuous application and growth.

The principal justification lies in the recent applications in the tracking of ballistic missiles [8], satellites, etc. and others which are completely outside the capabilities [9] of the instruments of only optical-mechanical scopes. The second justification lies in those applications where the concept of a simple central perspective projection is no longer adequate. Examples of these are strip and panoramic photography systems [10], electron micrography systems, etc. Also included are the applications in which the greatest accuracy is required in eliminating mensural errors due to lens distortion [11], atmospheric refraction, deformations of emulsions, comparator errors, etc., which are difficult or impossible to incorporate in optical-mechanical devices but are easily accomplished through mathematical models with a computer. The third justification lies in the inclusion of auxiliary information data and numerical adjustment procedures [12] in a fully satisfactory manner. Such information may be obtained from various sources like electronic positioning, inertial navigation system, etc. Often, such information may not be directly and rigidly enforced but may be entered as adequately weighed parameters to reinforce rather than override [13] the geometric strength of the normal photogrammetric procedures.

The basic material used in all these are the photographs, negatives or diapositives of various types. The basic inputs are the photo-coordinates in x, y (rectangular two-dimensional) system. The outputs may be of various types, like x, y, z ground coordinates, orientation elements, derived information on specific relations and conditions, etc.

The working system involves, broadly speaking, the following: Object (terrain, etc.), Sensing tool (camera or other sensor), Environment (atmosphere, etc.), Data acquisition tool (instrument or comparator), Data processing mechanisms [14] (computer, accessories and the mathematical models), and the human worker. Each offers working limitations and contributes towards errors of various nature. The comprehensive knowledge of such limitations and error contributions is essential for an efficient job.

Theoreticians and practical workers noticed analytical photogrammetry to be rapidly becoming more and more complex. Increased complexity does not necessarily mean increased worth. By being more complex, it may become less

used [15] because of the concern of the potential user. In this respect, it will be pertinent to emphasize [16] that such situations call for the wisest possible treatment of the photogrammetric resources and the involved technologies with sensible innovations at all stages.

VOCABULARY NOTES

[1] **through process of recording, measuring and interpreting** — за допомогою процесу запису, виміру та пояснення
[2] **included within the above definition** — до наведеного вище визначення включено
[3] **dimensional measurements** — просторові виміри
[4] **measurements made on photographs as input data** — виміри, що зроблені на фотографіях, як вихідні дні
[5] **to somewhat duplicate the performance of the analog instruments** — якоюсь мірою дублювати дію аналогових інструментів
[6] **such as are comparable** — які можуть бути порівняні
[7] **to justify their efforts on the basis that they should be able to obtain** — виправдати зусилля на тій підставі, що вони зможуть одержати
[8] **the tracking of ballistic missiles** — спостереження за балістичними ракетами
[9] **are completely outside the capabilities** — повністю лежать за межами можливостей
[10] **strip and panoramic photography systems** — вузькополосні й панорамні фотографічні системи
[11] **errors due to lens distortion** — помилки внаслідок перекосу лінз
[12] **numerical adjustment procedures** — числові установочні процеси
[13] **to reinforce rather than override** — скоріше підкріпити, ніж відкинути
[14] **data processing mechanisms** — прилади для обробки даних
[15] **by being more complex, it may become less used** — ускладнюючись, вона може стати менш уживаною
[16] **it will be pertinent to emphasize** — доречно буде підкреслити

EXERCISES

I. Read the text and find contextual Ukrainian equivalents of the following words:

record, precision, associated, interpretation, duplicate,

accurate, basis, ballistic, concept, adequate, manner, positioning, navigation, coordinates, complex, innovation.

II. Which of the following words are terms:

information, distribution, photogrammetry, object, problem, geometry, computation, tracking, micrography, refraction, deformation, diapositive, coordinates, terrain, missile, lens.

III. Find in the text English equivalents of the following Ukrainian words and word-combinations:

технологія, середовище, вимірювання, фотографічні зображення (образи), явища, визначення, точні просторові виміри, пояснення об'єктів, вихідні дані, на підставі (основі), спостереження за балістичними ракетами, математична модель, електричне позиціонування, оптично-механічні прилади, прилади (механізми) обробки даних, новинки.

IV. Read the text again and translate the sentences containing the following word-combinations:

reliable information, mathematical model, numerical adjustment procedures, adequately weighed parameters, data processing mechanisms.

V. Find in the text and translate the sentences describing:

a) photogrammetry; b) analytical photogrammetry; *c)* quantitative and qualitative aspects of photorgammetry.

VI. Translate into Ukrainian the following sentences with the Complex Object Construction:

1. We consider computer, accessories and the mathematical models to play a great role in photogrammetry. 2. The students watched the operator control the functioning of the equipment. 3. The students asked the engineer to show them sensing tools and data acquisition tools of photogrammetry. 4. We heard geophysicists do prospecting by means of radio instruments. 5. Radio-electronic devices permit the pilot to find the way in fog and storm. 6. The electric pressure of lightning causes the current to pass through the air.

VII. Find in the text the sentences with the Complex Object Construction and translate them into Ukrainian.

VIII. Comprehension questions:

1. Do you know the meaning of the term *photogrammetry?* 2. What do scientists consider photogrammetry to be? 3. What are the two distinct aspects of photogrammetry? 4. Can you describe in short the quantitative aspect of photogram-

metry? 5. What does qualitative aspect of photogrammetry include? 6. What does analytical photogrammetry deal with? 7. What is the basic material used in photogrammetry procedures? 8. What does the working system of photogrammetry involve?

IX. Write a short summary of the text and discuss it in class.

Text B. FROM HISTORICAL DEVELOPMENT OF GEODESY

1. Read aloud and memorize the following words:

assert [ə'sə:t] — обстоювати (право); solstice ['sɔlstɪs] — сонцестояння; Ass(o)uan [æs'wæn] — Асуан; circle ['sə:kl] — коло; cadastre [kə'dæstə] — кадастр; pursue [pə'sju:] — переслідувати, продовжувати; calif (caliph) ['keɪlɪf] — каліф; quadrant ['kwɔdrənt] — квадрант (чверть круга); hitherto ['hɪðətu:] — раніше, досі; pendulum ['pendjuləm] — маятник; infer [ɪn'fə:] — виводити, робити висновок; triangulation [traɪˌæŋgju'leɪʃn] — тріангуляція; parallax ['pærəlæks] — паралакс.

2. Words and expressions for the text comprehension:

earth disk — диск Землі; measurement method — метод вимірювання; summer soltice — літнє сонцестояння; plumb line — свинцевий висок; vertical staff — вертикальний футшток (стрілка сонячного годинника); hemispherical shell — напівсферичний корпус; complete circle — повне коло; stadia (від stadium) — міра довжини в Давній Греції і Римі; wagon wheel — колесо фургона; instrumentation technology — технологія контрольно-вимірювальних приладів; principal control networks — головні контрольні сітки; mean Earth radius — середній радіус Землі; light rays — промені світла.

The formulation of the problem of geodesy first developed in the course of the nineteenth century. However, the question of the figure of the Earth had already been raised in antiquity. After the sphere first served as a model for the Earth, the rotational ellipsoid as figure of the Earth asserted itself in the first half of the eighteenth century.

Various opinions on the form of the Earth prevailed in the past: e. g. the notion of an Earth disk encircled by Oceanus (Homer's Illiad). The founder of scientific geodesy is Eratosthenes of Alexandria, who under the assumption of a spherical Earth deduced from measurements a radius for the Earth.

The principle of the arc measurement method developed by him was still applied in modern ages.

Eratosthenes found that at the time of the summer solstice, the rays of the sun descended vertically into a well in Syene (Assuan, today); whereas in Alexandria, roughly on the same meridian, they formed an angle with the direction of the plumb line. From the length of the shadow of a vertical staff *(gnomon)* produced in a hemispherical shell *(skaphe)*, he determined this angle as 1/50 of a complete circle. He estimated the distance from Syene to Alexandria to be 5000 stadia as taken from Egyptian cadastre maps which are based on the information of *bematists* (step counters). With the length of an Egyptian stadium as 157.5 m, we obtain an Earth radius of 6267 km.

During the middle ages in Europe, the question of the figure of the Earth was not pursued further. An arc measurement handed down by the Arabs was carried out by the caliph of al-Mamun, northwest of Bagdad. At the beginning of the modern ages, the French physicist Fernel in 1525 observed on the meridian through Paris the geographical latitudes of Paris and Amiens using a quadrant; he computed the distance from the number of rotations of a wagon wheel.

The remaining arc measurements based on the notion of a spherical earth are characterized by fundamental advances in instrumentation technology (1611, Kepler telescope) and methodology (after the initial application of triangulation by Gemma Frisius (1508—1555) in the Netherlands, and by Tycho Brahe (1546—1601) in Denmark, the Dutchman Willebrord Snellius (1580—1626) conducted the first triangulation to determine the figure of the Earth).

In 1615 with triangulation applied by Snellius to the arc measurement between Bergen op Zoom and Alkmaar (Holland), the hitherto inaccurate estimate or direct measurement of the length of arc was replaced by a procedure of high precision. This method served into the twentieth century for arc measurements and for the formation of principal control networks. For Snellius, the deviation with respect to the mean Earth radius amounts to — 3,4 %.

Through the initiative of the Academy of Sciences, founded in Paris 1666, France in the seventeenth and eighteenth centuries assumed the leading role in geodesy. The French abbé J. Picard in 1669/70 carried out an arc measurement on the meridian through Paris between Malvoisine and Amiens with the aid of a triangulation network; he was the first to use a telescope with cross hairs. The value obtained by him for

the radius of the earth aided Newton in the verification of the law of gravitation which he had formulated in 1665/66.

Another solution of the determination of the central angle, different in principle, namely by using reciprocal zenith angles, found application in 1645 by the Italians Grimaldi and Riccioli. This procedure does not yield satisfactory results due to the insufficiently accurate determination of the curvature of light rays (refraction anomalies).

In the sixteenth and seventeenth centuries, new observations and ideas from astronomy and physics decisively influenced the perception of the figure of the Earth and its position in space. N. Copernicus (1473—1543) achieved the transition from the geocentric universe of Ptolemy to a heliocentric system. J. Kepler (1571—1630) discovered the laws of planetary motion and Galileo Galilei (1564—1642) developed modern mechanics (law of falling bodies, law of pendulum motion).

In 1666, the astronomer J. D. Cassini observed the flattening of the poles of Jupiter. The astronomer J. Richer in 1672 discovered on the occasion of an expedition to Cayenne to determine Martian parallaxes, that he must shorten a one-second pendulum which had been regulated in Paris, in order to regain oscillations of one second. From this observation and on the basis of the law of pendulum motion, one can infer an increase in gravity from the equator to the poles. Building on these and on their own works, Isaac Newton (1643—1727) and Christian Huygens (1629—1695) developed Earth models flattened at the poles and founded on principles of physics.

ASSIGNMENTS

I. Comprehension questions:

1. When did the formation of the problem of geodesy first develop? 2. What figure first served as a model for the Earth? 3. Who is considered to be the founder of scientific geodesy? 4. What did Eratosthenes find? 5. Was the question of the figure of the Earth pursued further during the middle ages? 6. What did the French physicist Fernel use a quadrant for? 7. Who conducted the first triangulation to determine the figure of the Earth? 8. Who are the authors of the Earth models flattened at the poles?

II. Discussion questions:

1. What opinion on the form of the Earth is expressed in Homer's Illiad? 2. What experiments did Eratosthenes

carry out? 3. Why was the question of the Earth figure not pursued further in the middle ages? 4. What new instrumentation technology and methodology did Kepler, Frisium, Tycho Brahe and Snellius apply? 5. Why did the role of the French Academy of Sciences become leading in geodesy in the 17—18th centuries? 6. What did the law of pendulum motion do for the development of the principles of physics?

III. Explain the etymology of the terms *heliocentric* and *geocentric*.

IV. Give a subtitle to each paragraph of the text. Retell the text.

V. Group activities:

a) What figure is the nature's favourite: the circle or the ellipsis?

b) What way is geodesy connected with geography, geometry and astronomy?

c) Name the victims among scientists, persecuted for their scientific teachings.

LESSON SEVENTEEN

Grammar: 1. Complex Subject Construction (Practice of Translation).
2. Terminology.

Text A. ENVIRONMENT SHOULD BE OUR COMMON CONCERN

1. Read aloud and memorize the following words:

oxygen ['ɔksɪdʒən] — кисень; combustion [kəm'bʌstʃən] — згоряння; respiration [ˌrespɪ'reɪʃn] — дихання; diversity [daɪ'və:sɪtɪ] — різноманітність; disease [dɪ'zi:z] — хвороба; vulnerable ['vʌlnərəbl] — уразливий; severe [sɪ'vɪə] — суворий; ultra-violet ['ʌltrə'vaɪəlɪt] — ультрафіолетовий; tillage ['tɪlɪdʒ] — обробіток землі; aggravate ['ægrəveɪt] — загострювати, погіршувати.

2. Words and expressions for the text comprehension:

to be doomed — бути приреченим; global society — світове суспільство; necessary ingredient — необхідна складова (частина); by-product — побічний продукт; natural balance — природна рівновага; atomic power plant — атом-

на електростанція; shortage — нестача; physiological response — фізіологічна реакція; competition for access to — змагання за доступ до; living creature — жива істота; harmful chemical — шкідливий хімікат; spray cans — розпилювальні балони (аерозолі); skin cancer — рак шкіри; human habitation — місце проживання (житло) людини; thermal blanket — теплова ковдра; acid rain — кислотний дощ.

It has been repeatedly said that a society which turns its back on [1] nature is doomed. Many people today believe that the dominant forces of global society are, in fact, ignoring Nature's needs.

Everywhere the natural environment is being over-exploited, weakened and soiled. Man uses atmosphere as both a resource and a place for depositing wastes. He takes from atmosphere oxygen as a necessary ingredient for his industrial activities and for his own biological processes. He returns to it a mixture of gases and solids, the by-products of combustion, respiration and other energy-transmitting activities.

The historical development of urbanization and industrialization has produced geographical regions where the natural balance is disturbed. Evidence abounds that [2] the dangers of uncontrolled industrialization are leading to the pollution of lakes and rivers and human tragedies like those which occurred at Bhopal (India), where thousands of people died as a result of a deadly gas leak [3] from a chemical plant in 1984, or at Chornobyl atomic power plant (Ukraine) in 1986. Just as obvious are the large-scale loss of tree cover [4], soils and biological diversity as a result of uncontrolled economic development, and the horrors of chemical warfare and nuclear power testing [5]. We have all experienced the result: air pollution, a shortage of drinking water, the ruin of forests, soil degradation, etc. As a result people are affected directly or indirectly.

Some effects are direct and evoke physiological response (eye irradiation, respiratory diseases, etc.), other effects are indirect, but nonetheless disturbing. Women, for instance, have learned that their breast milk is contaminated with dioxin, that pesticides and herbicides are present in ground water. They are told that the life-giving sun is becoming dangerous due to a weakened ozone layer, that children everywhere are vulnerable to genetic disorders caused by contaminated environments.

As the planet's natural resources diminish, and a growing world population increases demands on those resources,

competition for access to them will escalate. This struggle for limited resources will result in new resource wars.

The major environmental threat to life on Earth is the weakening of the ozone layer. The Earth's ozone shield — the vital layer of the atmosphere — protects all living creatures from the damaging effects of the Sun's rays.

Recent scientific research proved data that the protective layer of ozone around our planet is under severe attack [6]. The major cause of weakening of the ozone layer is believed to be the increasing amount of harmful chemicals that are being released into the atmosphere by mankind. Many scientists warn that the chemicals in spray cans also add to the destroying of the Earth ozone shield. Scientists stress that a further one per cent drop in the overall ozone layer[7] can cause an increase of skin cancer.

The air contamination due to man's economic activity [8] is bringing mankind to the greenhouse effect. It appears when CO and certain other gases in the atmosphere allow the sun's ultra-violet rays to penetrate and warm the earth but then absorb the infrared energy the earth radiates back into space forming a kind of *thermal blanket* around the Earth.

Acid rains and forest fires play their role in the destruction of forests. As a consequence the ruin of forests brings about ecological disaster.

Machine tillage of the soil affects its natural fertility, while the ever-growing application of fertilizers and pesticides damages nature by changing the ecological conditions of human habitation.

Basing on the above said one can conclude that environmental protection is a task requiring the joint efforts of the entire world population, of government agencies, and public organizations the world over.

Environmental ignorance inevitably aggravates the conflict between man and nature [9]. This conflict can be avoided by fostering a scientific ecological education.

VOCABULARY NOTES

[1] **to turn one's back on** — повернутися спиною до ...
[2] **evidence abounds that ...** — є багато доказів того, що ...
[3] **deadly gas leak** — витік смертельного газу
[4] **the large-scale loss of tree cover** — широкомасштабна втрата лісового покриття

[5] **chemical warfare and nuclear power testing** — хімічна війна і ядерні випробування
[6] **is under severe attack** — перебуває під суворою руйнівною дією
[7] **one per cent drop in the overall ozone layer** — падіння на один процент усього озонового шару
[8] **the air contamination due to man's economic activity** — забруднення повітря через економічну діяльність людини
[9] **the conflict between man and nature** — суперечність між людиною і природою

EXERCISES

I. Give contextual Ukrainian equivalents of the following English words:

nature, resource, ingredient, mixture, respiration, region, balance, ruin, degradation, protective, attack, application, ignorance, conflict.

II. Read the text again, write out terminological words, explain their structure and translate them into Ukrainian.

III. Read the text again and give Ukrainian equivalents of the following word-combinations:

natural environment, industrial activity, biological processes, natural balance, uncontrolled industrialization, atomic power plant, chemical warfare, nuclear power testing, air pollution, life-giving sun, ozone shield, protective layer, harmful chemicals, air contamination, greenhouse effect, ultra-violet rays, acid rains, environmental protection.

IV. Read the following sentences and enumerate key thoughts on the basis of which you can have a debate:

Man is a biological species and only one of many millions of things living. But man at the same time belongs to human society. Nature is the objective condition of man's existence and his life activity.

In the course of producing what they need people make and use machinery, buildings, roads, factories, mines and many other things without which there could be no industrial development. The rapid development of scientific and technological revolution, expansion of man's activities in outer space make the interrelationship between society and nature more complicated. Sometimes man's life activity may have a harmful effect on the biosphere of the planet, disturbs the ecological balance.

Earth's gaseous envelope is becoming less transparent and its composition is changing. Qualitative changes in the Earth's biosphere may bring to crisis situations. Nature's capacity to purify itself of industrial and other wastes has been nearly exhausted.

That's why society needs a purposeful regulation and control of the processes taking place in the system «man — society — production — nature» at each step of its progressive development.

Waste free technology is a thing of the future.

V. Formulate 5 questions on the above text and find answers.

VI. Explain the use of Complex Subject Constructions and translate the sentences into Ukrainian:

1. Man is known to have struggled against nature for millenia in order to survive and develop. 2. V. I. Vernadsky is known to be an outstanding Ukrainian scientist, naturalist, the founder of geochemistry, biochemistry and radiogeology. 3. Certain properties of matter are considered to be always the same under definite conditions. 4. This scientist is considered to be a great expert in biochemistry. 5. Certain gases have proved to be the main cause of the greenhouse effect. 6. Nuclear energy is considered to be a high-risk area by 70 per cent of the respondents.

VII. Look through the text again, find the sentences with Complex Subject and translate them into Ukrainian.

VIII. Comprehension questions:

1. Does ignoring nature cause positive consequences? 2. What does man use atmosphere for? 3. How do urbanization and industrialization affect nature? 4. Can you name facts of negative consequences of man's economic activity? 5. What can air pollution cause? 6. What are the major environmental threats to life on Earth at present? 7. What is the major cause of the ozone layer weakening? 8. When does the greenhouse effect appear? 9. How do acid rains affect our environment? 10. What can make environment protection more effective?

IX. Retell the text in short.

X. Speak about:

a) the negative consequences of man's economic activity;
b) the major ecological threats to all of us, earthlings;
c) what people the world over can do to protect our planet.

Text B. WILL THE EARTH BE LUCKY A THIRD TIME?

1. Read aloud and memorize the following words:

hypothesis [haɪ'pouθəsɪs] — гіпотеза; threaten ['θretn] — загрожувати; seething ['si:ðɪŋ] — киплячий; inferno [ɪn'fə:nou] — пекло; reign [reɪn] — панувати; thermonuclear ['θə:mou'nju:klɪə] — термоядерний; soot [su:t] — сажа, кіптява; apostle [ə'pɔstl] — апостол; confirm [kən'fə:m] — підтверджувати; colleague ['kɔli:g] — співробітник, колега; excruciatingly [ɪks'kru:ʃɪeɪtɪŋlɪ] — болісно; suffocate ['sʌfəkeɪt] — задихатися; amid [ə'mɪd] — серед, між.

2. Words and expressions for the text comprehension:

celestial body — небесне тіло; to share the lot (of) — розділити долю; to reign supreme — запанувати (над); icy desert — льодова пустеля; thermonuclear explosion — термоядерний вибух; thermonuclear Apocalypse — термоядерний апокаліпсис; to take a sober look — поглянути більш тверезо; harsh reality — жорстока реальність; nuclear war — ядерна війна; the probable overall number of victims — вірогідне загальне число жертв; authoritative scholars — авторитетні вчені; to wither away — зникнути; to be lucky — бути везучим (таланити); joint efforts — спільні зусилля.

According to one hypothesis, our planet was twice threatened with the fate of becoming a lifeless celestial body and thus sharing the lot of Venus and Mars, its neighbours in the solar system. Four and a half thousand million years ago, when the Earth's atmosphere had just begun to form, a mere 5 °C separated it from the fatal boundary beyond which begins the *greenhouse effect* which turned the surface of Venus into a seething inferno. Two thousand million years later a mere +1 °C saved the Earth from freezing under a blanket of ice such as that which covers Mars today.

Now Mars, the Roman god of war, threatens, both literally and figuratively, to reign supreme on the Earth and turn it into an iceberg in space. The sad truth is that the transformation of the common home of all people into an icy desert may be brought about by man himself, who stands at the tree of life with a thermonuclear axe in his hands.

Immense amounts of dust, soot, ash and smoke, thrown up into the Earth's atmosphere by the monstrous force of thermonuclear explosions, would screen out the Sun for a long period of time, and screen it out from people forever. The heaven would turn upside down, so that cold would

descend upon the Earth, while heat would be trapped in the upper layers of the atmosphere. All the continents would turn into Antarctics, but their snow and ice would be black. The rays of the Sun would take so long to reach the Earth that none of us would ever find out how long the *nuclear winter* would last...

Such in general outline is the description of the thermonuclear Apocalypse, a description, handed down to us not by John the Apostle but computed by American scientists, and later confirmed by their European colleagues. The prospect of a *nuclear winter* forces us all, both in the East and in the West, to take a sober look at the harsh reality.

That certain truths have become obsolete signifies that we have reached troubled times, when many prenuclear doctrines and postulates must be discarded, once and for all. The only possible continuation of politics in our time is peace.

People everywhere must learn the truth about nuclear war. According to UN experts, its very first explosions would instantly kill 200 million people and inflict grievous wounds on another 60 million. The probable overall number of victims of the first nuclear strikes would be 700—800 million civilians and 70—80 million combatants. Within just a few days of an all-out nuclear war one third of mankind would perish. The fate of those surviving from radiation poisoning is excruciatingly painful.

Many Western specialists, including authoritative scholars, believe that our civilization may poison itself even without a nuclear war, that we may be suffocated by industrial wastes and wither away amid environmental degradation. The only source of funds for environmental protection is disarmament.

Mankind can no longer live and act in the old way. The universal struggle against war is the only way to preserve peace. Only then will we be able to give a positive answer to the question: will the Earth be lucky for a third time?

All of us, earthlings of the present generation, are a link in the chain of universal human progress. We are answerable both to our ancestors and to future generations. Our duty is not only to save the Earth from a thermonuclear catastrophe but also to begin, through the joint efforts of all states, to heal its wounds, to save it from another possible catastrophe — an ecological one.

ASSIGNMENTS

I. Comprehension questions:

1. How many times was our planet threatened to become a lifeless celestial body? 2. When did the Earth's atmosphere begin to form? 3. Can man himself transform our common home into an icy desert? 4. What can create the *nuclear winter* on the Earth? 5. What kind of doctrines and postulates must be discarded now? 6. May our civilization poison itself without a nuclear war? 7. What must people do to save the Earth from a thermonuclear catastrophe?

II. Discussion questions:

1. What does the title of the text suggest? 2. Under what conditions does the *greenhouse effect* begin? 3. Why is peace the only possible continuation of the politics in our times? 4. When would *nuclear winter* set down on our planet? 5. What is the cause of the environmental degradation? 6. Why cannot mankind remain passive in problems of preserving peace on our planet? 7. How can the Earth be saved from the ecological catastrophe?

III. Suggest some other titles for the text.

IV. Group activities:

a) Comment on the following Latin proverb: «If you want peace, prepare war».

b) What facts is the hypothesis of the Earth's two alleged catastrophes based upon?

c) What are the prospects of the extinction of the biological species Homo Sapiens?

d) What is the Earth supposed to look like *the day after?*

LESSON EIGHTEEN (REVIEW LESSON)

Text. HORIZONS OF KNOWLEDGE: STARS AND METEORS IN SCIENCE

Read the following text and carry out assignments given below it:

Boundless are the limits of modern science, vast is the field of man's discoveries and inventions, hard and thorny is the road of mankind to cognition. In the world of research and investigation numberless attempts have been made to conceive the laws of nature, to find out the true essence of diverse phenomena in and around our environment, within our lives.

Sciences in the modern world are deeply interconnected and interrelated: thus, we have biochemistry, radiobiology, radiogeology, chemical physics, physical chemistry, etc. The borderline between various sciences and their affiliations is sometimes rather vague, if existing at all. Their mutual influence, interwined correlation, close interdependence are characteristic of contemporary scientific and technical progress. Discoveries of laws and regularities therein, inventions of new devices, materials, technological processes, alongside with existing ones, come into being, paving road to new, unprecedented and unforeseen heights of knowledge.

Illustrious individual names come forward now and then, prominent figures in science and research appear on the horizons of knowledge while millions of the rank-and-file of science work in laboratories and research centres, at plants and factories, at higher educational establishments, and in construction bureaus.

These rank-and-filers, side by side with outstanding investigators, do their best to penetrate into the mysteries of the universe, to conceive the unknown. Day after day, month after month, year after year, they toil incessantly and indomitably in search of genuine scientific truth, now advancing a little bit, now making a tiny step forward, now progressing a micron in their field of research.

The problems they work at, the tasks set before them, the issues demanding urgent solution, present a long, in fact an endless, row of nature's enigmas to be solved, of regularities to be found, the seemingly disconneced facts to be grouped and built into a logical, consistent theory.

