Н.В. Иванюк

ENGLISH

Английский язык для изучающих географию

Цель пособия – обучить студентов-географов различным видам чтения, переводу, аннотированию иноязычной литературы по специальности, а также сформировать у них навыки устной монологической речи. Тексты являются аутентичными, заимствованными из британских и американских источников.

Учебное пособие может быть использовано как для аудиторной, так и для самостоятельной работы.

Адресуется студентам географических факультетов университетов, а также всем, кто изучает английский язык и интересуется географией.

ПРЕДИСЛОВИЕ

Предлагаемое переработанное и дополненное учебное пособие предназначено для студентов географического факультета. Оно составлено в соответствии с базовой программой по иностранным языкам для неязыковых специальностей высших учебных заведений, предполагающей обучение различным видам чтения, профессионального общения, а также письменной речи для аннотирования иноязычной литературы по специальности.

При отборе материала учитывалась его познавательная ценность и языковые достоинства. Тексты пособия являются неадаптированными, заимствованными из книг, сборников статей, а также периодических изданий, вышедших как в Великобритании, так и в США, чем объясняется наличие американского варианта английского языка.

В структуру пособия входят одиннадцать уроков, два приложения и словарь терминов.

Каждый урок включает две части.

Первая часть урока содержит научный текст, относящийся к какой-либо отрасли физической географии (геоморфология, климатология, биогеография и др.), целью которого является изучающее чтение. Второй текст раздела, тесно связанный по тематике с первым, предназначен для обучения аннотированию.

Вторая часть урока содержит общеобразовательный текст, который может быть использован для обучения как аннотированию литературы по специальности, так и для обучения профессиональному общению. Текст на русском языке целесообразно использовать для передачи его содержания на английском языке.

Предтекстовые упражнения каждого урока направлены на обогащение словарного запаса студентов-географов, а также на снятие трудностей при произношении терминов и географических названий. Послетекстовые упражнения дают возможность проверить понимание содержания прочитанного, способствуют усвоению терминологии, расширению словарного запаса и развитию навыков устной речи.

В приложении даются тексты для самостоятельного внеаудиторного чтения, которые сопровождаются вопросами для контроля понимания, а также тексты для составления устных и письменных аннотаций. Пособие снабжено словарем наиболее часто встречающихся терминов.

Н.В. Иванюк

LESSON 1
GEOGRAPHY AS A SCIENCE

Part I

I. Practice the pronunciation of the following terms.

Geomorphology [ˌdʒiːəʊmɔː'fɔlədʒɪ], climatology [ˌklaɪmə'tɔlədʒɪ], biogeography [ˌbaɪədʒɪ'ɔgrəfɪ], hydrography [haɪ'drɔgrəfɪ], oceanography [ˌəʊʃjə'nɔgrəfɪ], demography [diː'mɔgrəfɪ], microgeography [ˌmaɪkrəʊdʒɪ'ɔgrəfɪ].

II. Read these international words and try to guess their meaning.

Physical, cultural, fundamental, regional, aspect, geology, phase, economy, economic, resource, mineral, potential, information, ocean, group, leader, region, continent, type.

III. Enlarge your active vocabulary.

surface ['sɜːfɪs] – поверхность
Earth [ɜːθ] – Земля
interrelation [ˌɪntərɪ'leɪʃ(ə)n] – взаимоотношение, взаимосвязь
to affect [ə'fect] – подвергать воздействию
approach [ə'prəutʃ] – подход
urban ['ɜːbən] – городской
application [ˌæpl'keɪʃ(ə)n] – применение
to distinguish [dɪs'tɪŋgwɪʃ] – различать

IV. Geography is a discipline that integrates a wide variety of subject matters. Read the text, name them and say what they study.

What Geography Studies

Geography is the science of place, i.e. the study of the surface of the Earth, the location and distribution of its physical and cultural features, the areal patterns or places that they form, and the interrelation of these features as they affect humans. The word ‘geography’ was invented in the 200s BC by the Greek scholar Eratosthenes. It is based on two Greek words – *geo* means ‘Earth’, and *graphy* means ‘to write’.

We can divide geography into three fundamental branches: physical geography, human geography, and regional geography. As the divisions are based only on differences in approaching geographic studies, the three branches are interdependent and are usually applied together. Each branch is divided into several fields that specialize in particular aspects of geography.

Physical geography includes the following fields: geomorphology (which uses geology to study the form and structure of the surface of the Earth), climatology (which involves meteorology and is concerned with climatic conditions), biogeography (which uses biology and deals with the distribution of plant and animal life), soils geography (which is concerned with the distribution of soil), hydrography (which concerns the distribution of seas, lakes, rivers, and streams in relation to their uses), oceanography (which deals with the waves, tides, and currents of oceans and the ocean floor).

Human geography, sometimes called cultural geography, involves all phases of human social life in relation to the physical earth. For instance, economic geography deals with the industrial use of the geographic environment. Natural resources, such as mineral and oil deposits, forests, grazing lands, and farmlands, are studied with reference to their position, productivity, and potential uses. Manufacturing industries rely on geographic studies for information concerning raw materials, sources of labour, and distribution of goods. Marketing studies concerned with plant locations and sales potentials are based on geographic studies. The establishment of transportation facilities, trade routes, and resort areas also frequently depends on the results of geographic studies. Many other fields of human geography include historical geography, urban geography, behavioural geography, demography and linguistic geography, political geography, which is an application of political science. Political geography deals with human social activities that are related to the locations and boundaries of cities, nations, and groups of nations. Military geography provides military leaders with information about areas in which they need to operate.

Regional geography concerns the differences and similarities among various regions of the Earth. This branch of geography seeks explanations for the variety among places by studying the special combination of features that distinguishes these places. Regional geographers may study the development of a small area such as a city. This study is called microgeography. Or they may focus on large areas, called macrodivisions, such as the Mediterranean region or an entire continent. Regional geographers identify macrodivisions according to their cultural characteristics. Regional geographers may divide macrodivisions into many smaller areas that share specific characteristics. For example, they may consider language, the type of agriculture or economy practiced by the population, terrain, or a combination of these factors to distinguish areas from one another.

V. Find the Russian equivalents of the following English phrases.

The study of the surface of the Earth, the location and distribution of the physical and cultural features, the areal patterns, the interrelation of the features, to divide into three fundamental branches, specialize in particular aspects, to be concerned with/to deal with, to involve all phases of human social life, in relation to, an application of political science, the differences and similarities among various regions, to seek explanations for, to distinguish areas from one another.

VI. Match the words with their definitions.

urban area **physical geography** **oceanography** **geomorphology** **climatology** **hydrography** **biogeography** **human geography**

1) a field of physical geography that studies the hydrosphere;
2) a geographic area with a high density of people over a limited area;
3) scientific study of phenomena found in the world's oceans;
4) a field of knowledge that investigates the origin of landforms on the Earth and other planets;
5) a field of knowledge that studies human-made features and phenomena on the Earth from a spatial perspective;
6) scientific study of the Earth's climate over long time spans (greater than several days);
7) a field of knowledge that studies natural features and phenomena on the Earth from a spatial perspective;
8) a field of physical geography that studies the spatial pattern of living organisms;

VII. Answer the following questions.

1. What does the word 'geography' mean?
2. When was the word 'geography' invented?
3. What branches does geography include?
4. What sub-fields does physical geography consist of? What do they study?
5. In what way does physical geography differ from human geography?
6. What are some of the sub-fields of human geography? What do they study?
7. Regional geography deals with the differences and similarities among various regions of the Earth, doesn't it?

VIII. Complete the following sentences with the information from the text.

1. This text deals with … . 2. Geography is defined as … . 3. …, … and … are considered to be the fundamental branches of geography. 4. The sub-fields of physical geography are …, …, …, …, …, … . 5. They specialize in particular aspects of physical geography: geomorphology studies …, climatology deals with …, biogeography is concerned with …, soils geography concerns …, hydrography focuses on …, oceanography studies … . 6. What distinguishes

human geography from the other branches of geography is that … . 7. It includes the following sub-fields: …, …, …, …, …, …, …, … . 8. The main branch of human geography is … which studies … .9. Some of the other dominant areas of study in human geography include: behaviour (…), politics (…), urban systems (…). 10. Regional geography specializes in … . 11. Regional geographers may focus either on … or … . 12. In order to distinguish areas from one another regional geographers may consider …, …, …, … .

IX. Discuss the text in the form of a dialogue, using set expressions and phrases given below:

Do you mind our brief regarding… ? **It is a well-known fact that …**
I can start by saying … **On the whole …**

History of Physical Geography

to reject – отрицать
responsible – ответственный
variety – разнообразие
measurement – измерение
to determine – определять

The nature of understanding in physical geography has changed over time. During the period from 1850 to 1950, there seems to have been four main ideas that had a strong influence on the discipline:

1. *Uniformitarianism.* This theory rejected the idea that catastrophic forces were responsible for the current conditions on the Earth. It suggested instead that continuing uniformity of existing processes were responsible for the present and past conditions of this planet.
2. *Evolution.* Charles Darwin's 'Origin of Species' (1859) suggested that natural selection determined which individuals would pass on their genetic traits to future generations. As a result of this theory, evolutionary explanations for a variety of natural phenomena were postulated by scientists.
3. *Exploration and Survey.* Much of the world had not been explored before 1900. Thus, during this period all of the fields of physical geography were actively involved with basic data collection which included activities like classification and description of landforms, measurement of various phenomena connected with weather and climate, and classification of soils, organisms, biological communities and ecosystems.
4. Conservation – a concern for the environment which began to develop as a result of the human development of once natural areas in the United States and Europe.

After 1950, the following two forces largely determined the nature of physical geography:

1. *The Quantitative Revolution.* Measurement became the central focus of research in physical geography. With measurement came mapping, models, statistics, mathematics, and hypothesis testing.
2. The study of *Human/Land Relationships*. The influence of human activity on the environment was becoming very apparent after 1950. As a result, many researchers in physical geography began studying the influence of humans on the environment.

X. You are a lecturer in Geography Study. You are invited to a workshop for geography students at the University of Westminster and are expected to focus on the essence of geography, problems the fundamental fields of geography deal with.

Part II

I. Practice the pronunciation of the following proper names.

Spitsbergen ['spɪts˛bɜ:gən] – Шпицберген
Franz Joseph Land ['frænts'jəʊzɪf'lænd] – Земля Франца-Иосифа

II. Read these international words and try to guess their meaning.
Arctic, barrier, expedition, polar, provision, principle, storm, temperature.

III. Enlarge your active vocabulary.
peninsular [pɪ'nɪnsjulə] – полуостров
impenetrable [ɪm'penɪtrəbl] – непреодолимый
to squeeze [skwi:z] – сжимать
erroneous [ɪ'rəunjəs] – ошибочный
to immerse [ɪ'mɜ:s] – погружать
to chart [tʃa:t] – составлять карту
morass [mə'ræs] – трясина
to traverse ['trævɜ(:)s] – пересекать
erratic [ɪ'rætɪk] – беспорядочный

IV. Read the text and find all the terms relating to geography.

Fridtjof Nansen

It was widely believed from 1866 to 1892 that Greenland and Wrangel 'Land' were peninsulas projecting from a great, but as yet undiscovered, arctic continent. A young Norwegian scientist Fridtjof Nansen was sure the hypothetical arctic continent did not exist. He felt it was impossible to sail a ship to the Pole not because of the land but because the ice was an impenetrable barrier. He decided to work with the forces of nature, not against them. All previous expeditions had travelled against the ice and currents; that is why they could not penetrate into the polar sea. Nansen proposed to build a ship ‘as small and strong as possible; just big enough to contain supplies of coal and provisions for 12 men for five years... The main point in this vessel is that it is built on such principles as to enable it to withstand the pressure of the ice. The sides must slope sufficiently to prevent the ice, when it presses together, to get hold of the hull. Instead of crushing the ship the ice must squeeze it upward and out of the water.’

Nansen thought this ship could sail in open water as far as the New Siberian Island, and then drift across the Pole and onwards to the sea between Greenland and Spitsbergen.

On June 24, 1893 the expedition sailed from Oslo. They rolled around the northern tip of Norway, spent a month and a half fighting the ice and storms of the Kara Sea and trying to find their way to New Siberia with inaccurate and erroneous charts. On September 21, the ship ran into the head of a large bay in the ice and was stopped at 78°30' North latitude – 700 miles from the North Pole.

Fog set in. When it lifted, the *Fram* was surrounded on all sides by thick floes which slowly began to close in on her. The ship was squeezed upward and out on top of the ice. When the sun went down they were frozen fast in the North Polar Sea.

Temperatures dropped quickly. The darkness increased every day until the sun disappeared, and the *Fram* became immersed in the silent blackness of the long arctic night. Thirteen men, alone and frozen in at the top of the world, began their drift over solid seas never before traversed, or seen by the eyes of man.

Observations of the sun and stars were the only means by which the *Fram’s* position could be determined from day to day and her drift charted. On Christmas Eve, 1893 they had gone only 40 miles to the north and were drifting toward Alaska instead of Greenland. In January 1894, the erratic drift to the east and south stopped and the ship began to move toward Greenland and Spitsbergen.

By March 1895 the *Fram* had drifted to within 360 miles of the Pole. From here, Nansen calculated he could reach 90° north in 50 days by dogsled. On March 14, 1895 Nansen and Frederik Johansen left the ship. They struggled on to within 226 miles of the North Pole, but the morass of chaotic ice and open water finally beat them. They turned south. The two did not plan to go back to *Fram*, but rather to attempt a trek over ice and water to the Franz Joseph Land, an uninhabited group of islands 200 miles north of Siberia. They reached the island in August and had to spend the winter in the Franz Joseph Land.

Nansen and Johansen returned to Norway aboard the English ship *Winward* on August 13, 1896, after an absence of three years and two months.

Nansen left the *Fram* in command of Captain Sverdrup when she was 356 miles from the Pole and some 325 miles north-east of Franz Joseph Land. From here the ship continued her drift north and west. In September 1895 the crew celebrated their second anniversary in the ice. During the second year they had drifted nearly twice as far as during the first, and their speed continued to increase as they moved homeward. On August 13, 1896 the same day Nansen and Johansen reached Norway, the ship came to open water.

V. Find the English equivalents of the following Russian words and phrases.

До сих пор неоткрытый, предполагаемый арктический континент, непреодолимый барьер, предыдущие экспедиции, провиант (съестные припасы), противостоять давлению льда, огибать, окружать плавучими льдинами, начинать погружаться, собачья упряжка, предпринять попытку перехода, продолжать дрейф, вторая годовщина.

VI. Match the words from column A with the suitable words from column B to make word combinations.

A	**B**
Arctic	point
to sail	water
an impenetrable	floes
the main	barrier
open	a ship
thick	continent
the erratic	a trek
to attempt	homeward
to move	drift

VII. Fill in the blanks with prepositions where necessary.

1. The captain sailed … his ship through the narrow channel.
2. Some countries are greatly at the mercy of the forces … nature.
3. The ship drifted … the North Sea.
4. They were drifting … Greenland … … Alaska.
5. The expedition reached the North Pole … dogsled.
6. The crew returned … Norway aboard the English ship.

VIII. Answer the following questions.

1. What did people of that time think about Greenland and Wrangel ‘Land’?
2. Did Nansen believe in the hypothetical arctic continent?

3. Why couldn't the previous expeditions reach the Pole?
4. What did Nansen propose?
5. When did the expedition sail from Oslo?
6. How did Nansen determine the position of the ship?
7. What direction was the ship drifting in?
8. Why did Nansen and Johansen leave the ship?
9. Where did they spend the winter?
10. How did they return to Norway?
11. When did the ship come to open water?

IX. Fill in the table with the main events from the text.

date	*event*
June 24, 1893	
September 21, 1893	
December 24, 1893	
January 1894	
March 1895	
August 1895	
September 1895	
August 13, 1896	

X. Say whether the following statements are true or false. Correct the false statements to make them true. Use the introductory phrases:

That's right.	**It's not correct.**
Exactly. Certainly.	**It's not right.**
Absolutely correct.	**It's wrong.**

1. From 1866 to 1892 people believed that Greenland and Wrangel 'Land' were islands projecting from a great, but as yet undiscovered, arctic continent.
2. Nansen decided to work with the forces of nature, not against them.
3. All previous expeditions had travelled against the ice and currents; that is why they could penetrate into the polar sea.
4. On June 24, 1893 the expedition sailed from Stockholm.
5. When fog lifted, the *Fram* was surrounded by thick floes on all sides.
6. Observations of the sun and stars were the only means by which the *Fram's* position could be determined from day to day and her drift charted.
7. By March 1895 the *Fram* had drifted to within 300 miles of the Pole.

8. Nansen and Johansen returned to Norway aboard the English ship *Winward.*
9. In September 1895 the crew celebrated their third anniversary in the ice.

XI. Describe the voyage of F. Nansen as depicted in the text.

XII. Render the text into English using the active vocabulary.

Путешествие Седова.

Люди давно стремились добраться до самой северной точки земного шара – Северного полюса.

Это было до революции. Русский мореплаватель Седов решил организовать экспедицию к Северному полюсу на санях. Царское правительство отказалось дать на это деньги. Пришлось собрать у разных людей. На собранные деньги в августе 1912 года вместе с другими участниками экспедиции он вышел из Архангельского порта в Белое море и повел свое судно на север.

У берегов Новой Земли судно попало в сильный шторм, но, несмотря на это, судно упорно пробиралось на север. У берегов Новой Земли Седов решил перезимовать.

Все следующее лето судно было сковано льдом. Только в сентябре 1913 года Седов смог продолжать свой путь на север. В середине сентября судно подошло к берегам Земли Франца-Иосифа. Здесь предстояла вторая зимовка. Наступили морозы. Люди болели.

К Северному полюсу Седов вышел с двумя матросами. Дорога оказалась очень трудной. Прошло семь дней. Здоровье Седова становилось все хуже и хуже.

Прошло три недели. Седов умер. Матросы похоронили его на одном из ближайших островов и двинулись в обратный путь. Так и не дошел Седов до полюса. Но его путешествие принесло большую пользу. Он составил карту тех мест, в которых был, и собрал ценные сведения о природе Северного Ледовитого океана.

XIII. Prepare a report on the topic "Geographical Discoveries and their Historical Significance". You may use the following phrases:

To establish contacts between continents, to bring about the growth of trade, new routes, to lead to the growth of production.

Present your report to the group. Choose the best report and the best reporter.

LESSON 2
THE CONTINENTS

Part I

I. Practice the pronunciation of the following proper names.

Europe ['juərəp], Asia ['eɪʃə], Australia [ɔs'treɪljə], Oceania [ˌəʊʃɪ'eɪnjə], the Eurasian continent [juə'reɪʒjən 'kɔntɪnənt], the Mediterranean sea [ˌmedɪtə'reɪnjən 'si:], the Baltic Sea ['bɔltɪk 'si:], Micronesia [ˌmaɪkrəʊ'ni:zjə], Melanesia [ˌmelə'ni:zjə], Polynesia [ˌpolɪ'ni:zjə].

II. Read these international words and try to guess their meaning.

Mass, political, line, tropical, jungle, tundra, distance, equator.

III. Enlarge your active vocabulary.

to surround [sə'raund] – окружать
island ['aɪlənd] – остров
to imply [ɪm'plaɪ] – предполагать
to override [ˌəuvə'raɪd] – отвергать, не принимать во внимание
vast [va:st] – обширный
desert ['dezət] – пустыня
range [reɪndʒ] – ряд
inhospitable [ɪn'hɔspɪtəbl] – недружелюбный, неприветливый

IV. Continents are considered to be parts of the continental platforms that stand above the oceans. The area of the continental platforms is about 66 million square miles. Read the text and obtain more information about the continents.

Physical Features of the Continents

A continent is defined as a large unbroken land mass completely surrounded by water, although in some cases continents are (or were in part) connected by land bridges. The seven continents are North America, South America, Europe, Asia, Africa, Australia, and Antarctica. The island groups in the Pacific are often called Oceania but this name does not imply that scientists consider them the remains of a continent.

Political considerations often overrode geographical facts when it came to naming continents. Geographically, Europe, including the British Isles, is a large western peninsula of the continent of Asia; and many geographers, when referring to Europe and Asia, speak of the Eurasian continent. But traditionally, Europe is counted as a separate continent, with the Ural and the Caucasus mountains forming the line of demarcation between Europe and Asia.

Asia occupies nearly one-third of the world's land, and contains more than half of the people. It is clearly bordered by the oceans in the north, east and south. Asia is a very hot continent in summer, but much of it is very cold in winter. It extends from the heights of Everest to below sea level in the Dead Sea, and contains tropical forests, jungles, tundra and ice caps.

Africa is the second largest continent, and extends an equal distance both north and south of the equator. It is a warm continent. There are forests on the equator and vast expanses of tropical grassland all around the tropical forest area. The Sahara and Kalahari deserts occupy large areas. The Sahara is much larger than the Kalahari because Africa is wider in the north and it is drier.

North America is the third largest continent, and is surrounded by the oceans. The southern tip contains the *Central American* republics which link North to South America. The islands of the West Indies are east of Central America. North America contains large expanses of forest, grassland and desert.

South America is broadest in the tropics and therefore is a fairly warm and wet continent. It does, however, contain the Atacama desert which is the driest area in the world. It also contains the longest range of mountains in the world, the Andes, which run from the north to the south of South America.

Antarctica is a large land mass almost completely covered by ice, and surrounded by the great Southern Ocean. The climate is so inhospitable that normal life would be impossible.

Europe is a climatically mild continent as the Mediterranean and Baltic Seas enable oceanic influences to extend far inland. It is broken up by many mountain ranges such as the Alps, Carpathians and Harz mountains.

Australasia consists of Australia, New Zealand and thousands of islands in the Pacific Ocean. These islands can be divided into three main groups – Melanesia, Micronesia and Polynesia. The islands to the north represent a transitional area with Asia.

More than half of the land in the world is uninhabitable – because it is rock, desert, tundra, dense jungle, swamp or is covered with ice. Nearly one-half of the world's population lives on one-thirtieth of the total area of land. There are immense areas which are very sparsely populated – such as the Northern Territory of Australia; other areas (such as Japan and India) are very densely populated.

V. Find the English equivalents of the following Russian phrases.

Полностью окружённый водой, рассматриваться как отдельный континент, простираться на одинаковое расстояние, занимать огромные территории, иметь (включать) самые длинные горные цепи в мире, климатически умеренный, океаническое влияние, непригодный для жилья, мало/много населённый.

VI. Match the words with their definitions.

rock **tundra** **desert** **equator**
peninsular **continent** **tropical rainforest**

1) biome that has plants and animals adapted to survive severe drought conditions. This area receives low precipitation;
2) location on the Earth that has a latitude of 0°;
3) an area of land that is nearly surrounded by water;
4) a compact and consolidated mass of mineral matter;
5) a forested biome found near the equator and dominated by evergreen vegetation;
6) a high latitude biome dominated by a few species of dwarf shrubs, a few grasses, sedges, lichens, and mosses. Productivity is low in this biome because of the extreme climate;
7) a part of the Earth's surface that forms one of the great dry-land masses of the world;

VII. Answer the following questions.

1. What is a continent?
2. What are the seven continents?
3. Is there any difference between traditional and geographical ways in which Europe is viewed?
4. What are some of the characteristic features of Asia?
5. What is characteristic of Africa?
6. What is the third largest continent? What features are characteristic of it?
7. Why is Southern America considered to be a fairly warm and wet continent?
8. What climate is characteristic of Antarctica?
9. What factors influence the climate of Europe?
10. Australasia includes Australia, New Zealand and thousands of islands in the Pacific Ocean, doesn't it?
11. Why is more than half of the land in the world counted as uninhabitable?
12. What factors influence the density of population of an area?

VIII. Complete the following sentences with the information from the text.

1. This text is concerned with … . 2. A continent is defined as … . 3. There are seven continents: …, …, …, …, …, …, … . 4. Traditionally Europe is considered to be a … though geographically it is a … . 5. Asia is … in the

world. 6. The climate of Asia is … 7. It contains … .8. Africa is … . 9. It is covered by … . 10. Large areas are occupied by … and … . 11. In comparison with the Sahara the Kalahari is … . 12. North America is considered to be … . 13. It contains … . 14. South America is warm and wet because … . 15. However, it contains … which is believed to be … .16. … run from the north to the south of South America. 17. Antarctica is described as a … . 18. Normal life is impossible there because … . 19. The climate of Europe is … because … . 20. It contains … . 21. Australasia is divided into several parts: …, … and … . 22. The land that is counted as uninhabitable is …, …, …, …, … or … .

IX. Discuss the text in the form of a dialogue, using set expressions and phrases given below:

The text is on …	**As far as I understand …**
It is important to point out…	**What I mean to say …**

The Antarctic Environment

to combine – соединять
remote – отдаленный
indigenous – местный
luxuriant – богатый (о растительности)
to deteriorate – ухудшаться
expansion – расширение

Did you know that Antarctica is as big as Australia and Europe combined, sunnier than California, drier than Arabia, higher than Switzerland and emptier than the Sahara? A hundred million birds breed there each year and the Southern Ocean contains the world's largest fish stocks. Beneath its surface are the world's largest coal deposits and probably the world's richest oil reserves.

The Antarctic is the most remote continent and the last to be discovered, but it constitutes about a tenth of the world's land surface. It is also the only continent without an indigenous human population.

In the past it had a warm climate, supporting luxuriant vegetation and large animals, but the climate deteriorated over the last 50 million years, once the great continent Gondwana had drifted apart sufficiently for a southern circumpolar current to become established. This, the largest ocean current in the world, cut off Antarctica from the warmer oceans to the north and allowed the ice sheets, in places over four kilometres thick, to develop.

This region is the Earth's major heat sink and contains ninety per cent of the world's ice and nearly three-quarters of its fresh water. Only two per cent of the continent is not covered by ice, and life retains a tenuous foothold there.

Nearly half of Antarctica's coastline is hidden by thick floating ice shelves or glaciers, and the rest is scoured by icebergs down to depths of 15 metres or more, which limits coastal life. But below this level, where water temperatures are stable, there is a colourful marine world containing a great diversity of life. The Southern Ocean makes up a tenth of the world ocean, and the expansion and contraction of the surrounding sea ice is the largest seasonal process on the Earth. Recent work has shown that the pack ice provides a surprisingly productive winter habitat for a number of small creatures.

X. Prepare a presentation on the topic 'The Continents'. Compare and contrast the characteristics (climate, relief, plant types, etc.) of the continents. You may use Internet resources.

Part II

I. Practice the pronunciation of the following proper names.

Siberian [saɪ'bɪərɪən], Thailand ['taɪlænd], Himalayas [ˏhɪmə'leɪəz].

II. Read these international words and try to guess their meaning.

Archipelago [ˏa:kɪ'pelɪgəʊ], flora, fauna, central, contrast, form, era, million.

III. Enlarge your active vocabulary.

resemblance [rɪ'zembləns] – сходство
shield [ʃi:ld] – щит
enormous [ɪ'nɔ:məs] – огромный
to submerge [səb'mə:dʒ] – погружать(ся)
isthmus ['ɪsməs] – перешеек
upheaval [ʌp'hi:v(ə)l] – поднятие земной коры
to mingle [mɪŋgl] – смешиваться

IV. Read the text to find out about the origin of Eurasia and pick out the information which is new to you. Name some other theories of the origin of Eurasia.

Eurasia

The origin of the largest of the continents Eurasia goes to the very dawn of our planet, but the continent-to-be (future continent) bore no resemblance whatever to the land mass we know now. Basically, it was represented by an archipelago of giant islands, or shields of Precambrian rock, rising above the surface of the vast seas which then covered much of our world. Essentially, these islands were five in number: the Scandinavian shield in the north-west; the Siberian shield, largest of all, in the north; the Chinese shield in the east; the Thailand Cambodian in the south-east; and the Indian shield in the south.

The seas above which these islands rose in these earliest days of the Earth's formation disappeared long ago, but two of them, the Tethys and the Uralian, lasted for so long that they played an important role in the history of Old World flora and fauna. The Tethys was the southern of these two enormous bodies of water: it lay between the Scandinavian, Siberian and Chinese shields in the north and the Indian and African shields in the south. Thus it reached from the Alps and the Mediterranean basin all the way to the Timor Sea in the Indonesian archipelago, covering the entire width of southern Asia, Turkey, Iran; the mountain systems of the Middle East, the Himalayas and Vietnam – all lay submerged beneath the waters of what was, in fact, a tropical ocean. And though its shorelines changed during the more than 560 million years of its existence, and temporary isthmuses appeared and disappeared, the Tethys persisted more or less from the Precambrian period up to the middle of Cenozoic era. The Mediterranean today is a relic of it, a remaining puddle so to speak, of a vastly greater Mediterranean ocean.

Not until Oligocene times, some 36 million years ago, did the Tethys at last begin to dry up, eventually leaving behind it some of the familiar contours of the lands we know today. Great upheavals of the Earth's crust gave birth to the Alps and the Himalayas, isolated its entire central area, and the two ends of this enormous sea became separated by thousands of miles of emerged land. But the common parentage of the Mediterranean and the seas around Japan is still evident in the great resemblance of the fishes found in these widely separated waters: these two areas have 79 genera and even some species in common. By contrast, the Mediterranean and the Red seas, separated by only a hundred miles or so of land, have quite different fishes, and it was not until the Suez Canal was cut in 1869 that they began to mingle.

The second and more northern sea, the Uralian, likewise went back to very early times. It ran north from the Tethys to what is now the Arctic Ocean and it separated the Siberian from the Scandinavian shields. In this general form it persisted through various changing shorelines from the beginning of the Paleozoic era for about 360 million years down to the late Permian. At that point, about 240 million years ago, what were to be the Urals began to emerge. There was a general raising of land which lifted the level of the continent-to-be above the waves, giving Eurasia its shape. The Ural Sea disappeared – but only for a while.

Succeeding upheavals and subsidences of the continental crust created new seas separating east from west more than once before the continent was again reunited at the end of Oligocene. Thus Eurasia, as we know it today has existed only for about 25 million years.

V. Find the Russian equivalents of the following English words and phrases.
The very dawn of our planet, giant islands, much of our world, the Earth's formation, these two enormous bodies of water, to cover the entire width, to be submerged beneath the waters, temporary isthmuses, to give birth to, to become separated by, the common parentage, in common, to mingle, to persist, a general raising of land, to be reunited.

VI. Match the words from column A with the suitable words from column B to make word combinations.

A	B
land	width
giant	upheavals
Earth's	times
Old	island
enormous	birth
entire	mass
to give	body
mountain	World
early	north
to run	system
succeeding	formation

VII. Fill in the blanks with prepositions where necessary.
1. The origin … Eurasia goes … the very dawn of our planet.
2. These islands were five … number: the Scandinavian shield, the Siberian shield, the Chinese shield, the Thailand Cambodian and the Indian shield.
3. The Tethys was the southern of these two enormous bodies of water: it lay … the Scandinavian, Siberian and Chinese shields … the north and the Indian and African shields … the south.
4. Not until Oligocene times, the Tethys … last began to dry … .
5. The second and more northern sea, the Uralian, likewise went back … very early times.
6. The Ural Sea disappeared only … a while.

VIII. Answer the following questions.
1. What was Eurasia represented by in very early times?
2. What islands did the archipelago include?

3. What islands played an important role in the history of Old World flora and fauna?
4. Where did the Tethys Sea lie?
5. When did the Tethys Sea begin to dry?
6. When did the Mediterranean and the Red Sea begin to mingle?
7. When did the Urals emerge?
8. What area did the Uralian Sea occupy?
9. When was the continent reunited?
10. How old is Eurasia?

IX. Say whether the following statements are true or false. Correct the false statements to make them true. Use the introductory phrases:

That's right. Quite OK.	**Quite the contrary (the reverse).**
Exactly. Quite so.	**It's unlikely.**
It's correct to say.	**Not quite so.**

1. The origin of the largest of the continents Eurasia goes to the very dawn of our planet.
2. Basically, it was represented by an archipelago of small islands, or shields of Precambrian rock.
3. These islands were four in number.
4. The seas above which these islands rose in these earliest days of the Earth's formation disappeared long ago.
5. The Tethys persisted more or less from the Precambrian period up to the middle of Cenozoic era.
6. Not until Cenozoic era, some 36 million years ago, did the Tethys at last begin to dry up.
7. Great upheavals of the Earth's crust gave birth to the Alps and the Urals, isolated its entire central area, and the two ends of this enormous sea became separated by thousands of miles of emerged land.
8. The second and more northern sea, the Uralian, likewise went back to very early times.
9. Succeeding upheavals and subsidences of the continental crust created new seas separating south from north more than once before the continent was again reunited at the end of Oligocene.

X. Render the text into English using the active vocabulary.

Евразия – самый крупный материк. На её долю приходится треть всей суши. Она расположена в Восточном и Западном полушариях. Евразия традиционно делится на две части: Европу и Азию. Евразия –

единственный материк, находящийся во всех климатических зонах: от арктической до экваториальной. Только в Евразии горные вершины поднимаются выше 7-тысячной отметки над уровнем моря. Самое высокое и протяжённое нагорье Тибет также находится на этом континенте. Тоже относится к самой низкой сухопутной впадине берега Мёртвого моря (365 метров ниже уровня моря). Крупнейшие равнины мира – Восточно-Европейская и Западно-Сибирская – располагаются в Евразии. Свыше четверти территории на севере занимают тундры и зона вечной мерзлоты. Примерно такую же площадь на юге занимают пустыни и полупустыни.

XI. Put the points of the plan into the right order. Retell the text 'Eurasia' one after the other using the plan.

1. The Tethys and the Uralian Sea.
2. An archipelago of giant islands.
3. The emerging of the Urals.
4. The origin of the Alps and the Himalayas.

XII. Find some information concerning other theories of the origin of Eurasia. Prepare reports and present them to your groupmates.

LESSON 3
THE EARTH

Part I

I. Read these international words and try to guess their meaning.

Lithosphere ['lɪθəˌsfɪə], asthenosphere [æs'θi:nəˌsfɪə], center, basalt, granitic, nickel, radius, volcano, tectonic, phenomenon.

II. Enlarge your active vocabulary.

oblate ['ɔbleɪt] – сплющенный у полюсов
core [kɔ:] – ядро
brittle ['brɪtl] – ломкий, хрупкий
to glide [glaɪd] – скользить, плавно двигаться
earthquake ['з:θkweɪk] – землетрясение
buoyant [bɔɪənt] – способный держаться на поверхности
% (per cent) [pə'sent] – процент

III. Geophysicists today picture the Earth as composed of three main concentric spheres. The crust of the planet is the part of the solid earth that comes under observation of man. Rocks once buried as deep as 5 to 10 miles have been exposed by erosion, and they may be seen and studied, but little is positively known of the nature of the Earth below a depth of 5 to 10 miles. Read the text and say what layers of the Earth scientists identify.