In investigating nature's phenomena, its laws, regularities and irregularities, researchers have to surmount mountains of contradictory facts. Broadening the horizons of human knowledge, overcoming unsurmountable obstacles, scientific workers of all ranks and ranges do their utmost to further the progress of knowledge, to promote the evolution of ideas, to radically change the existing conceptions.

Studying the surrounding nature, divining and foreseeing the ways and paths of its forces, broadening our cognition, scientists more than once prove the disputable, solve the apparently insoluble problems, bring about the previously unrealizable schemes. To further human cognition, researchers investigate lots of undiscovered domains, overcome myriads of uncertainties and unexplainable facts, brighten doubtful concepts and misty ideas, illumine the paths of the undiscovered.

In the unbreakable chain of man and nature scientists and researchers consider every link and bond thereof and sooner or later their regular studies and untiring efforts bring fruitful results and elucidate the hitherto unknown. The ranks of scientists all over the world grow incessantly, science has become a productive force of the developing and progressing society.

Incomparable are the fates of scientists, unpredictable are their roads to discoveries, unexplainable are the driving forces to their enlightenment. Devoting their lives to learning the unknown, they do their utmost to serve humanity, to bring well-being and benefit to mankind. A bright example of such selfless and self-denying service to science is the life of Academician D. K. Zabolotny.

Danylo Kyrylovych Zabolotny (1866—1929) went down into history as a talented scientist, a highly educated man, a brilliant pedagogue and a prominent social figure. A gifted researcher in his investigation area is like a skylark rising straight up into the air and perceiving all around for many miles therefrom. A health-protection specialist working in the fields of microbiology and epidemiology he was at the same time a many-sided intellectual and scientific organizer.

A resolute fighter against cholera, plague and other dangerous infectious diseases, he did not hesitate a moment to make experiments on himself risking his life for other people. A great humanitarian and philanthropist, D. K. Zabolotny endangered his life in numerous scientific expeditions organized to study and fight against plague (India in 1897, Mongolia and China in 1898, Persia (now Iran) in 1899), against cholera (Rostov-on-Don, Yekaterinoslav, Kherson and Kyiv in 1910), against typhus (Odessa in 1920) and an innumerable quantity of others.

From a student of Novorossiysk University (1885—1891) to President of the Ukrainian Academy of Sciences (1928—1929) — such is the scientific career of this renowned man, the founder of the Institute of Microbiology and Epidemiology in Kyiv named after him in 1930. In Bombay and Paris, in Berlin and Copenhagen, in many other places abroad and in his native land D. K. Zabolotny took part in numerous conferences and congresses raising his voice, organizing struggle for man, fighting disease wherever he could.

He died on December 15, 1929, in Kyiv and was buried in his native village of Chebotarka (named after him in 1930) with millitary honours. His last words addressed to his colleagues, friends and relatives were: «Dear children, love

science and truth». The great man's behest was taken up by his pupils and followers, by the scholars that followed in his footsteps continuing his glorious cause.

The fallen banner of the great man was taken up and raised by the army of those who came into science after him, who did their best to serve the people and their country.

One of them was Prokip Danylovych Yatel (1897—1941), a rank-and-filer of science whose short scientific carreer was mercilessly and abrupty broken by the war. He took part in World War I and World War II from which he never returned. Between the wars he was a teacher and director of a village school in Lystopadovo, Zlatopil district (1917—1930), a student of the agro-biological faculty at the Pedagogical Institute in Kherson (1930—1932), a scientific worker, a microbiologist, in Kyiv at the Institute of Microbiology and Epidemiology named after D. K. Zabolotny (1932—1941).

His main scientific merit is fighting against UD (unknown disease) raging in Ukraine in the thirties, the disease which arose due to man's gross intrusion into ecology, sweeping people and horses in rural districts of the Republic. Lethal cases were unexplainable, the cause of UD was unknown.

P. D. Yatel had neither scientific ranks nor high academic titles, but he found the cause of the disease and suggested a remedy against it. In the process of research he made dangerous experiments on himself to prove his theory. For this discovery he was awarded the Red Banner of Labour Order in February 1939.

He went to the front on June 23, 1941, leaving his thesis unfinished, his materials unpublished, his scientific plans unrealized. Killed in action, he was buried in a common grave, together with his comrades-in-arms — twenty officers, among them — Ukrainians, Russians and a Georgian whose names are known, and 507 soldiers whose names are unknown. The burial-place is 207 km from Kyiv, in a park off the railway station of Romodan, between Kyiv and Poltava. He never returned to his books, to his tests, to his photographs and protocols of experiments. There is a short, but heart-rending, poem on the monument to the fallen warriors standing in the center of the park:

Куди б не йшов, не їхав ти,	Whoever goes, wherever to,
Та все ж тут зупинись	Here, for a while, stand still.
І цій могилі дорогій	Before this sacred grave, with
Всім серцем поклонись.	heart
	In sorrow, you must kneel.

From spring to autumn the children of the Romodan school bring flowers to the common grave of the heroes who have given their lives in the struggle for the freedom and independence of our country.

A great big man and a great little man, a star and a meteor, their lives were given to science, to people, for their country, they were «nurselings of one mighty mother, hopes of her, and one another» (P. B. Shelley).

ASSIGNMENTS

I. Look through the text again and write out the unknown words and word-combinations.

II. Render the text into Ukrainian.

III. Make a short summary of the text in English.

IV. Retell the biographies of the scientists described in the text.

V. Basing on this text and other sources, dwell on some problems facing world science, scientists and researchers.

VI. Discuss some of the following topics:

1. New discoveries and inventions in modern Ukrainian science. 2. Hard and thorny road of Ukrainian scientists. 3. Contribution of Ukrainian scientists in world science. 4. Outstanding scientists of the English-speaking countries. 5. Tasks and problems of the present-day science the world over.

VII. Translate into English using key-words and word-combinations from the texts devoted to lives and activities of great men of science:

З історії Київського політехнічного інституту (нині Національний технічний університет України)

Головний інженерний вуз України має багаторічну славну історію. Основні його споруди було зведено протягом 1898—1901 рр. Цікаво зазначити, що на його будівництво кияни зібрали 1 мільйон карбованців. Шість корпусів інституту за своїми розмірами перевершили всі існуючі в Києві будівлі навчальних закладів. На початку XX сторіччя інститут мав бібліотеку, станцію випробовування машин, лабораторію, метеорологічну станцію, сад, дослідне поле та ін.

Для роботи у вузі було запрошено багато відомих учених з різних міст. Засновником і першим директором інституту був видатний вчений Віктор Львович Кирпичов, людина з величезним практичним досвідом, невичерпною енергією, відмінними організаторськими здібностями.

Народився В. Л. Кирпичов 8 жовтня 1845 року в Санкт-Петербурзі в сім'ї викладача вищої математики інженерного училища. Разом із своїми братами майбутній вчений здобув грунтовну математичну освіту. Свої знання він поповнив у Німеччині, Бельгії, Швейцарії, вчився в кращих математиків Європи.

Працюючи в С.-Петербурзькому практичному технологічному інституті, він став відомим ученим, видавав наукові розробки та підручники. До переїзду до Києва він працював у Харкові, де створив технологічний інститут, який і очолював.

22 квітня 1902 року В. Л. Кирпичов підписав акт про прийняття збудованих корпусів КПІ, але того ж 1902 року він змушений був піти у відставку в зв'язку з революційними подіями в Києві. Відомий вчений-педагог був проти репресивних дій царського уряду щодо студентів і своєю відставкою з посади директора висловив протест проти студентських арештів.

Після відставки В. Л. Кирпичов залишився в Києві. 28 вересня 1902 року його було обрано почесним членом Ради інституту, він продовжував читати курс опору матеріалів і спецкурс з будівельної механіки. У Києві В. Л. Кирпичов багато зробив як педагог і вчений, видав курс лекцій з графічної статистики, монографію про зайві невідомі в будівельній механіці, курс опору матеріалів.

Переїхавши 1903 року до С.-Петербурга, В. Л. Кирпичов не поривав своїх творчих зв'язків з друзями-колегами, але до Києва більше не повернувся. 20 жовтня 1903 року відомого вченого, засновника Київського політехнічного інституту, не стало. Пам'ять про цю обдаровану, талановиту людину заслуговує на глибоку шану і повагу.

Виплеканий ним вуз продовжує жити, розвиватися, протягом багатьох десятиріч готує кадри висококваліфікованих спеціалістів. Розширюється мережа спеціальностей, з'являються нові спеціалізації, росте кількість фахівців вищого розряду. Народне господарство України потребує високоосвічених, технічно грамотних працівників, здатних забезпечити наукові й навчальні заклади, промислові підприємства держави.

Серед вихованців Київського політехнічного інституту налічується багато видатних діячів науки й техніки, високоосвічених представників талановитого українського народу, імена яких широко відомі не лише в Україні, а й у країнах близького й далекого зарубіжжя.

Всесвітній пріоритет Росії в освоєнні космосу пов'язаний з українцями: Вернадським, Кондратюком, Корольовим, Глушком, Челомеєм, Янгелем (сибіряком українського походження).

Загальновідомим є той факт, що засновником практичної космонавтики став академік Сергій Павлович Корольов, уродженець Житомира, студент Київського політехнічного інституту. В державному архіві Києва зберігаються цікаві особисті документи творця перших у світі космічних кораблів С. П. Корольова. В одній із анкет, які заповнював Корольов українською мовою, а нею він володів бездоганно, у графі «національність» він власноручно зазначив: «українець».

Життєвий шлях славетної людини починався саме в Києві. Тут, у нашому місті, жив і навчався С. П. Корольов. На механічному факультеті Київського політехнічного інституту збережено меморіальну аудиторію і місце, де слухав лекції творець космічних кораблів. На його честь у Києві названо вулицю, його ім'я носить виробниче об'єднання «Радіоприлад», на території якого встановлено пам'ятник.

Саме наш талановитий земляк С. П. Корольов готував у першу космічну подорож українського космонавта Валентина Бондаренка, який напередодні польоту Ю. Гагаріна трагічно загинув під час пожежі в сурдобарокамері. У Державному архіві Києва, в музеях Житомира, Харкова та інших міст створено цікаві експозиції, що висвітлюють сторінки життя й діяльності творця космічних кораблів С. П. Корольова.

Випускники Київського політехнічного інституту, де б вони не працювали і куди б їх не закинула примхлива доля, завжди пам'ятають свою alma mater, своїх викладачів і наукових керівників, бережуть традиції свого уславленого вузу, підтримують його всесвітню славу і міжнародний авторитет.

ADDITIONAL TECHNICAL TEXTS FOR READING, TRANSLATION, RENDERING AND SUMMARIZING

STATES MATTER: LIQUID, SOLID AND GAS

Read the text without consulting the dictionary, render its contents in short (in English or Ukrainian):

If we compare various states of matter, we shall easily find out their connection to each other as well as their differences. A liquid is unlike a solid because it has no definite shape, but it is like a gas because it can flow. A gas is different from a liquid because it has no bounding surface, but both a liquid and a gas can take the form of any vessel they are placed in. A solid has a definite shape resisting any attempt to change it and is thus different from two other states of matter.

All these three states of matter are very much alike and most substances can readily be placed in one of these three categories or change one for the other. A solid may become a liquid when it is heated to a certain temperature (to a melting point) just as a liquid becomes ice at a freezing point or water becomes gas at a boiling point.

Some organic substances, e. g. plastics, may show fluid properties at some stage in their manufacture. When heated, many of them soften rather than melt.

Sublimation occurs when a solid passes directly to the gaseous state after being heated to a certain temperature.

Some gases are liquefied at room temperature by increasing the pressure. Such substances as chlorine, ammonia and sulphur dioxide are often transported as liquids under pressure. Gases are compressible, they become hot when subjected to an increase in pressure, as in a bicycle pump. And vice versa, a gas becomes cooler when it is allowed to expand through a valve. Applying such facts gives the means of liquefying gases or of making a refrigerator.

Each substance consists of very tiny building-blocks called atoms. They attract each other and combine into larger units—molecules which are in a constant state of vibration. The molecules of a solid, for instance, having a great attraction for each other, are placed very close together. In a liquid the attraction between the molecules is much less, and the ties between the molecules of a gas are rather loose.

A common example is water. It freezes and ice melts at 0 °C. Two states of matter — solid and liquid — are in a kinetic equilibrium: a bit more or less heat may change the substance from one state to another. Another border-line between such states of water as liquid and gas is 100 °C (a boiling point) when one state easily changes into another under standard atmospheric pressure: thus water turns into vapour. Evaporation of water can take place at any temperature. A liquid begins to boil when vapour pressure is equal to the external pressure. At higher pressures water boils at higher temperatures, at lower pressures water boils at lower temperatures. The boiling point of water may be greater under some other conditions, e. g. when salt is added to the liquid.

Many solid substances are hydrated: they contain water of crystallization. When heated, solutions are evaporated and crystals are obtained.

ELEMENTS, COMPOUNDS, MIXTURES

Read the text without consulting the dictionary, render its contents in English as closely to the text as possible:

Man has always wanted to discover the composition of the common substances which he meets every day. In earlier times alchemists tried to change base metals into precious ones, and also to find an elixir to restore youth to the aged. In our time it is common to change the appearance and the wearing properties of metals by depositing other metals upon their surfaces by electricity; this is termed electro-plating. Scientists have also succeeded in actually changing certain metals into others, although at very great cost.

Scientific and technological progress takes place because of the solid foundation produced by years of experiment, and is based on the fundamental laws and theories formulated in earlier times.

The ancient Greeks thought of all matter as composed of elements, but their elements were only four in number: fire, air, earth and water. In the course of centuries people's ideas of the basic elements have radically changed.

If we try to divide all the various substances in the world, we shall obtain simpler substances which in the end it will be impossible to divide into still simpler ones. The substances which can be obtained in this way are called elements and their quantity is about one hundred. Some of the commoner elements are iron, lead, aluminium, gold, copper, carbon, mercury, oxygen, hydrogen, nitrogen.

Most of the bodies we see around us are compounds. It is very important to remember that in a chemical compound the elements can be joined in certain very definite proportions. When elements combine to form new substances, they always do so in definite proportions.

All substances consist of atoms and molecules. An atom can be defined as the smallest part of an element which can exist separately, or as the smallest part of an element which can take part in a chemical change. For example, one atom of iron + one atom of sulphur = one molecule of iron sulphide.

A new word has appeared — a molecule. It has a similar meaning with respect to compounds that atom has for elements. If a compound is continually subdivided, we shall have molecules of that compound. An atom or a molecule are too small to be seen by the most powerful microscope, though large molecules can be seen in the electron microscope.

There is a difference between a compound and a mixture: a compound is a new substance consisting of several parts, and a mixture is a mechanical combination of substances involving no change in their character (e. g. gas or vaporized oil mixed with air forming explosive change in an intercombustion engine). Oxygen and hydrogen may be mixed together and the mixture is still a gas, with properties intermediate between those of its constituents, but if two atoms of hydrogen combine with one atom of oxygen (written H_2O), the substance is water.

Thus, an element is a substance which has not been divided into simpler substances. A compound is a substance composed of two or more elements which have combined to form a new substance. The elements cannot be obtained from the compound by mechanical means. An atom is the smallest portion of an element which can exist separately and take part in a chemical reaction. The same compound always consists of the same elements in the same proportion. Chemical reactions often result in the production of heat. Conversely, heat may be supplied to bring about chemical reaction.

DEFINITION AND DESCRIPTION OF CONCRETE

Give a short written summary of the text in Ukrainian:

Concrete is an artificial stone, cast in place in a plastic condition. Its essential ingredients are cement and water which react with each other chemically to form another mate-

rial possessing structural strength. A mixture of cement and water is termed *cement paste*. Such a mixture is expensive. In order to increase the volume of artificial stone produced from a definite amount of cement it is customary to add inert filler materials known as *aggregates*. A large amount of cement paste to which has been added a small amount of fine aggregate, to produce a mixture of fluid consistency, is called *grout*. When the amount of fine aggregate is increased to the extent that the mixture loses its fluidity and behaves as a cohesive plastic, the resulting mixture is termed *mortar*. With the further addition of coarse aggregate, the mixture is called *concrete*.

It is a custom of long standing to designate these mixtures in terms of the relative volumes of cement, fine aggregate, and coarse aggregate of which they are composed. The ingredients are always indicated in the same order: cement first, fine aggregate next, and coarse aggregate last. For example, a 1 : 2 : 4 concrete is a mixture of 1 cu. ft. of cement, 2 cu. ft. of fine aggregate, and 4 cu. ft. of coarse aggregate plus a nonspecified amount of water sufficient to produce a plastic consistency. A proportion given as 1 : 3 is intended to mean a mixture of cement and fine aggregate plus an indefinite amount of water but without the addition of coarse aggregate. Such a mixture would be classified as mortar.

This system of specifying concrete proportions by volume is still used for small projects. The current practice of progressive engineers is to indicate the proportions of materials in the same order but by weight and, frequently, to indicate the amount of water to be used.

Water, cement, and aggregates when mixed together in properly predetermined proportions produce concrete that is a plastic mass capable of being poured or cast into molds. These molds, which are actually called *forms*, must be built of such size and shape as to restrain the plastic mass until it solidifies. With few exceptions the forms must be constructed in such a manner that the concrete, when poured, will be in its final position in the structure. Besides restraining the plastic mass until solidification occurs, the forms serve a less obvious purpose which should not be overlooked. They support the solidified mass until it has attained sufficient strength to support itself without undue deflection or complete collapse.

Concrete does not solidify or attain appreciable strength instantaneously. The chemical reaction of cement and water is slow and requires time for its completion. The reaction continues for many years.

BRICKWORK. BONDS

Give a short oral summary of the text in English:

Bricklaying is the craft of laying and lapping comparatively small units of *brick,* for the purpose of producing a well united mass of any desired form, and such a mass of material efficiently united is known as brickwork.

Brick is an artificially prepared building material made by baking or burning prepared clay or shale, and is used as a substitute for other materials found in a natural state and more or less suitable for building purposes. It is easily and economically prepared by modern machinery and is in common use in most districts where natural stone is not obtainable cheaply and plentifully.

To facilitate the laying of bricks, each kind is made in some *regular size,* and proportioned to allow of some particular method of setting them.

The arrangement necessary to unite the pieces of brick by lapping one over another is called *bond.*

There are many ways of doing this, hence there are many *kinds of bond.* Some of these embody the good qualities of bonding to an almost perfect extent, while others, for convenience or economy, fall short of the ideal bond in varying degrees.

Thus variety of bond may arise from:

a) A desire to vary the surface appearance.

b) A demand for the greatest possible strength.

c) A desire to produce an economical structure sufficiently strong and durable for a required purpose.

Bonding is dependent on the relative dimensions of the bricks employed. Although bricks vary in size with locality and custom, a standard size of ordinary building brick has become fairly established.

FROM THE HISTORY OF STRENGTH OF MATERIALS

(Theory of Ship Structures)

Read the text, point out the key-words and word-combinations in the text, and use them in rendering the text in English:

Great progress has been made in the application of stress analysis to the structural design of ships during the 20th century. Designers have been confronted with many new problems owing to the rapid increase in size of these ships, the tendency to minimize the weight of the ship frame so as to

increase the ship's speed. To meet these demands, they have turned to theoretical analysis.

The work of O. M. Krylov (1863—1945), a great engineer and scientist, has had an important influence on the development of rational methods of stress analysis and on their application in structural design of ships.

O. M. Krylov's great mathematical ability was first noticed when he was still in the military marine school. By the time of his graduation from the school he had a broad mathematical background extending far beyond the established school programs. After some practical experience in the Russian Navy, O. M. Krylov entered the naval academy where he was particularly interested in the theory of ships and in their structural design. As an outstanding student, O. M. Krylov was invited to stay at the school as an instructor in mathematics and later became a lecturer in the theory of ships. The young man gave a series of lectures on approximate calculations and showed how the methods of calculation devised by mathematicians and astronomers could be used to advantage by engineers. Based on these lectures he prepared and published a book on approximate calculations which has not lost importance up to the present time.

Later O. M. Krylov became interested in the theory of motion of ships on waves. On solving this problem he published his results in English and in French. Next, he continued to investigate the general motion of a ship on waves and presented his conclusions in a paper. These publications placed O. M. Krylov in the first rank of authorities on the theory of ships. He also made experimental investigations of dynamical stresses on several ships in the Russian Navy.

O. M. Krylov gives a theoretical analysis of free vibrations of ships. About the same time O. M. Krylov got interested in vibration of bridges and published a paper on forced vibration of beams produced by moving loads. The method used in this paper was applied later to investigation of longitudinal vibration cylinders and to the measurement of gas pressure in guns.

Many structural problems were satisfactorily solved under O. M. Krylov's leadership. He developed a new method of analyzing beams on elastic foundations which greatly simplified calculations, especially those involving beams of variable cross-section.

As a result of his teaching, O. M. Krylov published several books on applied mathematics and mechanics. The one on the partial differential equations of engineering attrac-

ted so much attention from engineers and physicists that the first edition was sold out in a few days. His book on the numerical differential equations was translated into French. He undertook the huge task of translating Newton's «Principia» from English into Russian. In the latter part of his life, O. M. Krylov also translated Euler's books on the new theory of motion of the moon.

A complete collection of O. M. Krylov's works was published in eight volumes by the Academy of Sciences in 1936—1943.

TRANSPORTATION SYSTEMS

Give a written summary of the text in Ukrainian (not more than 1 page):

Introduction. The so-called transportation systems considered here are primarily *railroads, highways, air transport, pipelines,* and *waterways.* In a broad sense the classification also includes electric transmission lines for power, telephone, or telegraph; cableways and belt conveyers; aqueducts and flumes. The location and construction of these systems are governed by office plans based on field surveys, which may consist of actual ground surveys, aerial surveys, or a combination of these methods.

The universally accepted advantages of aerial protography and mapping as applied to all phases of route location and design coupled with the introduction and adaptation of electronic computers have revolutionized engineering procedures. However, the old-time ground-survey methods have not been entirely supplanted. They will be needed frequently as a check on aerial surveys, particularly for those areas where visibility of the terrain is obscured by trees or houses. Also, ground-survey operations are still required in the layout of curves and the setting of construction stakes.

Along with considerations of economy, feasibility, physical features of the terrain, purpose of the project, right of way, alternate locations available, these systems are alike in the requirement that the route be as direct as possible between controlling points. But since the gradients on routes for railroads, highways, and canals must be held to a reasonable minimum, changes in direction involving both vertical and horizontal curvature are usually necessary, except perhaps in flat country or where special situations in mountainous country justify the construction of a tunnel for directness. It is desirable of course that the location of all transpor-

tation facilities be governed by sound engineering principles in order that they may become an integral part of any possible future extension or imporvement.

Controlling Factors. Route location, particularly for railroads and highways, is influenced by a number of factors, prominent among which are the traffic to be accommodated and the physical features of the terrain generally classified as flat, rolling (light to heavy), and mountainous (light to heavy). From the standpoint of the drainage pattern of the country, routes may consist of a valley location, a ridge location, or a crosscountry location.

In flat country the line might be straight between termini; but frequently a change of direction (and curvature) is introduced to reach strategic points, to relieve the monotony of driving, or to avoid certain areas necessitating costly or undesirable property severance, such as the location of a right of way through or too close to cemeteries, churches, schools, etc.

In rolling and mountainous country a typical rairoad route will be a valley location with easy gradients and considerable curvature following the general direction of a stream receiving the drainage of the territory. Flood damage from the main stream and its tributaries is likely even if there is elevated above the highwater level, as it should be.

A ridge location possesses many desirable features: easy drainage, minimum cuts and fills, and gradients that may be within reasonable limits. But such ideal conditions seldom prevail for extended distances, since the general direction of a ridge rarely coincides with that of the route.

A cross-country location necessitating cuts and fills and bridges is the rule rather than the exception on highways, now that safety and convenience of operation call for long tangents and reduced gradients joined by slight curvature. Many existing highways of this undulating type provide inadequate vertical visibility for safe driving. Attention is called to the importance of long vertical as well as horizontal sight distance.

On routes crossing mountainous areas, the gaps or saddles in the ridges are definite points of control from which the line may proceed downward on either side of the watershed according to the maximum allowable gradient. Such a line has the characteristics of sidehill location with uniformly falling grades, curvature conforming somewhat to the shape of the ground, and light to heavy balanced cuts and fills. Loops, although objectionable, are sometimes necessary in the «development» process of introducing distance in

order to reach a summit without exceeding a maximum allowable grade.

The surveying operations applying in general to all these systems, but more specifically to railroads and highways, are classified as 1) the reconnaissance, 2) the preliminary survey, and 3) the location survey. Also, there is a construction survey as a guide to the contractor preceding actual construction of the facility. This survey includes the resetting, if need be, of the location center-line stakes with sufficient offset stakes, and special surveys for the layout of culverts or bridges, grade elimination structures, turnouts, possible changes in design during construction, finish grade stakes, etc.

Railroads. The engineering procedure establishing the line and grade of railroads is essentially the same as that for highways. But relatively greater refinements of gradients and curvature are necessary for successful railroad operation.

Aside from the extra tractive force required to accelerate a train, the drawbar pull of a locomotive in hauling a train of cars must overcome three types of resistances: 1) train resistance, 2) grade resistance, and 3) curve resistance.

Train resistance refers to the variety of opposing forces that must be overcome by the tractive power of the locomotive on a straight, level track. Among the causes of these resistances are 1) internal friction offered by the parts of the locomotive itself; 2) journal friction, rolling resistance, and the resistance resulting from track deflection under load-all increasing with the axle load; 3) flange resistance and air resistance that increase with speed. Numerous tests have shown that the train resistance to constant speed on a straight, level track is about 6 lb per ton of train.

INSTRUMENTATION IN PHOTOGRAMMETRY

Render the text in Ukrainian in a written form (not more than 1 page):

In computational photogrammetry, the primary requirement of instrumentation is to obtain the coordinates (x, y) of photograph image points. There are two principal approaches in such data acquisition, viz., monocular and stereoscopic measurements. For this purpose, one can use one of the following types of instruments:

a) Single-image comparators (Mono-comparators),
b) Double-image comparators (Stereo-comparators),
c) Stereoplotting instruments used as comparators.

The basic components of an instrument are 1) the viewing system, 2) the measuring system, 3) the readout and recording system.