The Structure of the Earth

The Earth is an oblate spheroid. It is composed of a number of different layers as determined by deep drilling and seismic evidence. These layers are the core (which is approximately 7000 kilometres in diameter (3500 kilometres in radius) and is located at the Earth's center), the mantle (which surrounds the core and is 2900 kilometres in thickness), the crust (which floats on top of the mantle and is composed of basalt rich oceanic crust and granitic rich continental crust).

The core is a layer rich in iron and nickel that is composed of two layers: the inner and outer cores. The inner core is theorized to be solid with a density of about 13 grams per cubic centimetre and a radius of about 1220 kilometres. The outer core is liquid and has a density of about 11 grams per cubic centimetre. It surrounds the inner core and is 2250 kilometres thick.

The mantle is almost 2900 kilometres thick and comprises about 83% of the Earth's volume. It is composed of several different layers. The upper mantle is 670 kilometres in depth from the base of the crust. The top layer of the upper mantle, 100 to 200 kilometres under the surface, is called the asthenosphere. Scientific studies suggest that this layer has physical properties that are different from the rest of the upper mantle. The rocks in this upper portion of the mantle are more rigid and brittle because of cooler temperatures and lower pressures. Under the upper mantle is the lower mantle which is from 670 to 2900 kilometres deep. This layer is hot and plastic. The higher pressure in this layer causes the formation of minerals that are different from those of the upper mantle.

The lithosphere is a layer that includes the crust and the uppermost portion of the asthenosphere. This layer is about 100 kilometres thick and has the ability to glide over the rest of the upper mantle. Because of increasing temperature and pressure, deeper portions of the lithosphere are capable of plastic flow over geologic time. The lithosphere is also the zone of earthquakes, mountain building, volcanoes, and continental drift.

The topmost part of the lithosphere consists of the crust. This material is cool, rigid, and brittle. Two types of the crust can be identified: the oceanic crust and continental crust. Both of these types of the crust are less dense than the rock found in the underlying upper mantle layer. The oceanic crust is thin and measures from 5 to 10 kilometres thick. It is also composed of basalt and has a density of about 3.0 grams per cubic centimetre. The continental crust is 20 to 70 kilometres thick and composed mainly of lighter granite. The density of the continental crust is about 2.7 grams per cubic centimetre. Both of these crust types are composed of numerous tectonic plates that float on top of the mantle. Convection currents within the mantle cause these plates to move slowly across the asthenosphere.

One interesting property of the continental and oceanic crust is that these tectonic plates have the ability to rise and sink. This phenomenon, known as isostacy, occurs because the crust floats on top of the mantle like ice cubes in water. When the Earth’s crust gains weight due to mountain building or glaciation, it deforms and sinks deeper into the mantle. If the weight is removed, the crust becomes more buoyant and floats higher in the mantle.

IV. Find the Russian equivalents of the following English words and phrases.

An oblate spheroid, the inner and outer cores, to be composed of several layers, to be 67 kilometres in depth/thickness, physical properties, the upper/lower mantle, to be rigid and brittle, increasing temperature and pressure, the oceanic/continental crust, tectonic plates, convection current, isostasy, to become more buoyant.

V. Match the words with their definitions.

continental crust	**convection current**	**earthquake**	**oceanic crust**
tectonic plate	**lithosphere**	**volcano**	**asthenosphere**

1) the movement of a gas or a fluid in chaotic vertical mass motions because of heating;
2) a sudden motion or trembling in the Earth. The motion is caused by the quick release of slowly accumulated energy in the form of seismic waves;
3) a granitic portion of the Earth's crust that makes up the continents;
4) an extensive layer of lithosphere that moves as a discrete unit on the surface of the Earth's asthenosphere;
5) a solid inorganic portion of the Earth (composed of rocks, minerals, and elements). It can be regarded as the outer surface and interior of the solid Earth;
6) a basaltic portion of the Earth's crust that makes up the ocean basins;
7) a zone in the Earth's mantle that exhibits plastic properties. It is located below the lithosphere;
8) an elevated area of land created from the release of lava and ejection of ash and rock fragments from the vent;

VI. Answer the following questions.

1. What is the core?
2. What layers is the core composed of?
3. What is the mantle?
4. Is the mantle composed of several layers? What is the difference between them?
5. What layers does the lithosphere include?
6. Is the crust cool, rigid, and brittle?
7. What layers is the crust divided into? What is characteristic of them?
8. What is a tectonic plate?
9. Why does isostasy occur?

VII. Complete the following sentences with the information from the text.

1. Through deep drilling and seismic evidence scientists have learned about … . 2. Structurally, the Earth is made up of … . 3. At the center of the Earth is … which is approximately … in diameter. 4. It consists of two sub-layers: … and … . 5. The inner core is … and the outer core is … . 6. The mantle is defined as … . 7. It is composed of two sub-layers: … and … . 8. The top layer of the upper mantle is called … . 9. The crust and the upper portion of the asthenosphere make up … . 10. It is the zone of …, …, … and … . 11. The crust is … . 12. It includes two sub-layers: … and … which are composed of … .

13. Tectonic plates have the ability to … . 14. This process is called … . 15. The greater the weight of the crust the deeper … 16. When the weight is removed the crust … .

VIII. Make a written summary of the text using the following phrases:

This text deals with … **The thing is that …**
It should be mentioned that … **To sum up …**

Plate Tectonics

evidence – основание, данные
to wane – ослабевать
to resurrect – воскресать
subsequent – последующий
to collide – сталкиваться

In the 19th and early 20th centuries, several scientists suggested that the continental masses had the ability to move across the Earth's surface. These early theories of continental drift were based on the following evidence:
1) locations of fossil occurrences suggested that some of the continental masses may have been connected in the geological past; 2) paleoclimatic evidence indicates that now tropical regions on some continents had polar climates in the past. This may indicate that these regions were located at different latitudes; 3) some continents seem to fit together like a jigsaw puzzle; 4) some geologic deposits of rocks on the East coast of North and South America are similar to deposits found on the West coast of Africa and Europe.

During the first 30 years of the 20th century the theory of continental drift was actively debated among geoscientists. However, during the following 30-year period, debate on this theory waned because of the inability of scientists to propose a mechanism to cause the movement of the continental masses.

In the 1960s, the theory was resurrected with the discovery of alternating patterns of rock magnetism in surface sea-floor rocks. Based on this information scientists developed the theory of sea-floor spreading which started a revolution in the Earth Sciences. Subsequent research discovered that the Earth's surface was composed of a number of oceanic and continental plates that float on top of the asthenosphere. In some cases, plates can collide with each other at the plate boundaries causing the production of earthquakes, volcanoes, mountain building and oceanic trenches. For example, the Marianas trench in the Pacific Ocean was created by the collision of the fast-moving Pacific Plate against the slower moving Philippine Plate. The theory of plate tectonics offered new and more scientifically sound explanations for a number of observed geologic phenomena.

IX. Imagine you are going to give a lecture about the structure of the Earth to a group of students. Prepare a presentation, comparing and contrasting the structure and composition of the layers that make up the solid Earth.

Part II

I. Practice the pronunciation of the following terms.

Nebular ['nebjulə], gaseous ['gæsjəs], hypothesis [haɪ'pɔθɪsɪs].

II. Read these international words and try to guess their meaning.

Cosmic, form, material, orbit, planet, astronomer, fact, theory, satellite, asteroid, primitive, platform, relief, diameter, position.

III. Enlarge your active vocabulary.

velocity [vɪ'lɔsɪtɪ] – скорость
centrifugal [sen'trɪfjug(ə)l] – центробежный
discrepancy [dɪs'krep(ə)nsɪ] – противоречие
to perpetuate [pə'petʃueɪt] – навсегда сохраняться
fluctuation [ˏflʌktju'eɪʃ(ə)n] – колебание

IV. Read the text and say which hypothesis you favour. Why are you 'for' or 'against' a particular hypothesis?

Early Earth History

The relations of the Earth and other planets to the Sun are such that cosmic or early history can be interpreted only through astronomic studies. These studies suggest a common origin for all members of the solar system. A hypothesis proposed by Laplace enables us to account for the origin of these bodies. The nebular hypothesis of Laplace postulates that all the matter in the solar system was once in the form of a huge gaseous spheroid rotating on its axis at a high velocity. As this nebula rotated, it slowly cooled and condensed. Shrinking caused it to rotate more rapidly, and eventually the centrifugal force of rotation in its equatorial zone became greater than the force of gravity. Consequently material separated from the surface of the spheroid and formed a ring that encircled it. According to this hypothesis, the matter composing the planets separated as rings from the nebula at approximately the positions now occupied by the orbits of the several planets. After nine such rings were formed, the parent gaseous spheroid continued to shrink and eventually formed the Sun. The matter composing each of these rings collected or condensed about some point within the ring and formed a planet.

During the last few decades astronomers have learned new facts about the solar system, and many discrepancies have been found in the Laplacian nebular hypothesis.

On the basis of these more recent observations Chamberlin and Moulten devised an alternative theory known as the planetesimal hypothesis.

According to this hypothesis, the Earth, the other planets, satellites and asteroids of our solar system are assumed to have come originally from the Sun. The Earth in an early formative stage was very much smaller than it is now. It grew to larger and larger size through the incoming to the Earth nuclei of billions of tiny solid particles of cooled sun material called planetesimals.

When the Earth had reached the size of the planet Mars, it had primitive continental platforms and ocean basins. These initial relief features are believed to have been formed through the irregular distribution of the planetesimals incorporated in the growing Earth. The hypothesis further holds that the Earth, when as large as Mars is likely to have had an initial hydrosphere and atmosphere. Continuing from this stage, as the Earth grew to its present size, the air and ocean currents were factors in distributing the incoming planetesimals, so that both continental platforms and ocean basins were perpetuated. The Earth finally became considerably larger in volume (not mass) than it is now. At the maximum, its diameter is believed to have been more than 9,000 miles. Since reaching this size it has been shrinking due to physical and chemical readjustments of its highly heated and compressed internal material.

The planetesimal hypothesis holds that ever since the formative stages of the Earth, the continental platforms and ocean basins have been essentially in their present position. Fluctuations of the borders doubtless have occurred and geologic evidence also shows clearly that upward and downward movements of the continents have occurred many times. Wrinkling of the portions of both continents and ocean floors by mountain-producing forces have taken place repeatedly during Earth history, but these movements do not violate the general principle of the permanency of these major relief features.

Liquid Earth theory enables us to suggest another possibility of the origin of relief features. This theory holds that at some time in its formative stage, the Earth was in a liquid condition. This liquid Earth was very hot and of greater volume than that of the present lithosphere. As it slowly cooled an outer ‘crust’ was formed. Cooling and consolidation of internal material caused the Earth to shrink and thus forced the cool outer crust to adapt itself to a shrinking interior. Because of inequalities in the composition of the Earth, some parts shrank more than others, thus leaving elevated portions of the crust as continental platforms and depressed portions as ocean basins. The adjustments have probably been brought about through folding downward of the crust or through faulting of the crust. In either case, sharp folds or faults probably occurred on what are now the continental slopes.

V. Find the English equivalents of the following Russian words and phrases.

Предложенный, вращающийся, согласно, обнаружить противоречия, на основании, происходить, черты рельефа, движения материков, неоднократно, жидкое состояние, когда-то, в пределах, в результате, первоначальный, по мере того как.

VI. Match the words from column A with the suitable words from column B to make word combinations.

A	**B**
solar	stage
a high	basin
to rotate	evidence
equatorial	a planet
to form	rapidly
an alternative	features
continental	readjustment
ocean	velocity
relief	theory
chemical	platform
geologic	system
formative	zone

VII. Fill in the blanks with prepositions where necessary.

1. Water can exist … the form … ice, snow and steam.
2. The centrifugal force … rotation in equatorial zone is greater than the force … gravity.
3. According … the hypothesis, the Earth, the other planets, satellites and asteroids … our solar system are assumed to have come originally … the Sun.
4. They have found many discrepancies … the Laplacian hypothesis.
5. Later the Earth grew … its present size.
6. … the maximum, the diameter of the Earth is believed to have been more than 9,000 miles.

VIII. Answer the following questions.

1. How can early Earth history be interpreted?
2. What do astronomic studies suggest?
3. What does the nebular hypothesis of Laplace postulate?

4. Who proposed an alternative theory?
5. What do we call planetesimals?
6. What caused the growth of the Earth?
7. How were the initial relief features of the Earth formed?
8. Did the continental platforms and the ocean basins change their position?
9. What does liquid Earth theory hold?
10. How were the continental platforms and ocean basins formed according to liquid Earth theory?

IX. Say whether the following statements are true or false. Correct the false statements to make them true. Use the introductory phrases:

That's right.
Quite so.
Absolutely correct.
Quite the contrary.
Not quite.
Just the reverse.

1. The relations of the Earth and other planets to the Sun are such that cosmic or early history can be interpreted only through geologic studies.
2. The nebular hypothesis of Laplace postulates that all the matter in the solar system was once in the form of a huge gaseous spheroid.
3. During the last few decades astronomers have found many discrepancies in the Laplacian nebular hypothesis.
4. The Earth in an early formative stage was very much bigger than it is now.
5. When the Earth had reached the size of the planet Mars, it had primitive continental platforms and ocean basins.
6. Finally the Earth became considerably larger in mass than it is now.
7. Liquid Earth theory enables us to suggest another possibility of the origin of relief features.
8. Liquid Earth theory holds that at some time in its formative stage the Earth was in a solid state.
9. Because of inequalities in the composition of the Earth, some parts shrank more than others.

X. Render the text into English using the active vocabulary.

История Земли насчитывает около 4,6 млрд. лет. За это время на ней возникали и вымирали многие миллионы видов растений и животных; вырастали и обращались в прах высочайшие горные хребты; громадные материки то раскалывались на части и разбегались в разные стороны, то сталкивались друг с другом, образуя новые гигантские массивы суши. Откуда же мы все это знаем? Дело в том, что, несмотря на все катастрофы и катаклизмы, которыми столь богата история нашей планеты, многое из ее бурного прошлого запечатлевается в горных породах, существующих и поныне, в окаменелостях, которые в них находят, а также в организмах живых существ, обитающих на Земле в наши дни. Разумеется, эта летопись неполная. Нам попадаются лишь ее фрагменты, между ними зияют пустоты, из повествования выпадают целые главы, крайне важные для понимания того, что происходило на самом деле. И все-таки даже в столь урезанном виде история нашей Земли не уступит в увлекательности любому детективному роману.

XI. Get ready to render the text 'Early Earth History'. Read it again carefully thinking of what you are going to say and what words you are going to use. Note down some names and places. Use the questions in ex. VIII to practice rendering.

XII. You are going to write an essay "The Earth and Other Planets". Write full answers to the following questions. Your answers must follow each other so that all your sentences will form a complete paragraph. Your paragraph will be a précis of the essay.

1. What is the main difference between the Earth and other planets?
2. What factors are responsible for the presence of life on the Earth?
3. Is there any evidence of the presence of flora and fauna on other planets?
4. What do you know about the exploration of other planets?

LESSON 4
CLIMATE

Part I

I. Read these international words and try to guess their meaning.

Classification, climatic, system, category, cyclone, dominate, function, factor, radiation, zone, maximum, minimum.

II. Enlarge your active vocabulary.

average ['æv(ə)rɪdʒ] – среднее (по сумме нескольких величин)

precipitation [prɪˌsɪpɪ'teɪʃən] – осадки

obvious ['ɔbvɪəs] – очевидный, явный

evaporation [ɪˌvæpə'reɪʃ(ə)n] – испарение

transpiration [ˌtrænspə'reɪʃən] – испарение

III. Climate may be defined as the sum total of the atmospheric conditions that exist in any region over a long period of time. Read the text and say what elements make up climate.

Climate Classification and Climatic Regions of the World

The Koppen Climate Classification System is the most widely used system for classifying the world's climates. Its categories are based on the annual and monthly averages of temperature and precipitation. The Koppen system recognizes five major climatic types; each type is designated by a capital letter.

A – Tropical Moist Climates: all months have average temperatures above 18° Celsius.

B – Dry Climates: with deficient precipitation during most of the year.

C – Moist Mid-latitude Climates with Mild Winters.

D – Moist Mid-latitude Climates with Cold Winters.

E – Polar Climates: with extremely cold winters and summers.

Tropical moist climates extend northward and southward from the equator to about 15–25° of latitude. In these climates all months have average temperatures greater than 18° Celsius. Annual precipitation is greater than 1500 mm.

The most obvious climatic feature of dry climates is that potential evaporation and transpiration exceed precipitation. These climates extend from 20–35° North and South of the equator and in large continental regions of the mid-latitudes often surrounded by mountains.

Moist Subtropical Mid-Latitude Climates generally have warm and humid summers with mild winters. Its extent is from 30 to 50° of latitude mainly on the eastern and western borders of most continents. During the winter, the main weather feature is the mid-latitude cyclone. Convective thunderstorms dominate summer months.

Moist continental mid-latitude climates have warm to cool summers and cold winters. The location of these climates is poleward of the C climates. The average temperature of the warmest month is greater than 10° Celsius, while the coldest month is less than –30° Celsius. Winters are severe with snowstorms, strong winds, and bitter cold from Continental Polar or Arctic air masses.

Polar climates have year-round cold temperatures with the warmest month less than 10° Celsius. Polar climates are found in the northern coastal areas of North America, Europe, Asia, and on the landmasses of Greenland and Antarctica.

The climate of a particular place is the function of a number of factors. The factors that influence the world climatic regions include latitude and its influence on solar radiation received, air mass influences, location of global high and low pressure zones, heat exchange from ocean currents, distribution of mountain barriers, pattern of prevailing winds, distribution of land and sea, altitude.

The world has several climatic zones. The classification is based on maximum and minimum temperatures and the temperature range as well as the total and seasonal distribution of precipitation.

Simple summary of climatic zones: polar (very cold and dry all year), temperate (cold winters and mild summers), arid (dry, hot all year), tropical (hot and wet all year), mediterranean (mild winters, dry hot summers), mountains (tundra) (very cold all year).

IV. Find the Russian equivalents of the following English words and phrases.

To be based on the annual and monthly averages of temperature and precipitation, potential evaporation and transpiration, to exceed, humid summer, convective thunderstorms, solar radiation, high/low pressure, ocean current, pattern of prevailing winds, altitude, the temperature range, arid.

V. March the words with their definitions.

air mass	**altitude**	**solar radiation**	**climate**
evaporation	**Mid-latitude cyclone**	**precipitation**	**pressure**

1) vertical distance above sea-level;
2) the process by which liquid water is converted into a gaseous state;

3) a body of air whose temperature and humidity characteristics remain relatively constant over a horizontal distance of hundreds to thousands of kilometres;
4) general pattern of weather conditions for a region over a long period of time (at least 30 years);
5) any aqueous deposit, in liquid or solid form, that develops in the atmosphere and falls to the ground generally from clouds;
6) the force acting on a surface from another mass per unit area;
7) electromagnetic radiation that originates from the Sun;
8) cyclonic storm that forms primarily in the middle latitudes;

VI. Answer the following questions.

1. What factors for classifying the world's climates are taken into account?
2. How many climatic types are included in the Koppen Climate Classification? Name them.
3. What are some of the characteristic features of Tropical Moist Climates?
4. Dry Climates extend from 20–35° North of the equator, don't they?
5. What are the main characteristics of Moist Subtropical Mid-Latitude Climates?
6. What features are characteristic of Moist Continental Mid-latitude Climates?
7. Where are Polar Climates found?
8. What factors influence the World Climatic Regions? Which of them do you think are taken into consideration in the Climate Classification?
9. What criteria is the classification of the climatic zones based on?
10. What climatic zones does the classification include?

VII. Complete the following sentences with the information from the text.

1. The text examines … . 2. The Koppen climate classification is based on … and … . 3. According to this classification the world's climates are divided into … types. 4. From the equator to the poles we have …, …, …, … and … . 5. Tropical Moist Climates are characterized by … . 6. Dry Climates are called 'dry' because … . 7. Moist Subtropical Mid-Latitude Climates have … . 8. Winters and summers of Moist Continental Mid-Latitude Climates are … . 9. One of the characteristic features of Polar Climates is … . 10. A number of factors influence the World Climatic Regions: …, …, …, …, …, …, … and … . 11. The main criteria of the classification of climatic zones are … and … . 12. The classification includes the following zones: …, …, …, …, … and … .

VIII. Read the text. Make a short summary of it using the following phrases:

This text deals with … **It is important to point out that …**

As far as I understand … **The results show …**

The Earth's Climatic History

subsequent – последующий
emergence – появление
settlement – поселение
famine – голод

Climatologists have used various techniques and evidence to reconstruct the history of the Earth's past climate. They have found that during most of the Earth's history global temperatures were probably 8 to 15° Celsius warmer than today.

The period from 2,000,000 – 14,000 B.P. (Before Present) is known as the Ice Age. During this period, large glacial ice sheets covered much of North America, Europe, and Asia for extended periods of time. Average global temperatures were probably 4 – 5° Celsius colder than they are today.

The warming of the Earth and subsequent glacial retreat began about 14,000 years ago (12,000 BC) (the Holocene epoch). By 5000 to 3000 BC average global temperatures reached their maximum level and were 1 to 2° Celsius warmer than they are today. Climatologists call this period the Climatic Optimum. During the Climatic Optimum many of the Earth's great ancient civilizations began and flourished. From 3000 a cooling trend occurred. This cooling caused large drops in sea-level and the emergence of many islands (Bahamas). The period from 750 BC – 800 AD saw warming up to 150 BC. Temperatures, however, did not get as warm as during the Climatic Optimum. During the time of the Roman Empire (150 BC – 300 AD) a cooling began. At its height, the cooling caused the Nile River (829 AD) and the Black Sea (800 – 801 AD) to freeze.

The period 900 – 1200 AD called the Little Climatic Optimum represents the warmest climate since the Climatic Optimum. During this period, the Vikings established settlements on Greenland and Iceland. A period of cool and more extreme weather followed the Little Climatic Optimum. There are records of floods, great droughts and extreme seasonal climate fluctuations up to the 1400s.

From 1550 to 1850 AD global temperatures were at their coldest since the beginning of the Holocene. Scientists call this period the Little Ice Age. The average annual temperature of the Northern Hemisphere was about 1.0 degree Celsius lower than today. Cold weather in Iceland from 1753 and 1759 caused 25% of the population to die from crop failure and famine.

IX. Role-play 'I'm a climatologist' interview in real life. Find 3 volunteers to be climatologists. Ask your questions in turns. Listen to the climatologists' answer the questions. Vote for the best climatologist.

Part II

***I. Read these international words and try to guess their meaning*.**
Characteristic, adaptation, productive, fruit, irrigation.

II. Enlarge your active vocabulary.
abundant [ə'bʌnd(ə)nt] – обильный, богатый
rarity ['rɛərɪtɪ] – редкость
eucalyptus [ˌju:kə'lɪptəs] – эвкалипт
scrubby ['skrʌbɪ] – поросший кустарником, низкорослыми деревьями
tangle ['tæŋgl] – беспорядок

III. The Mediterranean climate is a subtype of mesothermal climate (according to the W.Koppen System). Read the text to find out the features of the Mediterranean climate in North America.

The Mediterranean Climate

The Mediterranean climate occurs in Central California. The major characteristics of it are a dry summer, a mild, moist winter, and abundant sunshine (90 percent of possible sunshine in summer and as much as 50 to 60 per cent even during the rainy winter season).

There are two distinct subtypes: the moderate summer subtype associated with a strong maritime influence, and the hot summer subtype reflecting an increased continental influence.

Whichever the subtype, Mediterranean summers clearly show the influence of the subtropical highs. Days are warm or hot, skies are blue and clear, and sunshine is abundant. Daytime temperatures may be as high as 30° C to 38° C (86° F to 100° F), except where moderated by a strong ocean or coastal fog. Fog is common throughout the year in coastal locations and especially noticeable during the summer.

Despite the rain during the winter season, there are often many days of fine, mild weather. Frost is uncommon (the average temperature of the coldest month rarely falls below 4° C to 10° C (40° F to 50° F) and because of its rarity, when frost does occur, it can do great damage.

A severe freeze lasting several days occurred in December, 1972 in the San Francisco Bay area. This killed great numbers of introduced plants, including the eucalyptus trees that had been planted in the Berkeley hills. The following summer this forest of huge dead trees posed an enormous fire threat to the community, in the tinder-box conditions of the summer drought. The threat was so great that government aid was sought to help in the removal of the trees. Interestingly enough, the native vegetation was totally unaffected by the freeze, indicating its adaptation to such conditions. The natural vegetation reflects the wet-dry seasonal pattern of the climate: much of it is sclerophyllous (hard-leaved) and drought-resistant. One of the most familiar plant communities is made up of many low, scrubby bushes that grow together in a thick tangle. In the western United States this is called chaparral. The most common of these low bushes in California is the manzanita, a tough shrub with crooked limbs that interlock to form an almost impenetrable barrier.

People have often removed chaparral as a preventive measure against fires, yet the removal can have disastrous results, because the chaparral acts as a check against erosion of soils during the rainy season.

With the chaparral removed, soils wash or slide down hillsides during the heavy rains of winter, frequently taking homes with them.

Where trees appear in the Mediterranean climate they also respond to moisture conditions. For example, the great redwood forests of northern California probably could not survive without the heavy fogs that regularly invade the coastal lands in summer. These great trees demand a unique variation that should probably not be considered Mediterranean at all, as it has more in common with the marine west coast climate further north.

In all the Mediterranean regions the most productive soils are found in the alluvial lowlands. California, blessed with fertile valleys for growing fruits, vegetables, and flowers, as well as with snow melt water for irrigation, is probably the most agriculturally productive of the Mediterranean regions.

IV. Find the Russian equivalents of the following English words and phrases.

The moderate summer subtype, a strong maritime influence, an increased continental influence, to be as high as, to do great damage, introduced plants, an enormous fire threat, to be totally unaffected, a tough shrub with crooked limbs, a check against erosion of soils, to slide down hillsides, to respond to.

V. Match the words from column A with the suitable words from column B to make word combinations.

A	B
abundant	weather
subtropical	fog
daytime	a threat
coastal	sunshine
to pose	temperatures
mild	highs
a severe	forest
the native	freeze
a preventive	vegetation
redwood	measure

VI. Fill in the blanks with prepositions where necessary.

1. There are two distinct subtypes of the Mediterranean climate: the moderate summer subtype associated … a strong maritime influence, and the hot summer subtype reflecting an increased continental influence.
2. Despite the rain during the winter season, there are often many days … fine, mild weather.
3. The fire threat was so great that government aid was sought to help … the removal … the trees.
4. One of the most familiar plant communities is made … … many low, scrubby bushes that grow together … a thick tangle.
5. … the chaparral removed, soils wash or slide … hillsides during the heavy rains of winter, frequently taking homes with them.
6. The great redwood forests of northern California probably could not survive … the fogs that regularly invade the coastal lands … summer.

VII. Answer the following questions.

1. Where does the Mediterranean climate occur?
2. What are the major characteristics of the Mediterranean climate?
3. What are the subtypes of the Mediterranean climate?
4. Are days warm or cool in summers?
5. Where is fog common throughout the year?
6. What was the damage of a severe freeze in December, 1972 in the San Francisco Bay area?
7. What does the natural vegetation reflect?
8. Do trees in the Mediterranean regions respond to moisture or temperature conditions?
9. What do trees in the Mediterranean climate regions respond to?
10. Where are the most productive soils found?
11. What region of the Mediterranean is the most agriculturally productive?

VIII. Say whether the following statements are true or false. Correct the false statements to make them true. Use the introductory phrases:

Right it is.	**Far from it.**
Quite so.	**It's hardly likely that…**
This is the case.	**It's not correct.**

1. The Mediterranean climate occurs in Central California.
2. There are two distinct subtypes of the Mediterranean climate: the moderate winter subtype associated with a strong maritime influence, and the hot summer subtype reflecting an increased continental influence.
3. Mediterranean summers show the influence of the tropical highs.

4. Despite the rain during the winter season, there are often many days of fine, mild weather.
5. One of the most familiar plant communities is made up of many high, scrubby bushes that grow together in a thin tangle.
6. People have often removed chaparral as a preventive measure against drought.
7. The great redwood forests of northern California probably could not survive without the heavy fogs that regularly invade the coastal lands in summer.
8. In all the Mediterranean regions the least productive soils are found in the alluvial lowlands.

IX. Render the text into English using the active vocabulary.

Большая часть Южной Америки находится в жарком поясе, лишь южная часть материка лежит в умеренном поясе. Большое влияние на формирование климата оказывает рельеф – Анды на западе и обширные равнины на востоке. Анды преграждают путь воздушным массам с Тихого океана на востоке. Вдоль западного побережья с юга на север, почти до экватора, проходит мощное холодное Перуанское течение, сильно охлаждающее воздух прибрежных районов. К восточному берегу материка около экватора подходит теплое течение, которое способствует насыщению воздуха влагой. С Атлантического океана пассаты приносят влажные воздушные массы. На климат умеренного пояса Тихоокеанского побережья влияют западные ветры умеренных широт, приносящие с океана много влаги.

X. 1) Using the texts of the lesson speak about any climatic region you like. Pay special attention to its characteristics and peculiarities.
2) Speak about the climate and weather of the region you live in.

XI. Using your knowledge of geography speak on: 1) the problem of weather forecasting; 2) the development of meteorological services. Take notes on what you are going to say. Use the following phrases:
To predict the movement of weather systems, our understanding of weather process, efficient meteorological services, global telecommunications system, methods of observing, meteorological stations, ocean weather ships, aeroplanes, radiosondes, Earth-orbiting satellites, international conferences on meteorology.

LESSON 5
SPECIES, POPULATIONS, COMMUNITIES, ECOSYSTEMS

Part I

I. Read these international words and try to guess their meaning.
Organism, dynamic, population, ecosystem, morphologically, physiologically, situation, individual, identical, structure, regulation, genetic.

II. Enlarge your active vocabulary.
interbreeding ['ɪntə(:)'brɪdɪŋ] – межпородное скрещивание
fertile ['fɜːtaɪl] – всхожий (о семенах), плодоносящий
appropriate [ə'prəuprɪɪt] – соответствующий
acquisition [ˌækwɪ'zɪʃ(ə)n] – приобретение
diversity [daɪ'vɜ:sɪtɪ] – разнообразие, различие
nutrient ['nju:trɪənt] – питательное вещество

III. The biosphere (all living organisms of the Earth) is considered to be one of the four great realms, or spheres, of the Earth (together with the atmosphere, lithosphere and hydrosphere). Read the text to find out how life on the Earth is organized.

Organization of Life

Scientists have recognized that life can be organized into several different levels of function and complexity. These functional levels are: species, populations, communities and ecosystems.

Species are different kinds of organisms found on the Earth. A more exact definition of species is a group of interbreeding organisms that do not ordinarily breed with members of other groups. If a species interbreeds freely with other species, it would no longer be a distinctive kind of organism. This definition works well with animals. However, in some plant species fertile crossings can take place among morphologically and physiologically different kinds of vegetation. In this situation, the definition of species given here is not appropriate.

A population comprises all the individuals of a given species in a specific area or region at a certain time. Its significance is more than that of a number of individuals because not all individuals are identical. Populations contain genetic variation within themselves and between other populations. Even fundamental genetic characteristics such as hair colour or size may differ slightly from individual to individual. More importantly, not all members of the population are equal in their ability to survive and reproduce.

The term ‘community’ refers to all the populations in a specific area or region at a certain time. Its structure involves many types of interactions among species. Some of these involve the acquisition and use of food, space, or other environmental resources. Others involve nutrient cycling through all members of the community and mutual regulation of population sizes. In all of these cases, the structured interactions of populations lead to situations in which individuals are thrown into life or death struggles.

In general, ecologists believe that a community that has a high diversity is more complex and stable than a community that has a low diversity. This theory is founded on the observation that the food webs of communities of high diversity are more interconnected. Greater interconnectivity causes these systems to be more resilient to disturbance. If a species is removed, those species that relied on it for food have the option to switch to many other species that occupy a similar role in that ecosystem. In a low diversity ecosystem, possible substitutes for food may be non-existent or limited in abundance.

Ecosystems are dynamic entities composed of the biological community and the abiotic environment. An ecosystem’s abiotic and biotic composition and structure is determined by the state of a number of interrelated environmental factors. Changes in any of these factors (for example, nutrient availability, temperature, light intensity, grazing intensity, and species population density) will result in dynamic changes in the nature of these systems. For example, a fire in the temperate deciduous forest completely changes the structure of that system. There are no longer any large trees, most of the mosses, herbs, and shrubs that occupy the forest floor are gone, and the nutrients that were stored in the biomass are quickly released into the soil, atmosphere and hydrologic system. After a short time of recovery, the community that was once large mature trees now becomes a community of grasses, herbaceous species, and tree seedlings.

IV. Find the Russian equivalents of the following English words and phrases.

To be organized into several different levels of function and complexity, a group of interbreeding organisms, to breed with, fertile crossing, genetic variation, the ability to survive and reproduce, a community, interaction among species, nutrient cycling, mutual regulation of population sizes, a high/low diversity, the food webs of communities, to be more resilient to disturbance, the abiotic environment.

V. Match the words with their definitions.

population	**ecosystem**	**diversity**	**disturbance**
food web	**abiotic**	**community**	

1) the total number of species present;

2) a partial or complete alteration of a community or an ecosystem by a biotic or abiotic factor;
3) the individuals of a given species that occupy the same locality and form the interbreeding group in that location;
4) a model describing the organisms found in a food chain. It describes the complex patterns of energy flow in an ecosystem by modeling who consumes who;
5) a non-living thing. This word usually refers to the physical and chemical components of an organism's environment. It is also called inorganic;
6) a community of species together with the surrounding environment that function together as a coherent unit to maintain a flow of energy and to acquire, store, and recycle nutrients;
7) a group of populations of different species occupying a given place at a given time that are viewed as interdependent;

VI. Answer the following questions.

1. What levels of life organization are recognized by scientists?
2. What is a species?
3. In what cases does the definition of species work no longer?
4. What is a population?
5. What does the term 'community' refer to?
6. What does its structure involve?
7. What community is considered to be more complex and stable?
8. What is an ecosystem?
9. What are some of the major components of ecosystems? How are these components related to each other?