1. VIEWING SYSTEMS. The role of the viewing system is to bring the measuring (or, floating) mark into coincidence with the image (photo) and to present the combination to the eyes of the observer at an appropriate magnification. There are various kinds used in the instruments, as follows:

a. Single Eyepiece. This, the simplest viewing system, uses one objective (for focussing the illuminated protograph) and one eyepiece to examine the combined image. There are several elaborations and variations of such systems, e. g., with zooming eyepieces, interchangeable eyepieces of different magnifications, prisms added to incline the eyepiece for comfortable viewing, etc.

b. Binocular Eyepiece. In single-image instruments, both eyes see the same image, making such an instrument very comfortable to the observer. In a double image instrument, however, one eye sees one image such that a 'fused' stereo-image is viewed only after appropriate settings are made.

c. Projection Viewing. In some instruments, both the measuring mark as well as the photo image are projected on a screen, where the observer's viewing can be made without the aid of additional optical elements.

d. Photo-electric Setting. Such systems can be attached to the instruments. Such systems are excellent for symmetrical images (e. g., marked points, star images, etc.). Some viewing systems have image detecting devices which automatically locate the center of any image. The detector determines the center of gravity of image-density within the area being scanned. These are ideal for symmetrical images.

2. MEASURING SYSTEMS. The function of the measuring system is to obtain the relevant data (distances, angles or coordinates) on the photographs. The various devices are listed below:

a. Leadscrews. The most common measuring device is the leadscrew or spindle (in combination with a nut). A large drum attached to the end of the screw, graduated in decimal divisions would give the distances (and coordinates, accordingly) to the smallest unit possible in such a system.

While some comparators have the viewing microscopes moving over fixed photographs, the modern ones have fixed viewing systems with the possibility of translating the photographs. The movements can be made faster with added motor drives.

The leadscrew comparators can have errors in the observed coordinates caused by lack of straightness and orthogonality of the screws, variations in the pitch of the screws, instrumental back-lash and effects of temperature variations.

b. Scales and Micrometers. The movements of the plate under the viewing system are referenced to scales (glass or metal) parallel to the measuring axes. When a point is observed, the measuring mark may fall between two full divisions of such a scale. A micrometer or vernier measures the translation necessary to bring the index to the closest full division. The sum of the full divisions of the scale and the micrometer reading will then give the complete coordinate value.

c. Grid Plate and Micrometers. Here the basis of measurement is a grid plate made of glass with a series of points which is superimposed on the photograph to be measured. The grid plate can be precalibrated. The increment from the nearest grid point (or, line) to the image point is measured by micrometers. Such grid plates are usually represented by crosses or black dots. Minor variations in this system are in the movements of the grid plate or in the optics.

The greatest advantage of this system is that once calibrated, the grid system is not subject to variations from wear. Its temperature expansion coefficient is the same as that of the photo (diapositive or negative) and all accuracy requirements are met by the glass grid.

d. Ferranti Fringe Measurements. In this system, a length of optical diffraction grating having a precisely known number of lines per unit length is used. A grating as long as the axis to be measured is attached to the movable carriage and a short piece is placed over the photocells which do the counting. With two sections of such a grating superimposed with the line structure at a slight angle to each other, a moiré fringe pattern with an approximately sinusoidal distribution of density is produced at right angles to the grating lines.

Such a measuring system is entirely free from friction and wear. Minor imperfections, dust, scratches, etc. have no appreciable effect on the measurements.

e. Interferometer Measurements. This system is based upon the interference phenomenon produced by superimposing beams of monochromatic light. This has been used in ballistic photogrammetry where occasional operational problems have been reported.

f. DIG Linear Measurements. This is a non-incremental system capable of determining absolute positions over an unlimited range. The essential elements in this are, a precise

glass scale, a reading head and a display panel. It has several interesting features including the possibility of measuring along up to three axes. It has not been used so much in conventional applications of photogrammetry.

g. Computer-controlled Measurements. In a recently developed system it is possible to accurately center on stars and marked points on photographs with homogeneous or heterogeneous background. It is a precise computer-controlled mono-comparator with a TV camera, an operator console, a point locator and a computer system with card, magnetic tape and hard copy output possibilities. The most interesting feature of this equipment is the automatic centering program, in which the largest number of bits can be stored.

3. READOUT SYSTEMS. The function of a readout system is to permanently record all the measured coordinates. The various available systems are given below:

a. Optical-mechanical, manual. This is the simplest approach, which involves an optical readout by the operator and manual recording by the operator from verniers, micrometers, drums, scales, etc. of the instrument. Such manual recordings can be time-consuming and liable to human faults and errors.

b. Hard-copy Printout, for example, with shaft encoders. The outputs from such digitizers are fed to various kinds of typewriters. Some units also permit typing desired comments associated with particular points in addition to recording point numbers (for identification) and their coordinates.

c. Automated complete systems permit point identification, recording of coordinates on punched cards, punched paper (or, magnetic) tapes in such formats as are directly usable by a digital computer, an automatic plotter, etc. Such an automated recording system, adapted to any photogrammetric instrument, has several advantages. Firstly, the system eliminates human blunders and mistakes. Secondly, this increases the speed of observational work. Thirdly, it presents the data in computer compatible forms. In some instruments additional refinements in the form of photographic recording of each image point (with identification) is possible.

PRESTRESSED CONCRETE

Give a short summary of the text in English or Ukrainian:

Degree of Prestressing. Prestresses in the concrete are designed and induced to counteract the stresses caused by

external loads. The designer should aim at a high initial pretension of the steel. A low initial steel stress produces a low and rather uncertain concrete compression, combined with an uneconomical use of steel. The elastic elongations are relatively small and require fine adjustments in the stretching devices. In contrast, a high initial steel stress produces high and reliable concrete compression, obtained with a small amount of steel. The steel elongations are comparatively large, and therefore easier to adjust and maintain. High initial steel stresses are therefore more effective and more economical than low initial steel stresses.

The upper limits of the initial tension should be governed by the creep of the steel and by the crack coefficient.

Co-operation of Steel and Concrete. The working together of the two materials may be secured by bond, or by end anchorages on the prestressing members, or by a combination of both. For steel up to 0.5 in. diameter, the effect of bond is usually sufficient to ensure the transfer and the maintenance of the preliminary stresses. For heavier bars, anchorage blocks are required in addition to the bond effect. In bondless structures all prestresses must be induced by anchorage blocks, no matter what diameter the steel.

The strength properties of steel and concrete should be interrelated. The higher the strength of the available steel, the better should be the strength properties of the concrete in bonded structures. Where new types of bonded structures or structural units are to be mass produced, the successful cooperation of steel and concrete by bond should be proved by fatigue tests on prototypes.

Jointing of Pre-tensioned Steel. Prestressed members should be continuous over their full lengths and joints should be avoided. Connections by overlapping or turnbuckles should not be allowed. Welded connections may only be used when it has been established by preliminary tests that the steel is weldable. The test samples to be welded should be of the same thickness as the steel used in the structure, without any special preparation, and the quality of the welded joint should be tested in the usual manner.

Cables. Where a whole cable is tensioned in one process, all wires of the cable should have the same initial stress. To ensure this, it is adequate to ensure that the wires are as nearly as possible of the same initial straightness. A practical method is to group and maintain the wires in a prearranged disposition, so that no wire can diverge from the axis of the cable by an amount sufficient to cause an appreciable

variation in length. The spacing of the wires should be adequate to permit of grout penetrating through the whole length of the cable. Where sheathed cables are placed in the forms and concrete is cast around them, the sheathing must be completely water-tight.

Non-prestressed Reinforcement. Both prestressed steel as well as non-prestressed reinforcements may be used in the same structure. In fully prestressed structures with eccentric precompression, non-prestressed reinforcements are employed to balance the tensile stresses created in the concrete by the prestressing process before the live loads are applied. They are also placed eccentrically, but at the side opposite to the pretensioned steel. The cross-sectional area of the steel should be designed to cover the full tension in the concrete with a stress not exceeding the values permissible in ordinary construction.

In partially prestressed structures a substantial part of the eccentric main reinforcement is not prestressed. The permissible stress in the non-prestressed main steel may be substantially increased by the use of supplementary prestressed wire reinforcements. In this case both the prestressed wires and the non-prestressed bars are placed in the same zone of the structure, and the strengths of the two items are added to each other to form the tensile component of the inner moment.

Concrete Cover and Distances between Prestressing Members. The cover of concrete measured from the outside of all prestressing members, including transverse ties, spirals, stirrups, and all secondary reinforcement, should at all points be at least 0.5 in. or the diameter of the bar, whichever is the greater. In structures exposed to the weather, the cover should be at least 0.75 in. These relatively low values are justified by the accurate positioning of the stretched main steel, which in turn determines the position of the secondary reinforcements.

In girders of large spans, bridges over steam-operated railways, hydraulic structures, and structures exposed to acids, oils, fumes, or other harmful substances, the clear cover should be at least 1.5 in., and protective coating should be applied to the concrete.

The minimum lateral distance between bonded prestressing members is mainly dependent on the maximum size of the coarse aggregate used in the concrete, and should be, 0.25 in. greater than this maximum size. Both the lateral and vertical distances between compressor wires or anchored

steel bars should be at least 0.75 in. These minimum dimensions are based on the assumption that the concrete is filled and compacted by vibration.

Precautions against Rusting. Adequate cover against rusting must be provided on all stressing members and anchorages.

Concrete units with bonded compressor wires mass-produced on long stretching beds have their main steel showing at both end faces without any cover. Such units have been used for many years exposed to the weather and no penetration by rust has yet been ascertained. Nevertheless, it is recommended that the end faces with the cut steel wires be covered by a layer of gunite 0.5 in. thick.

Fire Precautions. Up to the present, little experience has been gained on the fire safety of prestressed concrete structures. A few British and German test reports indicate that a precompressed, dense concrete offers good protection to the steel. But there is no indication yet how the ultimate strength of the hard-drawn wire is affected, if the protection offered by the concrete should be overcome. Consequently, prestressed structures and units should only be regarded as fire-proof when prototypes have been subjected to, and passed, the specified fire tests. The prototypes must be true copies of the units to be tested, in the sense that they should be made of identical materials, prestressed to the same degree, and have the same shape and dimensions.

ПОПЕРЕДНЬО-НАПРУЖЕНИЙ БЕТОН

Translate the text into English using the text *Prestressed Concrete:*

Попереднє напруження в бетоні розраховується для того, щоб протидіяти зовнішнім навантаженням.

Низьке початкове напруження в арматурі призводить до низького тиску в бетоні і неекономного використання сталі. Високе попереднє напруження сталі приводить до високого й надійного тиску в бетоні, одержаному при малій кількості сталі.

Сукупна дія арматури й бетону може бути забезпечена зчепленням чи закріпленням кінців попередньо-напружених елементів. Параметри міцності арматури й бетону мають бути взаємопов'язані. Попередньо-напружені елементи мають бути безперервними по всій довжині, при цьому необхідно уникати їх з'єднання.

Як попередньо-напружена, так і ненапружена арматура можуть використовуватися в одних і тих самих конструкціях. У повністю попередньо-напружених елементах з ексцентричним попереднім стиском ненапружена арматура може вживатися для урівноваження розтягуючих напружень. У частково попередньо-напружених елементах значна частина ексцентричної основної арматури не є попередньо-напруженою.

Товщина покриття бетону, що вимірюється від зовнішньої поверхні всіх попередньо-напружених елементів, повинна бути скрізь рівномірною. Вона має бути більшою в спорудах, що зазнають температурного впливу, а також у спорудах більшого обсягу (таких як залізничні мости, гідроспоруди тощо).

Однакове покриття проти корозії повинно застосовуватися для всіх напружених елементів та їх з'єднань. Протипожежні заходи, що застосовуються в різних країнах, показують, що попередньо-напружений щільний (твердий) бетон є добрим захистом для арматури.

КОЗАЦЬКІ СУБМАРИНИ

Render the text in English:

Є свідчення, що запорізькі козаки мали підводний флот. Ось що писав 1827 року французький історик Монжері: «Запорізькі козаки користувалися гребними суднами, здатними занурюватися під воду, долати в зануреному стані великі відстані, а потім, спливши, здійснювати зворотний шлях під вітрилами». Монжері перший описав і козацьку субмарину: «Це був обшитий шкірою човен, корпус якого накритий герметичною палубою. Над нею вивищувалася шахта (прототип бойової рубки), де розташовувався спостерігач-керманич. Через шахту надходило повітря під час плавання в підводному стані. Саме плавання здійснювалося за допомогою весел, герметизованих у місцях проходу через корпус шкіряними манжетами».

І ще одне свідчення: «...1595 року, щоб захопити Синоп, козаки вдалися до хитрощів. Вони переобладнали свої човни-чайки, влаштувавши в них подвійне дно із стулками. Поклавши між першим та другим дном баласт — пісок, козаки в потрібний час відкривали стулки, пісок висипався, і човен спливав на поверхню. Палуба також закривалася стулками, а над нею здіймалася труба, через яку надходило повітря».

Отже, як стверджує французький історик, творцями

перших підводних човнів були запорізькі козаки, а не голландець Корнеліус ван Дрембель, який випробував свій винахід на чверть століття пізніше.

НЕСПОДІВАНІ ПРОБЛЕМИ ПОВІТРОПЛАВАННЯ

Render the text in English:

Ракетобудування, літакобудування, конструювання різних літальних апаратів — істотні віхи в нашій вітчизняній науці. Наші досягнення в цих галузях загальновідомі в усьому світі. Проте існує ще одна призабута «повітрофлотська» галузь, яка несподівано привернула увагу в наш час швидких та надшвидких повітряних перевезень.

Йдеться про дирижаблебудування, яке в час паливної кризи, різкого подорожчання всіх видів пального зненацька отримало «друге дихання». Цей вид повітряного транспорту зараз відроджується в США, Канаді, Англії, Німеччині, Китаї та інших країнах. Відродження «безкрилої авіації» є цілком закономірним і актуальним, оскільки саме їй притаманні такі якості, як практично необмежена вантажопідйомність, дальність і тривалість польотів, вертикальний зліт і посадка, незначний вплив на навколишнє середовище, менша кількість палива, ніж та, яку потребує літак і вертоліт.

Дирижаблі здатні виконувати ряд важливих функцій: обслуговувати нафтопромисли, вести спостереження за дорожнім рухом, виконувати рятувальні роботи на морі, контролювати стан атмосфери, перевозити туристів, рекламувати різну продукцію, а також брати участь у серйозних дослідженнях.

За кордоном побудовані й успішно функціонують десятки дирижаблів і тисячі повітряних куль різних класів і різноманітного призначення. В Україні ці безкрилі літальні апарати можуть використовуватися для транспортування рідкого й газоподібного палива на великі відстані, екологічного моніторингу атмосфери, земної й водної поверхні, перевезення пасажирів на найбільш завантажених лініях, у сільському й лісовому господарстві, на різних будівельних роботах, під час патрулювання державних кордонів.

На сучасному етапі розвитку повітроплавання дирижаблебудування є актуальним і своєчасним засобом допоміжної авіації. Створюються дирижаблі для транспортування великовагових об'єктів, зокрема тих, що використовуються нафтовиками й газовиками, радіокеровані дири-

жаблі для використання на виробництвах з шкідливими умовами, теплові й газові дирижаблі невеликої вантажопідйомності тощо.

DESCRIPTIVE GEOMETRY. ORTHOGRAPHIC PROJECTION

Translate the text into Ukrainian, give a short summary of the text in English or Ukrainian in written or oral form:

Descriptive Geometry deals with the theory that underlies a system of drawing [1] known as orthographic projection.

In engineering and construction work the use of orthographic projections, or views, as they are called, is universal. These views are not concerned primarily with the actual appearance of the object, however important that may be [2] from an aesthetic or commercial point of view, but are for the purpose of showing [3] its true shape and form, and the actual sizes and relative positions of its various parts.

An orthographic projection is based on the properties of a right angle, that is, on the properties of lines and planes which are mutually perpendicular.

Fundamental Conceptions. Through any point in space three mutually perpendicular lines can be drawn. Taking the point as origin [4], any other point in space can be located by not more than three coordinates parallel to these lines. In this sense, space may be said to be three-dimensioned [5].

Through any point in a plane, two mutually perpendicular lines can be drawn. Taking the point as origin, any other point in the plane can be located by not more than two coordinates parallel to these lines. In this sense, a plane may be said to be twodimensioned.

Planes of Projection. Starting with any set of three mutually perpendicular lines in space as axes, pass a plane parallel to any two of them. This plane will be perpendicular to the third axis, and the remaining two axes may be projected orthographically on the plane in a direction parallel to the third axis. Applying this process to a solid object in space, the result is a projection, or view, in which two of the rectangular dimensions of the object appear in their true relative positions and lengths, while the third dimension is entirely suppressed [6]. We have thus succeeded in forcing the two dimensions of a plane to represent two of the three dimensions of the solid object.

Obviously, however, a single orthographic view does not

completely represent a solid [7]. Pass a second plane parallel to the third axis, and to either of the others, say the first. This plane is perpendicular to the second axis, and the first and third axes may be projected orthographically on the plane in a direction parallel to the second axis. Applying to a solid, the result is again a view showing two dimensions, one of which is the dimension which failed to appear in the view first made [8].

It follows that at least two orthographic projections are necessary to represent or locate objects — by which term is meant points, lines, and surfaces, as well as solids — situated in ordinary, three-dimensional space. Also, it is evident that the two planes of projection used are at right angles to each other, and that each is parallel to the axis dimension, which appears in both views.

Choice of the Planes of Projection. The stability of any construction made at any particular place on the earth's surface depends on the relation of its parts to the direction of the force of gravity at that place. This direction is known as the vertical, and furnishes a natural direction for a plane of projection. A plane at right angle to the vertical is horizontal or level, which is also a natural direction. When but with two projections of an object the planes usually chosen are, one horizontal, the other vertical. Indeed, so fundamental are these planes that the projections made on them have special names. A view drawn on a horizontal plane is a plan; a view drawn on a vertical plane is an elevation.

Note that the horizontal direction is determined by a plane, so that all horizontal planes are parallel. But the vertical direction is determined by a line (the plumb line [9]), so that any two vertical planes are not necessarily parallel, and the choice of one as a plane of projection is to some extent arbitrary [10]. In fact, two vertical planes may be at right angles to each other, so that it is possible for an object to be represented by two elevations.

Point of View. A projection is always considered as a view of the object as seen from a particular direction. To be sure [11], natural vision, with an eye, or eyes, occupying a fixed station, cannot see the object in the form in which it is projected. The imaginary vision which sees the object must be able to look simultaneously at every point of the object in a direction perpendicular to the plane on which the view is drawn. Nevertheless, such a from of artificial vision is not difficult to conceive [12], and the direction of the resulting lines of sight is of primary importance.

A plan is a view of an object as seen from above. The direction of sight is vertical, and downward.

An elevation is a view of an object as seen from in front. The direction of sight is horizontal, and from front to back.

These two directions of sight are fundamental, and invariable.

VOCABULARY NOTES

[1] **the theory that underlies a system of drawing** — теорія, яка лежить в основі системи креслення
[2] **however important that may be** — яким би важливим це не було
[3] **are for the purpose of showing** — існують для того, щоб показати
[4] **taking the point as origin** — якщо взяти цю точку за початок
[5] **space may be said to be three-dimensioned** — можна сказати, що простір є тримірним
[6] **while the third dimension is entirely suppressed** — у той час як третій вимір є зовсім зайвим
[7] **does not completely represent a solid** — не повністю зображає геометричне тіло
[8] **failed to appear in the view first made** — виявилося відсутнім на першому плані
[9] **the plumb line** — лінія виска
[10] **is to some extent arbitrary** — є деякою мірою спірним
[11] **to be sure** — безсумнівно
[12] **is not difficult to conceive** — неважко уявити

ON MATERIALS AND THEIR PROPERTIES. PORTLAND CEMENT

Translate the text into Ukrainian, give a short summary of the text in English or Ukrainian in written or oral form:

Portland cement is made by heating an intimate mixture of chalk and clay [1] to a white heat (temperature of incipient fusion [2]) and, after the resultant clinker [3] has cooled, grinding it to extremely fine powder [4].

Portland cement is usually made by the wet process. The chalk and clay mixed with water are reduced to a creamy consistency [5] in washmills, circular tanks in which a central vertical spindle carries a rotating steel framework to which are suspended heavy harrows with projecting teeth [6]. The circumference is fitted with gratings, and the process conti-

nues until the creamy liquid called slurry is able to pass the screen. It passes then to a second and third washmill, fitted with screens of ever smaller mesh, until after passing the last washmill only 5 per cent is retained on a sieve of 32,400 meshes to the square inch. During this time the chemists are making periodic tests to ensure the correct proportion of lime to chalk and adjusting when necessary [7]. These proportions are vital.

The slurry is then passed to much larger tanks known as mixers, where it is kept stirred by rotating arms with vertical paddles [8] until the kilns are ready to receive it.

The calcining or burning is generally done in rotary kilns. They are lined with firebrick [9] and set at an angle of about 8 degrees to the horizontal.

The slurry is introduced at the top end by a rotating spoon feed [10], and gradually works its way down the kiln owing to the combined action of the slope and rotation. In so doing it meets the hot flames (the fuel, generally powdered coal, is introduced into the lower end) which pass up through the kiln and then to the chimney. In this way the slurry gets hotter as it descends and reaches the zone of maximum temperature (about 2,800 °F) some distance from the lower end, when chemical combination of the constituents takes place; all the water having, of course, long since been driven off.

At this stage the cement has formed itself into extremely hard nodules [11] about the size of walnuts known as clinker, which now drops into a lower but parallel rotating and inclined tube where it is cooled from a white heat by meeting a current of air. This air is thus heated to about 600 °F and used for blowing with the powdered coal into the kiln, so economising in fuel.

The next process is the grinding of the clinker in tube mills (horizontally rotating cylinders) divided into three or four compartments. Each compartment contains exceptionally hard steel balls, which, when the mill rotates and clinker is introduced, are lifted and fall on to the clinker and so crush it. The cement passes from one compartment to another, and grinding continues. During grinding about 2 per cent to 3 per cent of gypsum is ground in to make the cement slow setting [12]. The cement then goes to large circular silos, or into sheds where it is stored. The cement then has to be tested.

VOCABULARY NOTES

[1] **an intimate mixture of chalk and clay** — однорідна суміш крейди й глини
[2] **temperature of incipient fusion** — температура початкового плавлення
[3] **the resultant clinker** — одержаний в результаті клінкер
[4] **grind to extremely fine powder** — перемелювати на мінімально тонкий порошок
[5] **are reduced to a creamy consistency** — доводяться до кремоподібної консистенції
[6] **heavy harrows with projecting teeth** — важкі борони із зубцями, що виступають
[7] **adjust when necessary** — регулювати, коли необхідно
[8] **stir by rotating arms with vertical paddles** — перемішувати обертовими важелями з вертикальними лопатками
[9] **line with firebrick** — обкладати вогнетривкою цеглою
[10] **a rotating spoon feed** — лопать, що обертається й падає
[11] **has formed itself into extremely hard nodules** — перетворився на виключно важкий конгломерат
[12] **to make the cement slow setting** — щоб уповільнити його тужавлення

PORTLAND CEMENT

(Short Summary of the Tests and Requirements)

Translate the text into Ukrainian, give a short summary of the text in English or Ukrainian in written or oral form:

Test for soundness [1] (i. e. assurance that the cement will not expand after setting is complete). The cement is made into a plastic mass [2] with a specified water content, put into a small brass cylinder cut through on one side and provided with long wires or needles either side of the cut and boiled for 3 hours after being kept in water at 61 °F for 24 hours. The movement at the end of the needles shall not exceed 10 mm.

Test for setting time [3]. The cement is gauged into a paste [4] with a specified amount of water, put into a shallow circular mould and struck off level, and a needle 1 mm. square weighted to about half a pound [5] is applied repeatedly. When this fails to penetrate completely [6], the time since gauged is known as the initial set [7]. A needle with an annular attachment is then substituted for the plain needle, so arranged that the

needle projects half a millimetre below the annular attachment. When the needle makes an indentation but the annular attachment does not, the time since gauging is known as the final set. The initial set should be long enough to enable mixing, transporting, placing and tamping of the concrete to be completed before setting begins. It should not be less than half an hour for slow-setting cement [8]. (Rapid-setting cements can be supplied for special purposes, but these should not be used for reinforced concrete.) The final set should be not more than 10 hours.

Test for tensile strength [9]. The cement is gauged with a standard sand in the proportion of 1 cement to 3 sand, and with a carefully specified quantity of water.

This paste is moulded into moulds of special shape to form a test specimen [10] which is readily held in the jaws of a small testing machine. The central cross-section [11] where fracture occurs is 1 in. square.

The specimens are kept in air (temperature about 61 °F and relative humidity [12] at least 90 per cent) for 24 hours, then removed from the moulds and kept in water (temperature about 61 °F) till tested by breaking. The specimens are held in jaws of specified shape and tension applied at the rate of 100 lb./sq. in. in 12 seconds.

Test for compressive strength. Cubes are compacted by vibration in a special machine for 2 minutes, then kept in air at about 61 °F and 90 per cent relative humidity for 24 hours, and then in water at about 61 °F till tested. They are tested on their sides in a machine applying load at the rate of 5,000 lb./sq. in. per minute. No packing is used.

Some people hold that if the cement passes all the mechanical and soundness tests [13] it is to comply with the chemical requirements, for which the tests are more difficult, especially in the field. The principal object of this test is to guard against an excess or inadequacy [14] of lime in relation to silica, alumina and oxide of iron.

VOCABULARY NOTES

[1] **test for soundness** — випробування на доброякісність

[2] **is made into a plastic mass** — його перетворюють на пластичну масу

[3] **test for setting time** — випробування на час тужавлення

[4] **the cement is gauged into a paste** — цемент перетворюється на тісто

[5] **weighted to about half a pound** — навантажена до 1/2 фунта ваги
[6] **fails to penetrate completely** — не зможе проникнути повністю
[7] **the initial set** — початкове тужавлення
[8] **slow- (rapid-) setting cement** — цемент, що повільно (швидко) тужавіє
[9] **test for tensile strength** — випробування на опір розтягу
[10] **a test specimen** — зразок для випробування, дослідний зразок
[11] **the central cross-section** — центральний поперечний переріз
[12] **relative humidity** — відносна вологість
[13] **pass ... soundness tests** — пройти випробування на доброякісність
[14] **guard against an excess or inadequacy** — захист від надлишку чи непридатності

PROPERTIES AND MANUFACTURE OF CONCRETE

Translate the text into Ukrainian, give a short summary of the text in English or Ukrainian in written or oral form:

A concrete structure, either plain or reinforced, maintains a unique position [1] among the various systems of modern construction. With few exceptions it is the only type of structure that is completely manufactured from its component raw materials on the site of the work. In most instances, the quality of its essential raw materials is decidedly variable.

Structures built of steel, stone masonry, or various other materials are composed of elementary units which are partially or entirely prefabricated [2] in factories or shops. These other materials are fitted or assembled on the work by skilled mechanics, but concrete is usually manufactured at the site of the structure by unskilled laborers. The designer of reinforced-concrete structures [3] should remember this. He must know the useful properties and practical limitations of the materials with which his plan will be constructed. With this knowledge he should plan the work in such a manner that desirable results are easily and correctly attained in the field.