VII. Complete the following sentences with the information from the text.

1. This text deals with the problem of … . 2. Scientists have recognized that organisms can be organized according to … . 3. The functional level known as species refers to … 4. This definition does not work when … . 5. All of the different organisms of a single species that occupy … represent … . 6. Genetic variability found in a population of species is called … . 7. A community is defined as … . 8. The structure of a community involves many types of … which lead to … . 9. A community that has … is more stable and complex than a community that has … . 10. The most complex functional level of life organization is … . 11. It consists of … . 12. Changes in any of environmental factors can cause … .

VIII. Read the following text. Make an annotation of it in written form. Compare your annotation with your partner's. Present it to the group. Use the given phrases:

This text is concerned with … **It seems reasonable to say …**
The thing is that… **In conclusion I must say …**

distribution – распределение
to survive – продолжать существовать
predator – хищник

The geographic distributions of plant and animal species are never fixed over time. Geographic ranges of organisms shift, expand, and contract. These changes are the result of two contrasting processes: 1) colonization and establishment and 2) localized extinction. Colonization and establishment take place when populations expand into new areas. A number of processes can initiate this process including disturbance and abiotic environmental change. Localized extinction results in the elimination of populations from their former range. It can be caused by biotic interactions or, once again, abiotic environmental change.

Most species appear to be limited in their geographic range by abiotic factors, such as temperature, moisture availability, and soil nutrients. No species is adapted to survive under all conditions found on the Earth. All species have specific limits of tolerance to physical factors that directly effect their survival or reproductive success. The portion of the abiotic factor's range of variation which a species can survive and function in is commonly defined as the tolerance range. The level within the tolerance range at which a species or population can function most efficiently is termed the optimum.

For a species to maintain its population, its individuals must survive and reproduce. Certain combinations of environmental conditions are necessary for individuals of each species to tolerate the physical environment, obtain energy and nutrients, and avoid predators. The total requirements of a species for all resources and physical conditions determine where it can live and how abundant it can be at any place within its range. These requirements are termed abstractly the ecological niche.

IX. Find information about any unique species of animals or plants and prepare a report on the subject.

X. Plan a television documentary programme on organization of life. Make a list of topics you would like the programme to cover. Write a script for the announcer's opening and closing statements.

Part II

***I. Read these international words and try to guess their meaning*.**

Tanker, gallon, erosion, filter, dolphin, chemical, toxic, pesticide.

II. Enlarge your active vocabulary.

to dredge [dredʒ] – производить дноуглубительные работы
newsworthy ['nju:zwə:ðɪ] – достойный освещения в печати
rig – буровая установка
to foul [faʊl] – загрязнять
to hatch [hætʃ] – выводить
to endanger [ɪn'deɪndʒə] – подвергать опасности
noxious ['nɔkʃəs] – вредный, ядовитый

III. For many years people have been modifying and polluting coastal and wetland ecosystems. Read the text and pick out the facts which prove that U.S. coastlines and wetlands are under tremendous pressure from conflicting uses and rapidly rising land and water values.

Human Alteration of Coastal and Wetland Ecosystems

In the United States, the Atlantic, Gulf, Pacific, and Great Lakes coastlines are all under tremendous pressure from conflicting uses and rapidly rising land values. Coastal and wetland ecosystems worldwide have become extensively modified and polluted. Especially near large cities, coastal and wetland modification and pollution have taken their greatest toll. Dredging for harbors and expanding port facilities and filling of wetlands for airports, marinas, dumps, and industrial sites have completely changed the world's urban shorelines. Conflicting uses for residential development, industry, sewage treatment, energy production, agriculture, fishing, recreation, and environmental protection have intensified the demand and driven the land values upward.

Probably the most visible and newsworthy problem has been from oil pollution, especially from tankers, but also from offshore oil rigs. Oil spills know no boundaries and are a worldwide problem with recent major spills in the Persian Gulf, the North Sea, the English Channel, the Gulf of Mexico, the Mississippi, Chesapeake Bay, Puget Sound, Alaska and even in remote Antarctica. Yet even with the numerous spills, the demand for oil will keep tankers crossing the seas into the foreseeable future and will increase pressure to drill off-shore in productive marine areas such as off Alaska, California, Louisiana, New England, Newfoundland, and Antarctica.

In 1989 the *Exxon Valdez* ran around in Alaska's Prince William Sound, spilling millions of gallons of oil and fouling hundreds of miles of coastline in one of the world's richest marine wildlife areas. It was the largest oil spill in U.S. history. The spill harmed Alaskan commercial fisheries and killed thousands of seabirds and marine mammals. Uncounted millions of smaller creatures were also killed by the oil slick as it washed onto the pristine, rocky shoreline. Though cleanup efforts are attempted, after a major oil spill there really is no possibility of a clean coast, and only many years of natural healing can erase the damage caused by a minute of human folly and carelessness.

Wetlands, once considered useless swamp by many, are now regarded as some of the most complex and important ecosystems in the world. Two thirds of all the fish caught in U.S. waters are hatched in wetland areas. The wetlands also serve as a site for millions of native and migratory birds and the home for over one third of the nation's endangered species.

In recent years they have discovered that these wetlands offer a stabilizing effect on the shorelines of seas, lakes, and rivers. Their loss drastically increases the erosion rates around these water bodies. They have also discovered that wetlands have a great capacity to filter and purify water. The saturated grounds beneath the wetland vegetation naturally break down pollutants into harmless substances. Over 50 municipalities nationwide have developed systems where wetlands are now used to help treat sewage.

Through recent media attention to spectacular events such as the *Exxon Valderz* oil spill, the dolphins dying off the U.S. East Coast, outbreaks of contaminated shellfish sickness, or syringes and bloody hospital wastes washing up on beaches, many Americans are becoming aware of the danger that their carelessness causes. Yet it is probably the unseen pollutants lurking below the surface that are the most dangerous to the environment. According to the Environmental Protection Agency, the United States spews 32 million gallons of sewage and chemicals into the oceans and seas everyday. Half the pollutants come from industry, which pours noxious and toxic materials into the water. The other half comes from sewage plants, urban runoff, and agricultural pesticides and fertilizers.

Many wetland ecosystems could be cleaned up and much of the coastal ocean could clean itself if pollution and environmental destruction were halted. It will cost billions of dollars, however, and require improved sewage treatment, more severe pollution penalties, and protection for diminishing wetlands. As these are some of the most productive ecosystems on the planet, immediate action is imperative.

IV. Find the Russian equivalents of the following English words and phrases.

To be under tremendous pressure, worldwide, to become extensively modified, residential development, to drive the land values upward, remote Antarctica, the demand for, productive marine areas, a marine mammal, to serve as a site, to increase drastically, to purify, contaminated shellfish sickness, improved sewage treatment, severe pollution penalties, imperative.

V. Match the words from column A with the suitable words from column B to make word combinations.

A	B
human	shoreline
land	pesticides
wetland	the damage
to change	alteration
sewage	birds
the foreseeable	pressure
to increase	values
cleanup	treatment
to erase	future
migratory	water
to filter	pollutants
the unseen	efforts
agricultural	modification

VI. Fill in the blanks with prepositions where necessary.

1. In the United States a lot of areas are … tremendous pressure from conflicting uses and rapidly rising land values.
2. Dredging … harbors has completely changed the world’s urban shorelines.
3. The most visible and newsworthy problem has been … oil rigs.
4. The wetlands serve as a site … millions … native and migratory birds.
5. The saturated grounds beneath the wetland vegetation naturally break … pollutants … harmless substances.
6. Some countries spew millions of gallons of sewage and chemicals … the oceans and seas everyday.

VII. Answer the following questions.

1. What areas in the U.S. are under tremendous pressure from conflicting uses and rapidly rising land values?
2. Where have coastal and wetland modification and pollution taken their greatest toll?
3. What has intensified the demand and driven the land values upward?
4. What problem has been the most visible and newsworthy one?
5. What was the largest oil spill in U.S. history? What was the damage of it?
6. What is the use of wetland ecosystems?

7. What does the loss of wetland ecosystems cause?
8. Where do the pollutants in the United States come from?

VIII. Say whether the following statements are true or false. Correct the false statements to make them true. Use the introductory phrases:

Exactly.	**It's not right.**
Certainly.	**Quite the reverse.**
That's right.	**It's not correct.**

1. Coastal and wetland modification and pollution have taken their greatest toll near small towns and villages.
2. The most visible and newsworthy problem has been from oil pollution, especially from tankers, but also from off-shore oil rigs.
3. The demand for oil will keep tankers crossing the seas into the foreseeable future and will increase pressure to drill off-shore in productive marine areas.
4. The spill of millions of gallons of oil in the Gulf of Mexico was the largest oil spill in U.S. history.
5. Millions of smaller creatures were killed by the oil slick in Alaska's Prince William Sound.
6. Two thirds of all the fish caught in U.K. waters are hatched in wetland areas.
7. Wetlands offer a stabilizing effect on the shorelines of seas, lakes, and rivers.
8. Wetlands have a great capacity to pollute drinking water.

IX. Render the text into English using the active vocabulary.

На всех стадиях своего развития человек был тесно связан с окружающим миром. Но с тех пор как появилось высокоиндустриальное общество, опасное вмешательство человека в природу резко усилилось, расширился объём этого вмешательства, оно стало более разнообразным и сейчас грозит стать глобальной опасностью для человечества. Расход не возобновляемых видов сырья повышается, все больше пахотных земель выбывает из экономики, так как на них строятся города и заводы. Человек все чаще вмешивается в биосферу – часть нашей планеты, в которой существует жизнь. В настоящее время биосфера Земли подвергается нарастающему антропогенному воздействию.

X. Summarize the contents of the text 'Human Alteration of Coastal and Wetland Ecosystems'. Express your view on the issue.

LESSON 6
THE EARTH'S BIODIVERSITY

Part I

I. Read these international words and try to guess their meaning.

Mollusc, biome, Industrial Revolution, amphibian, reptile, catastrophe, meteor, anatomical.

II. Enlarge your active vocabulary.

biodiversity [ˌbaɪəʊ daɪ'vɜːsɪtɪ] – биологическое разнообразие
invertebrate [ɪn'vɜːtɪbrət] – беспозвоночное (животное)
worm [wɜːm] – червь
urchin ['ɜːtʃɪn] – морской ёж
crustacea [krʌs'teɪʃjə] – pl. ракообразные
to eliminate [ɪ'lɪmɪneɪt] – уничтожать, ликвидировать
assessment [ə'sesmənt] – оценка

III. Scientists believe that life appeared on the Earth about 3.5 billion years ago. At first, life was biologically simple and consisted of unicellular organisms. However, as time went on life became more complex and diversified because of evolution. Read the text and say what factors influence the biodiversity of the Earth.

Species Diversity and Biodiversity

Biologists are not completely sure how many different species live on the Earth. Estimates of how many species exist on the Earth range from 2 million to about 100 million. To date, about 2.1 million species have been classified, primarily in the habitats of the middle latitudes. Most of the unclassified species on this planet are invertebrates. This group of organisms includes insects, spiders, mollusks, sponges, flatworms, starfish, urchins, earthworms, and crustacea. These species are often difficult to find and identify because of their small size and the fact that they live in habitats that are difficult to explore. In the tropical rain forest, cataloging of species has been quite limited because of this later reason. Scientists estimate that this single biome may contain 50 to 90% of the Earth's biodiversity.

Many species have gone extinct over the Earth's geologic history. The primary reason for these extinctions is environmental change or biological competition. Since the beginning of the Industrial Revolution, a large number of biologically classified species have gone extinct due to the actions of humans. This includes 83 species of mammals, 113 species of birds, 23 species of amphibians and reptiles, 23 species of fish, about 100 species of invertebrates, and over 350 species of plants. Scientists can only estimate the number of unclassified species that have gone extinct. Using various methods of extrapolation, biologists estimate that in 1991 between 4,000 to 50,000 unclassified species became extinct, mainly in the tropics, due to our activities. This rate of extinction is some 1,000 to 10,000 times greater than the natural rate of species extinction (2–10 species per year) prior to the appearance of human beings. The continued extinction of species on this planet due to human activities is one of the greatest environmental problems facing humankind.

Several times during the Earth's history there have been periods of mass extinctions, when many species became extinct in a relatively short period of time (a few million years is a relatively short period of time when compared to the age of the Earth). Scientists are unsure of the causes of both background extinction and mass extinction. Possible explanations for mass extinctions include climate changes or catastrophes such as the Earth being hit by a meteor. Since the beginning of time, five or six mass extinctions have occurred that eliminated between 35% and 96% of all species on the Earth. Further, it is believed that of all species that ever inhabited the Earth over 99% of them are now extinct.

Assessment of the number of different organisms that live on this planet is plagued with difficulties. First and foremost, biologists lack a precise definition of what exactly a species is. The concept of a species often refers to a population of physically similar individuals that can successfully mate with each other, but cannot produce fertile offspring with other organisms. However, many species are composed of a number of distinct populations that can interbreed even though they display physiological and anatomical differences. Scientists developed the notion of biodiversity to overcome some of the difficulties of the species concept. To accomplish this task, biodiversity describes the diversity of life at the following three biological levels:

– Genetic Level (Genetic Diversity) refers to the total number of genetic characteristics expressed and recessed in all of the individuals that comprise a particular species.

– Species Level (Species Diversity) is the number of different species of living things living in an area. As mentioned above, a species is a group of plants or animals that are similar and able to breed and produce viable offspring under natural conditions.

– Ecosystem Level (Ecosystem Diversity) is the variation of habitats, community types, and abiotic environments present in a given area. An ecosystem consists of all living and non-living things in a given area that interact with one another.

The biodiversity found on the Earth today is the product of 3.5 billion years of evolution. In fact, the Earth supports more biodiversity today than in any other period of its history. However, much of this biodiversity is now facing the threat of extinction because of the actions of humans.

IV. Find the Russian equivalents of the following English phrases.

Biological competition, to estimate the number of unclassified species, to go/become extinct, background extinction and mass extinction, to lack a precise definition of, the total number of genetic characteristics, to comprise a particular species, to breed and produce viable offspring, under natural conditions, the variation of habitats, to interact with one another, to face the threat of extinction.

V. Match the words with their definitions.

species diversity	**biome**	**ecosystem diversity**
mass extinction	**biodiversity**	**genetic diversity**
habitat	**invertebrate**	**background extinction**

1) a normal extinction of species that occurs as a result of changes in local environmental conditions;
2) location where a plant or animal lives;
3) the variety of unique biological communities found on the Earth. A component of biodiversity;
4) the largest recognizable assemblage of animals and plants on the Earth. Its distribution is controlled mainly by climate;
5) an animal that does not have a backbone;
6) the diversity of different species (species diversity), genetic variability among individuals within each species (genetic diversity), and variety of ecosystems (ecosystem diversity);
7) a number of different species in a given region;
8) a catastrophic, widespread perturbation where major groups of species become extinct in a relatively short period of time;
9) genetic variability found in a population of a species or all of the populations of a species;

VI. Answer the following questions.

1. How many species live on the Earth?
2. How many species have been classified?
3. What species remain unclassified? Why?
4. What are the main causes of extinctions?
5. What is a mass extinction?
6. What may have caused mass extinctions?
7. How many mass extinctions have occurred since the beginning of time?
8. Why did scientists introduce the notion of biodiversity?

9. What types of diversity does it describe? What is the difference between them?
10. What is the main threat to the biodiversity of the Earth today?

VII. Complete the following sentences with the information from the text.

1. This text is concerned with … . 2. Scientists estimate that … species currently inhabit the Earth. 3. … have been classified. 4. Most of the unclassified species are … such as …, …, …, …, …, ……, … and … . 5. It is difficult to classify these species because … 6. In most cases, the extinction of a species is caused by … . 7. A mass extinction is … 8. Scientists think that the main causes of mass extinctions are … . 9. In order to overcome some of the difficulties of the species concept scientists developed the notion of … . 10. Biodiversity describes … . 11. At the Genetic Level the total number of … is dealt with. 12. At the Species Level the number of … is described. 13. … is analyzed at the Ecosystem Level. 14. Much of the biodiversity is now facing the threat of extinction because … .

VIII. Discuss the text in the form of a dialogue, using set expressions and phrases given below:

I would like to know … **Could you inform us about …**
This statement may be confirmed by … **I'd like to sum up …**

Natural Selection and Evolution

surroundings – среда, окружение
resistance – сопротивляемость (организма), устойчивость
application – применение
tremendous – огромный, потрясающий

Evolution describes the process by which species come to possess genetic adaptations to their environment. Its mechanism is natural selection. Natural selection acts through individuals by determining which individuals have the best adaptations to guarantee reproductive success. Because the state of the environment is always changing temporally, natural selection is always influencing the genetic characteristics of a population over time. Thus, natural selection acts to adapt the population to its ever changing surroundings.

Evolutionary change is also a change in gene frequency. New genes enter the species gene pool by way of mutations. By selecting those organisms that will become reproductively successful, natural selection controls the future frequency of the population's genes. The appearance of new mutations in a population together with the change in gene frequency results in evolution.

The best known example of natural selection operating in a modern species is the development of pesticide resistance in many insect species. Prior to the extensive use of pesticides that began in the 1940s, crop pest insect species only contained a small amount of genetic variability for resistance to these chemicals. Natural selection in the absence of pesticides could not lead to changes in the frequencies of genes causing resistance to chemical pesticides. However, once the spraying of pesticides started, individuals that happened to possess resistant genes became much more frequent as they survived the applications. Further, they were able to pass a greater percentage of their genes on to the next generation's gene pool. As a result, the introduction of pesticides into the environment provided a tremendous selective pressure to increase the frequency of resistant genes in the pest populations.

IX. Prepare a 3-minute report and a computer presentation on the topic 'The Earth's Biodiversity'. Use the information from the texts of Part I and Internet resources.

Part II

I. Practice the pronunciation of the following proper names.

The Cretaceous Period [krɪ'teɪʃəs 'pɪərɪəd], China ['tʃaɪnə].

II. Read these international words and try to guess their meaning.

Dinosaur ['daɪnəʊsɔ:], taxonomic, sort, debate, limit, effect, dose, comet.

III. Enlarge your active vocabulary.

reign [reɪn] – царствование
outlandish [aut'lændɪʃ] – необычный
acidic [ə'sɪdɪk] – кислотный
fascinating ['fæsɪneɪtɪŋ] – обворожительный
nitrogen oxides ['naɪtrədʒən 'ɔksaɪd] – окись азота
creature ['kri:tʃə] – создание

IV. The dinosaurs were the undisputed rulers of life on land right up to the catastrophic event. It is still not known what caused the death of the dinosaurs. Read the text and pick out the information which is new to you.

What Happened to the Dinosaurs?

There have been many mass extinctions throughout the history of the Earth. Probably the most famous is the extinction that finally saw the end of the dinosaurs reign on the Earth, 65 million years ago. It wasn't just the dinosaurs that died out in this extinction. Whatever caused the death of the dinosaurs it also caused the death of around 70% of all of the species on the Earth. In fact, dinosaurs represented but a small portion of the species that became extinct at or near the end of the Cretaceous Period. The extinction event that brought the Cretaceous Period to a close was truly a ‘mass extinction’, a wide variety of taxonomic groups from many different habitats were wiped out essentially at the same time.

Although the dinosaurs had been in a period of decline, it is thought that their recovery was prevented by some sort of catastrophic event. There are many theories about why the dinosaurs finally became extinct, some of which may seem a little outlandish.

One of the most popular theories about the death of the dinosaurs is that the world just grew too cold for them. Indeed, for large, cold-blooded creatures, even a few nights of cold could spell death.

Not everyone agrees that a change in weather would have been enough to kill the dinosaurs. The latest development in the debate amongst scientists about what killed the prehistoric dinosaurs is the suggestion that acid rain was the cause. Some geologists suggest that a large meteor hitting the Earth at 65 kilometres per second would have led to strongly acidic rain falling all over the world. These geologists calculated that if an ice-rich meteor weighing 12.5 million billion kilograms, hit the Earth, it would shock-heat the atmosphere enough to produce huge amounts of nitrogen oxides. This would result, they say, in strongly acid rain around the world. If the meteor were travelling more slowly, or if it were more rock-like in structure, this strongly acid rain would be limited to a small area so that the world effect would be much less important. However, other groups of researchers have suggested that volcanoes, rather than meteors, could have produced these heavy doses of acid rain, but over a much longer period – over 10,000 years.

The idea of a great asteroid or comet crash is fascinating. But it would mean the dinosaurs would all have been killed within a very short time – perhaps over a few months or years. What if the dinosaurs did not die out so quickly? Many scientists think that the dinosaurs had started to die off millions of years before the end of the Cretaceous Period. And even more amazing fossils have been found in the United States and southern China that might show dinosaurs lived long after they were supposed to have disappeared!

Could the death of the dinosaurs have been caused by their moving into new areas? Illness and disease can be carried by travelling animals. Is it possible that dinosaurs and other creatures died of terrible diseases caught from other animals?

If this was what ended the dinosaurs, does this mean there was no asteroid or comet crash? Some scientists think the dinosaurs might have been affected by such an object from outer space, but only, when they were already in trouble. Ill and dying the dinosaurs might have looked up to see a fiery ball falling from the sky.

If so, it might just have sealed the dinosaurs' fate.

What killed these mighty creatures? Science may never answer one of the most puzzling questions.

V. Find the English equivalents of the following Russian words and phrases.

Быть (являться) причиной смерти; привести к концу (завершить); быть уничтоженным; большое разнообразие; период упадка (спада); казаться немного диковинным (странным); холоднокровные существа; кислотный дождь; образовывать огромное количество окиси азота; ископаемые; вопрос, приводящий в замешательство.

VI. Match the words from column A with the suitable words from column B to make word combinations.

A	**B**
mass	variety
to cause	crash
to become	creatures
wide	the death
cold-blooded	extinct
acid	question
comet	extinction
puzzling	rain
to hit	heavy doses
to produce	the Earth

VII. Fill in the blanks with prepositions where necessary.

1. Scientists still don't know what happened … the dinosaurs.
2. The dinosaurs represented a small portion … the species that became extinct … the end … the Cretaceous Period.
3. Some geologists believe that a large meteor hit the Earth … 65 kilometres per second.
4. It resulted … strongly acid rain around the world.
5. The death of the dinosaurs may have been caused … their moving into new areas.
6. It is possible that the dinosaurs and some other species of animals died … terrible diseases which they caught … other animals.

VIII. Answer the following questions.

1. When are the dinosaurs supposed to have disappeared?

2. Why is the extinction that took place at the end of the Cretaceous period called ‘a real mass extinction’?
3. Why do scientists believe that low temperatures could have caused the death of the dinosaurs?
4. What do some geologists think would happen if a large piece of ice-rich meteor hit the Earth at a tremendous speed?
5. What other things could cause acid rain?
6. What facts make some scientists consider the theory of a comet crash groundless?
7. Why could the death of the dinosaurs have been caused by their moving into new areas?

IX. Say whether the following statements are true or false. Correct the false statements to make them true. Use the introductory phrases:

That’s right	**Quite the contrary**
Exactly. Quite so.	**It’s not correct.**
Absolutely correct.	**It’s wrong.**

1. It wasn’t just the dinosaurs that died out in this extinction at the end of the Cretaceous Period.
2. If some catastrophic event hadn’t happened the dinosaurs would have survived.
3. Scientists know for sure that a sudden and unexpected event killed all the dinosaurs on the Earth.
4. There are several theories about the dinosaurs’ death, but none of them can explain why they disappeared so suddenly from the Earth’s surface.
5. The dinosaurs were cold-blooded that’s why they liked cold weather.
6. If a large piece of ice-rich meteor hit the Earth at a terrific speed 12.5 million billion kg of nitrogen oxide would be produced.
7. The idea of a meteor would mean that the dinosaurs were killed within a few months or years.
8. Volcanoes couldn’t produce heavy doses of acid rain for a long time.
9. The dinosaurs had started to die off millions of years before the end of the Jurassic Period.
10. Some scientists think that the dinosaurs’ death can be explained if we combine two theories together (the theory of a comet crash and the theory of a terrible disease caught from other animals).
11. Science may answer one of the most puzzling questions.

X. Render the text into English using the active vocabulary.

Массовое вымирание крупных животных в конце плейстоцена

В истории жизни на Земле было несколько десятков крупных кризисов, приводивших к вымиранию значительной части видов животных и растений и к разрушению экосистем. На наших глазах развивается очередной кризис, причиной которого является деятельность человека. Обычно считают, что разрушительное воздействие человека на природу началось совсем недавно – в связи с развитием промышленности, резким ростом населения и т.д. Многие думают, что люди каменного века жили в полной гармонии с природой, и нам нужно брать с них пример, чтобы остановить разрушение биосферы. Однако есть основания полагать, что деятельность палеолитических и мезолитических охотников сыграла огромную (может быть, решающую) роль в массовом вымирании крупной наземной фауны, которое произошло около 15–10 тыс. лет назад на всех континентах. Эти факты заставляют пересмотреть сложившиеся представления о месте и роли человека в биосфере.

Ближайший к нам во времени глобальный экологический кризис, последствия которого сказываются и поныне, разразился на рубеже плейстоцена и голоцена. Волна вымирания в конце плейстоцена – начале голоцена была весьма мощной, но коснулась почти исключительно фауны крупнейших млекопитающих. Вымирание мегафауны обычно связывали с резкими ландшафтными перестройками, вызванными окончанием очередной фазы оледенения. Однако многие учёные предполагают, что вымирание мегафауны – в большой степени дело рук человека. Если это так, то мы сильно недооценивали последствия охотничьей деятельности человека в биосфере Земли.

Остается гадать: как и при каких обстоятельствах человек, возникший естественным путем как обитатель открытого ландшафта, вышел из-под его контроля? Есть ли у человечества хоть какой-то шанс продолжить свое неудержимое развитие и при этом сохранить то, что еще осталось от природных экосистем, или биосфера Земли обречена?

XI. Express your personal view on the topic ‘What could have caused the death of the dinosaurs?’ Which theory do you favour? Why are you ‘for’ or ‘against’ a particular theory? Use the following phrases:

In my opinion … .
As far as I can see … .
It is a well-known fact that … .
The thing (matter, point) is that … .

LESSON 7
THE CONCEPT OF GLACIATION

Part I

I. Practice the pronunciation of the following proper names.

The Pleistocene ['pleɪstəˌsi:n], the Holocene epoch['həʊləʊˌsi:n 'i:pɒk].

II. Read these international words and try to guess their meaning.

Paleoclimatic, global, peak, epoch, topography, document.

III. Enlarge your active vocabulary.

glacier ['glæsɪə] – ледник

glaciation [ˌgleɪsɪ'eɪʃ(ə)n] – оледенение

to stretch [stretʃ] –тянуться

convergence [kən'və:dʒ(ə)ns] – сближение, схождение в одной точке

cirque [sɜ:k] – горный амфитеатр

IV. Glaciers have played an important role in shaping the landscape of the middle and higher latitudes. Most of the glaciers are now gone but the evidence of their action is still quite obvious. Read the text and say what factors influence the formation of a glacier.

Glaciation

Various types of paleoclimatic evidence suggest that the climate of the Earth has varied over time. The data suggests that during most of the Earth’s history, global temperatures were probably 8 to 15° Celsius warmer than they are today. However, there were periods when the Earth’s average global temperature became cold. Cold enough for the formation of alpine glaciers and continental glaciers that extended into the higher, middle and sometimes lower latitudes. In the last billion years of the Earth’s history, glacial periods started 925, 800, 680, 450, 330, and 2 million years ago. Of these ice ages, the most severe occurred 800 million years ago when glaciers came within 5 degrees of the equator.

The last major glacial period began about 2,000,000 years B.P. (Before Present) and is commonly known as the Pleistocene or Ice Age. During this glacial period, large glacial ice sheets covered much of North America, Europe, and Asia for long periods of time. The extent of the glacier ice during the Pleistocene, however, was not static. The Pleistocene had periods when the glaciers retreated (interglacial) because of mild temperatures, and advanced because of colder temperatures (glacial). Average global temperatures were probably 4 to 5° Celsius colder at the peak of the Pleistocene than they are today. The most recent glacial retreat began about 14,000 years B.P. and is still going on. We call this period the Holocene epoch.

In North America, the Pleistocene glaciers began their formation in the higher altitudes of the Rocky Mountains, and high latitude locations in Greenland and north-central Canada. From these locations, the ice spread in all directions following the topography of the landscape. In North America, the glaciers from the Rocky Mountains and north-central Canada met each other in the center of the continent creating an ice sheet that stretched from the Pacific to the Atlantic Ocean. At their greatest extent, the ice sheets of North America covered most of Canada and extended into the United States to a latitude of about 40° North.

A similar pattern of glaciation has also been scientifically documented in Europe and Asia. In Eurasia, ice sheets had their birth place in the Alps, Scandinavia, the northern British Isles, and northern Siberia. The ice sheets of Eurasia, however, did not form a single ice sheet through convergence and their furthest extent south was limited to a latitude of about 45° North.

Today, glacial ice covers about 10% of the Earth's land surface. During the height of the Pleistocene, ice sheets probably covered about 30%. Currently, the most extensive continental glaciers are found in Antarctica and Greenland. We can also find smaller glaciers at higher elevations in various mountain ranges in the lower, middle, and higher latitudes.

Glaciers can be classified according to size. Continental glaciers are the largest, with surface coverage about 5 million square kilometres. Antarctica is a good example of a continental glacier.

Mountain or alpine glaciers are the smallest type of glaciers. These glaciers can range in size from a small mass of ice occupying a cirque to a much larger system filling a mountain valley. Some mountain glaciers are even found in the tropics. The merger of many alpine glaciers creates the third type of glaciers, piedmont glaciers. Piedmont glaciers are from several thousand to several tens of thousands of square kilometres in size.

V. Find the Russian equivalents of the following English words and phrases.

Paleoclimatic evidence, an average global temperature, to extend into the higher (middle, lower) latitudes, the Ice Age, a glacial ice sheet, to retreat, to advance, to spread in all directions, to follow the topography of the landscape, a pattern of glaciation, convergence, to range in size.

VI. Match the words with their definitions.

topography **paleoclimatology** **Pleistocene Epoch** **cirque**
ice sheet **Holocene Epoch** **Alpine Glacier**

1) the period of time when areas of land at higher and middle latitudes where covered with glacial ice;
2) a small glacier that occupies a U-shaped valley on a mountain;
3) a dome-shaped glacier covering an area greater than 50,000 square kilometres. It is larger than an ice cap;
4) the period of time when glaciers retreated because of a warmer global climate
5) the relief exhibited by a surface;
6) scientific study of the Earth's climate during the past;
7) a steep-sided bowl-shaped hollow on a mountain side, originally formed by ice;

VII. Answer the following questions.

1. When did glacial periods start?
2. What is the Pleistocene?
3. What was characteristic of glaciers during the Pleistocene?
4. What period is called the Holocene epoch?
5. What did glaciers form over some regions of North America?
6. Where in Eurasia did glaciers begin their formation?
7. Where are the most extensive glaciers situated?
8. What types of glaciers are identified? What criterion is the classification of glaciers based on?
9. What is a continental glacier? Give some examples of continental glaciers.
10. What is characteristic of alpine glaciers?
11. What is a piedmont glacier?

VIII. Complete the following sentences with the information from the text.

1. This text is on … . 2. During the last billion years of the Earth's history there were several periods where … . 3. The colder climates lead to the formation of … . 4. The last period of glacial advance … . 5. For the last 14,000 years we have been experiencing a warming of the global climate which has led to … . 6. During the last glacial advance ice sheets covered … . 7. Today only … is covered by glaciers. 8. Geomorphologists classify glaciers according to … . 9. The classification includes the following types of glaciers: …, … and … . 10. A continental glacier is … . 11. An alpine glacier is defined as … . 12. Piedmont glaciers are created by … .

IX. Read the text. Make an annotation of it in oral form. Compare your annotation with your partner's. Present it to the group. Use the given phrases:

This text deals with … **It should be noted that …**
It is evident that … **The results show …**

rigid – твердый
margin – край
constriction – сжатие
to enhance – усиливать

To be called a glacier, a mass of ice must be capable of motion. Glacial movement occurs when the growing ice mass becomes too heavy to maintain its rigid shape and begins to flow. In most mountain glaciers, flow of ice begins with accumulations of snow and ice greater than 20 metres.

Flow rates within the various regions of a glacier are not uniform. The middle of the glacier appears to flow with the greatest speed. At the margins of the glacier, surface movement is slowed down because of the frictional effects of the valley wall. The bottom of the glacier also moves slowly because of the influence of frictional forces.

The velocity of flow of glacier ice is influenced by a variety of factors. Some of the most important factors are the temperature and thickness of the ice, and the constriction caused by the valley walls. The movement of ice over the ground in most glaciers is enhanced by a process known as basal sliding. The immense pressure caused by the weight of the overlying glacial mass makes the ice contact with the ground. As a result, it starts melting because of pressure (pressure melting). The melting ice then forms a layer of water that reduces the friction between the glacial ice and the ground surface. This water then facilitates the movement of the ice over the ground surface by producing a layer with very little friction. Because of basal sliding, some glaciers can move up to 50 metres a day. However, average rates of movement are usually less than 1 metre per day.

Today most glaciers are retreating because of the general warming of global temperatures since the beginning of this century. This indicates that the mass balances of these glaciers are negative because of less snow accumulating or higher levels of ablation. During the Little Ice Age, when global temperatures were cooler than present, many glaciers all over the world made strong advances.

X. Imagine you are going to explain what the concept of glaciation is to the pupils of the 8th form. Practice in pairs.

Part II

I. Read these international words and try to guess their meaning.

Pyramid, process, fiord, final, statistic, liner, standard.

II. Enlarge your active vocabulary.

to protrude [prə'tru:d] – выдаваться вперед

viscous ['vɪskəs] – *зд.* густой
to be moulded [məʊldɪd] – формироваться, превращаться
tabular ['tæbjulə] – имеющий плоскую форму или поверхность
growler ['graʊlə] – гроулер, небольшой айсберг

III. It is a well-known fact that icebergs have caused a lot of problems for people. It is a dangerous phenomenon but quite an interesting one at the same time. Read the text and give your own comments concerning this phenomenon.

Icebergs

An iceberg is a massive piece of ice of greatly varying shape, protruding 5 metres or more above sea-level, which has broken away from a glacier and which may be afloat or aground. Glaciers form on land as a result of a net accumulation of snow over thousands of years. Successive layers compress earlier accumulations until, at depths below 60 to 70 metres, glacial ice is formed. Glaciers ‘flow’ or ‘creep’ outward under their own weight like a viscous fluid. When the edge of a glacier advances into the ocean the pieces that break off are what we call icebergs. The term ‘iceberg’ originates from the Dutch term ‘ijsberg’ which means ice hill.