Definition and Description of Concrete. Concrete is an artificial stone, cast in place in a plastic condition. Its essential ingredients are cement and water which react with each other chemically to form another material possessing struc-

tural strength [4]. A mixture of cement and water is termed *cement paste*. In order to increase the volume of artificial stone produced from a definite amount of cement it is customary to add inert filler materials known as *aggregates*. A large amount of cement paste to which has been added a small amount of fine aggregate, to produce a mixture of fluid consistency, is called *grout*. When the amount of fine aggregate is increased to the extent that the mixture loses its fluidity and behaves as a cohesive plastic, the resulting mixture is termed *mortar*. With the further addition of coarse aggregate, the mixture is called *concrete*.

It is a custom of long standing [5] to designate these mixtures in terms of the relative volumes of cement, fine aggregate, and coarse aggregate of which they are composed. The ingredients are always indicated in the same order[6]: cement first, fine aggregate next, and coarse aggregate last. For example, a 1 : 2 : 4 concrete is a mixture of 1 cu. ft. of cement, 2 cu. ft. of fine aggregate, and 4 cu. ft. of coarse aggregate plus a non-specified amount of water [7] sufficient to produce a plastic consistency. A proportion given as 1 : 3 is intended to mean a mixture of cement and fine aggregate plus an indefinite amount of water but without the addition of coarse aggregate. Such a mixture would be classified as mortar.

This system of specifying concrete proportions by volume is rapidly becoming obsolete on major works but is still used for small projects. The current practice of progressive engineers is to indicate the proportions of materials in the same order but by weight and, frequently, to indicate the amount of water to be used.

Water, cement, and aggregates when mixed together in properly predetermined proportions [8] produce concrete that is a plastic mass capable of being poured or cast into molds [9]. These molds, which are actually called *forms*, must be built of such size and shape as to restrain the plastic mass until it solidifies. With few exceptions the forms must be constructed in such a manner that the concrete, when poured, will be in its final position in the structure. Besides restraining the plastic mass until solidification occurs, the forms serve a less obvious purpose which should not be overlooked [10]. They support the solidified mass until it has attained sufficient strength to support itself without undue deflection or complete collapse.

Concrete does not solidify or attain appreciable strength instantaneously. The chemical reaction of cement and water is slow and requires time for its completion. The reaction continues for many years. It is frequently divided, for purposes

of description, into three distinct phases. The first, called the initial setting time [11], requires approximately 45 min. to 8 hr. for completion. During this time, the freshly mixed concrete gradually decreases in plasticity and develops pronounced resistance to flow [12]. Disturbance of the mass, or remixing during this time, may cause serious damage. The second phase is an interval during which the concrete may be considered as a soft solid without surface hardness. It will support light loads without indentation [13], but it is easily abraded [14]. Its surface can be scored, roughened, or otherwise marred without appreciable effort. This phase is frequently termed the interval of final set [15]. Its duration is very indefinite but may be considered to exist for approximately 5 to 20 hr. after the original mixing operation. The third phase is one of progressive hardening and increase in strength [16]. For concrete of good quality this progressive improvement continues indefinitely. It is rapid during early ages [17] until about one month after mixing, at which time the mass has attained the major portion of its potential hardness and strength. After one month the improvement continues at a greatly reduced rate.

VOCABULARY NOTES

[1] **maintains a unique position** — посідає унікальне місце
[2] **which are partially or entirely prefabricated** — які частково або повністю попередньо виготовлені
[3] **reinforced-concrete structures** — залізобетонні конструкції
[4] **structural strength** — будівельна міцність
[5] **it is a custom of long standing** — давно вже стало традицією
[6] **are always indicated in the same order** — завжди наводяться в тому самому порядку
[7] **a non-specified amount of water** — невизначена кількість води
[8] **when mixed together in properly predetermined proportions** — коли вони змішуються в заздалегідь визначених пропорціях
[9] **is ... capable of being poured or cast into molds** — здатна до розливки чи бетонування в формах
[10] **a less obvious purpose which should not be overlooked** — другорядна ціль, яку проте не можна ігнорувати
[11] **the initial setting time** — початкове тужавлення бетону
[12] **pronounced resistance to flow** — виражений опір деформації

[13] **without indentation** — без порушення цілісності, без западин
[14] **is easily abraded** — легко шліфується
[15] **final set** — остаточне тужавлення
[16] **progressive hardening and increase in strength** — поступове твердіння й нарощування міцності
[17] **it is rapid during early ages** — це відбувається швидко на початкових стадіях

BRICKS AND BRICKWORK

Translate the text into Ukrainian, give a short summary of the text in English or Ukrainian in written or oral form:

The traditional brick of the building trade [1] consists of blocks of clayey earth which have been baked or burnt. Other more modern types include concrete and sand-lime bricks [2]. The quality and properties of a clay brick depend on three factors, namely: a) the chemical and mineralogical composition of the earth used; b) the processes through which it passes prior to burning or baking; c) the temperature of burning and the care with which the burning is carried out.

Material suitable for the making of clay bricks consists essentially of clay and sand, i. e. of silica and alumina. Other constituents include oxides of iron, iron pyrites, chalk or limestone, salt, and small proportions of various minerals which yield manganese, sodium, potassium and traces of other metals, together with a certain amount of organic matter.

The colour of a brick is largely governed [3] by the chemical composition of the brick earth, but the temperature of burning is also important. Shades of orange and red are found in bricks made from clay containing oxides of iron, the exact shade depending on the amount of the iron and the temperature of burning while blue bricks are made from clay with a high iron content and a very high temperature of burning. Clays which are free from iron [4] yield white bricks; yellow bricks are obtained by the addition of magnesia to an iron-free clay [5], but in clamp burnt bricks [6] a yellow colour may be due to sulphur released from the breeze during burning. The colour of facing bricks [7] is often varied by sprinkling selected sand, sometimes with specially added pigments such as manganese dioxide, either on the raw brick or in the brick mould prior to firing. The surface of the brick then takes on the required colour during burning.

The actual making of a brick consists of two main processes, namely: 1) the preparation of the unburnt brick and 2) the burning or baking of the brick. The preparation of the brick may further be considered in three distinct stages, i. e. 1) the preparation of the earth, 2) the shaping of the brick, and 3) the drying of the brick prior to burning.

PREPARATION OF THE BRICK EARTH.[8]— Brick earths are quarried or dug from open pits. Stone-picking, i. e. the removal of large stones, is carried out by hand and then the clay is spread out to expose it to the action of the weather. The weathering is facilitated by placing alternate layers of materials such as sand, chalk or breeze with the brick earth, piled in banks up to a height of some 6 feet. Tempering follows weathering and in big brickfields it is carried out by means of pug-mills [9].

If the clay as dug is not suitable for brickmaking purposes, but requires conversion to malm [10], it is placed in a wash-mill [11], immediately it is dug. This machine resembles a pug-mill, but the cylinder is made of brick instead of iron. The other materials to be added, such as sand and chalk, are ground in water and added to the clay in the wash-mill. The mixture is reduced to a liquid of a creamy consistency, known as *slurry,*[12], and then passed through iron gratings to retain any large particles, and then into settling pits [13], or *backs*. The water is allowed to evaporate until the clay is almost solid.

THE SHAPING OF THE BRICK may be done by hand or by machine. The hand-made brick is shaped by means of a wooden mould. Thus this mould is larger than the finished burnt brick, to allow for shrinkage.

In moulding the brick, the inside of the wooden mould is sprinkled with either water (slop-moulded [14]) or sand (sand-moulded [15]) to prevent the clay from sticking to the wood [16]. In the best-quality bricks, the sand is carefully chosen so as to give the required colour and finish to the burnt brick.

The moulder throws a clot of clay into the prepared mould, with sufficient force to fill the mould, and removes excess clay from the top with a wooden *strike,* leaving a level top surface.

Slop-moulded bricks are wetter than sand-moulded ones, and they are left in the mould on covered drying-floors or drying-rooms for some 48 hours before being taken to the *hacks* for the final airdrying. Sand-moulded bricks are taken directly to the hacks, which are simply long rows of bricks

so placed that they are dried by winds, but are protected from rain by pent roofs.

The machine-made bricks may be moulded, pressed or wire-cut. Moulded machine-made bricks go through the same processes as the hand-made bricks, i. e. weathering, grinding and pugging [17], but the pugged material is mixed with enough water to make it of a workable consistency and this mix is run by machinery into moulds. The moulded brick is dried and fired in the normal way.

A pressed brick made by the stiff plastic process needs little or no drying when it comes from the press. A suitable clay is ground when dry, and then passes from mixer into a rough shaper and finally to a die box. Here the brick is pressed, sometimes twice, then fired.

The semi-dry process for pressed bricks [18] consists in running the ground, screened clay mechanically into a container which passes under the press head.

A wire-cut brick [19] is made by extruding the clay from a machine through a shaped die. This gives a continuous block of clay which is cut by wire into brick lengths. This may be done by hand or in more modern types of machinery the cutting may be automatic. Some wire-cut bricks are partially dried and then pressed.

THE DRYING OF BRICKS often takes place naturally in the hacks. Artificial drying is, however, used where waste heat is available from the kilns. Hot air flues or steam pipes are led from closed kilns to the shed in which the bricks are stacked, and this gives quicker drying, in from 8 to 10 days, than if wind drying alone is utilised. In general it is not possible to hasten the process of drying without damaging the quality of the brick, since too rapid drying produces flaws and cracks.

The burning of the bricks may be carried out in either a clamp or a kiln, the latter being either of the intermittent, the continuous or the tunnel type [20].

VOCABULARY NOTES

[1] **the traditional brick of the building trade** — традиційна будівельна цегла

[2] **concrete and sand-lime bricks** — бетонні й піщано-вапняні цеглини

[3] **the colour of a brick is largely governed** — колір цеглини значною мірою залежить

[4] **clays which are free from iron** — глини, до складу яких не входить залізо
[5] **an iron-free clay** — глина, що не містить заліза
[6] **clamp burnt bricks** — випалені в надольній печі цеглини
[7] **facing bricks** — облицювальна цегла
[8] **the brick earth** — сировина для цегли
[9] **by means of pug-mills** — за допомогою глином'ялок
[10] **conversion to malm** — перетворення на мергель
[11] **wash-mill** — водяна дробарка
[12] **a creamy consistency, known as *slurry*** — кремоподібна консистенція, відома як *рідка глина*
[13] **settling pits** — відстійні ями
[14] **slop-moulded** — що одержані у формах, змочених водою
[15] **sand-moulded** — що одержані у формах, посипаних піском
[16] **to prevent the clay from sticking to the wood** — щоб запобігти прилипанню глини до дерев'яної форми
[17] **weathering, grinding and pugging** — вивітрювання, подрібнення й перемішування
[18] **the semi-dry process for pressed bricks** — процес напівсухого пресування цеглин
[19] **a wire-cut brick** — нарізана дротом цеглина
[20] **the latter being either of intermittent, the continuous or the tunnel type** — при чому остання (піч) може бути чи періодичною, безперервною, чи тунельного типу

VERTICAL TRANSPORTATION

Translate the text into Ukrainian, give a short summary of the text in English or Ukrainian in written or oral form:

Evaluating the principal forms of vertical transportation for building design and use [1], the architect may wish to consider the major elements of an elevator, escalator, or electric dumbwaiter installation [2]. His primary concern is not with details of equipment construction and operation but rather with requirements for building space, structural support, electric power, and other provisions necessary to accommodate the transport system.

Architectural plans allocate space for elevator and escalator machine rooms, hoistways and pits, and wellways for escalators [3]. The building structure must support static, dynamic and impact loads; its electrical distribution system must supply energy to control as well as to operate machinery.

Standardization of escalator design has reduced the relative cost of this form of vertical transportation and contributed to its more extensive application [4].

Standard escalator widths range from 32 to 48 in. A 32-in.

escalator can comfortably carry an adult and child side by side on each step, while the 48-in. escalator can similarly accommodate two adults. Escalators move at 90 or 120 fpm and are reversible [5].

A modern escalator is built around the escalator truss, the structural steel frame that becomes an integral part of the building. Factory-fabricated trusses reduce installation cost, and their self-contained driving machinery eliminates separate machine rooms.

The truss contains or supports the treadway mechanism [6], the interior passenger way, the landing plates [7], balustrades, handrails, and decks. Modern units have steps with safety cleated risers [8], semicircular extended newels [9], pinch-proof handrail openings [10], replaceable comb teeth sections [11], and narrow-gauge step treads with safety demarcation lines [12].

Wellways through the floors of a building accommodate the escalator trusses. Their location depends on whether both units of a pair are placed between two rows of columns or one escalator on either side of a column. The first plan saves space and limits escalator construction work to fewer bays although, if the bays are not wide enough, traffic around the escalators may not move freely. The second plan may simplify framing and leave more space for circulation, but at the expense of higher installation cost. Manufacturers' layout drawing and dimensions [13] guide planning the wellway and supports for each truss.

Although escalator treads are horizontal when they carry passengers, the treadway moves upwards or downward at an angle of 30° or 35° formed by the truss and a horizontal plane. To transport people horizontally or on inclines up to 15°, moving walks are gaining favor.

Except that it has a treadway with steps only and no risers, a moving walk resembles an escalator in general design and operation. Like escalators, walks are available in 32 and 48-in. widths and move at speeds of 90 and 120 fpm. Moving walks are proving of especial value at air terminals and in shopping centers and other facilities where streams of people must be moved across considerable distances rapidly and comfortably.

Striking visual effects have been achieved in integrating escalators and moving walks, which may have transparent balustrades, with building interiors and exteriors. Besides their primary function of transportation, such installations may also expose buildings and their contents to the vision [14] of passengers being carried through them.

VOCABULARY NOTES

[1] **evaluating ... for building design and use** — оцінюючи ... з огляду на проект і використання будівлі
[2] **dumbwaiter installation** — розміщення грузового ліфта
[3] **hoistways and pits, and wellways for escalators** — люки підіймача і ями та зручні шляхи для ескалаторів
[4] **contributed to its more extensive application** — сприяла його ширшому застосуванню
[5] **are reversible** — можуть рухатись у зворотному напрямі
[6] **the truss contains or supports the treadway mechanism** — кроква містить чи підтримує механізм із ступінчастою стрічкою
[7] **the landing plates** — платформи для зупинки
[8] **modern units have steps with safety cleated risers** — сучасні ескалатори мають приступки з шпунтовими стояками для безпеки
[9] **extended newels** — витягнуті балясини перил
[10] **pinch-proof handrail openings** — безпечні щодо захоплювання й защемлення відкриті частини поручнів
[11] **replaceable comb teeth sections** — замінні секції гребеневих зубців
[12] **narrow-gauge step treads with safety demarcation lines** — вузькоколійний простір для пересування з демаркаційними лініями безпеки
[13] **manufacturers' layout drawing and dimensions** — креслення й розрахунки витрат виробників
[14] **expose ... to the vision** — дають змогу побачити

ESCALATORS AND MOVING WALKS [1]

Translate the text into Ukrainian, give a short summary of the text in English or Ukrainian in written or oral form:

Speaking about elevators and escalators, we should emphasize the use of moving stairway and moving walkway types [2] of vertical and horizontal transportation. Of the two, the escalator (or moving stairs) is the more important since it is used more frequently and has been in use for about a hundred years. The moving walkway, either inclined or horizontal, was introduced in its modern form in the 1960s.

In the later part of 1970, developmental work was begun on an accelerating moving walkway [3]. Numerous measures need to be perfected, one of the most important being a handrail capable of matching the acceleration [4], speed, and position of the steps or pallets. When perfected, the accelera-

ting moving walkway is intended to provide convenient horizontal transportation for distances between the 200 and 2000 ft (60 and 600 m) range.

There is no better way to guide people in a given path[5] in a building than by providing an escalator. Department store owners discovered this years ago and the most successful stores have their escalators as centers of attraction. The most desirable space is located in line with or next to the escalators. Major expositions have used escalators to direct people to desirable sights and have used moving walkways to keep people moving past exhibits to gain maximum exposure.

Transportation terminals, subway stations, and other areas in which large groups of people are required to be moved from one level to another are ideal applications for escalators and moving walks to speed circulation and avoid congestion. Everyone can be moved at a constant speed and people are carried efficiently from one place to another. When people are walking, some are slow, others are fast, some have baggage, others are accompanied by children, so that walking is often slowed to the speed of the slowest pedestrian. With a moving device [6], the velocity is established.

Escalators provide an effective means to make the second floor or basement space as attractive as street floor space. In a commercial building this increases revenue. In an institutional building service performance is enhanced, horizontal walking distance is shortened, and a greater concentration of service rendered can be attained.

Escalators are found in many places besides their initial field of applications in stores and transportation facilities. Today, hospitals, factories, offices, convention halls, sports arenas and other buildings must accommodate large groups of people within a short period of time.

Escalators can be advantageously applied to any building [7] if certain requirements are met. Equipment should be located so that most people entering the building can see it. Access to the escalator must be attractive and in the path of the heaviest expected traffic. Evaluation of expected traffic volume, which could range from a few people continuously to hundreds in a peak period, depends on the type of building facility and its use [8].

Escalators are most effectively used as a continuously running, unidirectional conveyor. Ample space for people must be provided at the entry and exit landings of an escalator. The escalator can feed people into an area [9] much more rapidly than they can climb a stairway or walk through

a restricted opening to leave that area. If an unloading area is restricted, people could be crowded into it. Such restrictions as doors or gates should be interlocked [10] with the escalator or ramp to ensure that the restriction is removed before the escalator can be run. Where escalators feed a restricted area such as a subway platform, security personnel must be alerted to the possibility of platform overcrowding if subway service is interrupted and instructed to stop the escalators.

In many localities a building can have fewer stairs if fire protective enclosures [11] are provided around the escalator. This enclosure must be equipped with sufficient doors and space at the landings for the doors to swing with the traffic and not impede prompt passenger transfer. When escalator traffic of any magnitude is expected its volume may reach the capacity limit of the unit and ample loading area must be provided. Means should be provided to automatically stop escalators which may travel into an area of the building endangered by a fire.

One of the attractions of an escalator is its continuous motion, providing service with zero interval in elevator terms. Normally people need not wait but may enjoy service the moment they reach the entry level. If the capacity of the escalator is exceeded, a wait may be necessary: however, the waiting time is readily apparent[12]. If more people are expected to arrive than the escalator system can handle, additional facilities, higher speed, or adequate alternative routes should be offered. Stairs adjacent to pair of escalators are an absolute necessity if the escalators are the primary means of entering or leaving [13] a building lobby.

Because escalators and walkways are usually driven by ac induction motors [14], operating speed is constant under load conditions and rating is at a single speed. The generally recognized escalator speeds are either 90 fpm (0.45 mps) [15] or 120 fpm (0.6 mps) along the incline. Faster escalators have been provided in some areas but their use is not common; the steps may move too fast for people to use them.

Very high-speed escalators are used in Russian and Ukrainian subway stations in cities such as Moscow, Kyiv, and St. Petersburg. This is due to the exceedingly high rises [16] in many of their stations, up to a record of 214 ft (65 m) in Kyiv. Speeds as high as 200 fpm (mps) are used to overcome the extremely long riding time and handling capacity is of secondary importance. Many escalators are equipped for two-speed operation by manual switching; these escalators

can be run at 120 fpm (0.6 mps) for the rush period and at 90 fpm (0.45 mps) during the rest of the day with the consequent reduction in operating mileage. The normal angle of incline of an escalator is 30°, give or take a degree or two for particular building conditions. In European countries, both 30° and 35° escalators are common, however the 35° escalator is limited to 90 fpm (0.45 mps).

The number of flat steps a passenger encounters upon entering an escalator is extremely important. A flat step is a step that is level with the preceding step prior to the step rising or depressing to form the incline. Observations have shown that the greater the number of flat steps, the more easily passengers adjust to the moving escalator and traffic handling ability is expedited [17]. This is to be expected since a person's stride is about 30 in. (750 mm) and two flat steps are about 32 in. (800 mm). The normal standard is one and one-third flat step. Additional flat steps can also be used for specific building conditions, such as lining up the newels of adjacent escalators.

VOCABULARY NOTES

[1] **moving walks** — рухомі доріжки
[2] **moving stairway and moving walkway types** — типи рухомих сходів і рухомих пішохідних доріжок
[3] **developmental work was begun on an accelerating moving walkway** — почала розвиватися робота з прискорення рухомих пішохідних доріжок
[4] **a handrail capable of matching the acceleration** — поручень, що рухався б відповідно до прискорення
[5] **to guide people in a given path** — спрямувати людей у потрібному напрямі
[6] **with a moving device** — за наявності рухомого пристрою
[7] **can be advantageously applied to any building** — можуть успішно застосовуватись у будь-якій будівлі
[8] **depends on the type of building facility and its use** — залежить від типу будівлі та її використання
[9] **the escalator can feed people into an area** — ескалатор може піднімати людей на місце
[10] **should be interlocked** — повинні бути взаємоузгоджені
[11] **fire protective enclosures** — протипожежні огорожі
[12] **the waiting time is readily apparent** — час очікування відносно невеликий
[13] **the primary means of entering or leaving** — основні засоби для входу й виходу

[14] **because escalators and walkways are usually driven by ac induction motors** — оскільки ескалатори й пішохідні доріжки звичайно приводяться в рух двигунами перемінного струму

[15] **90 fpm (0.45 mps)** — 90 футів на хвилину (0,45 метра за секунду)

[16] **this is due to the exceedingly high rises** — це зумовлюється винятково високими підйомами

[17] **traffic handling ability is expedited** — пропускна спроможність підвищується

ADDITIONAL TEXTS FOR DISCUSSIONS ON BRITISH CHARACTER, SCIENCE AND CULTURE

SOME ENGLISH BEHAVIOUR IN GENERAL

Almost every nation has a reputation of some kind. The French are supposed to be amorous, gay, fond of champagne; the Germans dull, formal, efficient, fond of military uniforms and parades; the Americans boastful, energetic, gregarious and vulgar. The British are reputed to be cold, reserved, rather haughty people, who do not yell in the street, make love in public, change their governments as often as they change their underclothes, or have revolutions. They are steady, easy-going and fond of sport. There is a common illusion, for instance, that the British are cold and reserved. A foreigner sitting in a second-class railway carriage, however, would soon realize that the British are just as friendly and warm-hearted as the people of his own country.

There are, however, certain kinds of behaviour, manners and customs which are peculiar to Britain, and are different from those of others.

In general the British are very polite in public. For example, if someone treads on your toe they will say «Sorry» or «Excuse me». Another example is queueing, which is governed by a strict code of fairness in Britain. Woe betide anyone who attempts to jump the queue!

On the other hand, British people eat in the cinema or theatre. Ice-cream, sweets, and nuts are sold at the cinema or theatre entrance or, during the interval, inside. In the cinema, the performances are continuous from eleven o'clock in the morning until eleven o'clock at night and one may enter the cinema at any time. There are, therefore, periodic intervals between the films, when ice-cream, chocolate, soft drinks and so on are sold. Smoking is allowed in all cinemas and in a few theatres.

The quiet, reserved Briton can best be observed at a football match. Naturally, the British shout and yell as much as any nation, especially if their side is losing. The crowd boos if it disapproves, and cheers if it approves of the team. Rattles, which make a harsh clattering sound, are carried, especially at the Cup Final, and rosettes are sometimes worn.

Cricket, on other hand, is not as popular as football, and is much quieter and more sedate.

More women began to smoke during the war. Women often smoke in the street in Britain. Before the war it was also unusual for women to accompany men to the public houses; nowadays, women often go with their menfolk to the *locat.* Incidentally, card-games are forbidden in pubs, but darts, dominoes, and shove-ha'penny are often played.

'Excuse me' is a phrase which often causes the foreigner difficulty. Getting off a crowded bus one says 'Excuse me, please' when one wishes to squeeze past someone. In a café, when asking if there is a place at the table.

'The Englishman's home is his castle', is a saying known all over the world; and it is true that English people prefer small houses, built to house one family, perhaps with a small garden. But nowadays the shortage of building land and inflated land values mean that more and more blocks of flats are being built, especially by the local Councils.

Englishmen do not, as a rule, like bright colours, outlandish hairstyles, very tight trousers, short shorts or exaggerated fashions. British people in general do not care much about clothes.

One last point which is difficult for foreigners to understand, is the English sense of humour. English humour is ironical, often directed against oneself in a self-critical way. It rests on verbal battles rather than on visual comedy. It is quite common to find good friends insulting each other in a verbal battle, each realising, however, that the other is merely pulling his leg. This is very common in families and a series of family jokes develops.

ENGLISH COMPROMISE

Courtesy, kindness, obligingness, tolerance, moderation, self-control, fair play, a cheerful temper, pleasant manners, calmness, stoicism, an extremely high degree of social civilization — these were the adorable things I discovered in the English when I first arrived in England. Gradually, however, I became aware of subtler characteristics and currents, not so adorable. In some cases, indeed, the very reverse of adorable.

Compromise. It is in their blood. It is the law of their organism. I won't go into its origins, which are probably geographical, and physical; what concerns me here is that it is so. The English compromise in every domain, as natural-

ly, inevitably, and unconsciously as the human lungs breathe air. Their constitution, their legal, social, industrial, economic systems are compromises. As a foreigner, these compromises do not affect me practically. It is the English who have to suffer for them not I. But when it comes to psychological and linguistic manifestations, I have a say in the matter, for I run up against them constantly in daily life, and they do not breed admiration or amity.

Because compromise is his fundamental cerebral process, the Englishman will not make up his mind at once on any question. He funks it. He'll patch it up, he'll snip bits out of it and stick bits on to it; he'll darn it and repair it and freshman it up; but he won't thrash it out, uproot it, and start again without it. There comes a time, eventually, when his maniacal ingenuity is defeated. Then he is cornered. At that point, he'll roll up his sleeves and do something new. But he will not meet his issues until he is cornered — until his back is painfully pressed against a wall, and a fist — but what losses, that trouble, what expenditure are incurred before things are set right — simply because he won't face facts in time.

I haven't an atom of sympathy for this disposition of his. It has led, leads, and will lead, to innumerable vexations, lettingdowns, misconceptions, blunders, and tragedies in international affairs.

For not only does his inveterate habit of compromise produce actions that look like an ugly chain of shameless volte-face, long enough to encircle the world, but his very speech is infected by it, so that he can't talk accurately. He has turned his splendid language into a series of stereotyped formulae. Translate, if you please, into any straightforward European tongue expressions like: «I am afraid not», «I would rather not», «I shouldn't say that», or the unsupportable «I don't mind». All translations would register pure dubiousness. Read abroad, they result, especially, in diplomatic relations, in a new crop of argumentations, wranglings, disappointed hopes, heart-burnings. But the Englishman himself is immensely surprised that the foreigner should not have immediately grasped that he just meant yes and no. And when he isn't understanding, he's overstanding. My gorge still rises when I hear someone tell me over the telephone that he is dying to see me.