Icebergs are nothing more than solid water. They float because the density of the ice is less than the density of sea water. Icebergs come in all shapes and sizes, they have been compared to mountains, pyramids and castles. Many icebergs are moulded into unusual and fascinating shapes by the action of the wind and waves. The process of melting causes an iceberg to change shape, too.

Icebergs are formed both in the Arctic and the Antarctic oceans. Arctic icebergs come mainly from Greenland, a huge island which is almost completely covered by an ice sheet. It is estimated that the Greenland ice cap produces from 10,000 to 30,000 icebergs each year. Up to several thousands can reach Newfoundland waters, starting in the north at Quirpon Island. The rest are lost by diversion into straits or bays, by being grounded in many fiords along Baffin Island and by deterioration. About 90% of all icebergs encountered in Canadian waters are calved from the glaciers of Western Greenland. That adds up to 10,000–40,000 icebergs annually.

The course of an iceberg cannot be judged by wind direction alone. Since nine-tenths of an iceberg’s mass lies under water, much more of the berg’s surface is affected by water currents than by wind. The final direction is one that takes both the wind and currents into account. A berg can move against or across the wind, as well as downward or at small angles to it.

The largest Northern Hemisphere iceberg on record was encountered near Baffin Island in 1882. It was 13 km long, 6 km wide and had a freeboard (height above water) of about 20 m. The mass of that iceberg was in excess of 9 billion tons – enough water for everyone in the world to drink a litre a day for over 4 years. Despite this staggering statistic, icebergs from Antarctica may be many times larger than that. In 1987 an iceberg with an area of 6350 square km broke from the Ross ice shelf. That berg had a mass of around 1.4 trillion tons and could have supplied everyone in the world with 240 tons of pure drinking water.

There are following types and size comparisons of icebergs:
1. A large, tabular iceberg, 100–200 metres long, is as big as an oil rig.
2. A medium iceberg, 50–100 metres long, is as big as an ocean-going ship.
3. A small iceberg, 15–50 metres long, is as big as a long liner.
4. A bergy bit, 5–15 metres long, is as big as a single family house.
5. A growler, less than 5 metres long, is as big as a standard grand piano.

IV. Find the Russian-English equivalents of the following words and phrases.

Greatly varying shape, огромный кусок льда, отрываться от ледника, above sea-level, происходить, a net accumulation of snow, плотность льда, under one's own weight, сравниваться, действие ветра, to advance into the ocean, процесс таяния, nothing more than, to come in all shapes and sizes, главным образом, полностью покрытый, by the action of something, ежегодно, принимать во внимание, to be estimated, to be grounded, чистая питьевая вода, нефтяная буровая установка, at small angles, on record, despite.

V. Match the words from column A with the suitable words from column B to make word combinations.

A	**B**
a massive	fluid
a successive	ship
glacial	shape
a viscous	piece
solid	ice
to change	layer
wind	current
water	iceberg
tabular	direction
an ocean-going	water

VI. Fill in the blanks with prepositions where necessary.

1. Glaciers form … land as a result … a net accumulation … snow … thousands of years.
2. Glaciers 'flow' or 'creep' outward … their own weight.

3. The term ‘iceberg’ originates … the Dutch term ‘ijsberg’ which means ice hill.
4. Icebergs come … all shapes and sizes, they have been compared … mountains, pyramids and castles.
5. Arctic icebergs come mainly … Greenland.
6. About 90% … all icebergs encountered in Canadian waters are calved … the glaciers of Western Greenland.
7. The mass of the largest Northern Hemisphere iceberg was … excess of 9 billion tons.

VII. Answer the following questions.

1. What is an iceberg?
2. What does the Dutch term ‘ijsberg’ mean?
3. Do icebergs come in all shapes and sizes? What causes an iceberg to change shape?
4. Where are icebergs formed?
5. Where do Arctic icebergs mainly come from?
6. Can the course of an iceberg be judged by wind direction alone?
7. When was the largest Northern Hemisphere iceberg encountered? What size was it?
8. What are the types of icebergs?

VIII. Say whether the following statements are true or false. Correct the false statements to make them true. Use the introductory phrases:

Exactly. Certainly.	**It’s not right.**
Absolutely correct.	**It’s wrong.**
That’s right.	**It’s not correct.**

1. An iceberg is a small piece of ice of greatly varying shape, protruding 5 metres or more above sea-level, which has broken away from a glacier and which may be afloat or aground.
2. The term ‘iceberg’ originates from the German term ‘ijsberg’ which means ice hill.
3. Icebergs float because the density of the ice is less than the density of sea water.
4. Icebergs are formed only in the Arctic Ocean.
5. About 90% of all icebergs encountered in Canadian waters are calved from the glaciers of Western Greenland.
6. The course of an iceberg can be judged by wind direction alone.
7. There are five types of icebergs.

IX. Render the text into English using the active vocabulary.

Ледники образуются, главным образом, за счет накопления снега и последующего его преобразования. Обязательным условием накопления снега является обилие атмосферных осадков, большая часть которых выпадает при температуре ниже 0°С. Для выяснения условий формирования ледников в низких широтах наибольший интерес представляет снеговая линия. Выше снеговой линии снег даже летом сохраняется всюду, а ниже может охраняться только отдельными небольшими пятнами, в понижениях рельефа.

Снег выше снеговой линии накапливается не повсеместно. Будучи сыпучим, он легко развевается ветром. При благоприятных рельефных условиях массы снега выше снеговой линии не скатываются, а преобразуются в лед.

X. Work in small groups. Close your books and check which group can remember more facts about icebergs. Choose two students to check the facts in the text.

LESSON 8
THE ATMOSPHERE

Part I

I. Practice the pronunciation of the following terms.

Atmosphere ['ætməsfɪə], troposphere ['trɒpəsfɪə], stratosphere ['strætəsfɪə], mesosphere ['mezəsfɪə], thermosphere ['θɜːməsfɪə], isothermal [ˌaɪsəʊ'θɜːməl], molecule ['mɔlɪkjul], ultraviolet ['ʌltrə'vaɪəlɪt].

II. Enlarge your active vocabulary.

oxygen ['ɔksɪdʒən] – кислород
gradually ['grædjuəlɪ] – постепенно
to breach [bri:tʃ] – пробивать
to absorb[əb'sɔb] – впитывать, поглощать
approximately [ə'prɔksɪmɪtlɪ] – приблизительно

III. The Earth is pictured as a ball surrounded by an envelope of air – the atmosphere. The coat is at least 50 miles thick. It means that wherever you may be when you read this, a column of air at least 50 miles high is pressing down upon you. Read the text and describe the structure of the atmosphere.

The Layered Atmosphere

The Earth's atmosphere contains several different layers that can be defined according to air temperature.

According to temperature, the atmosphere contains four different layers. The first layer is called the troposphere. The depth of this layer varies from about 8 to 16 kilometres. The greatest depths occur in the tropics where warm temperatures cause vertical expansion of the lower atmosphere. From the tropics to the Earth's polar regions the troposphere becomes gradually thinner. The average depth of the troposphere is approximately 11 kilometres. About 80% of the total mass of the atmosphere is contained in the troposphere. It is also the layer where the majority of our weather occurs. Maximum air temperature also occurs near the Earth's surface in this layer. With increase in altitude air temperature drops uniformly at a rate of approximately 6.5° Celsius per 1000 metres. This phenomenon is commonly called the Environmental Lapse Rate (ELR). At an average temperature of –56.5° Celsius, the top of the troposphere is reached. At the upper edge of the troposphere is a narrow transition zone known as the tropopause.

Over the tropopause is the stratosphere. This layer extends from an average altitude of 11 to 50 kilometres over the Earth's surface. This stratosphere contains about 19.9% of the total mass found in the atmosphere. Very little weather occurs in the stratosphere. Occasionally, the top portions of thunderstorms breach this layer. The lower portion of the stratosphere is also influenced by the polar jet stream and subtropical jet stream. In the first 9 kilometres of the stratosphere, temperature remains constant with height. A zone with constant temperature in the atmosphere is called an isothermal layer. From an altitude of 20 to 50 kilometres, temperature increases with increase in altitude. The higher temperatures found in this region of the stratosphere occur because of localized concentration of ozone gas molecules. These molecules absorb ultraviolet sunlight creating heat energy that warms the stratosphere. Ozone is primarily found in the atmosphere at varying concentrations between the altitudes of 10 to 50 kilometres. This layer of ozone is also called the ozone layer. The ozone layer is important for organisms on the Earth's surface as it protects them from the harmful effects of the sun's ultraviolet radiation. Without the ozone layer life could not exist on the Earth's surface.

Separating the mesosphere from the stratosphere is a transition zone called the stratopause. In the mesosphere, the atmosphere reaches its coldest temperatures (about 90° Celsius) at a height of approximately 80 kilometres. At the top of the mesosphere is another transition zone known as the mesopause.

The last atmospheric layer, as defined by vertical temperature change, has an altitude greater than 80 kilometres, and is called the thermosphere. The thermosphere is the hottest layer in the atmosphere. Heat is generated from the absorption of solar radiation by oxygen molecules. Temperatures in this layer can reach 1300 to 1800° Celsius.

IV. Find the Russian equivalents of the following English phrases.

Vertical expansion of the lower atmosphere, the upper edge of the troposphere, localized concentration of ozone gas molecules, to protect from the harmful effects of the sun's ultraviolet radiation, a transition zone.

V. Match the words with their definitions.

atmosphere **isothermal layer** **Environmental Lapse Rate**
mesopause **Polar Jet Stream** **thermosphere**
ultraviolet radiation

1) vertical layer in the atmosphere where temperature remains unchanged;
2) the vast gaseous envelope of air that surrounds the Earth. It contains a complex system of gases and suspended particles that behave in many ways like fluids;

3) relatively fast winds concentrated within the upper atmosphere. It exists in the mid-latitudes at an altitude of approximately 10 kilometres and flows from west to east at 110–185 kilometres per hour;
4) the rate of air temperature increase or decrease with altitude;
5) electromagnetic radiation with a wavelength between 0.1 and 0.4 micrometres (µm);
6) a thin boundary layer found between the mesosphere and the thermosphere. Coldest temperatures in the atmosphere are found in this layer;
7) an atmospheric layer characterized by air temperatures rising rapidly with height. In this layer gamma, X-ray, and specific wavelengths of ultraviolet radiation are absorbed and then converted into heat energy;

VI. Answer the following questions.

1. How many layers of the atmosphere do scientists identify?
2. What is the troposphere? What are some of its characteristic features?
3. What is meant by the ELR?
4. What is the stratosphere? What is characteristic of this layer?
5. What is an isothermal layer?
6. What causes higher temperatures in the stratosphere (from an altitude of 20 to 50 kilometres)?
7. Why is the ozone layer important for life on the Earth?
8. What is the mesosphere?
9. What is characteristic of the thermosphere?
10. What is a transition zone? What transition zones do scientists identify?

VII. Complete the following sentences with the information from the text.

1. This text examines … . 2. Scientists identify … layers in the atmosphere. 3. The depth of the lowest layer, … , is approximately … . 4. It contains … and it also he layer where … . 5. The Environmental Lapse Rate is defined as … . 6. The stratosphere is situated … . 7. It extends … and contains … . 8. The lower part of the stratosphere is influenced by …, … and … . 9. An isothermal layer is defined as … . 10. Higher temperatures in the stratosphere (from an altitude of 20 to 50 kilometres) are caused by … . 11. The fundamental importance of the ozone layer is that … . 12. The mesosphere is the third layer which is characterized by … . 13. The last atmospheric layer, … , is considered to be … . 14. A transition zone is defined as … 15. Scientists identify three transition zones in the atmosphere: …, … and … .

VIII. Read the text. Make an annotation of it in written form. Compare your annotation with your partner's. Present it to the group. Use the given phrases:

This text deals with … **It is necessary to pay attention to …**

There is no doubt that … **In conclusion I must say …**

The Ozone Layer

skin cancer – рак кожи
suppression – подавление
to alter – изменять
release – *зд.* выброс

The ozone layer is a region of concentration of ozone molecules in the Earth's atmosphere. In recent years, scientists have measured a seasonal thinning of the ozone layer primarily at the South Pole. This phenomenon is called the ozone hole.

The ozone layer naturally shields life on the Earth from the harmful effects of the sun's ultraviolet (UV) radiation. A severe decrease in the concentration of ozone in the ozone layer could lead to the following harmful effects: an increase in the incidence of skin cancer (ultraviolet radiation can destroy acids in DNA), a large increase in cataracts and sun burning, suppression of immune systems in organisms, adverse impact on crops and animals, reduction in the growth of phytoplankton found in the Earth's oceans, cooling of the Earth's stratosphere.

Ozone is created naturally in the stratosphere by combining atomic oxygen with molecular oxygen. This process is activated by sunlight. Ozone is destroyed naturally by the absorption of ultraviolet radiation and by the collision of ozone with other atmospheric atoms and molecules.

It appears that human activities are altering the amount of stratospheric ozone. The main agent responsible for this destruction was human-made chlorofluorocarbons or CFCs. CFCs are cheap to produce and are very stable compounds, lasting up to 200 years in the atmosphere. By 1988, some 320,000 metric tons of CFCs were used worldwide.

CFCs created at the Earth's surface drift slowly upward to the stratosphere where ultraviolet radiation from the sun causes their decomposition and release of chlorine (Cl). Chlorine in turn attacks the molecules of ozone chemically converting them into oxygen molecules.

A single chlorine atom removes about 100,000 ozone molecules before it is taken out of operation by other substances.

IX. Prepare a presentation on the topic 'The Earth's Atmosphere'. Describe the main characteristic features of the layers that make up the atmosphere. Use the information from the texts of Part I, Internet resources and your own knowledge.

Part II

I. Read these international words and try to guess their meaning.

Problem, meteorologist, diffusion, agent, horizontally, vertically, condensation, reaction, inversion, territory, progressive.

II. Enlarge your active vocabulary.

pollution [pə'lu:ʃ(ə)n] – загрязнение
contamination [kənˏtæmɪ'neɪʃ(ə)n] – *syn.* pollution
multitude ['mʌltɪtju:d] – множество
diurnal [daɪ'з:nl] – суточный
to impair [ɪm'pɛə] – снижать
affinity [ə'fɪnɪtɪ] – сходство

III. Pollution of the air by certain industrial processes has been a concern for many years. Read the text and say where the increase in pollution comes from.

Atmospheric Pollution

Probably the most widespread problem confronting industrial meteorologist is that of atmospheric pollution around cities and factories but it is not the problem of meteorologist alone. Weather and climate are not the cause of air pollution, but atmospheric conditions do greatly affect the rate of diffusion of contaminating agents, both horizontally and vertically. Since air pollution is far more common around cities than elsewhere and has increased with their growth it is evident that it is a man-caused problem. Reduced visibility due to pollution is related to the greater urban activity on weekdays. One can locate a distant city by its cap of smoke and haze. There are also some foreign materials in the air – in liquid, solid and gaseous forms. The increase in pollution has come from a multitude sources.

The meteorological effects of pollution are largely concerned with visibility and sunshine. Since many contaminants are hygroscopic they act as nuclei of condensation and create a haze or fog, further reducing visibility. Moreover, it appears that the water droplets thus formed are more stable than normal cloud droplets and do not evaporate so readily upon being heated. Oily substances especially tend to form a protective coating around a droplet, making it difficult to disperse. The combination of fog and pollutant has been termed smog. Solar radiation is appreciably reduced by polluted air in the day-time, and outgoing radiation is reduced at night. The net effect is a lowered diurnal range of temperature. Parts of the solar spectrum are transmitted selectively by different gaseous constituents in the air so that the quality as well as the quantity of insolation is impaired. Chemical reactions among various types of contaminants in the air produce new compounds that in some cases are more damaging than the original wastes. Certain of these reactions are photo-chemical, i.e. they take place under the effects of sunlight.

While it is comparatively easy to observe and describe the effects of atmospheric pollution, it is somewhat more difficult to explain meteorological conditions which favour the stagnation of pollution-ridden air at certain times and places more than others. In general, stable air and light winds or calms are conductive to the concentration of pollutants at or near the source of contamination. Industrial areas where stable air resides for extended periods are likely locations for a pollution problem. For numerous reasons, industries are commonly concentrated in valleys and depressions for which stable air has an affinity and where temperature inversions are common. Temperature inversions are particularly suited to the formation of palls of smoke and industrial haze. As the warm fumes, gases, or airborne solids rise, they are cooled adiabatically and by mixing; and, since the air is warmer overhead in an inversion they are soon at a temperature equal to that of the surrounding air. Therefore, they do not rise further. Cooling by radiation at night from the top of a smoke layer only intensifies the inversion, and the concentration of pollutants increases at and below the top of the inversion. Stable air, especially with an inverted lapse rate, often is accompanied by radiation fog which combines with the pollutants to form smog. As already indicated, hygroscopic particles may hasten the condensation process. If the inversion layer is well above the surface a pall will form with less drastic effects, but it will nevertheless inhibit the passage of radiation and may eventually ‘build down’ to the surface. The most intense smog usually develops when the inversion is within 1,500 feet of the ground. Unstable air and strong winds are inimical to formation of dense smogs. Rising air currents carry the wastes upward and wind disperses them through a large volume of air. Prevailing winds carry pollutants away from single-sources and produce a strip of territory to the leeward that is subjected to a progressive decrease in intensity of pollution. Local winds, such as mountain and valley breezes, may have a decidedly favourable effect on clearing away polluted air.

The effect of precipitation on local atmospheric pollution is not as great as might be expected. Although some materials are unquestionably washed out by rain, wind and unstable air are more effective in cleansing the air during a storm. On a larger scale, however, much of the material dispensed into the air must eventually be returned to the Earth by precipitation.

IV. Find the Russian equivalents of the following English words and phrases.

To confront, the rate of diffusion of contaminating agents, far more common, due to, the greater urban activity, cap of smoke and haze, nuclei of condensation, to be appreciably reduced, a lowered diurnal range of temperature, under the effects of, the source of contamination, for numerous reasons, airborne solids, to be cooled adiabatically, an inverted lapse rate, inimical, the effect of precipitation, as might be expected, unquestionably.

V. Match the words from column A with the suitable words from column B to make word combinations.

A	B
industrial	agents
atmospheric	compounds
contaminating	problem
a man-caused	effects
meteorological	fog
to create	inversions
solar	meteorologist
chemical	conditions
to produce	reactions
temperature	radiation

VI. Fill in the blanks with prepositions where necessary.

1. Weather and climate are not the cause … air pollution.
2. Air pollution is far more common around cities than elsewhere and has increased … their growth.
3. One can locate a distant city … its cap of smoke and haze.
4. The meteorological effects … pollution are largely concerned … visibility and sunshine.
5. Industrial areas where stable air resides … extended periods are likely locations … a pollution problem.
6. Temperature inversions are particularly suited … the formation … palls of smoke and industrial haze.
7. Prevailing winds carry pollutants … … single-sources and produce a strip of territory to the leeward that is subjected … a progressive decrease in intensity of pollution.
8. Some materials are washed … … rain, wind and unstable air are more effective in cleansing the air during a storm.

VII. Answer the following questions.

1. What is the most widespread problem confronting industrial meteorologists?
2. How do hygroscopic contaminants act?
3. What is smog?
4. What is solar (outgoing) radiation reduced by?
5. What produces new compounds that in some cases are more damaging than the original wastes?
6. What may hasten the condensation process?
7. When does the most intense smog usually develop?

8. What kinds of wind may have a decidedly favourable effect on clearing away polluted air?

VIII. Say whether the following statements are true or false. Correct the false statements to make them true. Use the introductory phrases:

That's right.	**Quite the contrary.**
Quite so.	**Just the reverse.**
Absolutely correct.	**Not quite.**

1. The most widespread problem confronting industrial meteorologist is that of atmospheric pollution around cities and factories.
2. Atmospheric conditions do greatly affect the rate of diffusion of contaminating agents, both horizontally and vertically.
3. There are no foreign materials in the air – in liquid, solid and gaseous forms.
4. The combination of smoke and pollutant has been termed smog.
5. Solar radiation is appreciably reduced by polluted air at night, and outgoing radiation is reduced in the day-time.
6. Chemical reactions among various types of contaminants in the air produce new compounds that in some cases are more damaging than the original wastes.
7. For numerous reasons, industries are commonly concentrated in valleys and depressions for which stable air has an affinity and where temperature inversions are uncommon.
8. Cooling by radiation at night from the top of a smoke layer only intensifies the inversion.
9. Local winds, such as ocean breezes, may have a decidedly favourable effect on clearing away polluted air.

IX. Render the text into English using the active vocabulary.

Аэрозоли – это твердые или жидкие частицы, находящиеся во взвешенном состоянии в воздухе. Твердые компоненты аэрозолей в ряде случаев особенно опасны для организмов, а у людей вызывают специфические заболевания. В атмосфере аэрозольные загрязнения воспринимаются в виде дыма, тумана, мглы или дымки. Значительная часть аэрозолей образуется в атмосфере при взаимодействии твердых и жидких частиц между собой или с водяным паром. В атмосферу Земли ежегодно поступает около 11 куб.км. пылевидных частиц искусственного происхождения. Большое количество пылевых частиц образуется также в процессе производственной деятельности людей.

X. What parts can the text 'Atmospheric pollution' be divided into? Entitle each part. Summarize the contents of the text using this outline.

XI. Man-made pollution over industrial areas has recently developed into a real threat to life. Give your opinion on the problem. Use the following phrases:

I consider (that) ….
As far as I can see it relates to ….
From my point of view ….
In this connection I'd like to give some comment … .

LESSON 9
AIR MASSES

Part I

I. Read these international words and try to guess their meaning.

Analysis, portion, transmission, thermal, modification, turbulence, front, barometric, circulation, amplitude, anticyclone, spiral.

II. Enlarge your active vocabulary.

humidity [hju(:)'mɪdɪtɪ] – влажность
moisture ['mɔɪstʃə] – *syn*. humidity
to be accomplished [ə'kɔmplɪʃt] – завершаться
turbulence ['tɜ:bjuləns] – турбулентность
inclement [ɪn'klemənt] – суровый (о климате)

III. Weather and climate everywhere are most often affected by the movements of air masses, and the majority of atmospheric disturbances result from the confrontations of different air masses. Read the text and be ready to speak about air masses, fronts and cyclones in detail.

Air Masses, Fronts and Cyclones

Meteorologists are constantly searching for improved methods of analysis in order to forecast the daily weather with greater accuracy. Contemporary weather analysis and prediction consist largely in the study of the properties of individual, discrete masses of air and the changes resulting when they meet.

An air mass is a portion of the atmosphere having a uniform horizontal distribution of certain physical characteristics especially of temperature and humidity, these qualities being acquired when a mass of air stagnates or moves very slowly over a large and relatively unvaried surface of land or sea. Under these circumstances surface air gradually takes on properties of temperature and moisture approaching those of the underlying surface, and there then follows a steady, progressive transmission of properties to greater heights, resulting finally in a clearly marked vertical transition of characteristics. Those parts of the Earth where air masses acquire their distinguishing qualities are called source regions.

The height to which an air mass is modified depends upon the length of time it remains in its source region and also upon the difference between the initial properties of the air when it first arrived and those of the underlying surface. If, for example, an invading flow of air is cooler than the surface beneath as it comes to rest over a source region, it is warmed from below and convective currents are formed, rapidly bearing aloft new characteristics of temperature and moisture to considerable heights. If, on the other hand, it is warmer than the surface of the source region, cooling of its surface layers takes place, vertical thermal currents do not develop and the air is modified only in its lower portion. The process of modification may be accomplished in just a few days of slow horizontal drift, although it often takes longer, sometimes several weeks. Radiation, convection, turbulence and advection are the chief means by which it is brought about.

Two converging air masses tend to retain their individual properties after they have met, creating a zone of discontinuity between them called a front. A front is a rather narrow transition zone, marked by lower barometric pressure between two discrete air masses. It is usually along a front that the ordinary changes in weather evident to the casual observer take place. A front is often described as resembling an inclined plane, separating cooler air below from warmer air above, in a wedgelike fashion.

The leading margin of an advancing mass of cold air is called a cold front. When a mass of warm air overtakes cooler air, its leading margin is called a warm front. The conditions necessary for the formation of fronts are: 1) the meeting of two air masses having temperatures that contrast to the extent that one is colder and hence denser than the other, 2) circulation of the two air masses such that they are brought together by converging currents of air.

Another type of frontal development is one that occurs during the life cycle of a migrating cyclone and is termed an occluded front. In some way not entirely understood at present, an undulation may result from changes in the velocity of winds adjacent to the front. The frontal wave then travels, very like an ocean ground swell, roughly eastward gaining amplitude and gradually acquiring a cyclonic circulation of its own as a low pressure cell takes form. This is the meteorologist’s low, barometric depression, cyclonic storm, cyclone.

The endless year-round procession of cyclones and anticyclones is mainly responsible for the ceaseless variation of the world’s daily weather. A migrating anticyclone usually brings a spell of relatively cooler, drier, bracing weather with clear, comparatively cloudless blue skies and light variable winds near its centre where pressures are higher. A cyclone is the reverse, consisting of warmer, more humid lighter air, its winds tending to form a contracting spiral of increasing velocity toward the centre, which is further distinguished by its lower pressure value. Migrating cyclones usually bring inclement weather with abundant clouds and are responsible for much of the rain or snow that falls in all latitudes.

IV. Find the Russian-English equivalents of the following words and phrases.
Improved methods of analysis, для того чтобы, with greater accuracy, largely, влажность, relatively unvaried surface, при таких условиях, to accomplish the process of modification, to take place, to bring about, a migrating cyclone,

adjacent to the front, обусловливать, сравнительно безоблачный, a contracting spiral.

V. Match the words with their definitions.

air mass **source regions** **front** **cold front**
warm front **occluded front** **cyclone** **anticyclone**

1) those parts of the Earth where air masses acquire their distinguishing qualities;
2) the leading margin of an advancing mass of warm air;
3) the leading margin of an advancing mass of cold air;
4) a portion of the atmosphere having a uniform horizontal distribution of certain physical characteristics especially of temperature and humidity;
5) a type of frontal development that occurs during the life cycle of a migrating cyclone;
6) a mass of air that is heavy, causing calm weather, either hot or cold, in the area over which it moves;
7) a zone of discontinuity between two converging air masses;
8) a very violent tropical wind or storm moving rapidly in a circle round a calm central area;

VI. Answer the following questions.

1. Why are meteorologists constantly searching for improved methods of analysis?
2. What do contemporary weather analysis and prediction consist in?
3. What is an air mass?
4. Under what circumstances does surface air gradually take on properties of temperature and moisture approaching those of the underlying surface?
5. What does the height to which an air mass is modified depend upon?
6. What conditions are necessary for the formation of a front?
7. How does cyclonic storm develop?
8. Migrating cyclones usually bring inclement weather with abundant clouds, do they?
9. What kind of weather are migrating anticyclones responsible for?

VII. Complete the following sentences with the information from the text.

1. This text deals with … . 2. Meteorologists are constantly searching for… . 3. Contemporary weather analysis and prediction consist largely in … . 4. An air mass is … . 5. There then follows a steady, progressive transmission of … . 6. The height to which an air mass is modified depends upon… . 7. If an invading flow of air is cooler than the surface beneath … . 8. The process of

modification may be accomplished in … . 9. A front is often described as … . 10. It is usually along a front that … . 11. The conditions necessary for the formation of fronts are … . 12. An undulation may result from … . 13. The endless year-round procession of cyclones and anticyclones is mainly responsible for … . 14. A migrating anticyclone usually brings … . 15. Migrating cyclones usually bring … .

VIII. Read the text. Make an annotation of it in written form. Compare your annotation with your partner's. Present it to the group. Use the given phrases:

The text is on… **The thing is that…**

It is important to point out that … **In conclusion…**

Anticyclones

clockwise – по часовой стрелке
counter-clockwise – против часовой стрелки
to confine – ограничивать
stationary – неподвижный
to reinforce – усиливать

The term 'anticyclone' implies characteristics opposite to those of the cyclone. Barometric pressure is highest at its centre and decreases outward. Consequently the anticyclonic wind system blows out from the centre, and because of the Coriolis force it has a clockwise circulation in the Northern Hemisphere (counterclockwise in the Southern Hemisphere). Further, the anticyclone is composed of subsiding air which renders it stable in contrast to cyclones or low pressure systems.

It does not have fronts or definite windshift lines, but a gradual change in wind direction takes place as it passes. Except where surface instability is induced (e.g. as the air moves over a warm surface) there is less cloudiness and therefore lack of precipitation in the typical anticyclone. In winter in middle and high latitudes anticyclones are essentially synonymous with the source regions of cold stable air masses which invade cyclonic systems in the form of cold fronts. These are known as 'cold' anticyclones and they are confined to the lower troposphere. Like the cyclone the anticyclone usually has a pressure pattern represented by circular or oval isobars, but it may assume various shapes. Diameters range from a few hundred to 2 thousand miles. On average it travels at a rate appreciably lower than the typical cyclone, but it is even more erratic than the cyclone in its direction. The paths of highs are roughly similar to those of lows across North America except that they do not usually turn northeastward near the Atlantic Coast but proceed more directly out over the ocean.

The anticyclones of the subtropics are associated with the subtropics high in the general circulation and are warmer than those of higher latitudes. Their high pressure results from the very cold air at great heights rather than in the lower troposphere.

Although they tend to be more nearly stationary, portions sometimes break away to move eastward along the margin of the westerlies. They are frequently reinforced by polar anticyclones which merge with them. Because of the considerable difference in temperature between the two, a front may be formed in the trough of lower pressure which separates the high cells before they completely merge.

IX. Find additional information and prepare a short report 'Fronts, Cyclones and Anticyclones'.

Part II

I. Read these international words and try to guess their meaning.

Tornado, cycle, associate, momentum, minute, automobile.

II. Enlarge your active vocabulary.

funnel-shaped ['fʌnl'ʃeɪpt] – воронкообразный
cumulonimbus ['kju:mjulə'nɪmbəs] – кучево-дождевые облака
waterspout ['wɔ:təspaut] – водяной смерч
alert [ə'lɜ:t] – тревога
clue [klu:] – ключ (к разгадке чего-либо)

III. One of the natural disasters which quite often occurs in the USA is tornado. Read the text and name the other areas that experience tornadoes.

Tornadoes

A tornado is a violent whirling wind, characteristically accompanied by a funnel-shaped cloud extending down from a cumulonimbus cloud. The air pressure at the bottom of the funnel of swirling air is extremely low. When this low pressure area touches the ground, it acts like a giant vacuum cleaner. Some tornadoes even occur over water. A tornado over a lake or ocean is called a waterspout.

Tornadoes generally exhibit a certain characteristic cycle of behaviour between formation and final disappearance. The first sign of a tornado may be a strong whirlwind of dust from the ground surface, often at the same time as a short funnel grows from the storm cloud above it. The funnel then becomes more organized and descends further from the cloud, sometimes touching the ground.

Meteorologists are not sure how tornadoes form. But they do know that they are the result of great instability in the atmosphere and are often associated with severe thunderstorms or in advance of cold fronts. Weather forecasts include tornado alerts when these conditions arise. Tornadoes can occur, however, ahead of warm fronts or even behind cold fronts. The existence of a strong updraft, such as that generated by a severe thunderstorm, and the conservation of rotational momentum, are clues to how they are formed. Tornadoes occur most often in spring during the late afternoon or early evening. In the United States they are most common on the Great Plains. In fact, tornadoes are so common that this part of the United States is often called Tornado Alley.

The diameter of an average tornado is only about 4 kilometres. The length of a tornado’s path varies, but it averages 6 kilometres. The speed of the funnel winds themselves is often placed at more than 480 km/hr although speeds of more than 800 km/hr have been estimated for extremely strong storms. Tornadoes generally last only a few minutes, but because they are so concentrated, they are intensely violent and dangerous storms. Roofs and walls of buildings may be blown away by the winds. Houses, railroad cars, automobiles and even people may be picked up and thrown hundreds of metres. A tornado in Nebraska tossed a 225 kilogram grand piano almost 400 metres across a corn field.

Tornadoes are now classified on the Fujita-Pearson scale which links maximum wind speed, path length and path width.

The greatest incidence of tornadoes is generally assumed to be North America, and especially in the Mississippi Valley. On an equal area basis, however, other countries, such as Italy, New Zealand, and the United Kingdom, exceed or at least challenge the incidence rate of the United States. In actual numbers observed, Australia ranks second to the United States. Tornadoes occurring in the tropics are usually extremely weak and often begin as waterspouts. The Stockholm, Sweden and Saint Petersburg, Russia areas appear to be the northernmost regions that experience tornadoes.

IV. Find the Russian-English equivalents of the following words and phrases.

A violent whirling wind, сопровождаться, to extend down from, давление воздуха, a giant vacuum cleaner, to exhibit, достигать земли, между образованием и окончательным исчезновением, to descend, прогноз погоды, in advance of, tornado alerts, updraft, чаще всего, быть унесенным (ветром), rotational momentum, подниматься, крайне (очень) слабый, Tornado Alley, to toss, to be assumed, to challenge, the northernmost regions, to experience.

V. Match the words from column A with the suitable words from column B to make word combinations.

A	B
a funnel-shaped	pressure
the air	surface
pressure	cloud
to touch	front
a strong	the ground
the ground	instability
great	area
a warm (cold)	whirlwind
weather	thunderstorm
a severe	regions
northernmost	forecast

VI. Fill in the blanks with prepositions where necessary.

1. Hard rain was accompanied … a severe storm.
2. Usually hurricanes are the result … great instability in the atmosphere.
3. Many trees were picked … and tossed … the street.
4. Tornadoes are often associated … severe thunderstorms or in advance … cold fronts.
5. Tornadoes usually occur … the Mississippi Valley.
6. Sometimes waterspouts form … the tropics.

VII. Answer the following questions.

1. What is a tornado?
2. What happens when low pressure area touches the ground?
3. What is a waterspout?
4. How does a tornado begin?
5. When do tornadoes most often occur?
6. What is the diameter, the length of a path, the speed of the funnel wind of an average tornado?
7. How long do tornadoes last?
8. What criteria is the classification of tornadoes based on?
9. Is the greatest incidence of tornadoes generally assumed to be North or South America?
10. What areas appear to be the northernmost regions that experience tornadoes?

VIII. Say whether the following statements are true or false. Correct the false statements to make them true. Use the introductory phrases:

That's right.	**It's not correct.**
Exactly. Certainly.	**It's not right.**
Absolutely correct.	**It's wrong.**

1. The air pressure at the bottom of the funnel of swirling air is extremely high.
2. Tornadoes do not occur over water.
3. Tornadoes generally exhibit a certain characteristic cycle of behaviour between formation and final disappearance.
4. Meteorologists are sure how tornadoes form.
5. Tornadoes are the result of great instability in the atmosphere.
6. Tornadoes can occur, however, ahead of cold fronts or even behind warm fronts.
7. In the United States tornadoes are most common on the Great Plains.
8. The Fujita-Pearson scale links minimum wind speed, path length and path width.
9. Tornadoes occurring in the tropics are usually extremely weak and often begin as waterspouts.

IX. Render the text into English using the active vocabulary.

Тропическая зона – регион тайфунов (typhoon). В северной части Тихого океана известны три района, приносящие планете разрушительные циклоны.

Когда поверхность моря сильно нагревается, вторжение холодных масс вызывает интенсивное испарение. Появляется мощная сила, которая вбирает все больше теплого и влажного воздуха. Вращение Земли придает ему вихревое движение. Постепенно вырастает гигантский волчок (vortex). Свирепствуют ветры, начинаются ливни. Сформировавшийся тайфун напоминает огромную воронку, в центре которой – затишье. Живет тайфун недолго (до семи суток), но бурно. Он захватывает огромные пространства, проносясь со скоростью более 39 метров в секунду. Часто тайфун движется не по стандартной траектории: петляет, резко меняет направление.

X. Write an article 'Natural Disasters: Causes and Effects' for the students' scientific conference. For information consult encyclopedias, books, magazines and Internet resources.

LESSON 10
WATER

Part I

I. Read these international words and try to guess their meaning.

Energy, meridian, parallel.

II. Enlarge your active vocabulary.

to exceed [ɪk'si:d] – превышать
terrestrial [tɪ'restrɪəl] – земной
unevenly ['ʌn'i:vənlɪ] – неравномерно
ratio ['reɪʃɪəʊ] – отношение, пропорция, коэффициент
proximity [prɔk'sɪmɪtɪ] – близость
salinity [sə'lɪnɪtɪ] – солёность

III. The ocean comprises the continuous body of water which covers the greater part of the Earth's surface. It is divided into some great divisions which have partly natural, partly imaginary boundaries. Read the text and say how the oceans are distributed over the Earth's surface.

The Oceans

Oceans cover approximately 71% or 360 million square kilometres of the Earth's surface. On average, the depth of the world's oceans is about 3.9 kilometres. Maximum depths, however, can exceed 11 kilometres! The oceans contain 97% of our planet's free water. The other 3% is found in the atmosphere, on the Earth's terrestrial surface, or in the Earth's lithosphere in various forms and stores.

The distribution of ocean basins and continents is unevenly arranged over the Earth's surface. In the Northern Hemisphere, the ratio of land to ocean is about 1 to 1.5. The ratio of land to ocean in the Southern Hemisphere is 1 to 4. The greater abundance of water in the Southern Hemisphere has some interesting effects on the environment of this area. For example, the climate tends to be more moderate in the Southern Hemisphere because of the ocean's ability to release large amounts of stored heat energy.

Humans have divided and named the interconnected oceans of the world into three groups: the Atlantic (including the Arctic Sea), the Indian, and the Pacific. According to American sources the areas of the three great oceans are distributed in the following way: 67.7million square miles for the Pacific, 34.7 for the Atlantic and 18.6 for the Indian.

The Pacific is the largest ocean basin. It is bounded in the east by America and the meridian of Cape Horn, in the west by Asia, the Greater Sunda Isles, Australia and the meridian of Tasmania, in the north it ends in Bering Strait, and in the south at the Antarctic circle. It has an average depth of 4.3 kilometres and has few shallow marginal seas, but many islands. Only a few rivers discharge into this ocean basin. This lack of rivers is demonstrated by the fact that the surface area of the Pacific is about 1000 per cent greater than the land area that adjoins it.

The Atlantic is a relatively narrow body of water that twists between nearly parallel continental masses. The Atlantic Ocean contains the majority of the Earth's shallow seas, but relatively few islands. Some of the shallow seas found in this basin include: the Caribbean, Mediterranean, Baltic, Arctic Seas, and the Gulf of Mexico. Many streams and rivers discharge into the Atlantic Ocean. This basin also drains some of the world's largest rivers including the Amazon, Mississippi, St. Lawrence, and Congo. The surface area of the Atlantic Ocean is about 1.6 times greater than the terrestrial area adjoining it. As a result, the Atlantic Ocean receives more fresh water from continental runoff than any other ocean basin.

The Indian Ocean is the smallest of the three major ocean basins. It is bordered by the landmasses of Africa and Asia. This basin has few islands and shallow seas. The surface area of the Indian Ocean is approximately 400 per cent larger than the area adjoining it. Because of its close proximity to the equator this basin has the warmest surface ocean temperatures.

The characteristic property of the ocean waters is that they contain dissolved salts. The relative composition of the dissolved solids is virtually constant.

Evaporation and the freezing of sea ice are the two processes that increase the salinity of water. The average salinity for all waters is usually taken to be 35%. The highest salinities occur in semilandlocked seas in mid-latitudes. Outstanding examples are the Red Sea and the Persian Gulf (about 40%).

IV. Find the Russian equivalents of the following English words and phrases.

On average, to release large amount of, a shallow marginal sea, to discharge into, continental runoff, to be bordered by, close proximity to the equator, the relative composition of the dissolved solids, to increase the salinity of, a semilandlocked sea.

V. Match the words with their definitions.

river runoff ocean ocean basin salinity sea

1) (1) a body of saline water found on the Earth's continental surface; (2) a portion of an ocean that is in close proximity to a continent;
2) a long narrow channel of water that flows across the Earth's surface;
3) a part of the Earth's outer surface that is comprised of the ocean floor, mid-

oceanic ridges, continental rise, and continental slope. It is filled with saline water that makes up the oceans;

4) the topographic flow of water from precipitation to stream channels located at lower elevations;
5) a body of saline water which occupies the Earth's ocean basins;
6) concentration of dissolved salts found in a sample of water;

VI. Answer the following questions.

1. What is an ocean? What are some of the characteristic features of the world's oceans?
2. How many oceans are identified by scientists? What are they?
3. What are some of the characteristic features of the Pacific Ocean?
4. What is characteristic of the Atlantic Ocean?
5. Why does the Atlantic Ocean receive more fresh water than any other ocean basin?
6. Where is the Indian Ocean situated?
7. Why is the Indian Ocean considered to be the warmest?
8. What is the characteristic property of the ocean waters?
9. What processes increase the salinity of water?
10. Where do the highest salinities occur? Give some examples.

VII. Complete the following sentences with the information from the text.

1. This text is concerned with … . 2. The oceans cover … and contain … . 3. On average, they are … deep. 4. The distribution of the oceans and land is … . 5. In the Northern Hemisphere … though in the Southern Hemisphere … . 6. Scientists divide the world's oceans into … . 7. … is the largest ocean basin. 8. It is bounded by … . 9. The depth of the Pacific is … . 10. It has a lot of … but few … . 11. In comparison with the Pacific Ocean the Atlantic Ocean is … . 12. It contains most of … although it has … . 13. The Atlantic Ocean gets more fresh water than any other ocean basin because … . 14. The Indian Ocean is situated … . 15. Warm surface temperatures of the Indian Ocean are caused by … . 16. The characteristic property of the ocean waters is … . 17. … and … increase the salinity of water. 18. The highest salinities are characteristic of … .

VIII. Read the text. Make an annotation of it in written form. Compare your annotation with your partner's. Present it to the group. Use the given phrases:

The text reveals …	**The thing is that …**
It is important to note that …	**In conclusion …**

Physical and Chemical Characteristics of Seawater

equilibrium – равновесие

drastically – радикально, коренным образом
constant – постоянный
initial – первоначальный
to involve – включать в себя

Seawater is a mixture of various salts and water. Most of the dissolved chemical constituents or salts found in seawater have a continental origin. It seems that these chemicals were released from continental rocks through weathering and then carried to the oceans by stream runoff. Over time, the concentration of these chemicals increased until an equilibrium was met. This equilibrium occurred when the ocean's water could not dissolve any more material in solution. The composition of seawater stopped changing drastically about 600 million years ago.

Only six elements comprise about 99% of sea salts: chlorine, sodium, sulfur, magnesium, calcium, and potassium. The relative abundance of the major salts in seawater is constant regardless of the ocean. Only the amount of water in the mixture varies because of differences between ocean basins (regional differences in freshwater loss (evaporation) and gain (runoff and precipitation)).

Water is one of the few substances existing on the Earth's surface in all three forms of matter. At 0° Celsius liquid water turns into ice and has a density of approximately 917 kilograms per cubic meter.

Seawater freezes at a temperature that is slightly colder than fresh water (0.0° Celsius). The freezing temperature of seawater also varies with the concentration of salts. The more salt the lower the initial freezing temperature. At a salinity of 35 parts per thousand, seawater freezes at a temperature of –9° Celsius.

Seawater also contains small amounts of dissolved gases. The concentration of gases that can be dissolved into seawater from the atmosphere is determined by temperature and salinity of the water. Some of the important atmospheric gases found in seawater include: nitrogen, oxygen, carbon dioxide, argon, helium, and neon. Some gases found within seawater are also involved in oceanic organic and inorganic processes that are indirectly related to the atmosphere.

IX. You are going to prepare a short speech 'The Oceans of the Earth'. Compare and contrast the characteristics of the oceans. Use the information from the texts of Part I and your own knowledge. Take notes on what you are going to say.

Part II

I. Read these international words and try to guess their meaning.

Concentration, technological, component, bacteria, nation, commission.

II. Enlarge your active vocabulary.
sewer ['sju:ə] – сточная труба
receptacle [rɪ'septəkl] – хранилище
crude [kru:d] – неочищенный
garbage ['ga:bɪdʒ] – отходы
to avert [ə'vɜ:t] – предотвращать

III. ‘Clean water’, ‘pure water’, ‘clear water’ are some of the terms we use in describing water of good quality. But almost everything that people do causes pollution. Read the text to find out about the scale of water pollution in the USA.

Sea – or Sewer?

Forecasts of what the sea will do are becoming all the more necessary depending on what we are doing to the sea; it has become mankind’s great sewer. Lakes, rivers and the very air itself have become clogged with our wastes. The sea, in its immensity, would appear to have an indefinite capacity to hide anything that might be thrown into it.

On the face of it, there does not seem to be much of a problem. The North Sea, for example, contains 54,000 cubic kilometres of water. Consequently, if 54,000 tons of any substance were dumped into this sea and perfectly dispersed, it would show up in a concentration of only one part per billion. This kind of reasoning has encouraged the use of the North Sea as a receptacle for everything from the raw sewage of the cities to the wastes of industry along the Rhine, one of the world’s busiest areas of economic activity.

Such reasoning does not stand up because the sea is not a tub of water mixed every day by wind and tide. Currents not only disperse waste, they also concentrate it. That was what happened in spring 1965 when the beach near the Hague was suddenly covered with rows of dead fish. Analysis of the water just off the beach showed that its copper content was no less than 500 times higher than normal.

It has been estimated that one or two truckloads – twenty tons in all – of copper were enough to do the trick. Dumped stealthily on some beach at low tide, they were not diluted by the sea. Instead tides and currents concentrated the waste into a narrow lethal river about 200 yards wide and flowing north ever so slowly.

Another case where the inability to predict the behaviour of the atmosphere and the sea had a disastrous effect was the wreck of the *Torrey Canyon* in March 1967. She piled up on the Seven Stones off Cornwall, dumping 117,000 tons of crude oil into the sea from her rent hull. Fourteen thousand tons landed on the Cornish coast where it was fought with 10,000 tons of detergents that destroyed the oil but at the same time killed most marine life on the shore as well. The French followed the event from what they thought a safe distance. They had every right to expect that the beaches of northern Brittany would be spared thanks to the south-west winds that usually prevail at that time of the year. Meteorologists and oceanographers could not forecast what wind and sea would do. It was ten to one that the wind would not back around to the north-east. But it did – and 15,000 tons of oil came ashore in a black tide that had to be fought with only shovels, buckets and bulldozers.

The problem of oil pollution grows more complex every day with new technological developments. The opening of the Northwest Passage from Alaska to the east coast of North America has drastic implications for the Arctic environment. If a giant tanker were to be wrecked in those waters, the effect would be even more lasting than in the temperate zone. In a cold climate, the volatile components of oil are no longer volatile and the breakdown of petroleum by bacteria in the sea occurs at much slower pace.

Another danger in the Arctic is that off-shore oilfields are vulnerable to icebergs. They are not only a formidable threat to a drilling platform but some bergs, drawing more than 600 feet of water can wipe out pipelines laid along the bottom to link well-heads to the shore.

More and more, we realize that we live on what has been called Spaceship Earth. We cannot just throw out garbage away into the environment; sooner or later, we will have to go on living with it – unless we blast it off into outer space.

The sea is threatened on all sides. The worst of it is that often we do not know we are polluting the environment until it is too late. All too often, we wake up to pollution too late and when there is too much of it already on our hands. To avert such a fate for the world ocean, the nations that have joined the Intergovernmental Oceanographic Commission have recommended the establishment of a world-wide system to monitor marine pollution.

Finally we must learn more about the ocean itself and the life it contains so that we will be able to recognize changes, whether harmful or beneficial, when and if they occur.

IV. Find the Russian equivalents of the following English words and phrases.

Mankind’s great sewer, to become clogged with the wastes, consequently, reasoning, to do the trick, to be diluted, rent hull, to be ten to one, to be fought with, drastic implications for the Arctic environment, the volatile components of oil, to be vulnerable to icebergs, drilling platform, a formidable threat.

V. Match the words from column A with the suitable words from column B to make word combinations.

A	B
the raw	waste
economic	pollution
to disperse	activity
copper	zone
oil	ocean
technological	content
the temperate	development
off-shore	platform
a drilling	oilfield

VI. Fill in the blanks with prepositions where necessary.

1. Forecasts of what the sea will do are becoming all the more necessary depending … what we are doing … the sea.
2. Such reasoning does not stand … because the sea is not a tub of water mixed every day … wind and tide.
3. Dumped stealthily on some beach … low tide, they were not diluted by the sea.
4. The problem of oil pollution grows more complex every day … new technological developments.
5. The danger … the Arctic is that off-shore oilfields are vulnerable … icebergs.
6. We cannot just throw … garbage away into the environment; sooner or later, we will have to go … living with it.

VII. Answer the following questions.

1. What happened in spring 1965? What did analysis of the water off the beach show?
2. What can you say about the wreck of the *Torrey Canyon* in March 1967? Where did it pile up?
3. Does the problem of oil pollution grow more complex with new technological developments?
4. What are the dangers for the Arctic environment?
5. What measures must be undertaken to avert marine pollution?

VIII. Say whether the following statements are true or false. Correct the false statements to make them true. Use the introductory phrases:

That's right.	**It's not correct.**
Exactly. Certainly.	**It's not right.**
Absolutely correct.	**It's wrong.**

1. Lakes, rivers and the very air itself have become clogged with our wastes.
2. Currents do not disperse waste, they also do not concentrate it.
3. Analysis of the water just off the beach showed that its zinc content was no less than 500 times higher than normal.
4. Another case where the inability to predict the behaviour of the atmosphere and the sea had a disastrous effect was the wreck of the *Torrey Canyon* in March 1967.
5. It was ten to one that the wind would not back around to the south-east.
6. The opening of the Northwest Passage from Alaska to the east coast of North America has drastic implications for the Arctic environment.
7. To avert such a fate for the world ocean, the nations that have joined the Intergovernmental Oceanographic Commission have recommended the establishment of a world-wide system to monitor marine pollution.

IX. Render the text into English using the active vocabulary.

Основными источниками загрязнения гидросферы являются атмосферные осадки, стекающие дождевые воды, бытовые и промышленные стоки. Особенно вредны синтетические моющие вещества, так как они не разлагаются бактериями, не оседают, не уничтожаются при разбавлении чистой водой. Постоянный приток сточных вод меняет экологическую обстановку водоема, ведет к гибели флоры и фауны, создает угрозу здоровью человека. Своеобразным загрязнителем оказывается вода, сброшенная тепловыми станциями.

Вред наносится и морским водам, причем особенно интенсивно в прибрежных районах. Самый главный загрязнитель здесь – нефть. Один литр нефти способен испортить миллион литров воды.

Очевидно, что специальные сооружения для очистки сточных вод необходимы, хотя они не могут очистить воду полностью.

X. Summarize the contents of the text 'Sea – or Sewer?' following the outline given below.

1. Is the sea a sewer?
2. Oil pollution of the sea.
3. Monitoring sea pollution.

Share your opinion on the problem discussed in the text.

XI. Prepare a 5-minute report on the topic 'Water pollution' using the information from the texts of the lesson. Give your own comments concerning the problem. Use the following phrases:

As I see it ….   I should say ….   As for me ….

LESSON 11
SOILS

Part I

I. Read these international words and try to guess their meaning.

Organic, pores, microscopic, humus, cultivate, calcium, element.

II. Enlarge your active vocabulary.

texture ['tekstʃə] – механический состав
loam [ləʊm] – суглинок
lime [laɪm] – известь

III. Soils are of great importance to people. Compared with the total volume of the earth, the soil forms a very thin layer, from a few centimetres to several metres in thickness. Yet this thin layer of soil produces most of our food supply. Many kinds of soil are identified. Read the text and say what factors contribute to differences in soils.

How Soils Differ

Soil is the layer of mineral and organic material that covers most of the Earth's land surfaces.

Soil is made by slow, continuous physical and chemical breakdown of rock and by decay of organisms that were once alive. Soil is dynamic. It evolves constantly as the proportions of its mineral, organic, air and water content change. Soil provides nutrients to environments such as grasslands, croplands, and forests, which supply people and other life forms with food and shelter. The fertility of soil is determined by its capacity to supply plants with the nutrients they need to grow.

There are many kinds of soil. Soil scientists, called pedologists, have designed classification systems to identify the kinds of soil found around the world. This system divides soil into ten major orders, or kinds.

Soil in general is made up of major components, or parts: minerals, organic matter, water and air. These components are combined in mixture of decomposing rock material and decaying plant and animal matter. The mixture contains openings called pores, which can hold water and air.

Pores make up about half of the volume of average soil. Much of the rest of the volume consists of mineral particles of varying sizes. The remainder of the soil, commonly ranging from one to twelve percent of the total volume, consists of organic matter, which includes decaying leaves, twigs, animal wastes, and the remains of dead animals, as well as a variety of living organisms.

An astonishing number of life forms make their home in soil. These include rodents, insects, worms, and microscopic bacteria.

In classifying soils, pedologists identify ways in which soils differ. Colour and texture help distinguish one soil from another. Pedologists recognize 175 colour variations within the basic soil shades of black, brown, red, yellow, grey and white. Although colour can provide clues to soil fertility, it can also be misleading. Dark soil often contains humus, an organic material that makes soil fertile. Infertile soil however, like that formed from volcanic ash that is acidic, can also be dark. In some regions a red colour indicates soil fertility. In other areas it may indicate leaching, washing out of mineral nutrients which results in infertile soil.

The texture of soil affects its fertility, its ability to hold moisture, and the ease with which it can be cultivated. Texture is determined by the sizes of mineral particles into three groups. From largest to smallest, the particles are sand, silt, and clay. Sandy soils dry out quickly. Clay soils are usually more fertile because they retain moisture and nutrients, but they are hard when dry, sticky and wet. Loam mixtures of almost equal amounts of sand, silt, and clay are more fertile, retain moisture, and are easy to cultivate. In general, loams are the best soils to grow plants.

The age of soil, the parent material from which it formed, climate, surface features, and vegetation contribute to differences in soils. The age of soil – how long the soil has been forming – often affects its depth and fertility. The kind of parent material affects the chemical composition and texture of soil. For example, when limestone is the parent material, the soil may be rich in calcium and other essential elements. Shale, a fine grained rock, can produce a smooth, clay soil that resists penetration by water and air. Sandstone, on the other hand, can produce loose easily penetrated sandy soil that is low in fertility.

Climate may affect the speed with which some biological processes occur. Soil depths are usually greater, and plant growth and the decomposition of dead plants and animals often occur faster in warm, moist climates than in cool, dry ones.

IV. Find the Russian equivalents of the following English words and phrases.

Physical and chemical breakdown of rock; decay of organisms; nutrients to environments; organic matter; decomposing rock material; decaying plant and animal matter; remains of dead animals; infertile soil; leaching; to retain moisture and nutrients; essential elements; easily penetrated sandy soil; decomposition of dead plants and animals.

V. Match the words with their definitions.

soil	**infertile soil**	**nutrient**	**surface**
fertile soil	**leached soil**	**weathering**	**erosion**

1) the upper boundary or top of ground or soil, exposed to the air;
2) the ground with respect to its composition, quality, etc. or as the source of vegetation;
3) the action or process of eroding;
4) the action of the atmospheric agencies or elements on substances exposed to them;
5) soil producing in abundance; fruitful, prolific;
6) soil allowing water to percolate through, as sandy or rocky soil;
7) serving as nourishment;
8) unproductive, barren, sterile soil;

VI. Answer the following questions.

1. What is soil?
2. What does soil contain?
3. What are major components of soil?
4. How can soils be distinguished?
5. What affects soil fertility?
6. What kinds of soil are more fertile? Why?
7. In what way may climate affect biological processes in soil?
8. What is the role of topography in the kind of soil?

VII. Complete the following sentences with the information from the text.

1. This text deals with… . 2. Soil is defined as… . 3. Soil is made by… . 4. Soil provides nutrients to environments such as… . 5. Soil scientists, called pedologists, have designed classification systems to identify… . 6. Soil in general is made up of major components, or parts: … . 7. Colour and texture help distinguish… . 8. The texture of soil affects… . 9. … contribute to differences in soil. 10. The age of soil often affects… . 11. The kind of parent material affects… . 12. Climate may affect… .

VIII. Discuss the text in the form of a dialogue, using set expressions and phrases given below:

Let me draw your attention to…	**It should be noted that…**
The thing is that…	**In conclusion I must say…**

Soil and Vegetation Zones

belt – пояс
scanty – скудный, ограниченный

to hug – стелиться

Russia’s vegetation was greatly affected by gradual cooling of the Earth which occured after the Tertiary epoch. The luxuriant subtropical vegetation which prevailed in the country during the Tertiary epoch disappeared and was succeeded by a new type of vegetation better adapted to the cold climate of the Ice Age. Russia can be divided into several latitudinal soil and vegetation zones or belts extending across the country.

The tundra belt lies along the coast and on the islands of the Arctic Ocean; it is at its widest in northern Siberia and reaches as far south as 60°N at the neck of the Kamchatka Peninsula. Its chief characteristic is the absence of forest vegetation. The extremely low temperatures hinder the development of physical and chemical decay of the scanty plant cover and produce only a thin top layer of humus above the permanently frozen subsoil. The short growing season, the low annual mean temperatures, the low precipitation and the thin though extended snow cover make it difficult for plants to exist. Dwarf birches and willows hug the ground where warmer temperatures prevail. In the south the wooded tundra forms a transition to the true forest. The wooded tundra gradually becomes denser and is followed by the taiga or a coniferous forest belt. This vast belt comprising about one-third of the forest land of the world, extends through the northern part of European Russia across the Ural Mountains and over most of Siberia. In the European part of Russia the pine and the spruce are the common species. Towards the Urals they merge with the Siberian larch, the fir and the stone pine. The most widespread species in Eastern Siberia is the larch.

The steppe zone extends in an uninterrupted belt from the western border of Russia to the Altai Mountains. It is characterized by a grass cover and very limited tree growth. The soil is “black earth” (Russian chernozem) which is one of the most productive in the world and accounts for two-thirds of the arable land of Russia.

In these areas forests have continued to exist since the Tertiary period. They are usually a mixture of deciduous and coniferous types accompanied by luxuriant undergrowth.

High mountain or Alpine vegetation occurs below the snow line throughout the mountain regions of Russia. The lower limits of the Alpine meadow belt vary from 1,000 feet in the northern Urals to 8,000- 9,000 feet in the Altai mountain system in the south. The elevation of the snow line which represents the upper limit of the Alpine zone varies with the precipitation and the location of the slopes.

IX. Discuss in small groups: Is it important for a nation to have large areas of fertile soil? Explain your point of view.

Part II

I. Read these international words and try to guess their meaning.

Mesothermal, oxide, hydroxide, prairie.

II. Enlarge your active vocabulary.

horizon [hə'raɪzən] – зд. слой
to irrigate ['ɪrɪgəɪt] – орошать
permafrost ['pɜ:məfrɔst] – вечная мерзлота

III. In the 1960s the United States Soil Survey used horizon-based classification to propose a new comprehensive system, which reflects strongly zonal distribution of soils, following the dominance of climate in the continent. Read the text about the kinds of soil found in the USA, name them and give their characteristics.

American Soils

Soils reflect the rock from which they were derived, the way in which they were laid down, conditions of temperature and moisture, and the plants and animals living in or on them. Climate has been used as the main basis for categorizing soils, with a division first into humid and arid groups, and then into subgroups according to the way in which temperature and moisture acted together to produce different horizons, or layers in the soils.

More recently, attention has been focused on the horizons themselves and on their unique characteristics.

Humid soils have the widest range in North America and include a number of subdivisions.

The west maritime temperate-equable climate – swept by frequent polar Pacific storms and with a growing season of up to 300 days and ample rainfall of 40 to 200 inches – has favoured the creation of deep, acidic, brown-coloured soil, with an upper horizon rich in humus formed by partly decayed organic matter from the region’s dense forests. These soils, known as inceptisols, are the fertile soils of the Pacific Northwest and of the British Columbia and Alaska coasts.

The cool-temperate climatic zone is characterized by spodosols, soils with a moderate humus layer at the surface succeeded beneath by a gray, leached or washed-out, horizon. Rather infertile, acidic, greyish soils, known as podzols, result from this leaching process. They extend under the boreal forests from Alaska to Newfoundland.

Found in the warm-summer subregion of the cool-temperate zone, where mixed forests of coniferous and deciduous trees cover the Great Lakes – St. Lawrence to the Ohio area, alfisols are characterized by a deep layer of humus, succeeded by a shallow leached layer, which, in turn goes down to a wide horizon of both plant and mineral nutrients including oxides of iron and aluminum. These are the moderately fertile gray-brown soils so typical of the northeastern United States.

Farther south, ultisols occur, roughly extending from the lower Ohio and Chesapeake Bay southward to the Gulf Plains. They correspond to the area of the southeastern mesothermal climate, which has more than 200 days free of frost and a rainfall of up to 60 inches a year. Here a rich deciduous forest supplies a deep layer of humus, some of which is leached down and accumulates with red oxides of iron or yellow hydroxides of aluminum to produce podzolized red-yellow earths of considerable fertility.

The tropical climates of southern coastal Mexico and of Central America, with constantly high temperatures of 65° to 82° F (18° to 28° C) and perennial rainfall of from 80 to 120 inches, have caused very active weathering of rock. The resulting soils, called oxisols, have developed.

Semi-arid and arid soils cover an extensive area of North America, including prairies, deserts, and tundras.

Marking the transition between humid and arid soils, mollisols are found in the open parkland or the tall-grass prairie of the outer Great Plains or in the humid prairies of the western Central Lowlands. They have a moderately deep surface horizon, which is black or chocolate-brown in colour from the humus of the closely matted roots set in the dense sod under the thick-growing grasses. With a short rainy period from April to mid-July followed by great evaporation in a dry, sunny summer whatever leaching occurs is short-lived and not pronounced. The leached layer is very shallow and passes down to a horizon in which the upward movement of water to offset high evaporation at the surface has brought up basic salts, especially lime in solution. The lime neutralizes the acidity of the surface humus. Very fertile neutral soil, called chernozem or black earth, has thus developed – seen at its best in the Dakotas and the fertile belt of the mid-Canadian prairies.

Characterizing the dry climates of the United States intermontane basins, of most of the Mexican Plateau and of Southwest Coast, aridisols are found where vegetation is sparse and where, accordingly, little humus has formed at the surface. Leaching has virtually ceased, and very strong evaporation has led to the upward movement of basic salts through capillary attraction, often working up to ground level in a skin of white crystals. The soils are too rich in lime and potassium to be fertile unless extensively irrigated.

In the Arctic tundras, permafrost soils also accumulate very little humus and are strongly leached by the melt of winter snows. The water can't pass down more than a foot or so before it strikes a permanently frozen horizon, and thus a thin, very acidic, waterlogged, infertile soil has developed. It is of practically no use to man.

IV. Find the Russian equivalents of the following English words and phrases.

To be derived from, a number of subdivisions, rich in humus, partly decayed organic matter, inceptisols, spodosols, podzols, alfisols, oxides of iron and aluminum, moderately fertile, ultisols, podzolized red-yellow earths, oxisols, mollisols, a moderately deep surface horizon, in solution, intermontane basins, aridisols, upward movement of basic salts, extensively irrigated, permanently frozen horizon, waterlogged.

V. Match the words from column A with the suitable words from column B to make word combinations.

A	B
Pacific	horizon
growing	storms
dense	season
leaching	climate
mesothermal	prairie
considerable	evaporation
tall-grass	forests
strong	fertility
frozen	process

VI. Fill in the blanks with prepositions where necessary.

1. Climate has been used as the main basis … categorizing soils, with a division first … humid and arid groups.
2. Attention has been focused … the horizons themselves and … their unique characteristics.
3. Rather infertile, acidic, greyish soils, known as podzols, result … this leaching process.
4. Farther south, ultisols occur, roughly extending … the lower Ohio and Chesapeake Bay southward … the Gulf Plains.
5. Marking the transition … humid and arid soils, mollisols are found in the open parkland or the tall-grass prairie … the outer Great Plains or in the humid prairies … the western Central Lowlands.
6. The soils are too rich … lime and potassium to be fertile unless extensively irrigated.

7. … the Arctic tundras, permafrost soils also accumulate very little humus and are strongly leached … the melt of winter snows.

VII. Answer the following questions.

1. What were soils derived from?
2. How are climate and soils interconnected?
3. What is the difference between the horizon-based classification and the zonal distribution of soils?
4. Characterize inceptisols (spodsols, alfisols, ultisols, oxisols, mollisols, aridisols, permafrost soils):
   1) Where are they situated?
   2) What do they consist of?
   3) Are they fertile or infertile?
   4) Are they arid or humid?
5. What soils are the most fertile and what soils are the least fertile?
6. What classification are all those characteristics of soil based on?

VIII. Say whether the following statements are true or false. Correct the false statements to make them true. Use the introductory phrases:

That's right.	**It's wrong.**
Quite so.	**It's not correct.**
Absolutely correct.	**It's not right.**

1. Humid soils have the widest range in South America and include a number of subdivisions.
2. Inceptisols are the fertile soils of the Pacific Northwest and of the British Columbia and Alaska coasts.
3. Rather fertile, acidic, greyish soils, known as podzols, result from this leaching process.
4. Moderately fertile gray-brown soils are so typical of the northeastern United States.
5. Ultisols correspond to the area of the southeastern mesothermal climate.
6. Sub-tropical climates of southern coastal Mexico and of Central America have caused very active weathering of rock.
7. Arid soils cover an extensive area of North America, including prairies, deserts, and tundras.
8. Mollisols have a moderately deep surface horizon, which is black or chocolate-brown in colour from the humus of the closely matted roots set in the dense sod under the thick-growing grasses.

9. Characterizing the wet climates of the United States intermontane basins, of most of the Mexican Plateau and of Southwest Coast, aridisols are found where vegetation is sparse.

IX. Render the text into English using the active vocabulary.

В настоящее время научно обоснованные работы по орошению и дренажу направлены на регулирование влажности почвы. Цель орошения и дренажа – дополняя друг друга, улучшать природные условия и способствовать созданию такого режима увлажнения почвы, который необходим для оптимального развития сельскохозяйственных культур.

Орошение в засушливых и полузасушливых районах мира применяют очень давно.

Эта наука в настоящее время охватывает не только вопросы подачи воды в почву с целью ее увлажнения до уровня, необходимого для роста растений, но и вопросы исследований, строительства, эксплуатации гидротехнических сооружений и каналов и все связанные с ними проблемы. Конечная цель орошения – получить максимально возможное количество сельскохозяйственной продукции в зависимости от природных условий и обеспечить постоянное и эффективное возделывание наиболее полезных культур в новых районах.

Цель дренажных работ – удалить избыток воды на землях. Дренаж устраивается в следующих случаях: на болотах, на землях с переувлажненными почвами, где избыток влаги – следствие природных условий, чтобы путем мелиоративных мероприятий сделать их пригодными для выращивания культур; на землях, где избыток воды образовывается в результате обильных осадков, с целью предотвратить ущерб, наносимый культурам; в местах, где избыточные воды образуются в результате глубокого (за пределы распространения корневой системы) просачивания оросительных вод, с тем чтобы обеспечить нормальное развитие культур.

Необходимость орошения и установка дренажа в различных странах мира обусловлена геологическими, географическими, геоморфологическими и метеорологическими условиями.

Во влажных районах основное требование – удаление избытка воды. Орошение в этих местах необходимо для защиты культур от заморозков или для восполнения временного недостатка влаги.

В зоне тропиков, где количество осадков обычно достаточно, но выпадают они в течение трех-четырех месяцев в году, орошение необходимо для обеспечения роста большинства культур в сухое время года, а также при дефиците осадков в критический период вегетации сельскохозяйственных культур.

Дренаж необходим для восстановления плодородия заболоченных, засоленных и щелочных земель, для быстрого отвода избыточных вод в районах с большим количеством осадков, а также для удаления избыточной влаги из корневой зоны растений в период дождей. Дренаж часто необходим для удаления избыточной воды при поливах, а также для поддержания нормального солевого баланса в почве.

X. Make a summary of the text "American soils" using the questions in ex. VII and the following expressions:

The text is on … .
It is important to point out that … .
To sum up … .

XI. Make a report on one of the types of soil. Pay attention to its importance to the economy of the area.

SUPPLEMENTARY READING

TEXT 1
Discoveries

The history of the Pacific Ocean exploration may be divided into two phases: the period of discovery of coastlines and islands, and the period of scientific study of what lies under the surface. Australia and the islands of southwest Pacific were discovered and populated by human beings thousands of years ago. The Japanese and Chinese navigators sailed along the Asiatic coasts and throughout the western archipelagoes during the first 1000 year AD. By 1300 all the major islands of the central Pacific, from New Zealand to Hawaii and the Marquises and Easter Island, had been settled by Micronesians and Polynesians. The Spaniard Vasco Nunez de Balboa, who crossed Panama in 1513, was perhaps the first to recognize that the Atlantic and Pacific were separate oceans. His discovery was confirmed when Ferdinand Magellan in 1520–1521 sailed through the straits that bear his name and crossed the ocean to the Philippines. Having enjoyed a smooth passage across the ocean, he called it the Pacific.