On the Continent, political leaders in opposite camps fight with open weapons; they are stung, assaulted and battered by their adversaries wherever they meet, in the

street, in social assemblies just as much as in the Press and in Parliament. Their political enemies are also their social enemies. This attitude may seem brutal on the surface, but it is indispensable if we aim at consistency. In sheer and stark antagonism there is no undermining factor — no invisible foe to weaken the blood of resistance; no germ warfare to complicate issues. In England, hostile political leaders meet in each other's homes; they are welcomed and fed one by the other, and the socially more experienced of the two drugs the less-experienced one's wine. No amount of initial sincerity, wisdom or determination can protect the mind successfully against the continual flattery, the warm, kindly, polite, drop-drop-drop-drop of pleasant and hospitable social relations. They wear away the keenness of opposition, and are the most dangerous arms in English political life — handled, by the way, with unexampled mastery by the Conservative party. No, no; the human brain is not divided into water-tight compartments; you cannot be honest in one cell, and a prevaricator in others. This incessant shifting, equivocating, and juggling with values, destroy them at last. The inborn spirit of compromise has tainted the whole substance of the English character, and made it a detestable puzzle in the eyes of the races that think along straight lines. What wonder that it has engendered suspicion throughout the world, and given to England a reputation for hypocrisy, unreliability, and double-dealing that baffles the English themselves as much as it saps their prestige and thwarts their well-meant efforts?... Dear, likeable, self-fooling, preposterous John Bull! Whoever advised him to choose the lion as his national emblem? He should have been offered an ostrich with its head in the sand.

AN ENGLISHMAN'S WEEK

Most people in Britain work a five-day week, from Monday to Friday; schools, colleges and universities are also closed on Saturdays and Sundays. As Friday comes along, as people leave work they say to each other 'Have a nice weekend'. Then on Monday morning they ask, 'Did you have a nice weekend?'

Saturday morning is a very busy time for shopping, as this is the only day when people who are at work can shop for any length of time. On weekdays shops close between 5.30 and 6.00 p. m. and they are closed all day on Sunday, except for newsagents and some small grocers and confectioners.

Saturday evening is the favourite time for parties, dances, going to the pictures or the theatre, in fact for *going out* generally.

Sunday for many English families begins with the by now traditional *lie-in,* when, instead of getting up at 7.30 or at 8 o'clock, as during the rest of the week, most people stay in bed for at least another hour. During the mid-morning most people indulge in some fairly light activity such as gardening, washing the car, shelling peas or chopping mint for Sunday lunch, or taking the dog for a walk. Another most popular pre-lunch activity consists of a visit to a *pub* — either a walk to the *local,* or often nowadays a drive to a more pleasant *country pub* if one lives in a built-up area. It is unusual for anyone to drink a lot during a lunchtime *session,* the idea being to have a quiet drink and a chat.

Sunday has always been a favourite day for inviting people — friends, relations, colleagues — to afternoon tea, and there are no signs that this custom is losing popularity nowadays.

The British people are the world's greatest tea drinkers. They drink a quarter of all the tea grown in the world each year. Many of them drink it on at least eight different occasions during the day. They drink it at meals and between meals. They drink early-morning tea in bed, and some early-morning tea drinkers have automatic tea-making machines connected to their alarm clocks.

Some people spend Sunday evening quietly at home, others go to see friends, go to a concert or film, or go out for a drink. The realization that the weekend is nearly over casts a slight melancholy on the evening.

Much leisure time is spent in individualistic pursuits, of which the most popular is gardening. Most English people love gardens, their own above all, and this is probably one reason why so many people prefer to live in houses rather than flats. Particularly in suburban areas it is possible to pass row after row of ordinary small houses, each one with its neatly-kept patch of grass surrounded by a great variety of flowers and shrubs. Many people who have no gardens of their own have patches of land or *allotments* in specially reserved areas — though a group of allotment gardens, with its mixed-up collection of sheds for keeping the tools and the dull arrangement of the rectangular sections of land, is usually not a thing of beauty. Although the task of keeping a garden is so essentially individual, for many people gardening is the foundation of social and competitive relation-

ships. Flower-shows and vegetable-shows, with prizes for the best exhibits, are immensely popular, and to many gardeners the process of growing the plants seems more important than the merely aesthetic pleasure of looking at the flowers or the prospect of eating the vegetables. In many places a competitive gardener's ambition is to grow the biggest cabbages or leeks or carrots, and the plain fact that the merits of most vegetables on the table are in inverse ratio to their size seems often to be forgotten.

Every Englishman is a countryman at heart.

FOOD AND DRINK

According to American visitors, the most common meat dish in Britain is fillet of an old bedroom slipper. The more enlightened of the British would probably agree that neither their food nor the Americans' reached the standard of, say, the French cuisine. But the British think that their national disaster is not fillet of bedroom slipper, but boiled cabbage, which far too many hotels and restaurants turn into a watery, sodden mess.

In many homes meals are over-weighted by bread, potatoes and suet, although a good deal of propaganda has been in favour of a more *balanced diet*. The British also have a tendency to drown themselves in tea, although they are drinking more and better coffee than they used to. And, because they eat so many sweets and chocolates, they have almost the worst teeth in the world. Meals and meal-times vary slightly from family to family, but these are approximately, the eating habits of the British.

Between 6.30 a. m. and 7 a. m., one heroic member of the family gets up, makes a pot of tea, and takes a cup to the rest of the family, still lazing in bed.

Breakfast is ready between 7.30 and 8, or earlier, if any member of the family works in a factory which starts at 8. The British are divided into two classes, almost equal in numbers: those who eat a cooked breakfast, and those who do not.

The cooked breakfast can be rather good. The writer Somerset Maugham said: «If you want to eat well in England, eat three breakfasts daily». It starts with porridge, or cornflakes, or some other cereal (hotels offer fruit, or fruit juice, as well, at this stage); then there is bacon and egg, bacon and tomato, sausage, or smoked fish; then toast, butter and mar-

melade. And, of course, several cups of tea, though a minority drinks coffee at breakfast.

In the middle of the morning, most people have a cup of tea, or coffee, and perhaps a biscuit. Children all get a glass of milk at school. This snack is popularly known as *elevenses,* whether it is taken at 10.30, 11, or later; *morning coffee,* or *morning tea* are the more formal terms.

At one o'clock comes a meal which is dinner to some people, lunch to others. More than half population has a hot dinner in the middle of the day, and a meal misteriously called *high tea* at about half past five or six. Others have a light lunch at one, and a hot dinner at seven or half past seven.

This hot dinner is likely to be more or less the same whether it is eaten at one or seven. There are usually two courses. The first in often meat, which may be a stew, chops, meat pie, a roast joint if it is Sunday (and therefore cold meat if it is Monday), with potatoes and one other vegetable. Most families have fish for dinner at least once a week. The sweet may be fruit, fresh or stewed, fruit pie, jelly, ice cream, or, in families which want a really solid meal, a boiled pudding, made with flour, suet, etc., a rice pudding, or some other heavy dish. After this meal there is the inevitable cup of tea, or perhaps coffee.

Restaurants and eating places in Britain are not very different from those in other countries. But completely English, and unlike anything outside the British Isles, are inns and public houses. Inns are usually to be found in villages and small country towns.

Public houses, or *pubs,* are numerous in towns, and rare in the country. Their business is to sell alcoholic liquor, mainly by the glass. Some have a dining-room where you can get a meal, but you can never stay overnight at a pub.

LEISURE AND SPORTS

Attitudes for leisure have been much influenced by the modern love of moving around and by the ease of travel.

Britain is the only country in Europe, except Malta, where driving is on the left. There are 2,500 km of motorway (mostly six lanes) and over 2,500 km of dual carriageway (divided high-way). Since Britain has the highest density of traffic in the world, traffic jams during rush hours and at holiday times are fairly common.

Britain is also the only country in the Common Market whose employers are not forced by law to give their workers

paid holidays. However, many employers have written agreements with their workers giving them three or four weeks' holiday a year — not counting the eight days of national holiday.

Camping holidays in the proper sense of the word, with tents, are not so developed in England as on the continent. The summer weather too often can be very unpleasant for tent-dwellers. On the other hand, caravans, pulling them behind their cars, others hire caravans, already in position.

The British people may be conservative about the times at which they take their holiday, but they have shown themselves very ready to take to new places. Each year more English people become familiar with some part of continental Europe. Many take their cars, often with tents and caravans, crossing the Channel in ferries; others use the travel agents' scheme for group travel and hotel booking, some of them, regrettably, being taken to hotels which have been trained to provide English food. When they get home again they talk endlessly of these things, boasting of their bargains and complaining of what they were asked to pay for cups of tea.

There are holiday camps all round the coast of Great Britain. They are ideal places for people who do not want the effort of looking for entertainment. Trained staff look after the children so that the parents can have time off to enjoy themselves.

There are youth hostels in different parts of Britain. It is possible to arrange a walking or cycling tour, moving from hostel to hostel.

The English are great lovers of competitive sports. The game peculiarly associated with England is cricket. Many other games too are English in origin, but have been adopted with enthusiasm in other countries, but cricket has been seriously and extensively adopted only in the Commonwealth countries, particularly in Australia, New Zealand, India, Pakistan, Sri Lanka, the West Indies.

For the great mass of the British public the eight months of the football season are more important than the four months of cricket. Football is the most popular team game in Britain. The British invented it and it has spread to every corner of the world. There are plenty of amateur association football (or *soccer)* clubs, but professional football is big business. Every large town has at least one professional football club. The players are bought and sold between the clubs, and *transfer fees* can be equivalent to dozens of thousands of pounds.

There is no British team. England, Scotland, Wales and Northen Ireland compete separately in European and World Cup matches. The English and Welsh clubs have together formed a League with four divisions. The Scottish League has two divisions. The champions of the English First Division, and the Scottish Premier Division qualify to play in the European Cup competition.

Rugby football, or *rugger,* is played with an egg-shaped ball, which may be carried and thrown (but not forward). If a player is carrying the ball he may be *tackled* and made to fall down. Each team has fifteen players, who spend much time lying in the mud or on top of each other and become very dirty.

There are two forms of Rugby — Rugby Union, which is strictly amateur, and Rugby League, which is a professional sport. Rugby Union in played throughout the British Isles. There is an international championship between England, Scotland, Wales, Ireland and France. Rugby has become the national game of Wales, New Zealand, South Africa and the Pacific Islands of Fiji and Tonga.

Next to Association Football, the chief spectator sport in English life is horse racing. Partly because of the laws which forbid such activities on Sunday, most horse racing takes place on working days and during working hours.

One of the famous horse race meetings is the Grand National, which takes place at Aintree, near Liverpool, in March or April. It is England's main steeplechase (race over fences). The course is over seven kilometres and includes thirty jumps, of which fourteen are jumped twice. It is a dangerous race. Jockeys have been hurt and horses have been killed.

Britain was the first home of many of the modern world's most popular sports. The British cannot claim, today, that they have, as a nation, surpassing skill in any form of sport when they engage in international competition. But they care strongly about the *sporting spirit,* the capacity to play with respect for the rules and the opponents, to win with modesty and to lose with good temper.

POSTGRADUATE RESEARCH WORK AT ENGLISH UNIVERSITIES

The undergraduate course of studies at English universities is completed when students are ready to take their Degree examinations. After graduating they attain the first academic

degree or distinction of a Bachelor of Science or a Bachelor of Arts. Those that have a bent for research work may apply for an advanced course of study extending over not less than two academic years for full-time postgraduates and not less than three academic years for part-time graduate students. A Ph. D. course in the United States can seldom be completed in less than four years even by a very brilliant student. The fact is that an American graduate student is usually forced to complete a relatively large number of lecture-courses and examinations before he can even apply for permission to submit a thesis. Some of this lecture-work represents material that the British undergraduate would have covered in his last year.

The British graduate who wants to do research and can get himself accepted by a university at all can cover his living expenses and fees by means of scholarship or a government grant without being specifically required to do any teaching or other work outside his research. Indeed, strict limits are usually set on the amount of teaching he may do, and other work is often forbidden altogether. This contrasts very strongly with the position of the American graduate student, who for the most part is obliged to take some parttime job. Thus he may be appointed *a graduate-assistant* by his department. A typical stipend would be 1,500 dollars a year, for which he is expected to give almost as much time to teaching as does a full member of the staff. This will usually consist mainly of laboratory demonstrating and supervising classes held in conjunction with the lectures and nearly always includes some formal lecturing. Add to this that a graduate student also has to pass various examinations and to pile up a fairly impressive record of attendance at advanced lectures as well as keeping himself informed in his own special field, and the wonder is that he has time for original thought at all.

Every postgraduate working on a research problem is provided with an adviser and referees for the refereeing and evaluation of his thesis.

On completing his course of study every candidate must submit a thesis which must comply with the following conditions:

a) The greater portion of the work submitted therein must have been done subsequently to the registration of the student as a postgraduate.

b) It must form a distinct contribution to the knowledge of the subject and afford evidence of originality, shown either

by the discovery of new facts or by the exercise of independent critical power.

A candidate will be also required to forward a short abstract of his thesis comprising not more than 300 words.

If the thesis is satisfactory on all points the candidate will be awarded the degree of Doctor of Science or a Ph. D. and will continue his work in the academic field.

ANDREW'S FIRST STEPS TO SCIENCE

«Sunk!» he muttered dismally. «Right bang off. I told you it was an impossible exam. There's a preliminary paper in languages. Four languages: Latin, French, Greek, German — and two of them are compulsory, before you can even sit the cursed thing. I don't know languages. All the Latin I know is dog lingo: *mist, alba — mitte decem.* As for French —»

She did not answer. There was a silence while he stood at the window gloomily considering the emply view. At last he turned, frowning, worrying, unable to leave the bone alone.

«Why shouldn't I — damn it all, Chris — why shouldn't I learn these languages for the exam?»

They made plans excitedly all day. They cleared the sitting-room for action. And that evening he went to school with her. The next evening and the next ...

Sometimes Andrew felt the sublime pathos of it, heard from afar off the mocking laughter of the gods. Sitting over the hard table with his wife, in this remote Welsh mining town, muttering after her *caput — capitis,* or *Madame, est-il possible que...*, wading through declensions, irregular verbs, reading aloud from *Tacitus* and a patriotic reader they picked up. *Pro Patria* — he would jerk back suddenly in his chair, morbidly conscious.

He had only the long nights in which to study. Sustained by black coffee and a wet towel round his head he battled on, reading into the early hours of the morning. When he fell into bed, exhausted, often he could not sleep. And sometimes when he slept he would awake, sweating from a nightmare, his head ablaze with terms, formulae, and some driveling imbecility of his halting French. His brain was inactive, almost dull. He felt that he knew nothing.

Yet, on the following day, when he began the written part of the examination which was held at the College of Physicians, he found himself answering the papers with a blind auto-

matism. He wrote, never looking at the clock, filling sheet after sheet, until his head reeled.

After the written papers, the practical and *viva voce* part of the examination began: and Andrew found himself dreading this more than anything which had gone before. There were perhaps twenty other candidates all of them men older than himself, and all with an unmistakable air of assurance and position. The candidate placed next to him, for instance, a man named Harrison, whom he had once or twice spoken to, had an Oxford B. Ch., an outpatient appointment at St. John's and a consulting-room in Brook Street. When Andrew compared Harrison's charming manners and obvious standing with his own provincial awkwardness he felt his chances of favourably impressing the examiners to be small indeed.

A few minutes later Andrew went downstairs with the other candidates. At the foot of the stairs beside his leather-hooded cave a liveried porter stood with a little pile of envelopes before him. As the candidate, next to Andrew, tore his open quickly, his expression altered; he said quietly, «It would appear I'm not wanted tomorrow». Then, forcing a smile, «How about you?» Andrew's fingers were shaking. He could barely read. Dazedly he heard Harrison congratulate him. His chances were still alive. He walked down to the A. B. C. and treated himself to a malted milk. He thought tensely, «If I don't get through now, after all this, I'll walk in front of a bus».

At last it was over. Dear God, he had *done* it! He was alive again, gloriously alive, his headache gone, all his weariness forgotten. As he dashed down to the nearest post office his heart sang wildly, madly. He was through, he had done it, not from the West End of London, but from an outlandish mining town. His whole being was a surging exaltation. It hadn't been for nothing after all: these long nights, these mad dashes down to Cardiff, these racking hours of study. On he sped, bumping and cannoning through the crowds, missing the wheels of taxies and omnibuses his eyes shining — racing, racing to wire news of the miracle to Christine.

ON NOT KNOWING ENGLISH

When I first came to England in 1938 I thought I knew English very well. In Europe my English was quite good.

In England I found two difficulties. First: I did not understand people. Secondly: people did not understand me.

It was easier with written texts. Whenever I read a leading article in *The Times,* I understood everything perfectly well, except that I could never understand whether *The Times* was for or against something.

The first step in my progress was when people started understanding me while I still could not understand them. This was the most talkative period in my life. I reached the stage of intelligibility fairly quickly, thanks to a friend of mine who discovered an important secret, namely that the English mutter and mumble. Once we noticed a thing in a shop window which looked like sausage and was marked pork brawn. We decided to buy some for our supper. We entered the shop and I said: «A quarter of pork brawn, please». «What was that?» asked the shopkeeper looking at me. «A quarter of pork brawn, please», I repeated, still casually. I repeated it again. I repeated it a dozen times with no success. I talked slowly and softly; I talked as one talks to the deaf and finally I tried babytalk. The shopkeeper still had no idea whether we wanted to buy or sell something. Then my friend had a brainwave. «Leave it to me», he said and started mumbling under his nose in a hardly audible manner. The shopkeeper's eyes lit up: «I see», he said happily, «you want a quarter of pork brawn. Why didn't you say so?»

But time passed and my knowledge and understanding of English grew slowly, until the time came when I began to be very proud of my knowledge of English. Luckily, every now and then one goes through a sobering experience which teaches one to be more humble. Some years ago my mother came here on a visit. She expressed her wish to take English lessons. I accompanied her to the school and we were received by a clerk. I said that we were interested in the class for beginners. I received all the necessary information and had a lengthy conversation with the man, in the belief that my English sounded perfectly well. Finally, I paid the fees for my mother. He looked at me with astonishment and asked: «Only for one? And what about you?»

THEY SPEAK ENGLISH TOO

«Thank heavens we won't have to worry about making ourselves understood on this trip», you think as you board an English liner, bound for Liverpool. «No need for interpreters or a 700 page dictionary again». But scarcely six hours pass before your high spirits begin to sink as you notice

that your English fellow-passengers do not speak the same after all.

At dinner the very first night, your eyes note the word «maize» on the menu. «Maize», you mutter, «Maize a color — appearing on a menu»?

A friendly Englishman next to you explains helpfully, «Maize» is what you Americans call Indian corn».

«Oh, corn», you smile understandingly.

«No, not just corn — but Indian corn», he patiently explains.

«Corn, to us, refers to wheat, rye, or barley».

You laugh weakly, daring no further remarks until you reach *dessert*. This you find does not mean the whole last course, but includes fruits only and is served after the course referred to as the *sweets*. In the *sweets* course are listed all the puddings, pastries and cakes you have always called *dessert*.

At breakfast, the biscuits turn out to be merely our *crackers*, yet should you ask for *crackers* the waiter would be horrifed, for *crackers* to him mean only *fire crackers* (most indigestible food, you'll agree).

As you retire that evening the stewardess reminds you to put out your *boots* to be cleaned. You thank her kindly, remarking, however, that you have only *shoes* with you. But a few moments of conversation reveal the fact that you are both talking about the same thing. Oddly enough, in England, a *shoeblack* polishes your boots, while in America *bootblack* polishes our *shoes*.

Two days later you confide to one of your fellow passengers how *ill* you were as a result of the storm the day before. *Ill* she exclaims sympathetically, «what was the trouble — stomach ache, headache»?

«Why no», I meant seasick, of course. «Whereupon it is her turn to be surprised — for one never refers to seasickness as illness». Should you have the flu, the grippe, or even a cold, you may be ill. But when that disturbing condition resulting from sea motion or any sensation like that is discussed, then, and then only, may you be *sick*.

Shortly after landing you start out from your hotel to visit the places of interest. You soon find yourself applying to the *Bobby* (policeman in America) for information or directions. If your destination is within walking distance, he'll probably say, *First turning* (never block) *right* or *second turning left*. If it's a greater distance away, he'll suggest a *tram* (our trolley or streetcar) or the *underground* or *tube* (never subway).

You won't be in London many days before you find your vocabulary changing. You no longer mail letters by dropping them into a mail box, you *post* them by dropping them into one of the red *pillar-boxes* that stand on the corners of the streets, you never stand in a line to buy anything, you stand in a *queue,* and you no longer reckon your weight in pounds, but in *stones.* An Englishman does not say he weighs 162 pounds, he says, «I weigh 11 stone 8».

Your first shopping experiences are rather annoying. Department stores in English are called *general* or *multiple* shops. In fact you do not go to a store to buy things, you go to a *shop.* The salesman is called a *shopassistant,* never a *clerk.* This word is applied to bookkeepers and office workers, and rhymes with *park.*

Exhausted from the shopping, you stop for tea at the nearest tea shop. You sink into a chair and order pie and tea with a pitcher of cream.

The waitress looks at you in astonishment, then timidly asks, «Beg pardon, madam, but are you sure that's what you really want?»

Realizing that again you have made a mistake, you patiently explain, and to your surprise discover that *pie* refers only to meat pies in other words, a main dish, never served at tea; while tea itself is served with a *jug* of milk or cream. There are no pitchers in England, only *jugs* (for water, cream, or milk) which serve the same purpose.

While you ask for your tea, you pick up your copy of the London *Observer.* There is an article about the strike of some employees of the *black coat class* for *forthight* holidays with pay. After carefully reading every word of it, you gather that the *white collar class* wants two weeks' vacation with pay.

With a deep sigh, you put down the paper, and when your waitress approaches, ask where the nearest bookshop is located which sells English dictionaries.

ERNEST RUTHERFORD — BRITISH PHYSICIST (1871—1937)

Rutherford's father was a wheelwright and farmer, and Rutherford worked on the farm. He showed great promise at school and in his teens gained a scholarship to New Zealand University, where he finished fourth. In the university he became interested in physics and developed a magnetic

detector of radio waves. He was completely uninterested in the practical applications of his discoveries.

In 1895 came the turning point, for he received a scholarship to Cambridge University.

At Cambridge he worked under J. J. Thomson. Then, after a short period at McGill University in Montreal, Canada, and a trip to New Zealand to get married, he returned to England.

Hard on the heels of Becquerel, Rutherford began work in the exciting new field of radioactivity. He was one of those who, along with the Curies, had decided that the rays given off by radioactive substances were of several different kinds. He named the positively-charged ones alpha rays and the negatively-charged ones beta rays. These names are still used, except that both are now known to consist of speeding particles, so one often speaks of alpha particles and beta particles instead. When in 1900 it was discovered that some of the radiations were not affected by a magnetic field, Rutherford was able to demonstrate them to consist of electromagnetic waves and named them gamma rays.

Between 1906 and 1909 Rutherford, together with his assistant, Geiger, studied alpha particles intensively and proved conclusively that the individual particle was a helium atom with its electrons removed. The alpha particles were like the positive rays that had been discovered by Goldstein, and in 1914 Rutherford suggested that the simplest positive rays must be those obtained from hydrogen and that these must be the fundamental positively-charged particle. He called it a proton.

Rutherford's interest in alpha particles led to something greater still. In 1906, while still at McGill in Montreal, he began to study how alpha particles are scattered by thin sheets of metal. He continued these experiments in 1908, when back in England working at Manchester University.

From his experiments Rutherford evolved the theory of the nuclear atom. He maintained that the atom contains a very tiny nucleus at its center which is positively charged and which contains all the protons of the atom and therefore virtually all of its mass. In the other regions of the atom are the negatively-charged electrons which are very light and which interpose no detectable barrier to the passage of the alpha particles.

This view of the atom is the one accepted today.

For working out the theory of radioactive disintegration of elements, for determining the nature of alpha particles,

for devising the nuclear atom Rutherford was awarded the 1908 Nobel Prize in chemistry.

In 1917 Rutherford got to work in earnest on quantitative measurements of radioactivity.

Rutherford was thus the first man ever to change one element into another as a result of the manipulations of his own hands. He had achieved the dream of the alchemists. He had also demonstrated the first man-made «nuclear reaction». However, only one alpha particle in about 300,000 interacted with the nuclei, so it wasn't a very practical form of transmutation. By 1924 Rutherford had managed to knock protons out of the nuclei of most of the lighter elements.

Rutherford accepted a professorship of physics at Cambridge in 1919, and was president of the Royal Society from 1925 to 1930.

After 1933 he was violently anti-Nazi in his sympathies.

Toward the end of his life he expressed himself as quite doubtful that the vast energy of the atomic nucleus, as made evident in radioactivity, could ever be controlled by man. In this he was overtly conservative (as he was in his reluctance to accept Einstein's theory of relativity). However, he died two years before the discovery of uranium fission by Hahn and so was not to know how wrong he was in this respect.