From the early 16th to the beginning of the 19th century the islands and the coasts of the Pacific were rediscovered and mapped by Spanish, Portuguese, Dutch, French, Russian, British and American explorers, whalers and traders. Among the most famous were Francis Drake, Abel Janszoon Tasman, Vitus Bering. Except in Antarctica, the period of discovery ended with the United States exploring expedition under Lt. Ch.Wilkes of the Navy, which charted many individual islands (1839–1842).

The Atlantic Ocean has been an enormous factor in human history. Situated west of the landmass of Eurasia which had been inhabited since the earliest times, it was the natural avenue for the expansion of populations. When the new world was colonized from Europe, the ocean was at first a barrier beyond which the new cultures developed in their own ways. With advances in technology, it became a means of communication among nations.

During ancient and medieval times, the Mediterranean Sea was the centre of maritime activity while the Atlantic marked the outer edge of European civilization. Once Columbus discovered the way to America, the westward push of the Europeans seeking adventure, wealth, or new homes led to steady increasing settlement overseas. The stormy 4,800 km of the North Atlantic became the busiest and most vital of all sea lanes, the highway between the Old World and the New.

There had been, to be sure, some Atlantic seafaring even before Columbus. Traders became acquainted with coastal waters of Western Europe, while the Scandinavian vikings or Northmen had ventured out to Iceland, Greenland, and briefly, around 1000 to North America. Systematic exploration dates from 1415 when Prince Henry the Navigator began to push Portuguese expeditions down the west coast of Africa in the South Atlantic, the Azores, Madeira, the Canaries, and the Cape Verde Islands were settled by Europeans.

The climax of the new discoveries came in the 30 years between 1492, when Columbus discovered America, and 1522 when one of Magellan's ships completed the first voyage around the world. During those years various voyagers explored the Caribbean and South America while John Cabot in 1497 crossed the North Atlantic and found the rich Grand Banks cod fisheries of Newfoundland. The next year Vasco de Gama reached India by way of the Cape of Good Hope at the southern end of Africa, thus developing an important trade route through the South Atlantic.

Almost immediately, Spain and Portugal began to develop colonies in America, and their ships were soon plying the Atlantic with silver from Mexico to Peru and sugar from Brazil. Shortly after 1600, Holland, England and France founded colonies in America, and trade flourished, especially on the ships of the transplanted English settlers to New England. Venice and Genoa which had long dominated Mediterranean trade were overshadowed by ports on the Atlantic – Lisbon, Seville, Bordeaux, Hamburg, Amsterdam, London and others. The North Atlantic shuttle soon overpassed all other sea routes. Neither the Pacific nor the Indian Ocean, then or later, could match that activity.

With transatlantic crossings taking many weeks it was difficult to keep the American colonies in touch with mother countries. The result was that most of the colonies became independent by the early 1800s. But in 1818 the Black Ball square riggers sailing on regular schedule, brought America in closer contact with Europe and the crossing was speeded up further when steamships began service in 1838. Instantaneous new transmission was made possible by cable after 1866. By the time of World War II aviation had begun to move passengers and mail across the Atlantic in a matter of hours.

1. What periods may the history of the Pacific Ocean be divided into?
2. Who rediscovered and mapped the islands and coasts of the Pacific?
3. What was the centre of maritime activity during ancient and medieval times?
4. When did the climax of the new discoveries come?
5. What countries founded colonies in America after 1600?

TEXT 2
The Mississippi River

The Mississippi River, the longest river in the United States, and with its far-reaching tributaries is one of the major systems of the world. Long ago, Ojibway Indians, roaming the forests of Wisconsin, called it *Missi Sipi*, or

‘Great River’. In the lower valley, where the impetuous current swollen in flood time overflows its banks to convert millions of acres of fertile land into a moving sea, other tribes termed it the ‘Father of the Waters’. Both names were appropriate, for the scope and volume of this vast stream have made it almost a synonym for great rivers everywhere: even the Volga has been termed the Russian Mississippi.

The length of the Mississippi has been variously interpreted. The Mississippi River Commission calculates the length at 3,986 miles (6,415 km) from the headwaters of the Missouri to the delta outlet on the Gulf of Mexico. The Nile River is slightly longer. The Mississippi’s length is not constant. Horseshoe loops are cut through, reducing the figure, which swells again when new loops are created as the river meanders down its lower valley.

What is now the lower basin of the Mississippi was once a prolongation of the Gulf of Mexico. The upper branches of the river underwent an extensive transformation. As the continental ice field, which had crossed the valley of the Ohio, slowly retreated before an increasing warmth, its formidable ramparts still dammed up all northward exits, so that its melting waters were forced to seek an outlet to the south. Several of the Great Lakes became united in one superlake, while another vast expanse called Lake Agassiz sprawled across Minnesota, North Dakota, and into Canada. The Missouri emptied into Hudson Bay.

Before the Great Lakes subsided into something like their present shorelines, two of them flowed for a time into the Mississippi. So also did Lake Agassiz until much of its volume had drained away. Many remnants of huge Lake Agassiz, however, remained within the original system. The Missouri turned eastward and the entire system began to assume something of its present form.

The Mississippi system cuts a wedge of 1,243,000 square miles (3,220,000 sq km) out of the heart of the continent. Southward it narrows to the state of Louisiana and becomes still more restricted as it pours its waters through several mouths into the Gulf of Mexico. Although it penetrates into the Rockies to the west and courses the wooded valleys of the Appalachians, the Mississippi system primarily drains the alluvial grain belt of the Middle West and the Canadian provinces swell its current. Of its hundreds of tributaries, 45 are navigable for at least 50 miles (80 km), providing a combined system of waterways that exceeds 15,000 miles (24,000 km).

The source of the upper Mississippi is usually given as Lake Itasca in northern Minnesota. From an elevation of 1,670 feet (509 m) above the sea, the river winds through swamps and forests, descending by numerous rapids and gaining volume from the spillways of other lakes.

Geographically, the true source of the Mississippi lies in western Montana. There, three streams unite to form the Missouri. Fed by the melting snows and gushing springs of the Rockies, it sweeps on through the Northwest.

Some 200 miles (320 km) to the south the rivers of the north unite with their eastern branch, the Ohio. The Ohio and its many tributaries drain the ridges and valleys of the Appalachian Mountains. Here the rainfall is more than twice that in the larger basin of the Missouri, so that the Ohio pours a greater volume of water into the Mississippi system than either of the other main branches.

Farther south the Mississippi attracts other tributaries, chief among these is the Arkansas, whose drainage basin is larger than that of the upper Mississippi itself. Another considerable affluent approaching from the west is the Red River. Through its lower course the Mississippi advances in a series of broad loops and horseshoe bend necessitating a frequent change in the channel.

From below the Red River to the Gulf of Mexico the Mississippi region might properly be termed delta since it fills the original oceanic trough, but the obvious delta extends into the sea and forms a formation of quaking mud and marshland.

The daily volume discharged by the Mississippi varies greatly. The maximum reported by the Mississippi River Commission occurred in 1927, a total of 2,278,000 cubic feet (64,507 cubic metres) a second. The minimum, recorded in 1939, was about 100,000 cubic feet (2,830 cubic metres). The mean annual output is 553,000 cubic feet (15,660 cubic metres) a second.

From the Ohio River to the Gulf of Mexico the width of the Mississippi, though occasionally broadening to 1.5 miles (2.4 km), usually ranges from 800 to 1,500 yards (730–1,370 m). Below its juncture with the Red River it narrows to 300 yards (275 m) for a considerable distance. The Mississippi is quite deep, with its channel ranging usually from 50 to 100 feet (15–30 m) or more.

Columbus may have sighted the river, for its mouth indicated on the admiral’s map of the region made in 1507. Hernando de Soto, however, is usually credited with the discovery. Advancing from the Atlantic seaboard, de Soto reached the river in the present state of the Mississippi in 1541. De Soto died there and was buried, and for more than a century the river remained little more than a legend.

In 1673 the French missionary explorers Father Jacques Marquette and Louis Jolliet voyaged down the Mississippi past the mouth of the Missouri. In 1682, Rene Robert Cavelier, sieur de La Salle, completed this voyage of discovery by sailing down the river to the sea. He dreamed of founding a vast French empire in the wilderness. But his ambitious schemes were cut short in 1687, when, during a second trip to the mouth of the Mississippi, he was murdered by his mutinous followers.

Pierre Radisson, whose stories of the wealth of the Canadian wilderness led to the organization of the Hudson's Bay Company, may have heard of the Missouri through Indian traders from what he termed the land of 'the beef' where great herds of bison ranged. But the honour of discovery is usually conferred upon Pierre Gaultier de Varennes, sieur de La Veerendrye, and his sons, who carried French arms and civilization into the western forests. Meriwether Lewis and William Clark, on their expedition to the Pacific coast (1804–1806), introduced the Missouri to the Outside world.

It would be difficult to exaggerate the influence of the Mississippi on the development of the United States. In the formative period of the country, its waterways provided the major means of transportation. Indian canoes were gradually supplanted by every conceivable type of craft that the pioneers could devise. Of these the simplest was the log raft. For decades northern timber was thus ferried to the South.

Such one way traffic was soon followed by the river steamboat. The first steamboat to follow the route of La Salle left Pittsburgh in 1811. By 1857, when this type of navigation reached its height, 1,100 river steamers called at St. Paul, while the number on all the tributaries was estimated at 3,000 or more. A colourful development was the showboat, which carried theatrical entertainments to settlements along the shores. Steamers still ply the Mississippi, but the day of their supremacy has passed.

1. What is the length of the Mississippi?
2. What can you say about the geological history of the Mississippi?
3. Where is the true source of the upper Mississippi?
4. Why may the Mississippi region below the Red River be termed delta?
5. How does the Mississippi influence the development of the United States?

TEXT 3
Atmospheric Elements

There are five basic characteristics of the atmosphere that serve as the 'ingredients' of weather and climate. They are (1) solar energy or insolation, (2) temperature, (3) pressure, (4) winds, and (5) precipitation (and moisture). We must examine these atmospheric elements in order to understand and categorize weather and climate. Thus a weather forecast will generally include the probable temperature range, the present temperature, a description of the cloud cover, the chance of precipitation, the speed and direction of the winds, and air pressure.

The amount of solar energy received at one place on the Earth's surface varies during a day and throughout the year. The amount of insolation a place receives is the most important weather element, as the other four are in part dependent upon the intensity and duration of solar energy.

The temperature of the atmosphere at a given place on or near the surface of the Earth is largely a function of the insolation received at that location. It is also influenced by many other factors such as land and water distribution and altitude. Unless there is some form of precipitation occurring, the temperature of the air may be the first element of weather we describe when someone asks us what it is like outside.

However, if it is raining, or the fog is in, or it is snowing, we will probably notice and mention that condition first. We are less aware of the amount of water vapor or moisture in the air (except in very arid or humid areas). However, moisture in the air is a vital weather element in the atmosphere, and its variations play an important role in the likelihood of precipitation.

We probably least aware of variations in air pressure, although the fluctuations in air pressure are basic to the development of winds and storms. However, there are some people who say they can feel a change in the weather ‘in their bones’ because they have arthritis and can probably sense the movement of fluids under pressure in their joints.

We all know that weather varies. It is the momentary state of the atmosphere at a given location, and it varies from time to time and from place to place. There are even variations in the amount that weather varies. In some places or at some times of year, the weather changes almost daily from rain to sunshine to clouds to rain to snow.

And in other places there may be weeks of uninterrupted sunshine, blue skies, and moderate temperatures and then weeks of persistent rain. There are a few places where there are only minor differences in the weather throughout the year. The language of the original people of Hawaii is said to have no word for weather because conditions there varied so little.

The variations in the atmospheric elements are caused by atmospheric controls. The major controls are (1) latitude, (2) land and water relationships, (3) ocean currents, (4) altitude, (5) landform barriers, and (6) human activities.

Latitude is an atmospheric control, that is, a factor that causes variations in the elements of weather and climate, primarily because of latitudinal changes in radiation received from the sun, both daily and throughout the year. Because solar radiation is a prime factor in an explanation of air temperature, we would expect that temperatures would vary with latitude as receipt of solar energy decreases poleward. That is, we can expect to see lower mean (average) temperatures as we move poleward from the equator. The only ex aption is temperatures in equatorial regions where, due to heavy cloud cover, annual temperatures tend to be lower than at places slightly to the north or south where the skies are clearer.

Not only do the oceans and seas of the Earth serve as storehouses of water for the whole system, but they also store tremendous amounts of energy. Their widespread distribution makes them an important atmospheric control that does much to modify the atmospheric elements.

Bodies of water heat and cool more slowly than the land; the air above the Earth's surface is heated or cooled in part by what is beneath it. Therefore, temperatures over bodies of water or on land subjected to ocean winds tend to be more moderate than those of landbound places at the same latitude. Thus, the greater the continentality of a location (the distance removed from a large body of water), the less its temperature pattern will be modified.

For instance, the mean temperature in Seattle, Washington, in July is I8°C (64°F), while the mean temperature during the same month in Minneapolis, Minnesota, is 21°C (70°F) although the two cities are located at similar latitudes. Much of this difference in temperature can be attributed to the fact that Seattle is near the Pacific Coast, while Minneapolis is in the heart of a large continent and far from the moderating influence of an ocean. Consequently, Seattle stays cooler than Minneapolis in the summer because the surrounding water warms up slowly, keeping the air relatively cool. Minneapolis, on the other hand, is in the center of a large landmass that warms very quickly and in turn warms the layer of air above it. In the winter, the opposite is true. Seattle is warmed by the water while Minneapolis is not. The mean temperature in January is 4.5° C (40°F) at Seattle and –15.5° C (4°F) at Minneapolis.

Surface ocean currents are large movements of water pushed by the winds. They may flow from a place of warm temperatures to one of cooler temperatures, or vice versa. These movements result from the attempt of Earth systems to reach a balance, in this instance of temperature and density.

The rotation of the Earth affects the movements of both the winds and ocean currents. It causes the currents to move generally in a clockwise direction in the Northern Hemisphere and in a counterclockwise direction in the Southern Hemisphere. The reason for this movement is known as the Coriolis effect.

Since the temperature of the ocean greatly affects the temperature of the air above it, an ocean current that moves warm equatorial water towards the poles or cold polar water towards the equator can significantly modify the air temperatures of those locations into which it flows. If the currents pass close to land and are accompanied by onshore winds, they can have a significant impact upon the coastal climate.

The Gulf Stream, with its extension, the North Atlantic Drift, is an example of an ocean current that moves warm water northward, keeping the coasts of Great Britain and Norway ice-free in wintertime and moderating the climates of nearby land areas. We can see the effects of the Gulf Stream if we compare the winter conditions of the British Isles with those of Labrador in northeastern Canada. Though both are at the same latitude, the climate of the British Isles is moderated by the effects of the Gulf Stream (North Atlantic Drift). For example, the average temperature in Glasgow, Scotland, in January is 4°C (39°F), while during the same month it is –21.5°C (7°F) in Nain, Labrador.

The California Current is a current off the west coast of the United States that helps moderate the climate of the coast as it brings cold water south to relatively warm areas. As the current swings southwest from the coast of central California, cold bottom water is brought to the surface, causing further chilling of the air masses above. San Francisco's cool summers (July average, 14°C or 58°F) reflect the effect of this current.

As we have seen, temperatures within the troposphere decrease with increasing altitude. In Southern California you can find snow for skiing if you go to an altitude of 2,400 to 3,000 meters (8,000 to 10,000 ft).

Change in altitude has a direct bearing on another atmospheric element, air pressure, which like temperature, decreases with increasing altitude.

Landform barriers, especially large mountain ranges, can block movements of air from one place to another and thus affect the weather and climate of an area.

If the prevailing winds are from the west, and if they tend to bring rain and moisture with them, then a mountain range that runs north-south will generally have a wet climate on its west-facing, windward slope and a dry one on its east-facing, leeward (sheltered) slope. While mountain ranges that run north-south, like the Rockies, Cascades, or Sierra Nevada in North America, block the movement of moisture-carrying air from the western oceans to the interior of the continent, thus helping create and maintain desert areas on their eastern sides, they do little to block the movement of cold polar air toward the equator. Therefore, because they are not protected by an east-west mountain range to the north, areas in the southern United States can be subjected to unusual cold spells from the invasion of polar air.

Human beings, too, may be considered 'controls' of weather and climate. Such activities as the building of cities, burning fossil fuels, the large-scale destruction of forests, draining swamps, or creating large reservoirs can significantly affect local climatic patterns and possibly world climatic patterns as well. In addition, people have tried to modify weather almost since the beginning of time. Though we have had only slight success, our potential for influencing weather and climate is considerable.

1. What are five basic characteristics of the atmosphere?
2. What is the most important weather element?
3. What factors is the temperature of the atmosphere influenced by?
4. What are major atmospheric controls?

5. What causes variations in the elements of weather and climate?
6. What affects the movements of the winds and ocean currents?
7. May human activities be considered controls of weather and climate?
8. What human activities can affect climatic patterns?

TEXT 4
Forests in Canada and the USA

Before the coming of the white man the forests covered slightly less than half of the area of what is now the mainland Canada and the USA. In addition, rather more than 1/3 of America was forest covered. Today this area has been reduced considerably by exploitation and destruction.

The greater part of the forested area of Canada is occupied by the Boreal forests. Coniferous trees form the climax vegetation. The Boreal forest region forms a continuous belt from Newfoundland and the coast of Labrador westward to the Rocky Mountains and north-west to Alaska. Among the dominant species are spruce, tamarack, balsam fir and various pine, and although the forests are primarily coniferous there is a great admixture of deciduous trees, such as poplar and white birch, these are important in the central and south central regions of Canada, particularly along the edge of the prairie.

Extending inland from the edges of the Great Lakes and the St. Lawrence River lies a mixed forest. The natural vegetation consists of coniferous trees mixed with deciduous trees. It is characterized by white pine, red pine, eastern hemlock, and yellow birch. With these are associated certain dominant broad-leaved species common to deciduous forests, including sugar maple, red maple, red oak, bass-wood and white elm.

A small portion of the deciduous forest wide spread in the USA extends into south-western Ontario. Here, with the deciduous trees common to the Great Lakes – St. Lawrence forest region, are scattered a number of other deciduous species which have their northern limits in this locality, such as tulip tree, cucumber tree, blue oak, black oak and pin oak.

Four other forest regions are evident in western and central Canada. The subalpine forest is located on the mountain uplands of Alberta and British Columbia. This is a coniferous forest where the major species are Engelman spruce, alpine fir, and Lodgepole pine.

The montane forest region occupies a large part of the interior uplands of British Columbia, as well as a part of the Kootenay Valley. Ponde-rosa pine is a characteristic species of the southern area. Douglas fir is found throughout but more particularly in the central and northern parts.

Lodgepole pine and trembling aspen are generally present, the latter particularly well represented in the north-central areas.

The coast forest is essentially coniferous, consisting primarily of western red cedar and western hemlock: with Sitka spruce abundant in the north and Douglas fir in the south. The Columbia forest closely resembles the coast forest region with western hemlock being the characteristic species. Douglas fir is generally distributed throughout the whole forest, while western white pine, western larch, grand fir and western yew are found in southern regions.

In the North-eastern United States and continuing into southern Canada is an area of hardwoods such as beech, birch, maple and oak. Except for relatively minor areas and volumes of red alder, oak and aspen in the western states, 95% of the country’s hardwood is found in the eastern states. On the lighter, sandy soils of the North-east of the States coniferous species such as red and white spruce, pine and hemlock are found.

The area of hardwoods extends also into the southern states. Here oak is dominant but several species of pine are also common. In parts of Appalachians below the higher coniferous forests there are chestnuts and yellow poplars.

In the extreme south-east pine is the major species present with cypress, oaks, tupelos, cottonwood, red gum found in the lowest lying areas.

The grasslands of the interior lowland separate the eastern and the western forest. The western forests of the USA are essentially coniferous with major species being western cedars, western hemlock and Douglas fir with Sitka spruce being more prominent towards the North. In California the forest belt narrows southward. In this zone the dominant tree is the coast redwood, the world’s tallest tree at over 30 metres high in some cases. In California too is the Sequoia which grows on the western slopes of Sierra Nevada.

1. What caused the reduction of the territories covered with forests?
2. Where are the Northern limits of such deciduous species as tulip tree, blue ash and pin oak situated?
3. What are the main characteristics of sub-alpine forests in Canada?
4. What species are typical of coast forests?
5. Which areas of the USA are occupied mostly by hardwood species?
6. What separates the western and eastern forests?

TEXT 5
The Wildlife of Great Forest

White-tailed deer is probably the most abundant large mammal in the United States today. Although nearly a million are shot each year, their total population is believed to exceed six million.

What is commonly called "deer" in North America refers in fact to two species – the white-tailed deer and the mule deer – although the elk, moose and caribou are also members of the same family. White-tails are found in much of the continent from the coniferous forest southward, the most notable exception being most of California. The mule deer or black-tailed deer lives chiefly in the forests and bushy areas in the west.

The main predator today besides man are dogs and to a small extent bobcats. Bobcats and deer live in much the same sort of forest habitat.

The bobcat in many ways resembles a large tom-cat, except for its very short tail. It is found throughout much of the United States and down into Mexico, but it penetrates only a short distance up into Canada where, in the coniferous forests and tundra it is replaced by its large relative, the Canada lynx.

The opossum is traditionally an inhabitant of more southern forests. The opossum is the only North American marsupial – a mammal which possesses an external pouch in which its young are carried. The babies crawl into the pouch immediately after birth and stay there for 40 days.

Another animal originally abundant throughout the forested regions of the continent is the beaver. It was heavily exploited for its fur, but later has been restored to safe levels of survivals. Once again the beaver now is seen in the eastern forests.

To early Americans bears were the prime game, especially the plentiful black bears. Heavily hunted and beset in most of their eastern domain by forest cutting, the large carnivores declined until 20th century game laws gave them protection. Today they are making a comeback. Pennsylvania, once populated by an esteemed 5 bears per 10 square miles, today can support an average of two in the same area. In the northwest and the Rockies where the less adaptable western grizzly is declining, hundreds of thousands of black bears still range over heavily logged forests.

To the red fox the opening of the great forest meant widening opportunities to live and breed for unlike its deep forest cousin, the gray fox, this is a creature of the open meadow lands. Cunning and swift they elude traps and in some localities, as in western Wisconsin, for example, there are six or more red foxes to a square mile.

The grassland has conditions for the animals which are strikingly different from those in the forest. Large mammals are dominant on the plains.

The pronghorn is one of the most truly American of all animals found on this continent. It has got special adaptations to grassland life. The pronghorn's eyes are unusually large for its head, it has excellent vision for considerable distance and throughout a wild field. It can reach the speed of 55 miles an hour, a speed no running animal of the continent can equal.

The pronghorn's remarkable vision and speed are its main defenses against its ancient enemy, the coyote. The only other large mammal of the continent whose numbers approached or possibly surpassed those of pronghorn was the bison. It's clumsy and slow moving, it has relatively poor eyesight and little fear of sound. It’s the largest land mammal in New World – the average bull weighs about 1,800 pounds. But the animal became extinct rapidly, there was probably not a single bison left in the southern portion of the prairie by 1879. By the beginning of this century, it appeared impossible that the species could survive. Only two wild herds were known to exist on the continent, a lot of efforts were being made to save it and today the remnant herds in the USA have grown nearly to 12,000 animals.

1. What is the total population of white-tailed deer in the United States?
2. What is the only North American marsupial?
3. Which animal was heavily exploited for its fur?
4. Where are large animals dominant?

TEXT 6
Natural Resources

The earth is a set of interrelated components that are vital and necessary for the existence of all living creatures. We have come to realize that important parts of our life support system, which may be called natural resources, can be abused and overused, thereby threatening the functioning of the whole system.

We are aware that some of the earth’s resources, such as air and water, can be polluted to the point where they are unusable or even lethal to some life forms. By polluting the oceans, we may be killing off some important fish species, while less desirable species may increase in number. Acid rain, caused by industries, power plants, and automobiles releasing pollutants into the atmosphere, is damaging forests and killing fish in lakes.

Because pollution is associated with human activity, it is not surprising that it represents a significant problem in locations with huge population densities. What some people do not realize, however, is that these pollutants are often transported by our winds and waterways hundreds or even thousands of kilometres from their source. Thus, pollution is a worldwide problem.

In addition, we may be using some resources, especially those we need for fuel, too rapidly. While we still have enough coal to last several hundred years, we have frequently been warned about future shortages in our petroleum supplies. When nonrenewable resources such as mineral fuels are gone, the alternative resources are invariably less desirable or more expensive.

We are learning that there are limits to the amount of space on the earth and we must use it wisely. In the search for living space, we occasionally construct buildings in places that are not safe, and many places where we live are overcrowded. Also we sometimes plant crops in areas that are ill suited to agriculture because there is not always enough good farmland to fill our needs.

As we continue to explore space, we are learning more and more about the world in which we live. Since human beings first walked the earth, they have affected each ecosystem they have inhabited. For example, a century ago the interconnected Kissimmee River – Lake Okeechobee – Everglades ecosystem comprised one of the most productive and stable wetland regions on earth. But sawgrass marsh and slow-moving water stood in the way of urban and agricultural development. Intricate systems of ditches and canals were built and, since 1900, half of the original 4 million acres of the Everglades has disappeared. The Kessimmee River has been channelized into an arrow-straight ditch, and wetlands along the river have been drained. Levees have prevented water in lake Okeechobee from contributing sheet flow to the Everglades, and highway construction has deviled the region, further disrupting natural drainage patterns. Fires have been more frequent and destructive, and entire biotic communities have been eliminated by lowered water levels. During excessively wet periods, portions of the Everglades are deliberately flooded to prevent drainage canals from overflowing. As a result, animals drown and birds cannot rest and reproduce. South Florida's wading bird population decreased by 95% within a hundred years. Without the natural purifying effects of wetland systems, water quality in South Florida has deteriorated, and with lower water levels, salt water encroachment is a serious problem in coastal areas. Today, backed by regional, state, and federal agencies, scientists are struggling to restore South Florida's ailing ecosystems. There are extensive plans to allow the Kissimmee River to meander again across its former floodplain, to return agricultural land to sawgrass marsh, and to restore historic water flow patterns through the Everglades. The problems of South Florida should serve as a useful lesson. Alterations of the natural environment should not be undertaken without serious consideration of all the consequences. All citizens of the earth must understand the effects of their actions on the complex earth system.

1. What are the causes of acid rain?
2. Where does pollution represent a significant problem?
3. How long have human beings affected each ecosystem they have inhabited?
4. What caused the problems of Kissimmee River – Lake Okeechobee – Everglades ecosystem?

TEXT 7
Hidden Lands

The first European ever to sail across the wide Pacific was curious about the hidden worlds beneath his ship. Between the two coral islands of St. Paul and Los Tiburones in the Tuamotu Archipelago, Magellan ordered his sounding line to be lowered. It was the conventional line used by explorers of the day, no more than 200 fathoms long. It did not touch bottom and Magellan declared that he was over the deepest part of the ocean. Of course, he was completely mistaken, but the occasion was none the less historic. It was the first time in the history of the world that a navigator had attempted to sound the depths of the open ocean.

Three centuries later in the year 1839, Sir James Clark Ross is known to set out from England in command of two ships bound for the ‘utmost navigable limits of the Atlantic Ocean’. As he proceeded on his course he tried repeatedly to obtain soundings but failed for lack of proper line. Finally he had one constructed on board of more than four miles in length. On January, 3, in latitude 27° 26 S, longitude 17° 29 W he succeeded in obtaining soundings. This was the first successful abyssal sounding.

To take soundings in the deep ocean was, and long remained, a laborious and time-consuming task, and knowledge of undersea topography lagged considerably behind our acquaintance with the landscape of the near side of the Moon. Over the years methods were improved. Now hundreds of vessels are equipped with sonic sounding instruments to trace a continuous profile of the bottom beneath the moving ship. Soundings are accumulating much faster than they can be plotted on the charts. Little by little the hidden contours of the ocean are emerging. But even with the recent progress, to construct an accurate and detailed map of the ocean basin will take years.

The general bottom, topography is, however, well established. Once we have passed the tide lines the three great geographic provinces are the continental shelves, the continental slopes, and the floor of the deep sea. Each of these regions is as different from the others as an Arctic tundra from a range of the Rocky Mountains.

The continental shelf is of the sea, yet of all regions of the ocean it is most like the land. Sunlight penetrates to all but its deepest parts. Plants drift in the waters, above them seaweeds cling to its rocks and sway to the passage of the waves. Familiar fishes – unlike the weird monsters of the abyss – move over its plains like herds of cattle. Much of its substance appears to be derived from the land – the sand and the rock fragments and the rich topsoil carried by running water to the sea and gently deposited on the shelf.

Its submerged valleys and hills, in appropriate parts of the world, have been carved by glaciers into a topography much like the northern landscape we know and the terrain is strewn with rocks and gravel deposited by moving ice sheets. Indeed, many parts (or perhaps all) of the shelf prove to have been dry land in the geologic past, for a comparatively slight fall of sea level has sufficed, time and again, to expose it to wind and sun and rain. The Great Banks of Newfoundland rose above the ancient seas and were submerged again. The

Dogger Bank of the North Sea was once a forested land inhabited by prehistoric beasts; now its ‘forests’ are seaweeds and its beasts are fishes.

Of all parts of the sea, the continental shelves are perhaps most directly important to man as a source of material things. The great fisheries of the world, with only a few exceptions are confined to the relatively shallow waters over the continental shelves. Seaweeds are gathered from their submerged plains to make scores of substances used in foods, drugs and articles of commerce. As the petroleum reserves left on continental areas by ancient seas become depleted, petroleum geologists look more and more to the oil that may lie, as yet unmapped and unexploited, under these bordering lands of the sea.

The shelves begin at the tidelines and extend seaward as gently sloping plains. A 100-fathom contour used to be taken as the boundary between the continental shelf and the slope; now it is customary to place the division wherever the gentle declivity of the shelf changes abruptly to a steeper descent toward abyssal depths. The world over, the average depth at which this change occurs is about 72 fathoms; the greatest depth of any shelf is probably 200 to 300 fathoms.

Nowhere off the Pacific coast of the United States is the continental shelf much more than 20 miles wide – a narrowness characteristic of coasts bordered by young mountains perhaps still in the process of formation. On the American east coast, however, north of Cape Hatteras and off southern Florida, it is merely the narrowest of thresholds to the sea. Here its scant development seems to be related to the press of that great and rapidly flowing river-in-the sea, the Gulf Stream, which at these places swings close inshore.

The widest shelves in the world are those bordering the Arctic. The Barents Sea shelf is 750 miles across. It is also relatively deep, lying for the most part 100 to 200 fathoms below the surface, as though its floor has sagged and been warped under the load of glacial ice. It is scored by deep troughs between which banks and islands rise – further evidence of the work of the ice. The deepest shelves surround the Antarctic continent where soundings in many areas show depths of several hundred fathoms near the coast and continuing out across the shelf.

Once beyond the edge of the shelf, we begin to feel the mystery and the alien quality of the deep sea – gathering darkness, growing pressure, starkness of a seascape in which all plant life has been left behind arid; there are only the unrelieved contours of rock and clay, mud and sand.

Biologically the world of the continental slope, like that of the abyss, is a world of animals – a world of carnivores where each creature preys upon another. For no plants live here, and the only ones that drift down from above are the dead husks of the flora of the sunlit waters. Most of the slopes are below the zone of surface wave action yet the moving water masses of the ocean currents press against them in their coastwise passage; the pulse of the tide beat against them; they feel the surge of the deep, internal waves.

Geographically the slopes are considered to be the most imposing features of all the surface of the Earth. They are the walls of the deep-sea basins. They are the farthermost bounds of the continents, the true place of beginning of the sea. The slopes are the longest and highest escarpments found anywhere on the Earth; their average height is 12,000 feet, but in some places they reach the immense height of 30,000 feet. No continental mountain range has so great a difference of elevation between its foothills and its peaks.

Nor is the grandeur of slope topography confined to steepness and height, the slopes are the site of one of the most mysterious features of the sea. These are the submarine canyons with their steep cliffs and winding valleys cutting back into walls of the continents. Some of the canyons seem to have been formed well within the most recent division of geologic time, a million years ago or less. But how and by what they were carved, no one can say. Their origin is one of the most hotly disputed problems of the ocean.

Like river-cut canyons, sea canyons are deep and winding valleys V-shaped in cross section, their walls sloping down at a steep angle to a narrow floor. The location of many of the largest ones suggests a past connection with some of the great rivers of the Earth of our time.

Their shape and apparent relation to existing rivers have led Professor Sheperd to suggest that the submarine canyons were cut by rivers at some time when their gorges were above sea level. The relative youth of the canyons seems to relate them to some happenings in the world of the Ice Age.

The floor of the deep ocean basins is believed to be as old as the sea itself. In all the hundreds of millions of years that have intervened since the formation of the abyss these deeper depressions have never, as far as we can learn, been drained of their covering waters. But this does not mean that the contours of the abyss have remained unchanged since the day of its creation. The floor of the sea like the stuff of the continents is a thin crust over the molten centre of the Earth. It is here thrust up into folds and wrinkles as the interior cools by imperceptible degrees and shrinks away from its covering layer; there are falls away into deep trenches in answer to the stresses and strains of crustal adjustment; and again it pushes up into the conelike shapes of undersea mountains as volcanoes boil upward from fissures in the crust.

Until very recent, to speak of the floor of the deep sea as a vast and comparatively level plain has been the fashion of geographers and oceanographers. The existence of certain topographic features was recognized, as for example the Atlantic Ridge and a number of very deep depressions like the Mindanao Trench of the Philippines. But these were considered to be rather exceptional interruptions of the flat floor that otherwise showed little relief.

This legend of the flatness of the ocean floor was thoroughly destroyed by the Swedish Deep-Sea Expedition which sailed from Gotenborg in the summer of 1947. The sole aim of this expedition was to explore the bed of the ocean. While the Swedish Albatross was crossing the Atlantic in the direction of the Panama Canal the scientists aboard were astonished by the extreme ruggedness of the ocean floor. Rarely did their fathometers reveal more than a few consecutive miles of level plain. Instead the bottom profile rose and fell in curious steps constructed on a Gargantuan scale, half a mile to several miles wide. In the Pacific, the uneven bottom contours made it difficult to use many of the oceanographic instruments. The deepest depressions on the floor of the sea occur not in the centres of the oceanic basins as might be expected, but near the continents. One of the deepest trenches of all, the Mindanao, lies east of the Philippines and is six and a half miles deep.