ENGLISH PROVERBS AND SAYINGS FOR USE IN EVERYDAY LIFE

Find Ukrainian equivalents of the following proverbs and sayings; explain their meaning in your own words; make up situations to use them in:

1) every cloud has its silver lining; 2) a drowning man will catch at a straw; 3) first catch your hare, then cook him; 4) to draw water in a sieve; 5) there is no use crying over spilt milk; 6) who shall agree when doctors differ; 7) all is well that ends well; 8) it's cat's concert; 9) don't build fire under yourself; 10) he that would not when he might could not when he willed aright; 11) put not your hand between the bark and the tree; 12) go while the going is good; 13) one fire drives out another; 14) he will not set the Thames on fire; 15) a nod is as good as a wink; 16) don't make a mountain out of a molehill; 17) as you sow you will mow; 18) they are tarred with the same brush; 19) a good lather is half a shave; 20) honey is not for the ass's mouth; 21) every heart knows its own bitterness; 22) accidents will

happen in the best regulated families; 23) no time like present; 24) out of sight, out of mind; 25) lookers-on see more than players; 26) it's written all over his face; 27) it is dogged that does it; 28) it came like a bolt from the sky; 29) as you make your bed, so you'll sleep in it; 30) a little body may have a great soul; 31) one's eye is bigger than one's belly; 32) it's no go; 33) between friends all is common; 34) no great loss without some small gain; 35) he that will eat the kernel must crack the nut; 36) he that has a great nose thinks everybody is speaking of it; 37) the darkest hour is nearest the dawn; 38) fault is thick where love is thin; 39) a miss is as good as a mile; 40) nothing comes out of the sack but what was in it; 41) the morning sun never lasts a day; 42) a bargain is a bargain; 43) nothing so bad, as not to be good for something; 44) all cats are grey in the night; 45) a cat in gloves catches no mice; 46) second thought is best; 47) a wonder lasts but nine days; 48) the receiver is as bad as the thief; 49) all is not gold that glitters; 50) experience keeps no school, but teaches her pupils singly; 51) you can't make omelettes without breaking eggs; 52) between the hand and the lip a morsel may slip; 53) charity begins at home; 54) the last straw breaks the camel's back; 55) idleness is the mother of all mischief; 56) what you lose on the swings you win on the roundabouts; 57) fear has a thousand eyes; 58) enough is as good as a feast; 59) it is double-Dutch to me; 60) everybody's business is nobody's business; 61) care killed a cat; 62) all talk and no cider; 63) he that has a tongue in his head may find his way where he pleases; 64) let every tub stand on its own bottom; 65) can the leopard change his spots?; 66) the voice of one man is the voice of no one; 67) threatened men live long; 68) better to slip with the foot than with the tongue; 69) promises are like pie-crust, made to be broken; 70) still waters run deep; 71) don't cast pearls before swine; 72) zeal without knowledge is fire without light; 73) he needs a long spoon who sups with the devil; 74) half a loaf is better than no bread; 75) beauty is in the eyes of the gazer; 76) he that mischief hatches mischief catches; 77) you may as well be hanged for a sheep as for a lamb; 78) well begun is half done; 79) a stitch in time saves nine; 80) nothing venture — nothing have; 81) as sure as eggs is eggs; 82) nothing falls into the mouth of a sleeping dog; 83) between saying and doing there is a long road; 84) don't foul the well, you may need its waters; 85) forewarned is forearmed; 86) practice makes perfect; 87) constant dropping will wear away the stone; 88) scratch my back and I'll

scratch yours; 89) land was never lost for want of an heir; 90) so got — so gone; 91) he who sows the wind will reap the whirlwind; 92) every cook praises his own broth; 93) it is the first step that counts; 94) a singed cat may be better than he looks; 95) you must take the rough with the smooth; 96) don't cross your bridges before you come to them; 97) it is enough to make a cat laugh; 98) the pot calls the kettle black; 99) there is life in the old dog yet; 100) the silly head will never save the fingers; 101) a trouble shared is half a trouble; 102) let George do it; 103) no living man all things can; 104) best is the enemy of good; 105) reap as you have sown; 106) a watched pot boils long; 107) a bird may be known by its song; 108) no sooner said than done; 109) roll my log and I'll roll yours; 110) every dog has his day; 111) one man's meat is another man's poison; 112) better to be a big fish in a small pond than a minnow in the ocean; 113) you cannot teach an old dog new tricks; 114) a burden of one's choice is not felt; 115) actions speak louder than words; 116) it is caviar to the general; 117) strike while the iron is hot; 118) so long goes the pot to the water, till at last it comes home broken; 119) put it in your pipe and smoke it; 120) birds of a feather flock together; 121) let sleeping dogs lie; 122) once bit, twice shy; 123) one leg of mutton helps down another; 124) too many cooks spoil the broth; 125) you can't eat your cake and have it; 126) envy keeps no holiday; 127) bears have all the luck; 128) do in Rome as the Romans do; 129) when the cat is away, the mice will play; 130) time and tide wait for no man; 131) you can't make a silk purse out of a sow's ear; 132) that's a horse of another colour; 133) give him an inch and he will take an ell; 134) faint heart never won fair lady; 135) his geese are all swans; 136) don't whistle before you are out of the wood; 137) look twice before you leap; 138) much water has flown under the bridge; 139) there is no smoke without fire; 140) the game is not worth the candle; 141) he laughs best who laughs last; 142) in at one ear out at the other; 143) two heads are better than one; 144) never put off till tomorrow what you can do to-day; 145) one bird in the hand is worth two in the bush; 146) no news is good news; 147) speech is silver but silence is gold; 148) there is no place like home; 149) the nearer the bone the sweeter the meat; 150) make hay while the sun shines; 151) it is waste of time giving tracts to the missionary; 152) to know which side one's bread is buttered; 153) cut your coat according to your cloth; 154) a grain of wheat in a bushel of chaff; 155) more haste less speed; 156) to give the sheep in care of the wolf; 157) to

knock at an open door; 158) don't cry before you are hurt; 159) so many countries, so many customs; 160) to rest on one's laurels; 161) once in a blue moon; 162) like water off duck's skin; 163) the later love comes, the more it burns; 164) all in good time; 165) Rome was not built in a day; 166) diamond cut diamond; 167) hunger is the best sauce; 168) you made the broth, now sup it; 169) to take the counsel of one's pillow; 170) not to see the wood for the tress; 171) least said soonest mended; 172) as like as chalk and cheese; 173) to build castles in the air; 174) the biter being bit; 175) to call a spade a spade; 176) to come for wool and go shorn; 177) not the only pebble on the beach; 178) fifth wheel of a coach; 179) the ball comes to the player; 180) to rob Peter to pay Paul; 181) born with a silver spoon in one's mouth; 182) to swallow a laughing bone; 183) a bull in a china shop; 184) to carry owls to Athens; 185) to pay one in coin; 186) as shy as an oyster; 187) that cock won't fight; 188) to put the cart before the horse; 189) to comb one's hair the wrong way; 190) to take one at his word; 191) not to turn a hair; 192) to take someone into a secret; 193) to run with the wind; 194) when two Sundays join together; 195) better see rightly on a pound than squint on a million; 196) thievish as a cat and timid as a hare; 197) a storm in a tea-cup; 198) the echo responds to the call; 199) to know like the palm of one's hand; 200) ask no questions and you will be told no lies.

ДОДАТКИ

Додаток 1

КОРОТКИЙ ЛЕКСИКО-ГРАМАТИЧНИЙ ДОВІДНИК

І. ЛЕКСИКО-СЕМАНТИЧНІ ОСОБЛИВОСТІ СТИЛЮ НАУКОВО-ТЕХНІЧНОЇ ЛІТЕРАТУРИ

І.1. Термін як основа науково-технічного стилю

Для правильного розуміння англомовного науково-технічного тексту та його адекватного перекладу українською мовою спеціаліст з технічною освітою повинен мати певну підготовку в галузі лінгвістики й техніки перекладу. Працюючи з науково-технічним текстом, він має розуміти значення наявних у тексті граматичних конструкцій, лексичних особливостей тощо.

Наукова (технічна) комунікація відрізняється значною мірою від побутової не тільки своїм змістом, а й засобами вираження й семантикою лексичних одиниць, граматичною структурою речень.

Науково-технічні тексти відрізняються також від художніх. Для них характерна велика кількість складних речень і конструкцій, тут широко вживаються підрядні речення, інфінітивні, діеприкметникові та герундіальні звороти тощо.

Основною ознакою науково-технічного тексту є його насиченість термінами і термінологічними словосполученнями, реаліями (назви фірм, підприємств, марок устаткування тощо), кліше і т. д. Така насиченість текстів спеціальними термінами, особливо неологізмами, становить значні труднощі для розуміння й перекладу. Насиченість термінами зумовлена природою науково-технічної комунікації й підтверджує те, що терміни за своєю природою є найбільш плинним, рухомим шаром словникового складу мови, який безперервно поповнюється неологізмами. В науково-технічній літературі, яка за своєю сутністю повинна відображати найновіші досягнення науки і техніки, неологізми становлять відносно високий процент лексики.

Що ж таке термін, які шляхи і способи його творення й поповнення? *Термін* — це слово або словосполучення, що вживається в тій чи іншій галузі науки або техніки

і виражає наукове поняття. Слова-терміни мають деякі особливості порівняно з іншими словами, а саме: точність, однозначність, незалежність від контексту. Важливою особливістю терміна, як і науково-технічної літератури в цілому, є відсутність емоційного забарвлення. Однак це тільки в ідеалі. В порівняльному плані слід відзначити, що стиль науково-технічної літератури англійською мовою допускає певну образність, якої практично немає у відповідних текстах українською мовою. В перекладі англійські образні вислови слід замінювати емоційно-нейтральними виразами.

Терміну притаманні певною мірою всі властивості загальновживаного слова. Багато термінів грішать такими недоліками, як багатозначність (один термін має два або більше значень), синонімія (для одного поняття є два або більше термінів) тощо.

Науково-технічна термінологія неоднорідна. Вона містить:

1) значну кількість загальновживаних слів, які, крім своїх основних значень, набувають в певній сфері науки чи техніки специфічних (термінологічних) значень. Наприклад, загальновживане слово *head* (голова, керівник) у журналістиці має значення *рубрика, заголовок;* у гідротехніці — *гідростатичний напір,* у будівельній техніці — *верхній брусок рами вікна або дверей;* у машинобудуванні — *бабка* (верстата) і деякі інші. Таке явище, коли загальновживане слово набуває певного термінологічного значення, називається *термінологізацією;*

2) загальнотехнічні (загальнонаукові) терміни, що виступають у кількох галузях науки і техніки. Наприклад, *rectifier* в електротехніці означає *випрямляч,* у радіотехніці — *детектор,* у хімії — *ректифікатор;*

3) спеціальні терміни, що належать тільки одній якійсь галузі науки чи техніки. Наприклад, *antenna — антена* (радіотехніка). Виділяють ще вузькоспеціальні терміни, тобто терміни, які мають значення, характерні для якоїнебудь спеціальності певної галузі.

Отже, при перекладі їх необхідно перевіряти (в сумнівних випадках) за допомогою термінологічних словників і відшукувати потрібне значення. Цієї вимоги слід дотримуватись і у разі багатозначності термінів з однієї і тієї самої галузі. Так, термін *plug* у радіотехніці має значення: 1. штепсель; 2. штиковий контакт; 3. штекер. При знаходженні правильного значення багатозначних термінів, як і у випадку багатозначних загальновживаних слів, потрібно

спиратися на контекст, в якому конкретизується значення багатозначного слова. Наприклад, широковживаний у радіотехніці термін *circuit* вживається в значеннях *контур, схема, коло, сітка*. Тільки контекст розкриє його значення в конкретному випадку.

У мові є багато шляхів поповнення терміносистем. Нижче ми розглянемо їх докладно.

І.2. Функціональне використання засобів термінологічної номінації *

Науково-технічний прогрес безпосередньо впливає на функціонування, розвиток і взаємодію мов світу, на безперервний світовий лінгвістичний процес. Найяскравіше цей вплив виявляється в розвитку суспільних функцій конкретних мов, а також в активізації термінологічних систем та їх безперервній диференціації. Науково-технічна й суспільно-політична термінології в сучасний період становлять найдинамічнішу частину лексико-семантичної системи мови.

Прискорений науково-технічний прогрес і потік інформації зумовлюють радикальні зміни в багатьох наукових дисциплінах і виникнення нових галузей знань. У результаті різко збільшується потреба в номінації, на наших очах відбувається *термінологічний вибух,* тобто масове виникнення нових термінологічних полів і цілих термінологічних систем, зміни в галузевих термінологіях.

Цей термінологічний вибух, деякою мірою стихійний процес, потребує перетворення на керований, стабільний процес. Стандартизація й уніфікація термінологій, упорядковане використання термінів, адекватний їх переклад різними мовами із збереженням певних мовних норм є актуальним завданням, що стоїть перед мовознавцями. Досить важливими є питання термінознавства й аналізу структурно-семантичних особливостей термінологічних систем різних мов, у цьому випадку англійської, в нових галузях знань.

Потребують розробки основні питання термінознавства, визначення його місця в системі лексико-семантичних одиниць мови, виділення термінотипів і визнання їх структурних і функціональних особливостей.

Аналіз термінологічної системи сучасної англійської мови, як і інших мов, дає змогу встановити, що розвиток

* Автор цього розділу — проф. Г. П. Ятель.

і вдосконалення цієї системи відбувається за рахунок поповнення таких структурних типів: непохідних слів, похідних слів, абревіатур, складних слів, словосполучень (найпродуктивніший тип).

Серед цих структурних типів чільне місце належить словосполученням-термінам, які становлять досить продуктивний синтаксичний спосіб терміноутворення. Ускладнення цієї логіко-понятійної системи потребує великої кількості словосполучень-термінів, різних за обсягом, структурою, семантичним наповненням.

Функціональне використання термінологічних словосполучень базується не лише на використанні готових, структурно-семантичних одиниць рівня словосполучення, а й на базі включення в терміносистему різних оказійних лексико-граматичних утворень. Для англійської мови, наприклад, характерним є розширення функціонування різних прийменникових структур у складі словосполучень-термінів, закріплення їх не лише в мовній практиці, а й у двомовних і тлумачних словниках.

У процесі розшарування прийменникового словосполучення типу «дієслово + прийменник + іменник чи будь-яка субстантивована форма» виникли усталені прийменникові групи: препозитивна, тобто «прийменник + іменник», і постпозитивна, тобто «дієслово чи віддієслівна форма + + прийменник». На їх основі виник цілий ряд словосполучень-термінів, до складу яких вони входять як усталені компоненти.

На матеріалі такої динамічної категорії, як термінологія обчислювальної техніки, чітко видно, як відбувається процес входження стійких прийменникових груп типу «прийменник + іменник» до складу термінологізованих словосполучень. Так, препозитивна група, компоненти якої адвербіалізувалися (тобто набули рис прислівника), входить, наприклад, до складу таких термінологічних одиниць: on-line debugging (відлагодження в режимі онлайн), off-line equipment (автономне обладнання), in-house equipment (власне обладнання), in-line equipment (обладнання, що працює в лінії), on-chip testing (тестування на кристалі). Адвербіалізовані прийменникові звороти нерідко виступають в атрибутивній функції як еквіваленти прикметників, наприклад: on-site (місцевий, власний), in-plant (розташований у тому самому помешканні) і т. п.

Постпозитивна прийменникова група, тобто сполучення дієслівного чи віддієслівного елемента з прийменником, компоненти якого зазнали стягнення, нерідко входить до

термінологізованих одиниць, наприклад: reach-through hole (наскрізний отвір), stuck-at fault (контактна несправність) і т. д.

Словосполучення типу «прикметник + прийменник + + прикметник», що зустрічаються в художній літературі рідко, часто входять як компоненти до складу словосполучень-термінів у галузі обчислювальної техніки. До їх складу входять прикметники чи іменники в атрибутивній функції як доприйменникові і післяприйменникові елементи: binary-to-decimal conversion (перетворення двійкового коду на цифру), decimal-to-numeric translator (перетворювач десяткового коду на цифру), keyword-in-context index (покажчик ключових слів програми), man-to-computer language (мова людсько-машинного спілкування), card-to-card conversion (перенесення даних з перфокарти на іншу перфокарту) і т. п.

Прийменник, що входить до складу наведених вище термінологічних структур, по суті, втрачає свою основну синтаксичну функцію засобу двостороннього синтаксичного зв'язку і перетворюється на словотворчий формат.

Таким чином, загальномовні процеси, що відбуваються на сучасній стадії розвитку мови, знаходять повне відображення в такій мобільній синтактико-семантичній категорії, як словосполучення-терміни.

Процесс перерозкладання синтаксичних зв'язків усередині прийменникового словосполучення, характерний для сучасної англійської мови взагалі, неминуче приводить до утворення лексико-граматичних одиниць нового типу в галузі терміноутворення. Ті динамічні процеси, які характерні для розвитку й удосконалення синтаксичної будови мови взагалі, знаходять відображення в підмовах типу терміносистеми.

Основними способами утворення термінів у сучасній англійській мові є синтаксичний, семантичний і морфологічний, а також запозичення з інших мов і галузевих терміносистем.

1.3. Термінолексика, утворена морфологічним способом

В англійській мові багато термінів виникло (і продовжує виникати) шляхом морфологічного словотворення: афіксації, тобто додаванням до кореня слова суфікса або префікса, конверсії і словоскладання. Отже, під час читання й перекладу істотну роль відіграє знання значень суфіксів,

префіксів і словотворчих моделей. Слово може мати один або кілька афіксів, наприклад: un-real-ist-ic-al-ly — нереалістично.

Ось деякі з основних афіксів:

Префікси та їх значення*

anti- анти-, проти-: antibody — антитіло, antiphase — у протифазі

co- спільність дії: co-alignment — узгоджена установа, co-exist — співіснувати

counter- проти-: countercurrent — струм протилежного напряму

de- де-, роз-: deactivation — деактивізація, debunching — розгрупування

dis- роз-: discharge — розряджати, розвантаження

extra- над-, понад-: extra-heavy pipe — потовщена труба (понад норму)

inter- між-, взаємо-: interstage — між контурами, interconnection — взаємодія

mis- не- (заперечне значення): instability — нестабільність

over- понад- (пере-): overcharge — перезаряд, перевантаження

re- повторність, пере-: recall — повторний виклик, reset — переключення

sub- суб-, під-, нижче-: subharmonic — субгармоніка, subcarrier — піднесуча (частота), sub-zero — низькотемпературний

super- пере-, (по)над-: superconductivity — надпровідність, supersaturation — перенасичення

trans- транс-, пере-: transverter — трансвертер, transplant — пересадити

ultra- (по)над-, ультра-: ultrafast — надшвидкий, ultrasonic — ультразвуковий

un- не-/роз-, без-: unoriented — неорієнтований, uncouple — роз'єднувати

under- недо-: undermodulation — недостатня модуляція.

Суфікси **, що вживаються для творення термінів, такі як: **-um** (deuterium), **-ite** (pentolite), **-ant** (coolant), etc. практично переводять слово до іншої лексико-морфологічної категорії, тобто вказують лише на частину мови, до

* Див. Додаток 2.
** Див. Додаток 2.

якої належить термінологічне слово, своїх семантичних значень не мають і в плані перекладу істотних труднощів не викликають.

В англійській науково-технічній літературі часто зустрічаються прикметники латинського походження, які мають відповідні англійські іменники. Такі гетерогенні іменниково-прикметникові пари становлять певні труднощі для розуміння і перекладу. Наведімо деякі з таких пар:

body — corporal	тіло — тілесний
brain — cerebral	мозок — мозковий
citizen — civil	громадянин — цивільний
city — urban	місто — міський
earth — terrestrial	земля — земний
father — paternal	батько — батьківський
gender — generative	рід — родовий
gold — auric	золото — золотий
hand — manual	рука — ручний
head — capital	голова — головний
heart — cordial	серце — сердечний
heat — thermal	тепло — тепловий
house — domestic	дім — домашній
iron — ferrous	залізо — залізний
king — royal	король — королівський
law — legal	закон — законний
letter — literal	буква — буквений
light — luminous	світло — світлий
life — vital	життя — життєвий
lips — labial	губи — губний
man — masculine	чоловік — чоловічий
man — human	людина — людський
mind — mental	розум — розумовий
money — monetary	гроші — грошовий
mother — maternal	мати — материнський
mouth — labial	губа — губний
sea — maritime	море — морський
side — lateral	бік — бічний
sky — celestial	небо — небесний
son — filial	син — синівський
star — astral	зірка — зоряний
sun — solar	сонце — сонячний
time — temporal	час — часовий
tongue — lingual	мова — мовний
tooth — dental	зуб — зубний
wave — undulatory	хвиля — хвилястий
war — military	війна — військовий

water — aquatic	вода — водний
woman — feminine	жінка — жіночий
word — verbal	слово — словесний
village — rural	село — сільський
year — annual	рік — річний

Конверсія (безафіксальне словотворення) — один з основних способів словотворення в сучасній англійській мові. При конверсії нові слова виникають без зміни основної форми слів, з яких вони утворюються. Іншими словами, словоформа переноситься в іншу лексико-морфологічну групу (іншу частину мови) і набуває всіх лексико-граматичних властивостей (парадигму) нової частини мови, але з тим самим загальним лексичним значенням.

Наприклад:

water — вода	to water — поливати
air — повітря	to air — провітрювати
work — робота	to work — працювати
control — управління (контроль)	to control — управляти (контролювати)
cause — причина	to cause — бути причиною (спричиняти)

Іменники можуть утворюватися від дієслів. Наприклад: fall-out — радіоактивні осади (від дієслова to fall out — випадати).

Практично найчастіше іменники переходять у дієслова, хоч теоретично будь-яке слово може бути конвертоване (переведене) з однієї частини мови в іншу.

Дієслова можуть утворюватися від відповідних іменників:

S : V — form — форма	to form — формувати, утворювати
oil — олія	to oil — змащувати
razor — бритва	to razor — голитися

Іменники — від відповідних дієслів:

V : S — to drop — крапати, падати	a drop — крапля
to buy — купувати	a buy — покупка
must — мусити	a must — необхідність
to decay — занепадати	a decay — занепад
to blow — ударяти	a blow — удар

Дієслова — від прикметників:

Adj : V — empty — порожній to empty — випорожняти

Цей тип словотвору (конверсія) не має аналогу в українській мові і перекладається залежно від синтаксичної функції відповідного слова, наприклад:

He works as a turner.— Він працює токарем.

The works of this scientist are very valuable.— Праці цього вченого дуже цінні.

Словоскладання — це спосіб утворення нових слів шляхом поєднання двох і більше основ в одне ціле (слово). При цьому утворюються нові слова, які пишуться через дефіс або разом.

Наприклад:

radio (радіо) + antenna (антена) = radioantenna — радіоантена

steam (пара) + ship (корабель) = steamship — пароплав

radio (радіо) + engineering (техніка) = radioengineering — радіотехніка.

Термінологічні скорочення. Для мови науково-технічної літератури, зокрема для англійської та американської, властиве широке вживання термінологічних скорочень. За структурою скорочення бувають:

а) абревіатурні (ініціальний тип), наприклад DAC — digital-analog conversion — цифроаналогове перетворення; VHF — very high frequency — ультрависока частота;

б) скорочення типу зрізаних слів, наприклад: navig від navigation — навігація, spec від specification — специфікація;

в) комбіновані, в яких ініціальні скорочення поєднуються зі складовими, наприклад: shoran — short-range navigation — система точної радіонавігації;

г) складові скорочення, які являють собою початкові склади компонентів термінів-словосполучень, наприклад: AIRCOM — airspace communication — система аерокосмічного зв'язку.

У перекладі ініціальні скорочення, або розшифровуються і передаються повними назвами термінів, так як це показано в наведених вище прикладах, або передаються відповідними українськими скороченнями. Наприклад, скорочення PPM — pulse-position modulation (фазова імпульсна модуляція) можна передати прийнятим у нашій термінології скороченням ФІМ. Скорочення — зрізані слова і скорочені терміни, що складаються із складів двох компонентів, передаються, як правило, розгорнутими повними назвами. Наприклад: PANAR (panoramic radar) — панорамна радіолокаційна станція.

Деякі скорочення внаслідок широкого і частого вживання тепер уже не розчленовуються на окремі елементи, а сприймаються як нова одночленна термінологічна одиниця. Це такі терміни, як radar — скорочення від radio

detection and raging (виявлення об'єктів за допомогою радіосигналів і визначення відстані до них), COBOL (Common Business Oriented Language) — машинна мова, орієнтована на розв'язання економічних і комерційних завдань і т. ін. У перекладі вони передаються як одночленні терміни в транслітерованій формі, відповідно радар, КОБОЛ тощо.

В усіх випадках значення скорочень необхідно знаходити в словниках. Вони здебільшого подаються окремо в кінці загальних і спеціальних словників. Існують також спеціальні словники скорочень.

У процесі роботи над науково-технічними текстами студентам потрібно активно засвоювати найуживаніші термінологічні скорочення:

AC, ac (alternating current)	змінний струм
AF (audio frequency)	звукова (низька) частота
A (ampere)	ампер
c (capacitance)	ємність
cm (centimetre)	сантиметр
cps (counts per second)	відліки за секунду
(cycles per second)	цикли за секунду
cu, cub (cubic)	кубічний
cw (clockwise)	у напрямку годинникової стрілки
dB (decibel)	децибел
dc (direct current)	постійний струм
deg (degree)	ступінь, градус
F (Fahrenheit)	Фаренгейт
fig (figure)	цифра, фігура (рисунок)
ft (foot)	фут
HF (high frequency)	висока частота
i. e id est (that is)	тобто
in (inch)	дюйм
KC, kc (kilocycle)	кілоцикл
kc/s kilocycle per second	кілоцикли за секунду
kg (kilogram)	кілограм
km (kilometre)	кілометр
km/h (kilometre per hour)	кілометр за годину
kV (kilovolt)	кіловольт
kW (kilowatt)	кіловат
kWh (kilowatt-hour)	кіловат-година
lab (laboratory)	лабораторія
lb (libra, pound)	фунт
lg (length)	довжина
lim (limit)	межа

liq (liquid)	рідина
log, lg (logarithm)	логарифм
mc (megacycle)	мегацикл
meg (megohm)	мегом
MeV (million-electronvolt)	мільйон-електронвольт
MF (medium frequency)	середня частота
mV (millivolt)	мілівольт
mW (milliwatt)	міліват
pc (per cent)	процент, відсоток
p a (per annum)	за рік
psi (pounds per square inch)	фунти на квадратний дюйм
r (R) (resistance)	опір
ref (reference)	посилання *(на літературу)*
rpm (revolutions per minute)	оберти за хвилину
VHF (very high frequency)	ультрависока частота
V (volt)	вольт
vol (volume)	об'єм, обсяг

І.4. Лексичні відповідники і контекст

Більшість слів англійської мови багатозначна. Багатозначність слова характерна тією чи іншою мірою кожній мові. Різні значення одного слова пов'язані між собою і, як правило, об'єднуються навколо одного, основного (найзагальнішого) значення. Конкретне значення такого слова виявляється в контексті, тобто в його безпосередньому лексичному оточенні, а інколи і в ширшому контексті, оскільки (як уже згадувалося вище) навіть не всі терміни є однозначними. Випадки повної відповідності слів двох мов, тобто повного збігу їх лексичного значення в усьому обсязі, трапляються дуже рідко. Такі постійні рівнозначні відповідники в перекладі називаються *еквівалентами*. До слів-еквівалентів належать такі лексико-семантичні групи слів:

1. Власні назви (особові та географічні, назви місяців, днів, фірм і т. д.). Переклад таких слів, окрім реалій, не створює особливих проблем, тому на них ми докладно не зупиняємося.

2. Науково-технічні терміни як, наприклад, oxygen — кисень, hydrogen — водень, gas — газ, particle — частка, atom — атом. Але багато термінів вживається в різних терміносистемах з різними значеннями.

Багато слів, як і деякі терміни, не мають одного еквівалента. Еквівалент може мати окреме значення багатозначного слова. Наприклад, слово *figure* в технічній літературі може означати: *фігура, цифра, малюнок, статуя,*

зображення. Тільки перше значення англійської мови збігається з українським *фігура,* а до інших треба добирати значення відповідно до контексту. Іменник *number* має значення: *число, кількість, номер,* а дієслово *number* означає: *рахувати, нараховувати, нумерувати, лічити, зараховувати* (I number him among my friends.— Я зараховую його до своїх друзів). Очевидно, що кожне з цих значень визначається з контексту, тому потрібно уважно добирати український відповідник, щоб не спотворити зміст речення (тексту).