The least-known region of the ocean floor lies under the Arctic Sea. The most daring plan for sounding the Arctic Sea was conceived by Wilkins, who actually set out in the submarine Nautilus in 1931. His intention was to travel beneath the ice across the entire basin from Spitsbergen to the Bering Strait. Mechanical failure of the diving equipment a few days after the Nautilus left Spitsbergen prevented the execution of the plan. Soon after the close of the Second World War, the United States Navy began tests of a new method obtaining soundings through the ice, which may provide the key to the Arctic riddle. One interesting speculation to be tested by future soundings is that the mountain chain that besets the Atlantic and has been supposed to reach its northern terminus at Iceland may actually continue across the Arctic basin to the coast of Russia. The belt of earthquake epicentres that follows the Atlantic Ridge seems to extend across the Arctic Sea and where there are submarine earthquakes it is at least reasonable, to guess that there may be mountainous topography.

A new feature on recent maps of undersea relief – something never included before the 1940s – is a group of about 160 curious, flat-topped sea mounts between Hawaii and the Marianas. A Princeton University geologist H. H. Hess happened to be in command of the US Cape Johnson during two years of the wartime cruising of this vessel in the Pacific. Hess was immediately struck by the number of these undersea mountains that appeared on the fathograms of the vessel. Time after time as the moving pen of the fathometer traced the depth contours it would abruptly begin to rise in an outline of a steepsided sea mount, standing solitarily on the bed of the sea. Unlike a typical volcanic cone, all of the mountains have broad flat tops, as though the peaks had been cut off and planed down by waves. But the summits of the sea mounts are anywhere from half a mile to a mile below the surface of the sea. How they acquired their flat-topped contours is a mystery perhaps as great as that of the submarine canyons.

Unlike the scattered sea mounts, the long ranges of undersea mountains have been marked on the charts for a good many years. The Atlantic Ridge was discovered about a century ago. Now we can trace the outlines of this great mountain range and dimly we begin to see the details of its hidden peaks and valleys. The Ridge rises in mid-Atlantic near Iceland. From this far-northern latitude it runs south midway between the continents, crosses the equator into the South Atlantic and continues to about 50° south latitude where it turns sharply eastward under the tip of Africa and runs toward the Indian Ocean. Its general course closely parallels the coastlines of the bordering continents, even to the definite flexure at the equator between the hump of Brazil and the eastward-curving coast of Africa. To some people this curvature has suggested that the ridge was once part of the great continental mass left behind in mid-ocean when according to one theory the continents of North and South America drifted away from Europe and Africa. However recent work shows that on the floor of the Atlantic there are thick masses of sediments which must have required hundreds of millions of years for their accumulation.

Throughout much of its 10,000-mile length, the Atlantic Ridge is a place of disturbed and uneasy movements of the ocean floor, and the whole ridge gives the impression of something formed by the interplay of great, opposing forces. From its western foothills across to where its slopes roll down into the eastern Atlantic basin, the range is about twice as wide as the Andes and several times the width of the Appalachians. Near the equator a deep gash cuts it from east to west – the Romanche Trench. This is the only point of communication between the deep basins of the eastern and western Atlantic, although among its higher peaks are other, lesser mountain passes.

The greater part of the Ridge is, of course, submerged. Its central backbone rises some 5,000 to 10,000 feet above the sea floor, but another mile of water lies above most of its summits. Yet here and there a peak thrusts itself up out of the darkness of deep water and pushes above the surface of the ocean. These are the islands of the mid-Atlantic. The highest peak of the Ridge is Pico Island of the Azores. It rises 27,000 feet above ocean floor, with only its upper 7,000 to 8,000 feet emergent. The sharpest peaks of the Ridge are the cluster of islets known as the Rocks of St. Paul near the equator. The entire cluster of half a dozen islets is not more than a quarter of a mile across, and their rocky slopes drop off at so sheer an angle that water more than half a mile lies only a few feet off shore. The sultry volcanic bulk of Ascension is another peak of the Atlantic Ridge.

But most of the ridge lies forever hidden from human eyes. Its contours have been made out only indirectly by the marvelous probings of sound waves, bits of its substance have been brought up to us by corers and dredges; and some details of its landscape have been photographed with deep-sea cameras. With these aids our imaginations can picture the grandeur of the undersea mountains, with their sheer cliffs and rocky terraces, their deep valleys and towering peaks. If we are to compare the ocean's mountains with anything on the continents, we must think of terrestrial mountains far above the timber line, with their silent snow-filled valleys and their naked rocks swept by the winds, for the sea has an inverted 'timber line' or plant line, below which no vegetation can grow. The slopes of the undersea mountains are far beyond the reach of the sun's rays, and there are only the bare rocks and, in the valleys, the deep drifts of sediments that have been silently piling up through the millions upon millions of years.

Neither the Pacific Ocean nor the Indian Ocean has any submerged mountains that compare in length with the Atlantic Ridge, but they have their smaller ranges. The Hawaiian Islands are the peaks of a mountain range that runs across the central Pacific basin for a distance of nearly 2,000 miles. The Gilbert and Marshall islands stand on the shoulders of another mid-Pacific mountain chain.

One of the most fascinating fields for speculation is the age of the submarine mountains compared with that of past and present mountains of the continents. Looking back over the past ages of geologic time, we realize that mountains have been thrust up on the continents to the accompaniment of volcanic outpourings and violent tremblings of the Earth, only to crumble and wear under the attacks of rain and frost and flood. What is about the sea's mountains? Were they formed the same way and do they, too, begin to die as soon as they are born?

There are indications that the Earth's crust is more stable under sea than on land. Quite a fair proportion of the world's earthquakes are traced through seismographs to sources under the oceans, and, as we shall see later, there are probably as many active volcanoes under water as on land. Apparently the Atlantic Ridge arose along a line of crustal shifting and rearrangement; although its volcanic fires seem to be largely quiescent, it is at present the site of most of the earthquakes in the Atlantic area. Almost the whole continental rim of the Pacific basin is aquiver with earthquakes and fiery with volcanoes, some frequently active, some extinct, some merely sleeping a century-long sleep between periods of explosive violence. From the high mountains that form an almost continuous border around the shores of the Pacific, the contours of the land slope abruptly down to very deep water. The deep trenches that lie off the coast of South America, from Alaska along the Aleutian Islands and across to Japan and southward off Japan and the Philippines give the impression of a landscape in process of formation, of a zone of the Earth subject to great strains.

No sooner is a continental mountain thrust up than all forces of nature conspire to level it. A mountain of the deep sea, in the years of its maturity, is beyond the reach of the ordinary erosive forces. It grows up on the ocean floor and may thrust volcanic peaks above the surface of the sea. These islands are attacked by the rains and in time the young mountain is brought down within the reach of the waves; in the tumult of the sea attack it sinks again beneath the surface. Eventually the peak is worn down below the push and pull and drag even the heaviest of storm waves. Here, in the twilight of the sea, in the calm of deep water, the mountain is secure from further attack. Here it is likely to remain almost unchanged, perhaps throughout the life of the Earth.

Because of this virtual immortality, the oldest oceanic mountains must be indefinitely older than any of the ranges left on land. Prof. Hess, who discovered the sea mounts of the central Pacific, suggested that these ‘drowned ancient islands’ may have been formed before the Cambrian period, or somewhere between 560 million and billion years ago. This would make them perhaps of an age with the continental mountains of the Laurential upheaval. But the sea mounts have changed little, if at all, comparing in elevation with modern terrestrial peaks; while of the mountains of the Laurentian period scarcely a trace remains. The Pacific sea mounts, according to this theory, must have been of substantial age when the Appalachians were thrust up, 200 million years ago; they stood almost unchanged while the Appalachians wore down to mere wrinkles on the Earth’s face. The sea mounts were old 60 million years ago, when the Alps and the Himalayas, the Rockies and the Ands, rose to their majestic heights. Yet, it is probable that they will be standing unchanged in the deep sea when these, too, shall crumble away to dust.

1. Who was the first to sound the depths of the open ocean?
2. Why is taking soundings in the deep sea a laborious task?
3. How can you prove that continental shelves are like land?
4. Why are continental slopes considered to be the most imposing features of the earth?
5. What is the origin of sea canyons?
6. What changes does the floor of the sea undergo?
7. What is a new feature on recent maps of undersea relief?
8. How are the contours and substance of undersea mounts made out?
9. What is the origin of sea mountains?

TEXT 8

The Shape of Ancient Seas

We live in an age of rising seas. Along all the coasts of the United States a continuing rise of sea level has been perceptible on the tide gauges since 1930, for the thousand-mile stretch, the rise amounted to about a third of foot between 1930–1948. The water is also rising (but more slowly) along the Pacific shores. These records of the tide gauges do not include the transient advances and retreats of the water caused by winds and storms, but signify a steady, continuing advance of the sea upon the land.

This evidence of a rising sea is an interesting and even an exciting thing because it is rare that, in the short span of human life, we can actually observe and measure the progress of one of the great Earth rhythms. What is happening is nothing new. Over the long span of geologic time, the ocean waters have come in over North America many times and have again retreated into their basins. For the boundary between sea and land is the most fleeting and transitory feature of the Earth, and the sea is forever repeating its encroachments upon the continents in its flood, reluctant in its ebb, moving in a rhythm mysterious and infinitely deliberate.

Now once again the ocean is overfull. It is spilling over the rims of its basins. It fills the shallow seas that border the continents, like the Barents, the Bering and the China seas. Here and there it has advanced into the interior and lies in such inland seas as Hudson Bay, the St. Lawrence embayment and the Baltic Sea. On the Atlantic coast of the United States the mouths of many rivers, like the Hudson have been drowned by the advancing flood, the old submerged channels being hidden under bays like the Delaware.

The advance noted so clearly on the tide gauges may be part of a long rise that began thousands of years ago – perhaps when the glaciers of the most recent Ice Age began to melt. But it is only within recent decades that there have been instruments to measure it in any part of the world. Even now the gauges are few and scattered, considering the world as a whole. Because of the scarcity of world records, it is not known whether the rise observed in the United States since 1930 is being duplicated on all other continents.

Where and when will the ocean halt its present advance and begin again its slow retreat into its basin, no one can say.

If, however the rise should be as much as 600 feet, large areas in the eastern half of the continent would disappear under the waters. The Appalachians would become a chain of mountainous islands. The Gulf of Mexico would creep north. Much of northern Canada would be covered by water from the Arctic Ocean and Hudson Bay.

All of this would seem to us extraordinary and catastrophic but the truth is that North America and most other continents have known even more extensive invasion by the sea than the one we have just imagined. Probably the greatest submergence in the history of the Earth took place in the Cretaceous period, about 100 million years ago. Then the ocean waters advanced upon North America from the north, south and east, finally forming an inland sea about

1,000 miles wide that extended from the Arctic to the Gulf of Mexico and then spread eastward to cover the coastal plain from the Gulf to New Jersey. At the height of the Cretaceous flood about half of North America was submerged, the seas rising all over the World. They covered most of the British Isles, except for scattered outcroppings of ancient rocks. In southern Europe only the old rocky highlands stood above the sea, which intruded in long bays and gulfs even into the central highlands of the continent. The ocean moved into Africa and laid down deposits of sandstones; later weathering of these rocks provided the desert sands of the Sahara. From drowned Sweden, an inland sea flowed across Russia, covered the Caspian Sea, and extended to the Himalayas, parts of India, Japan and Siberia being submerged. On the South American continent, the area where later the Andes were to rise was covered by sea.

With variations and detail, these events have been repeated again and again. You do not have to travel to find the sea, for the traces of its ancient stands are everywhere about. Though you may be a thousand miles inland, you can easily find reminders that will reconstruct for the eye and ear of the mind the processions of its ghostly waves and the roar of its surf, far back in time. So, on a mountain top in Pennsylvania, I have sat on rocks of whitened limestone, fashioned of the shells of billions upon billions of minute sea creatures. Once they had lived and died in an arm of the ocean that overlay this place, their limy remains having settled to the bottom. Then, after eons of time, they had become compacted into rock and the sea had receded; after yet more eons the rock had been uplifted by bucklers of the Earth’s crust and now it formed the backbone of a long mountain range.

Far in the interior of the Florida Everglades we have wondered at the feeling of the sea that came to me – wondered until we realized that here were the same flatness, the same immense spaces, the same dominance of the sky and its moving, changing clouds; wondered until we remembered that the hard rocky floor on which we stood, its flatness interrupted by upthrust masses of jagged coral rock, had been only recently constructed by the busy architects of the coral reefs under a warm sea. Now the rock is thinly covered with grass and water; but everywhere is the feeling that the land has formed only the thinnest veneer over the underlying platform of the sea, that at any moment the process might be reversed and the sea reclaim its own.

So in all lands we may sense the former presence of the sea. There are outcroppings of marine limestone in the Himalayas, now at an elevation of 20,000 feet. These rocks are reminders of a warm, clear sea that lay over southern Europe and northern Africa and extended into southwestern Asia. This was some 50 million years ago. Immense numbers of a large protozoan known as nummulites swarmed in this sea and each, in death, contributed to the building of a thick layer of nummulitic limestone. Eons later, the ancient

Egyptians were to carve their Sphynx from a mass of this rock; other deposits of the same stone they quarried to obtain material to build their pyramids.

The famous white cliffs of Dover are composed of chalk deposited by the seas of the Cretaceous period, during that great inundation we have spoken of. The chalk extends from Ireland through Denmark, and forms its thickest beds in south Russia. It consists of shells of those minute sea creatures called foraminifera, the shells being cemented together with a fine-textured deposit of calcium carbonate.

Many of the natural wonders of the Earth owe their existence to the fact that once the sea crept over the land, laid down its deposits of sediments and then withdrew. There is the Mammoth Gave in Kentucky, for example, where one may wander through miles of underground passages and enter rooms with ceilings 250 feet overhead. Caves and passage-ways have been dissolved by ground water out of an immense thickness of limestone, deposited by a Paleozoic sea. In the same way, the story of the Niagara Falls goes back to the Silurian time, when a vast embayment of the Arctic Sea crept southward over the continent. Its waters were clear, for the borderlands were low and little sediment or silt was carried into the inland sea. It deposited large beds of the hard rock called dolomite, and in time they formed a long escarpment near the present border between Canada and the United States. Millions of years later, floods of water released from melting glaciers poured over this cliff, cutting away the soft shales that underlay the dolomite, and causing mass after mass of the undercut rock to break away. In this fashion the Niagara Falls and its gorge were created.

Some of these seas were immense and important features of their world, although all of them were shallow compared with the central basin where, since earliest time, the bulk of the ocean waters resided. Some may have been as much as 600 feet deep, about the same as the depths over the outer edge of the continental shelf. No one knows the pattern of their currents but often they must have carried the warmth of the tropics into far northern lands. During the Cretaceous period, for example breadfruit, laurel and fig trees grew in Greenland. When the continents were reduced to groups of islands there must have been few places that possessed a continental type of climate with its harsh extremes of heat and cold; mild oceanic climates must rather have been the rule.

Geologists say that each of the grandeur divisions of Earth history consists of three phases: in the first the continents are high, erosion is active, the seas being largely confined to their basins; in the second the continents are lowest and the seas have invaded them broadly; in the third the continents have begun once more to rise. According to the late Charles Schuchert, who devoted much of his distinguished career as a geologist to mapping the ancient seas and lands: ‘Today we are living in the beginning of a new cycle when the continents are largest, highest and scenically grandest. The oceans, however, have begun another invasion upon North America.'

What brings the ocean out of its deep basins, where it has been contained for eons of time, to invade the lands? Probably there has always been not one alone, but a combination of causes.

The mobility of the Earth's crust is inseparably linked with the changing relations of sea and land – the warping upward and downward of that surprisingly plastic substance which forms the outer covering of the Earth. The crustal movements affect both land and sea bottom but are most marked near the continental margins. They may involve one or both shores of an ocean, one or all coasts of a continent. They proceed in a slow and mysterious cycle, one phase of which may require millions of years for its completion. Each downward movement of the continental crust is accompanied by a slow flooding of the land by the sea, each upward buckling by the retreat of the water.

But the movements of the Earth's crust are not alone responsible for the invading seas. There are other important causes. Certainly one of them is the displacement of the ocean water by land sediments. Every grain of sand or silt carried out by the rivers and deposited at sea displaces a corresponding amount of water. Disintegration of the land and the seaward freighting of its substance have gone on without interruption since the beginning of geologic time. It might be thought that the sea level would have been rising continuously, but the matter is not so simple. As they lose substance the continents tend to rise higher like a ship relieved of part of its cargo. The ocean floor, to which the sediments are transferred, sags under its load. The exact combination of all these conditions that will result in a rising ocean level is a very complex matter, not easily recognized or predicted.

Then there is the growth of the great submarine volcanoes, which build up immense lava cones on the floor of the ocean. Some geologists believe these may have an important effect on the changing level of the sea. The bulk of some of these volcanoes is impressive. Bermuda is one of the smallest, its volume beneath the surface is about 2,500 cubic miles. The Hawaiian chain of volcanic islands extends for nearly 2,000 miles across the Pacific and contains several islands of great size; its total displacement of water must be tremendous. Perhaps it is more than coincidence that this chain arose in the Cretaceous time, when the greatest flood the world has ever seen advanced upon the continents. For the past million years, all other causes of marine transgressions have been dwarfed by the dominating role of the glaciers. The Pleistocene period was marked by alternating advances and retreats of a great ice sheet. Four times the ice caps formed and grew deep over the land, pressing southward into the valleys and over the plains. And four times the ice melted and shrank and withdrew from the lands it had covered. We live now in the last stages of this fourth withdrawal. About half the ice formed in the last Pleistocene glaciation remains in the ice caps of Greenland and Antarctica and the scattered glaciers of certain mountains.

Each time the ice sheet thickened and expanded with the unmelted snows of winter after winter, its growth meant a corresponding lowering of the ocean level. For directly or indirectly, the moisture that falls on the Earth's surface as rain or snow has been withdrawn from the reservoir of the sea. Ordinarily, the withdrawal is a temporary one, the water being returned via the normal runoff of rain and melting snow. But in the glacial period the summers were cool, and the snows of any winter did not melt entirely but were carried over to the succeeding winter, when the new snows found and covered them. So little by little the level of the sea dropped as the glaciers robbed it of its water, and at the climax of each of the major glaciations the ocean all over the world stood at a very low level.

Today, if you look in the right places, you will see evidences of some of these old stands of the sea. Of course the strand marks left by the extreme low levels are now deeply covered by water and may be discovered only indirectly by sounding. But where in past ages, the water level stood higher than it does today you can find its traces. In Samoa, at the foot of a cliff wall now 15 feet above the present level of the sea, you can find benches cut in the rocks by waves. You will find the same thing on the Pacific islands.

During the other half of the cycle, when the sea sank lower and lower as the glaciers grew in thickness, the world's shore-lines were undergoing changes even more far-reaching and dramatic. Every river felt the effect of the lowering sea; its waters were speeded in their course to the ocean and given new strength for the deepening and cutting of its channel. Following the downward-moving shore-lines, the rivers extended their courses over the drying sands and mud of what only recently had been the sloping sea bottom. Here the rushing torrents – swollen with melting glacier water – picked up great quantities of loose mud and sand and rolled into the sea as a turgid flood.

During one or more of the Pleistocene lowerings of the sea level, the floor of the North Sea was drained of its water and for a time became dry land. The rivers of the northern Europe and of the British Isles followed the retreating waters seaward. Eventually the Rhine captured the whole drainage system of the Thames. The Elbe and the Weser became one river. The Seine rolled through what is now the English Channel and cut itself a trough out across the continental shelf – perhaps the same drowned channel now discernible by soundings, beyond Lands End.

The greatest of all Pleistocene glaciations came rather late in the period – probably only about 200 thousand years ago, and well within the time of man. The tremendous lowering of sea levels must have affected the life of the

Paleolithic man. Certainly he was able, at more than one period, to walk across a wide bridge at the Bering Strait, which became dry land when the level of the ocean dropped below this shallow shelf. There were other land bridges, created in the same way. The ocean having retreated from the coast of India, a long submarine bank became a shoal, then finally emerged, and primitive man walked across 'Adam's Bridge' to the island of Sri Lanka.

The last glacial stage was the Reindeer Age of French history. Men then lived in the famous caves overlooking the channels of the French rivers, and hunted the reindeer which throve on the cool plains of France south of the ice border. The Late-Glacial rise of the general sea level was necessarily accompanied by a rise of the river waters downstream. Hence the lowest caves are likely to have been partly or wholly drowned. There the search for more relics of the Paleolithic man should be pursued.

Some of our Stone Age ancestors must have known the rigors of life near the glaciers. While men as well as plants and animals moved southward before the ice, some must have remained within sight and sound of the great frozen wall. To these the world was a place of storm and blizzard, with bitter winds roaring down out of the blue mountain of ice that dominated, the horizon and reached upward into grey skies, all filled with the roaring tumult of the advancing glacier, and with the thunder of moving tons of ice breaking away and plunging into the sea.

But those who lived half the Earth away, on some sunny coast of the Indian Ocean, walked and hunted on dry land over which the sea, only recently, had rolled deeply. These men knew nothing of the distant glaciers, nor did they understand that they walked and hunted where they did because quantities of ocean water were frozen as ice and snow in a distant land.

In any imaginative reconstruction of the world of the Ice Age, we are plagued by one tantalizing uncertainty: how low did the ocean level fall during the period of greatest spread of the glaciers when unknown quantities of water were frozen in the ice? Was it only a moderate fall of 200 or 300 feet – a change paralleled many times in geologic history in the ebb and flow of the epicontinental seas? Or was it a dramatic drawing down of the ocean by 2,000, even 3,000 feet?

Each of these various levels has been suggested as an actual possibility by one or more geologists.

1. When did the greatest submergence in the history of the Earth take place?
2. What fact do many of the natural wonders of the Earth owe their existence to?
3. What phases do the grandeur divisions of Earth history consist of?
4. What is the mobility of the Earth's crust linked with?
5. What factors are responsible for the invading seas?
6. When did the greatest of all Pleistocene glaciations come?

TEXT 9
Soil Conservation

When Americans came to the new continent, they found "a land of unlimited forests and fertile plains". But the thin forest soils were unwisely converted to cropland and when they failed to yield well after a few years, people abandoned the farms or sold them to later comers and moved westward – to start new farms on cutover forest land. A state of Ohio, for example, was nearly 95 % forest-covered in 1788. It was still 54 % woodland in 1853. And only a declining rate of deforestation saved it from going below 14 % in 1940. It has not changed much since then.

The removal of the forests in Ohio and in much of the Ohio River Valley has resulted in a denuded soil which simply cannot soak up the heaviest rains. Once the millions of trees, each with thousands of leaves, broke the force of pounding rain, cascading the raindrops downwards from one leaf to another until they tumbled gently onto the deep, spongy humus mat of the forest floor, where drops continued to fall and to be absorbed for hours after the rain had stopped. Now rain drops fall with force on bare or sparsely covered soil which, through long years of erosion has had much of its humus removed, leaving behind a hard pavement – like surface of close-packed soil and pebbles.

Wherever rain falls on bare soil, on soil made hard by erosion of its spongy upper layer, on soil laid bare by the teeth of too great a concentration of cattle or sheep, on soil laid bare by fire, the water cannot soak in readily. Much of it runs off, carrying with it a load of the finest materials and leaving behind an increasingly unabsorbent surface. The compacted soil now sheds 50% or more of the rainfall, which may run off in great sheets into small gullies and then large ravines.

Whether the erosion starts on forestland unwisely converted to crops, or on arid grassland that is overgrazed and therefore fails to reseed itself, the result will be equally tragic. When most of the fertile topsoil is gone the land becomes unfit for any kind of agricultural crop. The weathering of the ruined soil, the eventual capture of the surface by pioneering plants, and the decay of plants and animals will eventually restore the soil fertility – but only after thousands of years. Perhaps some new civilization will make a fresh start then and use the soil more wisely.

Fertility can be lost locally even where soil practices are good. During great dust storms fertile tracts have been covered inches deep with the sterile dust and sand blown from overexploited areas or carefully tended farms may be covered with soil wash and pebbles from flooded areas upstream.

Sometimes "badlands" are created by industrial processes, as from the poisonous fumes or copper smelters or steel plants. Strip mining in Pennsylvania removes the fertile surface and then dumps and buries it so deeply that the land becomes unfit for agriculture. In Illinois and elsewhere, such stripped areas have been replanted to trees, which can grow on land that will not support crops. The trees slow the erosion and stabilize the soil so that natural processes can begin the slow renewal of surface fertility.

At present time one-third of total topsoil in the country has been removed by erosion. Some of it went in steady week-by-week attrition. Much went in great floods. The 1936 flooding in Ohio River Valley removed 300 million tons of topsoil from the land – about as much as the Mississippi River removes in a whole year. Some of the topsoil loss is widely distributed over the country, resulting in a shallower topsoil and lowered fertility. Some of it is concentrated loss, complete enough to rule out any agriculture. Of such completely ruined land there are 200 million acres – an area four times the size of Nebraska! The country still has at present 450 million acres of good land. About one-fourth of this is receiving proper care by enlightened farmers; the remaining 3/4 is still being slowly or rapidly ruined. We have already made a good start on research in farm practices, and some of what has been learned is already part of enlightened farm practice through the country. Contour plowing and strip planting are two of the most effective devices for delaying the runoff of water from the soil and so minimizing the load of silt that can be carried off. Terracing, which is practiced with great skill in Asia and in Europe, is being used in modified forms, on American slopes.

Quantitative knowledge of the effectiveness of different kinds of vegetative cover in controlling erosion can be obtained experimentally. Crops are planted in parallel strips on a hillside near an agricultural station. Water is then collected from below each strip, and the volume of run off, together with the amount of contained silt, is recorded. Fallow soil is the worst from the point of view of erosion.

1. What has the removal of the forests in Ohio and in much of the Ohio River Valley resulted in?
2. What processes can restore soil fertility?
3. What processes influenced the creation of “badlands”?
4. What are the most effective devices for delaying the runoff of water from soil?

TEXT 10

Irrigation and Salt Problems in Renmark, South Australia

The deserts of this planet, which cover about 19 percent of the continental surfaces, support only about 5 percent of the world’s population. These arid lands have acted as formidable barriers between settled areas and have prevented a more even distribution of people over the face of the earth. Within these dry lands settlement patterns tend to be ones of clusters and even ribbons, reflecting the availability of usable water. Renmark, South Australia, is such a cluster and is one of the many "oasis" towns along the Murray River.

The Renmark oasis has been selected for study because it is located in a country where the results of scientific research are readily available. Still, the Renmark irrigated lands, like most of the oases along the Murray River, are endangered by the encroachment of salt. This deterioration of agricultural land is truly disturbing when one considers that less than a quarter of Australia has a growing season of five months or more, during which evaporation is not more than three times precipitation, and that a third of the entire continent is unsuited to commercial agriculture of any kind. At the same time the Murray River system supports about nine-tenths of all irrigated land in Australia. Thus the sight of salt-burnt vines, browning pastures and wilting citrus groves in the heart of Australia's irrigated garden district cautions against complacency in the efforts to close the gap between available scientific knowledge and its practical applications in the management of irrigated lands.

Renmark lies on the north bank of the Murray. The Murray River, meandering in its broadly incised valley through a semi-arid region is the life-giving source for the horticultural centres, whose success or failure to a large extent depends on the availability and quality of irrigation water. Through the construction of storage ponds between large weirs, water has been made available at all times. However, the water quality varies with a number of factors, such as river flow, seepage of saline drainage water into the river, wind conditions, thermal overturn, and the rate of pumping.

Of all the South Australia river oases, Renmark is at the greatest distance upstream. Thus all centers downstream are affected by what happens to the return flow and seepage of salinized drainage water deriving from the Renmark area. With a yearly use of more than 50,000 acre-feet of water on the Renmark, area's 12,400 irrigated acres, the problems of salt accumulation and the subsequent disposal of saline drainage water have become critical not only for Renmark but particularly for the downstream towns.

Few places reflect more clearly man's ability to speed up, or to retard, the deterioration of land resources than the intensively used oases along the world's exotic rivers. The ultimate fate of such oases will depend almost entirely on man's ability to recognize and to deal with the causes of soil salinization. Whether or not irrigated land becomes salinized depends on a variety of physical factors, among them the quantity and quality of the irrigation water, the amount of precipitation and evaporation and the drainage capability of the soils under irrigation. Obviously the quantity and kinds of salts already present in the soils, as well as the salt content of materials deposited by wind action, play a significant part.

All water used for irrigation at Renmark comes from the Murray which has incised its broad valley into a wide peneplain underlain by relatively young deposits of clay, by gypsum beds, by both unconsolidated and cemented layers of sand and gravel, and by thin beds of limestone. All of these sediments are the remnants of shallow marine encroachments during the early Pleistocene, and they attain an aggregate thickness of about 1,500 feet. In the late Pliocene a general uplift gave rise to the present coastline and also rejuvenated the drainage system of the Murray and its tributaries. Consequently, the river cuts through various calcareous strata and unconsolidated materials, which in part explains the relatively high mineral content of its water.

Another major factor in salinization, the climate, does not require elaboration. Precipitation is both deficient and erratic, and the evaporation is generally six to seven times greater than the average precipitation. The severe excess of evaporation over precipitation clearly indicates the conditions that favour soil salinization.

A third factor, the drainage capability of soils over a large area, is by far the most difficult to evaluate. From the often sandy surface material of a great number of soil types in the Renmark area, one could easily, if correctly, conclude that the soils have a high drainage capability. Since quite a number of these soils have buried profiles and also have clay layers at various depths, the drainage potentials vary greatly within short distances. Moreover, in many places the Blanch-town Clay accounts for perched water tables at shallow depths. Soluble salts contained in the irrigation water and in the parent materials of the soil tend to move upward by capillary action into the root zone or even to the surface. Only in places where the clay surface is inclined toward natural or artificial drainage ways it is possible to conduct the excess water out and away from the irrigation sites.

The water table, except in the deep accumulations of the sandy ridges at the outer margins of the irrigation district, lies anywhere from 20 to 60 inches below the surface. This means that in almost all areas the groundwater is at a level which easily permits salinized water to rise to the surface by capillary action. Eight to twelve feet can be viewed as the maximum distance that capillary water will rise from the water table, though this general assumption does not hold true for all soils, since capillary rise is strongly influenced by soil texture.

1. Where is Renmark situated?
2. Why is deterioration of agricultural land in Australia especially disturbing?
3. What factors are responsible for soil salinization?
4. Why is the mineral content of the Murray water high?
5. What climatic factors favour soil salinization?

TEXTS FOR ANNOTATING

Oceanology

Modern oceanology can be said to have begun about a hundred years ago. However, men have been interested in the sea for millennia and there was a scattering of scientific ocean studies before the mid-nineteenth century.

With the advent of open sailing voyages, navigators began to take an interest in the physical side of oceanology, at least as far as major ocean currents were concerned, although the old sailing records produced little that could be called scientific studies of currents. Benjamin Franklin, however, was able to draw a tolerable chart of the Gulf Stream, based partly on reports of Yankee sailing captains. He also made his own observations of water temperature on several Atlantic crossings by picking up buckets of surface water and measuring their contents. The British explorer Captain James Cook also gathered oceanographic information during his three celebrated voyages of exploration which occupied the latter part of his life and included circumnavigation of the Pacific.

In spite of such early interest, oceanography as an organized research effort is a young science. It grew in the latter part of the nineteenth century partly because of the rapid spread of science in general and partly because the basic sciences that lie behind it – physics, chemistry, geology, biology – and the technology of research had reached a point where scientific exploration of the deep oceans became possible.

One of the pioneers who helped turn men’s curiosity about the sea into a science was Matthew Fontaine Maury (1806-73). Maury’s interests were those of a practical sailor. But his intensive study of currents helped lay the foundation for the modern science of physical oceanography. Before Maury, men sailed without accurate knowledge of currents, winds, or storm patterns. When his lifework was finished, charts of major currents, prevailing winds and storm tracks were part of every navigator’s equipment.

Maury’s work led directly to one of the first international scientific conferences. It met at Brussels in 1853 to consider setting up a uniform marine weather observing system. Maury is credited with inspiring the establishment of the official meteorological office in both Great Britain and Germany. Because of the demonstrated value of Maury’s charts and partly as a result of this conference, other maritime nations began establishing hydrological services, which often cooperated with one another and with Maury in charting the seas.

Continental Shelves

The transition from continent to ocean is rarely sudden. Almost everywhere the land is bordered by shallow continental shelves where land and sea merge into one another. They are the threshold over which one must pass to enter the deep ocean.

In some places the shelves are wide, as in the North Sea area of Europe or along the Arctic coast of Asia. In other areas they are narrow or virtually nonexistent, as off the eastern tip of Florida. On the whole, to give a few general statistics they have an average width of about 42 miles, an average depth of 180 to 210 feet, an average depth at the outer edge of 432 feet.

These valuable undersea margins are thought to be a gift of the last ice age. At its peak, 18,000 years ago, so much water was locked up in the ice that the general sea level fell anywhere from 250 to 500 feet. This was an ice-age phenomenon that affected all the seacoasts of the world, even those far removed from the glaciers themselves. Waves can quickly erode soft materials. Thus, when extensive new coast areas were exposed by the retreating seas, wave-cut terraces were formed. Then with the rise of the seas as the ice melted, and perhaps aided by the slow sinking that many coastal areas are known to be experiencing, the continental shelves were created by submersion.

The shelves especially in the glaciated areas, still show the marks of their ice-age origin. In many places glacial rubble has been dredged up, while off northern Europe and North America the topography of the shelf shows the same glacial scouring as the adjacent land. The fiords, in particular, are believed to have been carved by the ice.

Elsewhere the shelves have a varied topography. In some places they are hilly. Occasionally they are very smooth. There are many basins, banks, sand bars and remains of drowned river valleys, while the material covering the bottom is a veritable patchwork of muds, sediments, and rocks.

The most common sediment is sand. Some of this, the "terrigenous" sand, is land-derived. Some of it is organic, such as the "calcarcenite" sands made up of coral fragments, the shells of microscopic animals and the calcium carbonate remains of other organisms. There are also the so-called "chemical" sands that are deposited by chemical processes in the sea. Besides the various sands, there are muds, silts, and clays which are respectively made up of finer materials, all finer than the sand. Last, there are gravels, pebbles, cobbles and boulders – stones ranked according to increasing size – which cover the shelf in some places.