Такий тип відповідників називається *варіантним відповідником.* Основне завдання при перекладі полягає в тому, щоб із ряду варіантних відповідників вибрати саме той, який найточніше передає значення слова в контексті.

1.5. Інтернаціоналізми і псевдоінтернаціоналізми

В українській та англійській мовах є багато слів, які мають схожу форму (в написанні та звучанні) й однакове значення. В науково-технічній літературі такі слова також посідають значне місце. Вони виникли в результаті запозичення їх однією мовою з іншої або запозичення з якоїсь третьої мови (наприклад, з французької або латинської) як, наприклад, contrast, control, diagram, machine. Часто такі слова мають свої корені в латинській або грецькій мовах. Ці слова називають *інтернаціональними (інтернаціоналізмами).*

Інтернаціональні слова — це такі, що вживаються в багатьох мовах і мають спільне основне значення. Вони поширені насамперед у галузі політики, науки, техніки, медицини, спорту. Наприклад, у фізиці: atom — атом, proton — протон, focus — фокус, cosmos — космос; у математиці: plus — плюс, integral — інтеграл, differentiation — диференціація; у радіоелектроніці: radio — радіо, diode — діод, theristor — теристор. Самі назви багатьох наук є міжнародними (інтернаціональними): фізика, хімія, математика, геометрія, біологія, медицина і т. д. Усі ці слова входять до міжнародного фонду наукової термінології, їх розпізнавання, розуміння та переклад не становить особливих труднощів, за умови, що ці слова мають однакове значення в обох мовах. Трапляються, однак, інтернаціоналізми, які в різних терміносистемах мають різне значення. Наприклад, слово *revolution — революція,* поширене пере-

важно в суспільно-політичній літературі, в технічній означає *повний оберт* (машини тощо).

Залежно від функціональної характеристики інтернаціоналізми англійської науково-технічної літератури можна умовно поділити на три основні групи: 1) слова, що повністю збігаються за значенням з відповідними словами української мови, наприклад, metal, gas, meter; 2) слова, що в англійській мові мають значно ширше значення і сферу вживання, наприклад, operation — *операція, робота, дія;* 3) слова, що подібні за вимовою (написанням), але мають різні значення в англійській та українській мовах. Загальновідомі такі слова, як conductor — провідник (а не кондуктор), accurate — точний (а не акуратний), division — (роз)поділ (а не дивізія), contribution — внесок (а не контрибуція), compositor — набирач, складач (а не композитор) і т. д. Ці слова отримали назву «зрадливі друзі» перекладача (false friends of the translator) *. З такими інтернаціоналізмами слід бути уважним, перекладаючи їх українською мовою.

1.6. Термінолексика, утворена синтаксичним способом

Крім семантичного і морфологічного способів збагачення терміносистем і лексичних запозичень, є й синтаксичний спосіб: творення словосполучень (вільних і фразеологічних).

Словосполучення поділяються на 1) елементарні (прості) прийменникові і безприйменникові та 2) багатокомпонентні (складні, ускладнені).

Розгляньмо їх коротко і наведімо основні моделі (структурні типи).

1. *Елементарні вільні словосполучення.* Під час перекладу вільного словосполучення значну роль відіграє переклад його компонентів.

Ціле складається з перекладу елементів (компонентів), але при цьому неодмінно враховується відношення між елементами. У вільному словосполученні слова зберігають свої самостійні значення.

Словосполучення, які виражають складні поняття (на відміну від слів, що виражають прості поняття), є засобом номінації, тобто називання дій, предметів, якостей, які

* Див. Додаток 4.

перебувають у певних співвідношеннях з іншими предметами, явищами, властивостями тощо.

Перекладаючи словосполучення, які мають термінологічні значення, можна простежити закономірності, пов'язані з особливостями української та англійської лексики. В той час як англійській мові властиве атрибутивне вживання іменників, в українській мові словосполученням такого типу відповідають словосполучення, які означають предмет і його ознаку, виражену прикметником або іменником у родовому відмінку (a solid body — тверде тіло, electron micrography — електронна мікрографія, fracture mechanics — механіка руйнування і т. д.). Знаючи моделі вільних словосполучень, їх легко перекласти українською мовою.

Елементарні безприйменникові словосполучення

1. Структурна схема V + S: to conduct electricity, to distinguish the elements, to understand the theory.

2. Структурна схема V + Adv: to establish experimentally, to move rapidly, to arise at once, to come in freely.

3. Структурна схема V_1 + V_2: to begin to work, to plan to investigate, to go to get.

4. Структурна схема S + V: a book to read, a problem to solve, the experiment to be carried out.

5. Структурна схема A + V: easy to get, impossible to find out, important to find out, important to understand.

6. Структурна схема A + S: the electrical circuit, the gaseous state, important uses.

7. Структурна схема P + S: all the elements, these changes, such combinations.

8. Структурна схема S_1 + S_2: miniature planets, the information machine, spaceship flights, the word molecule.

9. Структурна схема N + S: two molecules, three states, the first condition, 327 Centigrade.

10. Структурна схема Adv + A: very great, so small, truly remarkable.

11. Структурна схема Adv + Adv: so quickly, far apart, just there.

12. Структурна схема Adv + S: simply water, exactly the electrons, almost a mile.

В усіх випадках, коли залежним компонентом словосполучення є іменник, його можна замінити відповідним займенником або формою, еквівалентною іменникові.

Елементарні прийменникові словосполучення

1. Структурна схема V + p + S: to exist in the world, to think of the problem, to consist of atoms.

2. Структурна схема S_1 + p + S_2: the kind of substance, the interaction of forces, the characteristics of the atom.

3. Структурна схема A + p + S: true for substances, different in properties, divisible into particles.

4. Структурна схема P + p + S: some of the students, none among the substances, each of the liquids.

5. Структурна схема N + p + S: two of the states, one of the molecules, the first of the elements.

6. Структурна схема Adv + p + S: somewhere in Africa, early in 1986, forward to victory.

7. Структурна схема V + p + S: turn to normal, to get back to ordinary, to take for granted.

8. Структурна схема V + p + Adv: to work till then, to know by now, to learn since then.

9. Структурна схема A + p + A: far from clean, red upon green, moderate to fresh, white to blue.

10. Структурна схема S + p + A: a change to quiet, the transition to soft, a wall of green.

11. Структурна схема S + p + N: a figure of 100, the meeting at three, the division into two.

12. Структурна схема N + p + N: one in ten, two by two.

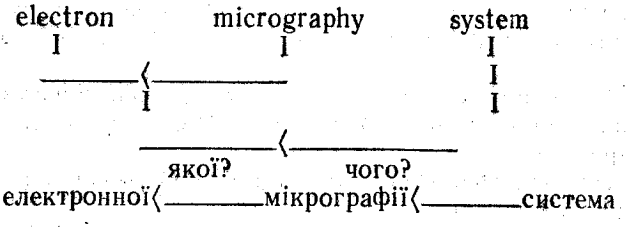
Розглянутими вище типами не вичерпується розмаїтість структурних схем (моделей) словосполучення (як безприйменникового, так і прийменникового).

Грунтовне знання основних структурних схем словосполучення допоможе краще орієнтуватися в оригінальному англійському технічному тексті та знаходити їх українські відповідники під час перекладу.

2. *Багатокомпонентні терміни-словосполучення.* У роботі з англійською науково-технічною лексикою найбільші труднощі для розуміння і перекладу становлять багатокомпонентні терміни-словосполучення, які утворюються лексико-синтаксичним способом за певними моделями. Наприклад: precision dimensional measurements — точні просторові виміри, electron micrography system — електронна мікрографічна система, turned-diode charge transformer logic — логічні схеми на тунельних діодах з нагромадженням заряду.

Для перекладу таких багатокомпонентних термінів треба знайти значення кожного компонента, а потім вста-

новити семантико-граматичні зв'язки між ними. Наприклад, у словосполученні *electron micrography system* семантико-синтаксичні відношення між словами-компонентами виявляються так. Аналіз починаємо з головного слова *system*. До нього є атрибутивне означення *electron micrography*, в якому також є атрибутивні відношення головного й атрибутивного компонентів. Вони мають такий вигляд:



Цей лексико-синтаксичний спосіб творення термінів у вигляді ланцюжка слів з прийменником або без нього, дедалі активніше входить у практику термінотворення в англійській мові.

Таким чином, перекладаючи термінологічні словосполучення з багатьма компонентами слід з'ясувати насамперед, в якому порядку потрібно розкривати значення цього словосполучення.

3. *Стійкі словосполучення (фразеологічні одиниці).* До особливостей науково-технічного тексту, які мають важливе значення з точки зору перекладу, належать стійкі фразеологічні одиниці (ФО).

ФО визначають як «лексико-граматичну єдність двох або більше компонентів, які мають цілісне значення». Труднощі перекладу пов'язані з тим, що цілісне значення ФО, на відміну від вільного словосполучення, не є простою сумою значень лексичних одиниць (компонентів), з яких вона складається. Наприклад, слово *account* має такі основні словникові значення: *рахунок, звіт, оцінка,* а стійкі сполучення з ним дістають такі значення: on account of — через, внаслідок, на основі; of no account — без значення; on no account — у жодному разі; to account for — пояснити, бути причиною.

Отже, під час перекладу, коли знайдені в словнику значення якогось слова не підходять за змістом, треба припускати, що та чи інша група слів є ФО і її слід перекладати як стійке словосполучення. Такі ФО в багатьох випадках подаються в словниках у кінці словникової статті. Існують також спеціальні двомовні фразеологічні словники.

Найуживаніші ФО, такі як by all means — за будь-яку ціну, as far as — що стосується ..., in spile of — зважаючи на те що, слід активно засвоювати.

1.7. Лексико-граматичні одиниці

Адекватність перекладу науково-технічної літератури залежить від правильного розуміння лексико-граматичних одиниць типу in addition to — крім того, на додаток до.

Особливість їх полягає в тому, що вони є частиною речення і впливають на граматичні зв'язки. Це — сполучники і прийменники.

Лексико-граматичні одиниці можна умовно поділити на такі смислові групи:

1) сполучення і логічна послідовність ідей (and, also, apart from, besides, furthermore, in addition to, moreover, simultaneously, thus, too);

2) парафраз і накладання (as if, in the same way, in like manner, like, similarly);

3) причинність (accordingly, as, because, consequently, hence, once, since, therefore, as long as, owing to);

4) контраст і зіставлення (alternatively, although, but, if, however, nevertheless, otherwise, in spite of, on the other hand);

5) обмеження (except, impossible, occasionally, only, unless, if, when);

6) припущення (conclude, confirm, consider, reduce, imagine, suppose, in principle, it follows);

7) питання (how big?, how long?, what?, when?, with what purpose?, to what extent?).

Найуживаніші сполучники

На точність розуміння і адекватність перекладу науково-технічного тексту впливає точне значення семантики сполучників.

Наведімо найголовніші з них.

Сполучники сурядності:

and	і, а
as well as	також, як
both ... and	і ... і, як ..., так і
not only ... but also	не тільки ..., а й
but	але, а

or	або, інакше
either ... or	або ... або, чи ... чи
neither ... nor	ні ... ні

Сполучники підрядності

а) часу:

after	після того як
as	у той час як; в міру того як
as long as	поки; до тих пір, поки
as soon as (no sooner)	як тільки
before	перед тим, як; скоріше, ніж
since	з того часу, як; після того, як
till, until	до того часу, поки ... (не)
while	в той час як

б) причини:

as	так як; оскільки
because	тому, що; так як (оскільки)
since	так як; оскільки

в) умови:

if	якщо
provided	за умови, що
unless	якщо ... не

г) мети:

lest	щоб не
in order that	для того, щоб; щоб(и)

д) способу дії:

as	як
as if	буцімто; ніби-то
such ... that	такий ..., що

е) порівняння:

as ... as	такий самий ..., як; так ..., як
not so as	не так ..., як; не такий ..., як
than	ніж

є) наслідку:

so that	так що

ж) поступки:

in spite of	незважаючи на те що
though (although)	хоч, хоча
since	оскільки

Найуживаніші прийменники і сполучники та прислівники, що співпадають з ними за формою

Часто перекладачі-початківці та студенти припускаються помилок на вживання тотожних за формою слів різної лексико-граматичної семантики.

Наведімо найуживаніші з них.

about	про, стосовно; приблизно, біля; навколо, по
above	вище, над
above all	передусім, насамперед, перш за все
across	поперек, через, на протилежному боці
(to) come across	знайти, зустріти *(випадково)*
after	після; за; після того як *(сполучник)*
after all	кінець кінцем, зрештою, врешті-решт
against	проти
along	вздовж, по
along with	разом (з)
among	серед
around (round)	навкруг(и), навколо; приблизно, біля
at	при *(місце)*; в, на, у *(місце, час, заняття)*; за *(заняття)*
at last	нарешті
at least	принаймні
before	перед, до *(місце, час)*; раніше *(прислівник)*; перед тим, як *(сполучник)*; до того, як; перед тим, як
behind	позаду, за
below	нижче, унизу
beside	поряд з
besides	(о)крім
between	поміж, з-поміж
by	*еквівалент українського орудного відмінка іменника;* шляхом, за допомогою; до *(час)*
by way of	до речі, між іншим
by means (of)	за допомогою
by no means	ніяким чином
down	униз по, униз *(прислівник)*
(to) write down	записати
for	за, заради; для; протягом; через; так як
from	від, з
in	в, через *(час)*
in this way	таким чином
in spite of (despite)	незважаючи на

into	в *(куди?)*
of	*еквівалент українського родового відмінка іменника;* з (із); про
of course	звичайно
on = upon	на; по; про; в *(часові відношення)*
over	через; над; понад
since	з, з часу (моменту), з того часу, як; оскільки; так як
though	усе-таки; хоч; однак
as though	ніби; так, ніби
till = until	до; (до тих пір) поки ... не
to	*еквівалент українського давального відмінка іменника;* до, в *(рух у напрямку до чого-небудь)*
toward (towards)	до; у напрямку до
under	під; при; згідно з
up	вгору по; вгору *(прислівник)*
up to	аж до
with	*еквівалент українського орудного відмінка іменника;* з; при
within	у межах; через *(протягом часу)*
without	без

II. ГРАМАТИЧНІ ОСОБЛИВОСТІ НАУКОВО-ТЕХНІЧНОЇ ЛІТЕРАТУРИ ТА ПИТАННЯ ПЕРЕКЛАДУ

Мова науково-технічної літератури відрізняється від інших стильових різновидів більшою частотністю деяких граматичних форм і конструкцій. Для англійських текстів характерний складний синтаксис, тому для їх читання й перекладу слід уміти аналізувати речення з точки зору їх структури. Для науково-технічних текстів характерна велика кількість складних речень (складносурядних і складнопідрядних) і конструкцій, інфінітивних, дієприкметникових та герундіальних зворотів.

Отже для правильного розуміння й адекватного перекладу науково-технічних текстів потрібно не тільки добре знати лексичні та лексико-граматичні особливості слів, а й наполегливо вчитися розуміти і перекладати речення різної структури, прості і складні граматичні одиниці.

II.1. Структура простого поширеного речення

Точність і правильність перекладу англійських текстів українською мовою залежить як від розуміння граматичної системи англійської мови, так і від уміння правильно аналізувати речення. Цей аналіз полягає насамперед в умінні визначити члени речення (підмет, присудок, додаток і т. д.) і частини мови, якими ці члени речення виражено.

В англійській мові просте розповідне речення, в тому числі й емфатичне речення, має певний усталений порядок слів, що відображає відповідні синтаксичні відношення. Оскільки морфологічна система англійської мови розвинена досить слабо, функцію вираження лексико-синтаксичних відношень між словами в реченні виконує, крім прийменників, усталений порядок слів. Завдяки цьому кожний член речення посідає певне місце щодо присудка.

Англійське стверджувально-розповідне речення має такий порядок слів: перше місце щодо присудка належить підмету (S), друге — присудку (P), третє — додатку (O), нульове або четверте місце — обставинам (M).

Схематично цей порядок членів речення можна представити так:

0	1	2	3	0
Обставина	Підмет	Присудок	Додаток	Обставина
M	S	P	O	M

Слід пам'ятати, що означення не має постійного місця в структурі речення, тому що воно входить до складу смислової групи означуваного слова (підмета, додатка) і може стояти перед ним або за ним:

During recent years methods of measurements have changed considerably.— Протягом останніх років методи вимірювання значно змінилися.

Кожний член речення може виражатися як одним словом, так і групою синтаксично і семантично пов'язаних слів (словосполучень):

During recent years ... — група обставини часу;

methods of measurements ... — група підмета, виражена іменником у множині та означенням — іменником з прийменником **of**, що відповідає українському родовому відмінку;

have changed ... — присудок;

considerably — обставина.

Для правильного перекладу слід розбити речення на лексико-синтаксичні групи і перекладати кожну групу, враховуючи її особливості, характерні ознаки і розмістити відповідно до порядку слів, властивого українській мові.

При аналізі й перекладі простого речення слід звертати увагу на ряд формальних ознак, які допомагають визначити межі між окремими його членами. Так, відсутність прийменника перед іменником або його еквівалентом у початковій позиції (можлива наявність визначника) в реченні свідчить про те, що це слово є підметом, якщо дієслово-присудок стоїть в активній часовій формі:

Hydrogen finds numerous uses in modern industry.

Однак, коли дієслово-присудок вживається в пасивній формі, іменник-підмет стає додатком в українському перекладі, а речення перекладається як безособове:

The delegates were asked to select the school they themselves wanted to visit.— Делегатів попросили самих вибрати школу, яку вони хочуть відвідати.

Службові частини мови (прийменник, сполучник і артикль) є формальними ознаками межі між членами речення. Межею між членами речення можуть служити також і деякі повнозначні частини мови: допоміжні і модальні дієслова, вказівні, присвійні, питальні, неозначені та особові займенники.

В англійській мові підмет є обов'язковим членом будь-якого речення, крім наказового, де він (підмет) домислюється. Навіть у безособових реченнях типу *кажуть, відомо, можна сказати* формальним підметом ставиться займенник-замінник **it** або **one**. Наприклад: It is said that ...; It is known that ...; One can say ... . У таких реченнях підмет завжди виражається займенником **it**, який українською мовою не перекладається. Він смислового значення не має, а виконує лише граматичну функцію формального підмета:

It is frequently necessary to find the components of a force in other than horizontal and vertical directions.— Часто слід шукати складові сили в інших, ніж горизонтальні і вертикальні, напрямках.

В англійській мові такі конструкції зі словами-замінниками вживаються часто. В описах різних пристроїв, технології виробництва, методики проведення експерименту тощо на першому плані стоїть інформативна суть тексту. Тому розповідь часто ведеться в безособовій чи неозначено-особовій формі, що характеризується наявністю підмета, вираженого неозначено-особовим займенником **one**, який часто вживається з модальними дієсловами:

one must one has (to)	потрібно,	one can one may	можна
one ought (to) one should	необхідно, слід	one could one might	було (б) можна

One should clearly understand that the direction and magnitude of the electric forces are represented by the lines of force.— Треба ясно розуміти, що напрямок і величина електричних сил представляються лініями сили.

Інколи слід виділити той чи інший член речення (підмет, додаток, обставину). Для цього в англійській мові вживається так звана емфатична конструкція *it is (was) ... that,* яка ставиться переважно на початку речення.

Українською мовою такі речення перекладаються за допомогою підсилювальних слів, таких як *саме, як раз, (і) тільки, дійсно:*

It is the process of fission that made possible the nuclear reactor and the atomic bomb.— Саме процес розщеплення зробив можливим створення ядерного реактора і атомної бомби.

Конструкції із словами-замінниками не властиві українській мові, що спричиняє певні труднощі для розуміння і перекладу. Такі речення перекладаються українською мовою як неозначено-особові і безособові.

II.2. Складне речення

Складні речення, до яких входить два або більше взаємопов'язаних за змістом простих речень, бувають *складносурядні* і *складнопідрядні.*

1. Складносурядне речення (the Compound Sentence) складається з двох або більше простих речень, які аналізують так само, як і прості речення. Переклад їх також не становить труднощів, оскільки це фактично переклад двох або більше простих речень.

2. У складнопідрядному реченні (the Complex Sentence) одна частина є головною, інша — підрядною. Кожне підрядне речення треба розглядати як розгорнутий член головного речення. Отже, підрядні речення можуть бути підметовими, присудковими, додатковими, обставинними і означальними.

Підрядні речення можуть приєднуватися до головного за допомогою сполучників і сполучних слів: *that, which, who, when, after, before, since, until, unless, if* і т. д.

При аналізі і перекладі складнопідрядного речення слід:

— розбити його на окремі прості речення;

— виявити, скільки простих речень входить до його складу і яке з них головне, а які підрядні;

— виділити і перекласти кожний член підрядних речень.

Значно складніше зрозуміти і перекласти складнопідрядне безсполучникове речення. Наприклад:

We know (that) the temperature of the Sun is exceedingly high.— Ми знаємо, що температура Сонця винятково висока.

Тип підрядного речення визначається за його місцем у реченні і за допомогою питань. Найчастіше безсполучникові підрядні речення бувають додаткові і означальні:

We learned quite recently the instrument was not of the highest quality.— Нещодавно ми з'ясували, що цей прилад не найвищої якості.

The lasers we have just described are not the only available.— Лазери, які ми щойно описали, не єдині з наявних.

II.3. Неповні підрядні речення

В англійських реченнях часто напрапляємо на сполучення слів, які складаються із сполучника обставинного підрядного речення (if, when, while, though) і дієприкметника, прикметника або прийменникової групи іменника. Такі сполучення слів розглядаються як неповні обставинні речення і перекладаються українською мовою обставинними підрядними реченнями, причому підметом у такому реченні стає підмет головного речення, а час присудка узгоджується з часом присудка головного речення:

This construction, though useful, is not used on a wide scale.— Хоч ця конструкція і є корисною, вона не має широкого застосування.

This polyatomic molecule, if present in appreciable amount, affects the character of the discharge.— Якщо ця поліатомна молекула наявна в достатній кількості, вона впливає на характер розряду.

II.4. Умовні речення

Підрядні умовні речення вводяться сполучниками *if, unless, provided, in case* та ін.

Тип умовного речення	Час присудка підрядного речення	Час присудка головного речення
I. Реальне	Present Indefinite *	Future Indefinite
II. Маловірогідне *(для майбутнього)* і нереальне *(для теперішнього часу)*	Форма, омонімічна Past Indefinite (або were)	Should (would), might, could + Indefinite Infinitive
III. Нереальне *(для минулого часу)*	Форма, омонімічна Past Perfect	Should (would), might, could + + Perfect Infinitive

* В умовних реченнях I типу присудок головного і підрядного речень може стояти в будь-якому часі дійсного способу. Наведені в таблиці форми зустрічаються найчастіше.

Умовні речення I типу перекладаються українською мовою дійсним способом:

If conditions are favourable we shall apply this method in practice.— Якщо умови будуть сприятливими, ми застосуємо цей метод на практиці.

He will calculate the area of this body, provided he knows its dimentions.— Він визначить площу цього тіла за умови, що йому будуть відомі його розміри.

Примітки: 1. У підрядній частині умовних речень I типу інколи вживаються аналітичні форми умовного способу (**should** в усіх особах + інфінітив без частки to). Перекладаються такі речення дійсним способом:

If the lubricant supply should stop (should the lubricant supply stop) even momentarily, serious damage may result.— Якщо подача мастила припиниться навіть на одну мить, то може статися серйозна поломка.

2. У підрядній частині умовного речення I типу інколи вживається синтетична форма умовного способу **be**. В головній частині присудок виражений дійсним способом. Перекладаються такі умовні речення дійсним способом:

If any material be placed in a magnetic field, the effect of the field is to set up magnetic poles at opposite ends of the specimen. — Якщо який-небудь матеріал помістити в магнітне поле, то ефект поля виявиться в створенні магнітних полюсів на протилежних кінцях зразка.

Умовні речення II і III типу перекладаються українською мовою умовним способом:

If a satellite moved in different orbits, each within a thousand kilometers from the Earth's surface — the variations in speed would be relatively small.— Якби супутник рухався різними орбітами, розташованими в межах тисячі кі-

лометрів від поверхні Землі, то різниця в швидкості руху була б відносно малою (незначною).

If these instructions were violated (were these instructions violated), we could not get the right answer.— Якби ці інструкції були порушені, то ми не могли б отримати правильної відповіді.

If he had taken into account (had he taken into account) the properties of this metal he would have got better results.— Якби він (був) взяв до уваги властивості цього металу, то він би (був) отримав кращі результати.

Примітки: 1. У підрядній частині умовних речень II типу інколи вживаються аналітичні форми умовного способу (**should** в усіх особах + інфінітив без частки **to**) або **were** + інфінітив, що вказує на меншу вірогідність здійснення дії порівняно із звичайними умовними реченнями II типу.

If the lubricant supply should stop (should the lubricant supply stop) even momentarily, serious damage might result.— Якби подача мастила припинилася навіть на одну мить, то могла б статися серйозна поломка.

If we were to make (were we to make) a close study of this metal, we should find that it does not oxidize.— Якби ми ретельно дослідили цей метал, то встановили б, що він не окислюється.

2. Для вираження можливості або вірогідності дії в головній частині умовних речень II і III типу вживаються дієслова **could** або **might** у сполученні з неозначеним інфінітивом (Indefinite Infinitive), а для неможливості дії — Perfect Infinitive:

If the satellite's speed were much less than the necessary one, the satellite might drop and enter the denser layers of the atmosphere.— Якби швидкість польоту супутника була нижчою за необхідну, то супутник міг би впасти і ввійти в щільніші шари атмосфери.

II.5. Переклад пасивних конструкцій

Речення з присудком у пасивному стані (The Passive Voice) перекладаються українською мовою трьома способами:

1) сполученнями дієслова *бути* і дієприкметником пасивного стану (Participle II):

The experiment was repeated twice.— Експеримент було повторено двічі;

2) дієсловами на **-ся** зі значенням пасивного стану:

This cycle is continued in each of the cylinders.— Цей цикл продовжується в кожному з циліндрів;

3) неозначено-особовими конструкціями:

This metal is heated and then cooled in the air.— Цей метал нагрівають, а потім охолоджують на повітрі.

Треба мати на увазі, що багато англійських пасивних конструкцій у перекладі українською мовою можуть мати кілька варіантів. Наприклад, речення This universal

motor is adopted as being more economical можна перекласти: Цей універсальний мотор прийнято, тому що він економніший; Цей універсальний мотор приймають, ...; Цей універсальний мотор приймається, ...

При перекладі слід звертати увагу також на конструкції, побудовані на основі непрямого додатка:

The scientists were offered new themes for research.— Вченим запропонували нові теми для наукових досліджень. Крім використання неозначено-особових речень у перекладі такі конструкції можуть передаватися дійсним станом з дієсловом в особовій формі (тоді як в англійському реченні вказано логічний суб'єкт дії):

This version of solution was objected to by almost everybody.— Майже всі були проти цього варіанта вирішення (проблеми).

Треба також звертати увагу на переклад сполучення модальних дієслів з Passive Infinitive.

Модальні дієслова *can, may, must,* а також *should* в модальному значенні в сполученні з Passive Infinitive перекладаються словами *можна, може, треба, слід* з інфінітивом значущого дієслова:

The alloying process can be used in the manufacture of transistors.— У виробництві транзисторів може застосовуватися (можна застосовувати) метод сплавлювання.

II.6. Конструкції з неособовими формами дієслова

1. *Об'єктний інфінітивний зворот* (The Objective Infinitive Construction or Complex Object) складається з іменника (в загальному відмінку) або особового займенника (в об'єктному відмінку) + Infinitive:

We consider metals to be good electrical conductors.— Ми вважаємо, що метали є добрими провідниками електричного струму.

We want research to be continued.— Ми хочемо, щоб дослідження було продовжено.

У реченні об'єктний інфінітивний зворот є складним додатком і перекладається українською мовою додатковим підрядним реченням, яке вводиться сполучниками *щоб, що, як.*

Об'єктний інфінітивний зворот часто зустрічається після дієслів: to think — думати, to consider — вважати, to suppose — припускати, to know — знати, to believe — вірити, to expect — очікувати, припускати, to want — хотіти та ін. Після дієслів, які виражають чуттєве сприй-

няття (to see, to hear, to observe etc.), частка to не вживається.

2. *Суб'єктний інфінітивний зворот* (The Subjective Infinitive Construction or Complex Subject) являє собою сполучення іменника (в загальному відмінку) або особового займенника (в називному відмінку) з інфінітивом, який виступає у функції другої частини складного дієслівного присудка:

1 2 3

Semiconductors are known to have crystalline structure.— Відомо, що напівпровідники мають кристалічну будову.

Цей зворот виконує в реченні функцію складного підмета і найчастіше вживається з особовою формою Passive Voice дієслів: to say — сказати, to know — знати, to assume — припускати, to find, to consider — вважати, to believe — вірити і т. п.

Суб'єктний інфінітивний зворот також вживається з особовою формою Active Voice дієслів: to appear, to seem — здаватися; to prove — виявитися; to happen — траплятися:

Transistors proved to be more efficient than tubes.— Виявилося, що транзистори ефективніші за електронні лампи.

Як бачимо, ці звороти перекладаються складнопідрядними реченнями; присудок англійського речення стає присудком головного речення в неозначено-особовій формі, підмет — підметом підрядного речення, а інфінітив — присудком. Можна також перекладати простим реченням, в якому неозначено-особовий зворот вживається як вставне речення:

Magnetism is believed to be set up by the motion of electrons.— Припускається, що магнетизм виникає в результаті руху електронів. (Магнетизм, як вважають, виникає в результаті руху електронів.)

3. *Вживання деяких модальних дієслів з перфектною формою інфінітива. Must* і *may* з перфектним інфінітивом (Perfect Infinitive) виражають припущення і перекладаються словами *мабуть, можливо, вірогідно, очевидно:*

Some mistakes must have been made in assembling the parts of the machine.— Мабуть, при складанні цієї машини було допущено якість помилки.

These poles may have existed in the original magnet.— Ці полюси, очевидно, існували в природному магніті.

Could і *might* перед Perfect Infinitive перекладаються

словами *міг би; should* перед Perfect Infinitive — умовним способом:

It is evident that the motor car of today could not have been produced in the quality and quantity without the liberal use of forgings.— Очевидно, що сучасний автомобіль не міг би випускатися з такими якостями і в таких кількостях без широкого використання поковок.

You should have assembled this machine in time.— Вам слід би (було) зібрати цю машину вчасно.

4. *Незалежний дієприкметниковий зворот* (The Absolute Participle Construction) складається з іменника в загальному відмінку або займенника в називному відмінку і дієприкметника. Цей зворот не має аналогу в українській мові і перекладається підрядними реченнями часу, умови, причини, супутніх обставин із сполучниками *після того як, коли, так, як, оскільки, якщо* та ін. або навіть самостійним реченням із сполучниками *причому, а, і*:

Other things being equal, iron will oxidize more rapidly than mercury or silver.— А за інших рівних умов залізо буде окислюватися швидше за ртуть або срібло.

The electric circuit being closed, a current passes through it.— Оскільки електричне коло замкнуте, по ньому проходить струм.

Незалежний дієприкметниковий зворот причини і супутніх обставин може стояти як перед головним реченням, так і після нього:

Power is the basis of civilization, all industry and transport being dependent upon power in some form.— Енергія є основою цивілізації, оскільки вся промисловість і транспорт залежать від енергії в тій чи іншій формі.

5. *Герундіальний зворот* перекладається українською мовою додатковим підрядним реченням, причому іменник, який стоїть перед ним (або присвійний займенник), стає підметом підрядного речення, а герундій — присудком або за допомогою прийменникового звороту:

Mere mechanization is muscular action, that is to say, our limbs can move without our having to use our brain.— Проста механізація — це мускульна дія, інакше кажучи, наші кінцівки можуть рухатися без необхідності використання нашого мозку.

Для читання і перекладу науково-технічного тексту потрібно не тільки володіти спеціальною термінологією, а й правильно аналізувати граматичні явища англійської мови, добирати адекватні їм українські відповідники.

Додаток 2

НАЙУЖИВАНІШІ СУФІКСИ ТА ПРЕФІКСИ

Суфікси іменників

а) на означення національності, професії, особи — виконавця дії або знаряддя дії:

-ian	Ukrainian	українець
	mechanician	механік
	librarian	бібліотекар
	historian	історик
-ent, -ant	student	студент
	assistant	помічник
-ist	specialist	спеціаліст
	physicist	фізик
-or, -er	inventor	винахідник
	writer	письменник
	driver	водій

б) на означення абстрактних понять, процесів, дій тощо:

-age	passage	проходження
	leakage	теча, витікання
-ance, -ence	resistance	опір
	difference	різниця
-ancy, -ency	constancy	постійність
	efficiency	ефективність
-ion (-ation,	collection	збірка
-tion, -sion,	production	виробництво
-ssion)	dictation	диктування, диктант
	division	поділ, ділення
	transmission	передача
-ism	realism	реалізм
	optimism	оптимізм
-ment	requirement	вимога
	achievement	досягнення
-ness	usefulness	корисність
	readiness	готовність
-ty, -ity	safety	безпека
	possibility	можливість
	speciality	спеціальність
-th	length	довжина
	growth	ріст
-ure (-ture,	mixture	суміш
-sure, -ssure)	measure	міра
	pressure	тиск

-ic, -ics	mathematics	математика
	characteristic	характеристика
-ship	friendship	дружба
	leadership	керівництво
-ate	delegate	делегат

Суфікси прикметників

-able, -ible	measurable	вимірний
	comparable	порівнюваний
	possible	можливий
	visible	видимий
-al	central	центральний
	industrial	промисловий
-ent, -ant	different	різний
	important	важливий
-ful	peaceful	мирний
	useful	корисний
-less	useless	некорисний
	powerless	безсильний
-ic	historic	історичний
	patriotic	патріотичний
-ive	active	активний
	comparative	порівняльний
-ous	courageous	сміливий
	dangerous	небезпечний
-y	cloudy	хмарний
	dirty	брудний
-ate	separate	окремий
	adequate	відповідний

Суфікси числівників

-teen	fifteen	п'ятнадцять
	sixteen	шістнадцять
-ty	forty	сорок
	seventy	сімдесят
-th	the fifteenth	п'ятнадцятий
	the fiftieth	п'ятдесятий

Суфікси дієслів

-ate	communicate	повідомляти
	indicate	вказувати
-ute	contribute	вносити

-en	strengthen	зміцнювати
	lengthen	подовжувати
-(i)fy	solidify	твердіти
	intensify	підсилювати

Суфікси прислівників

-ly	rapidly	швидко
	uselessly	даремно
-ward(s)	forward	уперед
	toward(s)	у напрямку (до)

Префікси

Префікси з протилежним (негативним) значенням

un-	unpleasant	неприємний
	unequal	нерівний
in- (il-)	indirect	непрямий
	illiterate	неграмотний
ir- (im-)	irregular	неправильний
	impossible	неможливий
dis-	dislike	нелюбов
	disorder	безпорядок
de-	demobilize	демобілізувати
non-	non-conductor	непровідник
	non-standard	нестандартний

Префікси з різними значеннями

re-	rewrite	переписати
	reconstruct	перебудувати
mis-	misunderstand	неправильно зрозуміти
	mislead	збивати з правильного шляху
en-	enlarge	збільшувати
	enrich	збагачувати
over-	overload	перевантаження
	overproduction	надвиробництво
under-	underground	підземний
	underestimate	недооцінювати
co-	cooperation	співробітництво
	coexistence	співіснування

inter-	intercontinental	міжконтинентальний
	interaction	взаємодія
sub-	submarine	підводний човен
	subway	підземна залізниця (метро)
pre-	pre-war	довоєнний
	pre-fabricated	виготовлений завчасно
post-	post-war	післявоєнний
	post-operative	післяопераційний

Додаток 3

НАЙУЖИВАНІШІ ПРИЙМЕННИКИ

about	1. *розміщення або рух навколо чого-н.* навколо, довкола; 2. *розташування поблизу чого- н.* поблизу, біля, при; 3. *місце, де відбувається дія* по; 4. *приблизність у часі* близько, біля, перед; 5. про, стосовно, відносно
above	1. над; 2. зверху, вище, більше
according to	1. згідно з; відповідно до; 2. згідно з твердженням, за словами, на думку
across	крізь, через; на тому боці
after	1. *місцезнаходження позаду предмета або рух навздогін* позаду; 2. *послідовність у часі, проміжок часу* після, за, через; 3. *подібність до чого-н. або наслідування кому-н.* з, за, згідно
against	*1. протилежний напрямок або положення* проти; *2. опора, перешкода, фон* в, об, на, по, до; 3. *безпосереднє сусідство* поряд, при; *4. зіткнення або дотик* по, об
along	вздовж, по
among	серед, між
around (round)	1. навколо; 2. по, за, поблизу (близько); 3. біля; приблизно
at	1. *місцезнаходження* в, на, при, біля; 2. *рух у певному напрямку* в, до, на; 3. *момент, час дії* в, на; 4. *дія заняття* за; 5. *стан, положення* в, на

before	1. *розміщення* перед; 2. *час* до, перед
behind	за, позаду, після
below	нижче, під
beside	поряд, з, біля, поблизу
besides	окрім, крім
between	між
beyond	1. по той бік; за; 2. поза, понад, вище
by	1. *близкість* при, біля, коло; 2. *проходження повз предмет чи певне місце* повз; 3. *наближення до певного моменту, терміну* до; 4. *позначення авторства; прийменниковий зворот, що передається орудним або родовим відмінком;* 5. *позначення засобу пересування, прийменниковий зворот перекладається орудним відмінком;* 6. *причина, джерело* через; за допомогою, від, з
by means of	за допомогою, з допомогою
concerning	відносно, стосовно
down	униз; (вниз) по, вздовж по
due to	завдяки
during	протягом, впродовж
except	за винятком, крім (окрім)
except for	за винятком, крім
for	1. для, заради; 2. за; 3. *напрямок* до, в; 4. із, через, з причини; 5. протягом
from	1. *просторове значення* від, із, з; 2. *часове значення* з, від
in	1. *перебування всередині або в межах чого-н.* в, на, у; 2. *вхід або внесення в межі або в середину чого-н., проникнення в яке-н. середовище* в, на; 3. *часове значення* в, під час, протягом, через; 4. *умови, обставини здійснення дії* в, при, з, на
in accordance with	відповідно до, згідно з
in addition to	на додаток, на доповнення до, крім того, до того ж
in front of	перед, спереду, попереду
in spite of	незважаючи на
instead of	замість
into	*рух або напрямок всередину чого-н.* в, на
like	подібно, як

near	біля, поблизу, при
of	1. *вказує на приналежність; прийменниковий зворот перекладається родовим відмінком;* 2. *вказує на відношення частини і цілого* із, з; 3. про, відносно
on	1. *перебування на поверхні* на (також upon); 2. *напрямок* на (також upon); 3. *часове значення* в; 4. *послідовність дій* по, після; 5. *стан, процес, характер дії* в, на; 6. *основа, причина, джерело* з, на, в, по, у; 7. про, відносно, стосовно
opposite	проти, напроти
out of	за, з, поза
over	1. над, вище; 2. по той бік, за, через; 3. *характер руху* через, по; поверх, на; по всій поверхні; 4. *проміжок часу, за який відбувається дія* за, протягом; 5. *кількісне перевищення* понад, більше, зверх
owing to	через, внаслідок, завдяки
past	1. повз, мимо; 2. за, по той бік; 3. *про час* після, за, через, по тому, понад, з, після
since	з, після
tranks to	завдяки
through	1. *просторові відношення* через, в, крізь, по; 2. *часові відношення* протягом; 3. внаслідок, завдяки
throughout	1. через, по всьому; 2. протягом *(всього часу)*
till (until)	до, до тих пір, поки
to	1. *напрямок* до, в, на; 2. *межа руху, відстані, часу, кількості* на, до; 3. *вказівка на особу, на яку спрямовано дію; прийменниковий зворот перекладається давальним відмінком* 4. *визначає час, тривалість* до
toward(s)	1. до, у напрямку до; 2. *час* до, біля
under	1. *положення одного предмета нижче іншого, напрямок дії вниз* під, нижче; 2. *умови, за яких відбувається дія* при, під, на
up	1. вгору по, нагору по, в напрямку; 2. вздовж по; вглиб

up to	аж до, до (самого)
with	1. *зв'язок, спільність, узгодженість* з; *2. значення предмета дії чи знаряддя, за допомогою якого виконується дія, українською мовою перекладається орудним відмінком;* 3. *обставина, що супроводжує дію* а, при, причому
within	1. в межах; 2. в, всередині
without	1. без; 2. поза, за; 3. *перед герундієм або віддієслівним іменником* без того, щоб

Додаток 4

СПИСОК ПРИКЛАДІВ «ЗРАДЛИВИХ ДРУЗІВ» ПЕРЕКЛАДАЧА

arm	спиця
basin	таз, миска
balance	вага
bench	верстат
beard	зубець, зазублина
benzene	бензол
billet	заготовка
blind	діафрагма
boss	штейгер, шток
breast	амбразура
bug	скоба
bus	шина *(в ЕОМ)*
bush	втулка
cabinet	корпус, футляр
calculus	*амер.* математика
camera	фотоапарат
canister	невелика бляшана коробка, бляшанка
cap	ковпачок, головка
carboy	*хім.* оплетений бутель
chair	*тех.* подушка для рейок
character	знак, буква, символ
collar	підшипник
compass	циркуль
concrete	бетон
control	управління, керівництво
data	дані, інформація
ear	зажим

elevator	підйомник
essay	випробування, аналіз
fabric	тканина, матерія
factor	коефіцієнт, множник
fly	маховик
fountain	бачок
frog	хрестовина
gate	затвор *(у транзисторній схемі)*
ghost	другий образ *(телебачення)*
grass	стрічка шумів
hand	стрілка *(годинника)*
hat	покрівля
horse	рама
instrument	прилад
jacket	стінка циліндра
leg	катет
lip	*гідр.* поріг
mason	каменяр, муляр
meter	лічильник
monkey	баба *(для забивання свай)*
needle	стрілка *(пристрою)*
nose	головка домкрата
nut	гайка
pig	болванка
plum	заповнювач бетону
replica	репродукція
spy	вічко
tank	бак, цистерна
tolerance	допуск
free	*тех.* вал
revolution	повний оберт
root	вершина шва *(зварка)*
shoe	колодка, башмак
transit	теодоліт

Додаток 5

ЗАПОЗИЧЕНІ ФОРМИ МНОЖИНИ ІМЕННИКІВ

Singular	*Plural*
-us [əs]	**-i** [aɪ]
abacus ['æbəkəs] — рахівниця	abaci ['æbəsaɪ]
calculus ['kælkjuləs] — обчислення	calculi ['kælkjulaɪ]
focus ['foukəs] — фокус	foci ['fousaɪ]

nucleus ['nju:klɪəs] — ядро	nuclei ['nju:klɪaɪ]
radius ['reɪdɪəs] — радіус	radii ['reɪdɪaɪ]
stimulus ['stɪmjuləs] — стимул	stimuli ['stɪmjulaɪ]
-a [ə]	**-ae [i:]**
antenna [æn'tenə] — вусик тварини	antennae [æn'teni:]
formula ['fɔ:mjulə] — формула	formulae ['fɔ:mjuli:]
-um [əm]	**-a [ə]**
curriculum [kə'rɪkjuləm] — навчальна програма	curricula [kə'rɪkjulə]
datum ['deɪtəm] — дане, дана величина	data ['deɪtə]
maximum ['mæksɪməm] — максимум	maxima ['mæksɪmə]
minimum ['mɪnɪməm] — мінімум	minima ['mɪnɪmə]
medium ['mi:djəm] — засіб	media ['mi:djə]
pendulum ['pendjuləm] — маятник	pendula ['pendjulə]
spectrum ['spektrəm] — спектр	spectra ['spektrə]
vacuum ['vækjuəm] — вакуум	vacua ['vækjuə]
-ix [ɪks], -ex [eks]	**-ices [ɪsi:z]**
appendix [ə'pendɪks] — додаток	appendices [ə'pendisi:z]
index ['ɪndeks] — індекс	inidices ['ɪndɪsi:z]
matrix ['meɪtrɪks] — матриця	matrices ['meɪtrɪsi:z]
radix ['reɪdɪks] — корінь	radices ['reɪdɪsi:z]
-is [ɪs]	**-es [i:z]**
analysis [ə'nælɪsɪs] — аналіз	analyses [ə'nælɪsi:z]
axis ['æksɪs] — вісь	axes ['æksi:z]
basis ['beɪsɪs] — базис	bases ['beɪsi:z]
crisis ['kraɪsɪs] — криза	crises ['kraɪsi:z]
metamorphosis [ˌmetə'mɔ:fəsɪs] — метаморфоза	metamorphoses [ˌmetə'mɔ:fəsi:z]
parenthesis [pə'renθɪsɪs] — круглі дужки	parentheses [pə'renθɪsi:z]
thesis ['θi:sɪs] — тези, дисертація	theses ['θɪsi:z]

-es [i:z]	**-es [i:z]**
series ['sɪəri:z] — серія	series ['sɪəri:z]
species ['spi:ʃi:z] —вид	species —['spi:ʃi:z]
-on [ən]	**-a [ə]**
automaton [ɔ:'tɔmətən] — автомат	automata [ɔ:'tɔmətə]
criterion [kraɪ'tɪərɪən] — критерій	criteria [kraɪ'tɪərɪə]
phenomenon [fɪ'nɔmɪnən] — явище	phenomena [fɪ'nɔmɪnə]
-a [ə]	**-ata [ətə]**
dogma ['dɔgmə] — догма	dogmata ['dɔgmətə]
stigma ['stɪgmə] — тавро	stigmata ['stɪgmətə]
-o [ou]	**-i [i:]**
solo ['soulou] — соло	soli ['souli:]
tempo ['tempou] — темп, ритм	tempi ['tempi:]
-eau [ou]	**-eaux [ouz]**
bureau ['bjuərou] — бюро	bureaux ['bjuərouz]
plateau ['plætou] — плато	plateaux ['plætouz]

Додаток 6

НАЙУЖИВАНІШІ АМЕРИКАНІЗМИ

British English	*American English*	
all right	O. K.	гаразд
autumn	fall	осінь
booking office	ticket office	каса продажу квитків
bowl	basin	миска
chemist's shop	drugstore	аптека
college grounds	campus	університетське містечко
corn	grain	зерно
earthed	grounded	заземлений
filling station	gas station	бензоколонка
flat	apartment	помешкання, квартира
form	grade	клас (у школі)
gaol	jail	в'язниця
gearbox	transmission	коробка швидкостей
government	administration	уряд
guard	conductor	провідник
ill	sick	хворий

inquiry office	information bureau	довідкове бюро
journalist	pressman	журналіст
leader	editorial	передова *(стаття)*
lend	loan	позичати *(комусь)*
lift	elevator	ліфт
lorry	truck	вантажний автомобіль
luggage	baggage	багаж
mathematics	calculus	математика
milliard	billion	мільярд
note	bill	банкнота
pavement	sidewalk	тротуар
porridge	cereal	каша
post	mail	пошта
pub	bar	бар
queue	line	черга
railway	railroad	залізниця
secondary school	high school	середня школа
shop	store	крамниця
spanner	monkey wrench	гайковий ключ
staff	personnel	штат, персонал
street	avenue	вулиця
student, 1st-year s.	freshman	студент I курсу
2nd-year s.	sophomore	студент II курсу
3rd-year s.	junior	студент III курсу
4th-year s.	senior	студент IV курсу
sweets	candy	цукерки
technology	know-how	технологія
think	guess	думати
time-table	schedule	розклад
tin	can	банка
tram	streetcar	трамвай
tutor	instructor	тютор, наставник
underground	subway	метро
wireless set	radio-set	радіоприймач

Додаток 7

ДЕЯКІ МАТЕМАТИЧНІ СИМВОЛИ І ВИРАЗИ

$+$	addition, plus, positive
$-$	subtraction, minus, negative
$\times$ *or* $\cdot$	multiplication sign, multiplied by, times
.	point
...	and so on
$:$, $-$	division sign, divided by; ratio sign; is to
$::$	sign of proportion, equals, as
$=$	sign of equality, equals, (is) equal to
$\neq$	(is) not equal to
$>$	greater than
$\ngtr$	not greater than
$<$	less than
$\nless$	not less than
$\geqslant$	equal or greater than
$\leqslant$	equal or less than
∞	infinity, infinite
$\sqrt{}$	square root
$\sqrt[3]{}$	cube root (out) of
$\sqrt[n]{}$	n-th root (out) of
dy/dx	derivative of y with respect to x
d^2y/dx^2	second derivative of y with respect to x
d^ny/dx^n	n-th derivative of y with respect to x
$\lvert x \rvert$	absolute value of x
$\int$	integral of
$\int f(x)\,dx$	intergal of a function of x over dx
$\int_n^m$	integral between limits n and m
0.1	zero point one
0.34	zero point three four
0.001	zero point zero zero one
'	apostrophy
,	comma
.	full stop
[ ]	brackets, square brackets
( )	parentheses, round brackets
{ }	braces
$\parallel$	parallel to
5^2	five squared
6^3	six cubed

7^5	seven to the fifth power
°	degree
′	minute, foot, feet
″	second, inch
a'	a prime
a''	a second prime or a double prime
a'''	a third prime or a triple prime
b_1	b sub one or b first
b_2	b sub two or b second
c_m	c sub m or c m-th
a_m	a sub m or a m-th
lim	limit
log	logarithm
$\log_{10}$	common logarithm
ln	logarithm natural
sin	sine
cos	cosine
tan, tg	tangent
ctn, cot	cotangent
sec	secant
csc	cosecant
vers (versine)	versed sine
covers (coversine)	coversed sine
$\sin^{-1}$	antisine
$\cos^{-1}$	anticosine
sinh	hyperbolic sine
cosh	hyperbolic cosine
tanh	hyperbolic tangent
$f(x)$ or $\varphi(x)$	function of x
Δx	increment of x
Σ	summation
dx	differential of x

Додаток 8

АНГЛІЙСЬКІ ОДИНИЦІ ВИМІРУ

Лінійні міри

Linear Measure

1 inch	дюйм	in	2.54 cm
1 foot	фут	ft (12 in)	30.48 cm
1 yard	ярд	yd (3 ft)	91.44 cm

1 mile	миля	ml (1760 yd)	1609.33 m
1 International Nautical Mile	миля морська	INM (6076 ft)	1.852 km

Міри ваги

Weight Measure

1 dram	драхма	dr	1.77 g
1 ounce	унція	oz (16 dr)	28.35 g
1 pound	фунт	lb (16 oz)	453.59 g
1 stone	стон	st (14 lb)	6.35 kg
1 quarter	квартер	gr (28 lb)	12.7 kg
1 hundredweight	хандредвейт	hwt (112 lb)	50.8 kg
1 ton	тонна велика	tn (20 hwt)	1016 kg

Міри сипких речовин

Dry Measure

1 gill	джил	gi	0.14 l
1 pint	пінта	pt (4 gills)	0.57 l
1 quart	кварта	qt (2 pt)	1.14 l
1 gallon	галон	gal (4 qt)	4.55 l
1 bushel	бушель	bu	36.35 l
1 quarter	квартер	qr (8 bu)	290.94 l

Міри площини

Square Measure

1 square inch	квадратний дюйм	sq in	6.45 cm^2
1 square foot	квадратний фут	sq ft (144 sq in)	9.29 dm^2
1 square yard	квадратний ярд	sq yd (9 sq ft)	0.836 m^2
1 acre	акр	ac (4.8 sq yd)	0.4 hectare
1 square mile	квадратна миля	sq ml (640 ac)	2.59 km^2

Міри об'єму

Cubic Measure

1 cubic inch	кубічний дюйм	cu in	16.39 cm^3
1 cubic foot	кубічний фут	cu ft (1728 cu in)	28.32 cm^3
1 cubic yard	кубічний ярд	cu yd (27 cu ft)	764.53 cm^3
1 register ton	тонна реєстрова	reg t (100 cu ft)	2.83 m^3

Міри часу

Time Measure

1 minute	хвилина	60 seconds
1 hour	година	60 minutes
1 day	день	24 hours
1 week	тиждень	7 days

Міри кута

Angles Measure

1 minute (1′)	хвилина	60 seconds (60″)
1 degree (1°)	градус	60 minutes (60′)
1 right angle	прямий кут	90 degrees (90°)
1 circle	розгорнений кут	360 degrees (360°)
		4 right angles

Навчальне видання

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(поглиблений курс)
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Мета підручника — вдосконалення навичок читання, усного мовлення, безперекладного, свідомого й активного сприйняття оригінального технічного тексту англійською мовою, передавання іноземною мовою власних думок з найактуальніших проблем науки і техніки.

Курс розраховано на 140 годин. Кожний урок підручника складається з основного і додаткового текстів, а також лексико-граматичних і комунікативних вправ, спрямованих на свідоме засвоєння мовних елементів технічного стилю, виконання таких видів роботи, як складання анотації, реферату, резюме, плану до текстів тощо. Додаток 1 ознайомить студентів з основами перекладу англійської науково-технічної літератури.

Для студентів вищих технічних навчальних закладів.

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