One of the most curious and occasionally valuable features of the shelves are the salt domes. These sometimes are associated with oil and have been used as a cheap source of high-quality salt and sulphur. These domes which look like rounded hills, are really oval plugs of salt, sometimes over a mile in diameter, that rise up from deep underlying salt beds. They have been pushed upward by subterranean forces until they rise with vertical walls through thousands of feet of sediment. Where they have risen, these mountains of salt are surrounded by uplifted sediment beds. Oil is often found in these beds. Being lighter than the water that is also present in the sediments, it floats up through the tilted sediments until it is blocked by the wall of salt.

Paleoclimatology

Climate, as we know too well, is a subject to change. Just a few thousand years ago glaciers spread over North America and Eurasia as far south as the latitude of the Ohio River, and it may happen again, fairly soon. Thriving cities once lay where desert winds now blow. Lately the human occupants of this Earth have helped the process along by damaging the balance of the environment, but climatic changes have always taken place.

Thus, we may examine the climatic history of Gondwana's landmasses. Today Africa, South America, India and Australia lie close enough to the equatorial zone to be relatively warm and mild; only Antarctica lies in polar regions. But there is evidence in the rocks that there was a time when those continents were glaciated. This glaciation, the Dwyka glacial period, was preceded and followed by times of cooler climates. Forests stood in Gondwana, more than 200 million years ago – and those forests now yield coal from southern Brazil to western Australia and from India to South Africa.

From all sorts of evidence, from fossil vegetation, fossil faunas, the character of the matrix in sedimentary rocks, even from the colour of rock strata it is possible to reconstruct the prevailing climatic environment. Often the record is incomplete, of course, but there are always bits of evidence to store for eventual use even when the total picture is clouded. During the hundred million years of the life of Gondwana, a great period of deposition occurred, beginning with the Dwyka glaciation and ending, just as Gondwana broke apart, with a massive outpouring through numerous fissures of basaltic and other lava. This period of accumulation, which amassed rock thickness as great as 25,000 feet, saw the environment of central Gondwana change drastically. The Dwyka ice sheets scoured the surface and deposited hundreds of feet of tillite (the compacted glacial till). As the ice sheets receded, semi-desert conditions took over in what is now western South Africa and Argentina, while to the east there were low-lying, flood-prone (subject to floods) flatlands with much swampy vegetation. Gradually the desert spread, and sandstones accumulated that appear today as unbedded, thick, light-coloured strata with semi-rounded grains of quartz and some feldspar. Eventually the weight of the sediments on the crust became too great, and it fractured, aided perhaps by the forces that were to pull Gondwana apart. In any case the concluding phase of the Karroo sequence of accumulation witnessed the eruption of thousands of feet of mostly basaltic lavas. South Africa's Great Escarpment is sustained by this lava, as is India's Deccan Plateau, and much of Antarctica may consist of it too. Now the

Gondwana landscape was one of smoking volcanoes and gaping fissures, vast lava plains and constant scenic change, earthquakes and instability – the end of millions of years of quiet deposition and passive, slow modification.

How Weeds Clean Water

Fanciers of tropical fish use marine vegetation to help keep the water in their aquariums clean, and the same or similar plants are used in many reservoirs to aid the process of water purification. Now engineers are using the same approach to help purify sewage and industrial water wastes.

The "living filters", which include a number of reeds, rushes and irises cleanse water in a variety of interrelated ways. They absorb inorganic pollutants such as nitrates, phosphates and metals and toxic organic compounds such as phenol. Their roots trap small particles of insoluble pollutants. The plants reduce the number of pathogenic bacteria in water, possibly by producing chemicals that destroy the bugs. They add oxygen to dirty water and act as hosts for various bacteria, insects and small fish that also clean up pollutants.

Sudanese tribesmen have long used green plants to make the murky waters of the Blue Nile potable and palatable, but the large-scale use of this natural treatment is a recent innovation. The most advanced process of this kind is a system used to purify water from the befouled Rhine River for the German town of Krefeld. The Rhine water, containing huge amounts of municipal and industrial sewage, is first subjected to chemical treatment which removes the bulk of the pollutants, and then sprayed into a lagoon planted with bulrushes. The spraying increases the amount of oxygen in the water, and the rushes remove almost all of the remaining pollutants, including toxic organic chemicals and coliform bacteria. This water infiltrates the soil below the lagoon – which purifies it further – and is then pumped off, through wells dug close to the lagoon, into Krefeld's water system.

Other schemes using green plants are on a somewhat smaller scale. In Holland's Zuider Zee region, long water-filled trenches planted with reeds have successfully cleaned up sewage from summer camp sites, at about a quarter of the cost of conventional plants. Researchers are testing the use of natural and artificial marches to treat municipal effluents and experimenting with lagoons full of water hyacinths for the same purpose.

Experts recognize that the method is not a panacea for water-treatment problems. The plants require a lot of space, are vulnerable to pollutants that kill plants and cannot work year-round in areas where ponds freeze. Nevertheless green plants could provide clean water for small communities that cannot afford full-scale purification systems. And in combination with conventional techniques, biological treatment offers a relatively cheap way to remove the last traces of the pollutants that now end up in the drinking water of most large cities.

The Outlook

In Australia, where about one-third of the land area is totally unsuited to commercial agriculture of any type and where much of the rest is not endowed with adequate or reliable precipitation, irrigation assumes an increasingly important role. It is therefore necessary to prevent irrigated land from deteriorating, either as a result of faulty practices or through natural processes.

The oasis centers along the lower Murray are particularly endangered and at least two major tasks should be undertaken. First, through careful land management and sound irrigation practices soil salinization must be reduced, or at least retarded. Second, the return flow of saline drainage water must be halted to prevent further deterioration of the water quality.

In the light of field studies carried out in the lower Piura Valley of northern Peru, where in recent years massive salinization has spelled disaster for irrigated land, several effective measures for the reduction of salinization should be recommended for the centres along the lower Murray: 1) the construction of an intensive network of observation wells designed to indicate the level, pressure and directional flow of the groundwater (through a careful balance between irrigation and drainage, the water table can be kept at the recommended depth of about 60 to 72 inches below the surface); 2) the development of water-table and soil-salinity maps to identify the gravity points of salinization; 3), the systematic mapping of the drainage capability of the soil types to eliminate from the irrigation system-soils that have unfavourable characteristics; 4) the systematic reduction of the sodium level through cation exchange with calcium sulfate and effective leaching. Other measures such as large-scale application of green manure and possibly sulphur, would help to prevent excessive concentrations of carbonates and salts in the soil and would lower the pH to more acceptable levels.

The removal of saline drainage water presents a more difficult, and also a more costly, problem. However, the cost must be weighed against the long-range damage and deterioration in the irrigation centres along the Murray. Although the evaporation basins may temporary stem the saline seepage into the streams, the massive accumulations of salts can only lead to eventual disaster. It is therefore necessary to prevent the return of any salinized water to the river or its floodplain. The construction of a concrete pipe conduit could be suggested, roughly paralleling the river, which would collect the drainage water from the irrigation centres and would carry it to the lower reaches of the river or even to the salt flats near the coast, where the water is no longer used. Such a system would have a duel effect; it would increase water quality at all the downstream locations, and it would permit leaching with a larger quantity of water than has been permissible in the past.

By following these suggestions, and by searching for additional safeguards, the future of the downstream communities as prosperous horticultural centres could be protected. Moreover, enlightened handling of the complex problems of irrigation would set an example for other oases of the world’s arid lands in their struggle against the ever-present danger of soil salinization.

Stratigraphy and Structure

Stratigraphy, in the present context, involves the sequential (successive) layering of rocks. Vertical successions of strata can reveal much about the conditions under which deposition took place The structure of rocks relates to their position and attitude, whether they are folded, tilted, warped, faulted. Naturally, when rocks possessing a certain persistent sequence and well-developed structure abut against (border) a coastline, we should search for a continuation of both on the opposite side of the dividing ocean. This is what Du Toit did when he researched his *Our Wandering Continents*, and eventually he could argue that he would predict from what he saw in Africa, where certain rocks and structures would be in South America.

Take, for example, the Cape Ranges, the east-west trending mountain range that lies at the southern end of the African continent. The Cape Ranges consist of a parallel series of ridges underlain by a complex succession of sedimentary rocks. The lowest series of rocks contains five layers: a reddish shale at the bottom, then a thick sandstone, then a tillite reflecting cold conditions, followed by another shale layer and then, at the top, a second sandstone layer. Above this series lie several thousand feet of additional shales, sandstones and a quartzite. After all these strata were laid down, probably under conditions like those prevailing in a large delta which experienced periodic subsidence, a period of folding occurred which threw the layers into structures we see today.

When Africa and South America are placed adjacent to each other on a map, the question arises whether these Cape Ranges extend into South America. It is, however, not enough merely to discover a range of mountains on a comparable topographic scale. The rock successions must be similar or at least related to those of the Cape Ranges, and the degree of folding ought to be similar. This was the sort of evidence Du Toit sought, when he studied the South Atlantic’s opposite coasts, and in the case of the Cape Ranges he found, in Argentina at the southern margin of the Pampa region, a range called Sierra de la Ventana. Geologic investigation proved that the rock sequences there were comparable to those in South Africa to an extent that went beyond chance. The Sierra de la Ventana was the western flank of the Cape Ranges.

It would be possible to chronicle hundreds, indeed thousands of cases of this sort. Fault lines, rock types, and numerous other geologic phenomena can indeed be traced across oceans of water. Before the mechanism for continental drift was understood it was necessary to add to the mass of field evidence, and the literature is full of examples of the trans-oceanic persistence of geologic occurrences.

Global Tectonics

Now we should return to the question of continental mobility, for behind it lies the whole problem of the structure and behaviour of the crust and upper mantle of the Earth. Current research indicates that the garth's outer shell, the crust, and the upper portion of the underlying mantle consist of a set of six large plates. Several smaller plates also exist, but their exact number and location are still not precisely identified. These plates are quite rigid and hard, and they rest on the weaker asthenosphere. They average some 60 miles (100 km) in thickness, and the six larger plates have diameters of thousands of miles. The African continent, for example, is only a part of the larger African Plate.

What has it all to do with continental drift? In the first place, it has been discovered that these plates, which incorporate both continental and oceanic areas, move with respect to one another. It is not that they simply move relative to each other: they are born along a world-wide system of oceanic ridges amid a giant upwelling of basaltic magma, then spread apart, and inevitably collide and crumple up into mountain ranges or slide under. Not until the characteristics of the globe-encircling system of mid-oceanic ridges became understood was it possible to recognize sea-floor spreading as a critical element in crustal mobility. The Mid-Atlantic Ridge, for example, had been known f many decades as a submarine, linear mountain range extending the length of the Atlantic about midway between Europe and Africa to the east and the Americas to the west. Seismographs the world over had identified that this was a zone of crustal instability. But only recently research revealed that here the American Plate is generated, its forces pushing to the west, diverging (separating) from the Eurasian and African plates, whose development is eastward. Thus the Mid-Atlantic Ridge, in common with the remainder of the Earth's 40,000 miles (60,000 km) of oceanic ridges, is in effect a tensional rift valley. As the tensional forces pull the plates apart, space is made for new liquid magma to flow through the fissures to create new ocean floor, material, replacing that which has moved away. The movement is slow, perhaps one inch (just under 2,5 centimeters) per year, but it is measurable. The whole system resembles two giant conveyor belts positioned adjacent to each other, slowly carrying their loads (the landmasses) away from the middle, the Mid-Atlantic Ridge.

One of the discoveries that led to this interpretation relates to the age of rocks in the ocean floors. When it became possible to drill bore holes and recover samples from the ocean floor, no rocks were found whose age was as great as those of the older rocks on the continents. The ocean basins are floored by comparatively young rocks, nothing other than, say, 125 million years. The scientists also found, as they studied samples along cross-sections of the ocean, that the rocks became younger as they approached the mid-oceanic ridges. This fits the theory, that the ocean basins were created along magma-producing rifts that became progressively wider, as described above.

So far we have discussed the divergent contact between the earth's major plates, that is, the lines along which they are created and move apart, carrying the continental landmasses with them. What about the collision zones? Two kinds of convergent contact occur: either one plate plunges below the other, a process that produces major mountain ranges of the linear, folded variety (such as the Andes) and, often, associated deep-sea trenches (such as the Peru Trench), or the plates slide past each other along great vertical faults. The San Andreas fault is an example of the latter contact marking the contact plane between the Pacific and American plates. Much of the rest of the Pacific "Ring of Fire" consists of the former type of contact with a high incidence of earthquakes and frequent volcanism attesting to the crust's instability.

The Earth's Interior

The crust of the Earth is the part of the solid earth that comes under observation of man. Rocks once buried as deep as 5 to 10 miles have been exposed by erosion, and they may be seen and studied, but little is positively known of the nature of the Earth below a depth of 5 to 10 miles.

It is known that the interior of the Earth is hot, for hot materials are expressed from it. Thermometer measurements of the temperatures in mines and bores show that the temperature of the Earth's crust increases steadily downward. The average increase is about 1° F per 60 or 65 feet, approximately 1° C per 100 feet.

If this increase continued to a depth of 100 kilometers, the temperature would be about 3,000° C, which is far above the melting points of ordinary rocks at the Earth's surface, but because of pressure the rocks are mainly in a solid state. Very little is known of the temperatures within the Earth. It is probable that they increase downward at a uniform rate. It is certain that most of the Earth is essentially solid, for most of it transmits earthquake waves of a character that do not pass through liquids. If, by compression or by radioactivity, parts of the Earth become molten, it is probable that some of this hot material rises toward the surface and carries heat with it. It is not unlikely that the outer part of the Earth has a relatively high temperature due to this process.

If the Earth were made of the same material from the surface downward, its density should vary with the pressure and presumably its elasticity and rigidity would vary approximately with the pressure. This evidently is not the case, however, for the rate at which earthquake waves are transmitted changes very irregularly with depth. At a depth of 60 miles the rate of increase of speed falls off, and at a depth of about 1,600 kilometers the velocity of earthquake waves becomes about uniform.

If the Earth were composed of the same material from the surface downward, for example of granite, it should be expected to show a nearly uniform change in density from the surface downward; because it does not do so, it is reasonable to suppose that the nature of the material changes, and it is supposed that the Earth is made up of zones of material of different composition.

The nature of these zones is stated below.

1. The outer shell is one composed chiefly of sedimentary rocks. At places this shell is wanting, and granite or gneiss or other igneous rocks crop out at the surface. At other places the sedimentary shell is known to be about 2 miles thick. Its average thickness is probably between 1 and 2 miles.

2. At many places granite-gneiss is formed below the sedimentary shell. The rigidity of the Earth increases rapidly to a depth of 60 kilometers or about 37 mile! This zone with a thickness of about 37 miles under continents is believed to be made up chiefly of granite and gneiss but becomes more basic probably changing to gabbro near its base.

3. Below the granite-gneiss shell is one of basic rocks probably peridotite in the main, which contains much iron in silicate minerals but probably no iron in the metallic state. In this material the earthquake wave travels at a velocity increasing with depth until it reaches a zone about 1,600 kilometers or about 1,000 miles below the surface.

4. Below the depth of 1,000 miles the velocity of the earthquake wave is about uniform. Although it passes through more highly compressed material, there is no increase in its speed, and it is believed that there is a change in the character of the material, so that the speed of the wave remains about uniform notwithstanding the increase in density of the material through which it passes. In this zone the material is believed to be pallasite, a mixture of the minerals of basic rocks and metallic iron, the latter increasing with depth.

Probably increased pressure does not cause the velocity of the wave to increase in iron as much as it does in basic rock. The effect of steady increase of pressure might be balanced by increase of iron if the proportion of iron steadily increased so that the velocity of the wave would remain essentially uniform.

5. At a depth of about 2,000 miles the velocity of the earthquake wave decreases, although it is passing through denser material. It is believed that this change is due to another change in the character of the material through which the wave passes and that below that depth the material of the Earth is essentially iron or nickel iron.

Satellites

The artificial Earth-orbiting satellite is a new means of observing the weather; it presents two important advantages over all other known techniques:
1) it provides a means of observing the weather from out-side the atmosphere;
2) it is a means of providing weather information promptly and on a truly global scale.

Meteorological satellites which have so far been used have carried ingenious devices for observing the atmospheric conditions. They include such items as television cameras which take photographs of the Earth's surface and which hence reveal the cloud formations; such cameras incidentally also provide supplementary information such as snow over land masses and floating ice over sea areas. They may also be equipped with instruments for making various kinds of radiation measurements in the infra-red band which reveal the temperature of the land or cloud layer immediately below the satellite and thus enable cloud areas to be detected; moreover this system may be used at night for detecting cloud systems during darkness when normal photographic methods cannot be used.

A meteorological satellite may also be equipped with sensitive photometric devices which measure by optical means the brightness of the Earth's surface, enabling cloud areas to be detected.

Initially all the observations had to be stored in the satellite until transmitted on command to a major read-out station with its vast array of telecommunications equipment but a later development made it possible for photographs to be transmitted on a continuous basis and to be received in any country over which the satellite is passing, by means of relatively simple and inexpensive ground equipment. This important new development, which is known as Automatic Picture Transmission (APT), will mean that direct reception of weather information in the form of photographs covering an area of a radius of 1,600 kilometers around the receiving station will be within the reach of every country of the world. In other words each country, whether large or small, will have the possibility of participating directly in the space age. Many countries are in fact already equipped with APT receivers.

Another important advantage of the APT system is that it will simplify the arrangements which would otherwise have to be made for transmitting such information from one or other of the few major read-out stations to each country.

The use of satellites for practical meteorological purposes is not simply a hope for the future. Useful satellite data has in fact been received continuously from the very successful series of TIROS satellites of the United States, the first of which was launched in 1960. It must be noted however that interpretation of the Information obtained from meteorological satellites is a very skilled operation and requires specially trained personnel.

Detection of the main cloud masses is of course not difficult but a skilled scientist can deduce much more than this from the satellite photographs. The type and height of cloud, the wind direction and even the jet stream (a narrow band of very strong wind which frequently occurs in temperate latitudes at heights of out 10,000 m and which is of great importance for aviation and general forecasting purposes) may be detected.

Today's World Exchange of Weather Information

In any period of 24 hours about 100,000 observations of weather conditions at the surface of the Earth and about 11,000 observations of the upper atmosphere are recorded. These observations are made at some 8,000 land stations distributed among all countries of the world, on 3,000 transport and reconnaissance aircraft and 4,000 merchant ships.

These observations are made by day and by night at fixed times which are standardized throughout the world. The observations are collected by a network of national, regional and continental centres and are then transmitted as collective messages to all countries. It is this information which constitutes the basic information plotted on weather maps throughout the world. Such maps are generally prepared at sixhourly intervals (and sometimes more frequently) and they are the means of analyzing existing weather situations and of preparing weather forecasts for all purposes – agriculture, aviation, shipping, etc. A meteorological telecommunications system covering the whole world has therefore been developed to ensure the prompt collection and dissemination of this basic weather data.

The system of weather observing and exchange demonstrates the importance of weather information in the modern world and is indeed quite a remarkable example of international co-operation; it is nevertheless incomplete and deficient in many ways as regards the means of observing the atmosphere and the international exchange of the data so obtained. The main deficiencies are as follows:

In the Southern Hemisphere, 75% of which is covered by oceans weather observations, both at the Earth's surface and in the upper-air, are very inadequate. Facilities for exchanging observations within the Southern Hemisphere also need improvement.

Information regarding the upper layers of the atmosphere is insufficient all over the world. This information is essential, not only for forecasting (in particular for aviation), but also for a better understanding of the processes of the atmosphere. Satellite photographs of cloud formations have already revealed phenomena in the upper-air which had not been observed at all by routine balloon ascents and have thus demonstrated how scanty our upper-air observation network is.

Usefulness of the weather information received by the forecaster depends to a very large degree on how quickly he obtains it; therefore speed of transmission of weather observations is an important problem. To improve forecasting the international exchange of weather reports must not only be extended to obtain more information, but must also be speeded up.

Progress in the science of meteorology made possible by the system of exchange data so far developed has demonstrated that there is a relationship between weather phenomena in the Northern and in the Southern Hemispheres. In particular, efforts to extend the range of forecasting to several days or even a month have shown that further progress in this direction can only be achieved if information from both hemispheres is constantly available to the forecaster. Thus the prompt exchange of data between the two hemispheres is required.

Need for weather information has increased very greatly because of worldwide recognition of the benefits which it can provide to economic development. Agriculture, water utilization, transportation, etc, are all important aspects of economic development and all depend in one way or another on weather and climate. The present system does not enable the maximum assistance to be given in these fields.

How can these deficiencies be rectified and so enable a world system to be introduced capable of meeting present day needs more effectively? Fortunately, several new tools have become available for observing and analyzing the weather—they include artificial satellites, high speed electronic computers, automatic weather stations and meteorological buoys. Fortunately also, new telecommunications techniques are constantly being developed and are becoming available for meteorological purposes.

The Development of Weather Services

Although man has been exposed throughout the ages to the vagaries of the weather and has been forced to adapt his life and habits to them, it is strange to recall that only in relatively modern times has it been realized that weather systems move. They may change their form as they move: thus a particular storm as it moves may become more intense or less intense – and the problem of forecasting the weather is essentially one of predicting the movement of weather systems and the way in which they will change as they move. It is for this reason that weather forecasting is only possible if up-to-date weather information is available over a large area surrounding the place for which the forecast is required. It is for the same reason that weather can only be effectively studied on an international basis and by collaboration between all nations.

Man is an inquisitive creature and from the earliest days of civilization his dependence on the weather has made him curious as to how it is created, where it comes from and where it goes. With the steady growth of general scientific knowledge over the centuries our understanding of weather processes developed. The recognition of the inter-relationship of such things as temperature, wind, pressure, cloud and rain was a gradual but significant achievement. Nowadays much more is known about the behaviour of the atmosphere and, within the limits of such knowledge, efficient meteorological services now exist in most countries of the world.

We are however still far from a complete understanding of the complex processes involved in the change and movement of weather systems and much knowledge still remains to be gained. But the stage has been reached where some of the major problems, as yet unsolved – such as long-range forecasting and weather modification – can at least now be studied with a hope of success which only a few years ago could not have been conceived.

International collaboration will be even more essential in the future than it was in the past, for modern techniques require that information be obtained from greater and greater areas of the Earth’s surface and the World Weather Watch is now conceived as a global system. One of the main problems to be solved is how to observe the weather on a global scale. There is also the problem of establishing a global telecommunications system to ensure the collection of these data at appointed centres and their subsequent dissemination in one form or another to all countries of the world. Another important factor is that, unlike many other sciences, meteorology does not lend itself to experiments under a set of predetermined conditions.

While man’s interest in the weather is as old as his ability to think, it was only about a century ago that the science of meteorology and the practical application of the science on a significant scale may be said to have begun. The reason for this is that the meteorologist, unlike some scientists, cannot obtain the observations he requires by, the touch of a button or by simply reading a set of instruments; he clearly cannot himself observe the whole of his laboratory – the atmosphere – at one time. The observations made elsewhere must come to him, and they must come quickly if they are to be used for forecasting. The invention of the telegraph system in the first half of the nineteenth century made this possible. From that time onwards, weather reports from different places could be rapidly collected and up-to-date weather maps could be plotted.

Much of the early progress in the development of organized weather services was due to sailors, for in the days of sailing ships a good sailor had perforce to be a good meteorologist. It was in fact a violent storm in 1854 which sank British and French warships in the Black Sea and the subsequent awareness that the disaster could have been averted, had news of approaching storm been transmitted by telegraph to the part of Balaklava, which provided the stimulus which led to the creation of national meteorological services in Europe.

It was also by the initiative of mariners that an international meeting on weather reporting was held in Brussels in 1853; it was the first international conference on meteorology to be held and may be said to mark the beginning of international meteorology as we know it.

With the establishment of weather services many improvements followed. Improved methods of observing the atmosphere were developed. Networks of meteorological stations on land appeared; the use of merchant ships to obtain regular information from the ocean areas was introduced and later, in some regions special ocean weather ships came into operation. The upper atmosphere was explored in a routine manner by balloons, kites and later by aeroplanes, radiosondes and rockets; most recently, Earth-orbiting satellites, for observing the Earth's atmosphere on a global scale appeared.

Nowadays, there is no country in the world which does not have a national meteorological service and few in which investigational research work in some form or other is not being conducted. They all serve their respective countries; they all contribute to and benefit from the world weather system.

The Global Observation System

The largest single obstacle to a full scientific understanding of our atmosphere is the lack of adequate weather observations from the entire globe. Little real progress in improving the accuracy of weather forecasts, or in extending their period of validity, is likely until this shortcoming is remedied.

At present less than one quarter of the surface of the globe has sufficient meteorological stations. Even over those land areas where the density of surface weather reports is adequate the number of stations making soundings of the upper atmosphere is frequently too small or their observations fail to reach the desired heights. As regards the oceans, valuable reports are received from ships plying the world's trade routes, but for the most part the oceans yield little or no meteorological information. This means that over most of our planet we do not know the structure of the atmosphere in sufficient detail to understand the physical processes taking place at any given moment. Since current methods of weather forecasting start from the knowledge of actual weather conditions the implications of this ignorance are evident.

The development of a truly global observation system presents one of the most exciting challenges of the World Weather Watch and at the same time a problem of enormous dimensions. It is a problem that calls for a bold and adventurous approach. The gap in the continental networks of stations reporting surface conditions must be filled by new stations and, more urgently, the number of radiosonde station must be greatly increased, notably in developing countries. In a few parts of the world the problems cannot be overcome by conventional methods and the completion of the surface network may only be achieved when suitable automatic equipment can be installed.

Over the ocean different solutions must be found and it is here that the full resources of scientific ingenuity and skill must be employed. Conventional observations taken at the sea level aboard merchant ships must evidently be increased; and in addition if the large-scale introduction of radiosonde observations on these vessels could be arranged, a considerable improvement in the present upper-air network would result. But these methods alone will by no means solve the problem of sampling the atmosphere over the vast empty reaches of ocean where no ship sails.

Several new methods are fortunately available or are being studied to fill these gaps on land and sea. In the first place the meteorological satellite has already demonstrated beyond any doubt its unique and unprecedented capacity for obtaining certain types of weather information on a truly global scale. By means of television cameras and infra-red sensors cloud patterns covering the Earth can be detected and from this information much can be learned about weather systems and their movement and development. These valuable functions, which have given us the first global view of e world's weather will certainly be extended in the future. Spectrometers and other new devices, perhaps including lasers, will enable satellites to be used for vertical sampling of temperature and other elements. It is clear that within a few years space techniques will have to play a leading role in a new observational system.

Other methods used to complete the system will include special aircraft reconnaissance flights as well as reports from commercial aircraft. The use of radiosondes which transmit observations as they descend on a parachute after release from an aircraft is likely to become more widespread. Meteorological rockets and ocean weather ships will also play their role.

Many of these projects are still experimental and the final mixture of observing techniques will evidently depend on many factors, not least the cost and efficiency of each type in different parts of the world. Whatever the choice, meteorology stands on the threshold of a new era as the result of the rapid development in space technology and advances in electronics, with the promise of considerable benefits to be reaped from the money and effort expended upon the global observing system.

But effort and money devoted to this end will be of little avail unless it is effectively supported by a speedy and reliable system for the collection and distribution of the resulting data. For this reason a telecommunication system capable of handling a greatly increased quantity of material is being developed whose task is to collect weather observations from all parts of the world, taking into account various methods used to obtain measurements, and then to ensure that they are rapidly transmitted to the national, regional and world meteorological centres which are waiting to use them. It also has a second function, hardly less important, to provide a means by which the analyses and forecasts based on the observations can be given the required distribution. Not infrequently as a part of the forecasting system the telecommunication channels must carry warnings of the approach of bad weather for which early device is vital to the safety of human life. The essence of the system is therefore speed and reliability.

More About Life on Venus

The possibility of life on the surface of Venus has been given another airing, this time by the distinguished American scientist Dr. Libby, Professor of Physics at University of California, at Los Angeles. The essence of Dr. Libby's argument is that, in spite of the high temperatures thought to be characteristic of the surface of Venus, it should nevertheless be possible for ice-caps to exist there.

The conclusion is based on data obtained by the Russian spacecraft *Venera-4*. Measurements by *Venera-4* show that the atmosphere of Venus consists largely of carbon dioxide. There seems to be as much carbon dioxide in the atmosphere of Venus as there is in the form of limestone in the earth's crust.

This suggests that the planets may be similar in composition and history. The carbon dioxide on the Earth is believed to have been liberated by volcanic action, together with large amounts of water, presumably in the form of steam. This poses the question: what has happened to Venus' water?

The *Venera-4* measurements show that the water cannot be in the atmosphere, and there are good reasons for believing that there are no oceans on Venus. Professor Libby therefore suggests that water may be trapped in ice-caps at the poles.

At first sight this seems to contradict much to what is known about Venus. Evidence based on the emission of short wavelength radiowaves, called microwaves, shows that the temperature at the surface of the planet might be as high as 400° C in equatorial regions and 200° C at the poles.

Venera 4, however, found the temperatures in the equatorial regions to be lower than this, about 200°. This suggests to Professor Libby that a temperature below the freezing point of water may be possible at the poles. The polar temperature based on the microwave data could be in error, Dr. Libby suggests, because of the great thickness of the atmosphere through which emission from the polar regions has to travel.

For similar reasons, he suspects the surface temperatures measured by the US space probe *Mariner-2*. In his article in the *Science*, Professor Libby says that our knowledge of Venus supports the idea that the Earth and Venus were made of similar material and contained about the same amount of carbon in the form of carbides, carbonates and so on. These carbon compounds were converted to carbon dioxide and released to the atmosphere in association with water by volcanic action. In the case of Venus, most of the water condensed to form icecaps at the polar regions.

Professor Libby cites evidence that the thick clouds obscuring the surface of Venus consist of water vapour. He visualized streams running from the edge of the ice-caps into a hot equatorial desert and evaporating. In this way the clouds are continually replenished, and the water returns to the polar regions as snow.

Given these conditions, Dr. Libby thinks that forms of life able to exist in high concentrations of carbon dioxide, may live on Venus in mild conditions at the boundary of the ice sheets.

GLOSSARY

A

abiotic – абиотический
ablation – таяние ледников, размывание пород
absolute humidity – абсолютная влажность
accumulation – накопление
acid – кислота
acid precipitation – кислотные осадки
acid rain – кислотный дождь
advection – адвекция, перенос воздуха в горизонтальном направлении
air mass – воздушная масса
air pollution – загрязнение воздуха
alfisols – серые лесные почвы
Alpine glacier – альпийский ледник
altitude – высота над уровнем моря
amphibian – земноводный
anticyclone – антициклон
aquatic – водяной; водный
aridisols – красно-бурые пустынные почвы
atmosphere – атмосфера
atmospheric pressure – атмосферное давление

B

bacteria – бактерия
basin – бассейн, водоем
bay – бухта, залив
beach – (морской) берег
biogeography – биогеография
biome – биом
biosphere – биосфера
boreal forest – арктический лес

C

Cambrian – кембрийский
Canadian shield – канадский щит
canyon – каньон, глубокое ущелье
cartography – картография
cell – биол. клетка
Celsius – термометр Цельсия; шкала термометра Цельсия
Cenozoic – кайнозойский

chlorophyll – хлорофилл
cirque – горный амфитеатр; цирк
climate – климат
climatic optimum – климатически наиболее благоприятные условия
climatology – климатология
coastal wetland – прибрежная заболоченная территория
coastal zone – прибрежная зона
coastline – береговая линия
cold front – холодный фронт
community – общность
competition – конкуренция, соперничество
convection – конвекция, перемещение, круговорот
Coriolis force – сила Кориолиса
Cretaceous – меловой период
crust – земная кора; поверхностные отложения
cyclone – циклон

D
deciduous – лиственный
deforestation – обезлесение, вырубка леса
diversity (Species Diversity) – разнообразие (разнообразие видов)
drift – медленное течение, снос, ледниковый нанос
drought – засуха; засушливость; нехватка дождей

E
Earth rotation – вращение Земли
ecological diversity – экологическое разнообразие
ecology – экология
ecosystem – экосистема, экологическая система; биогеоценоз
ecosystem diversity – видовое разнообразие экологической системы
endangered species – вымирающие виды
equator – экватор
erosion – эрозия, разъедание; разрушение; размывание; выветривание
evaporation – испарение
evolution – эволюция
extinction – вымирание (вида животных)

F
fiord – фиорд
fog – туман; дымка; мгла

food chain – пищевая цепь, трофическая связь (в биологическом сообществе)
food web – пищевая “сеть” (в биологическом сообществе)
fossil – ископаемое, окаменелость
freezing – замерзание; застывание, затвердевание
fresh water – пресная вода
frost – мороз
funnel – любой объект в форме воронки

G
gene – ген
genetic diversity – генетическое разнообразие
geoid – геоид
geology – геология
geomorphology – геоморфология
glacier – ледник
global warming – глобальное потепление
grassland – луг
greenhouse effect – парниковый эффект
groundwater – подземные воды

H
habitat – естественная среда
Holocene – голоцен
human geography – социальная география
humidity – влажность
hurricane – ураган
hydrology – гидрология
hydrosphere – гидросфера

I
Ice age – ледниковый период
iceberg – айсберг
icecap – ледниковый покров (в горах); полярный лед
ice sheet – ледниковый щит
inceptisols – бурые почвы
insolation – инсоляция
interaction (biological) – взаимодействие (биологическое)
interglacial – межледниковый
irrigation – ирригация, орошение
isostacy – изостазия

J
jet stream – струйное течение
Jurassic – юрский
L
latitude – широта
liquid – жидкий
lithosphere – литосфера
little climatic optimum – малый климатический оптимум
longitude – долгота
lower mantle – нижняя мантия

M
mammal – млекопитающее
mantle – мантия
marine – морской
mass extinction – массовое вымирание
melting – таяние
meltwater – талая вода
meridian – меридиан
mesosphere – мезосфера
Mesozoic – мезозойский
microgeography – микрогеография
mid-latitude cyclone – циклон средних широт
mollisols – черные почвы прерий

N
native species – *биол.* аборигенные виды
North Pole – Северный полюс

O
occluded front – окклюдированный фронт
ocean floor – дно океана
oceanic crust – океаническая кора
oceanography – океанография
origin – происхождение
oxisols – красно-бурые почвы
ozone hole – озоновая дыра
ozone layer – озоновый слой
ozonosphere – озоносфера

P
Paleozoic – палеозойский
permafrost – вечная мерзлота
pesticide – пестицид, средство для борьбы с вредителями
physical geography – физическая география
piedmont glacier – ледник, находящийся у подножия горы
platform – платформа
Pleistocene – плейстоцен
Precambrian – докембрий, докембрийский
precipitation – выпадение осадков

R
relative humidity – относительная влажность
relief – рельеф местности
resource – запасы, ресурсы, средства; природные богатства
rock – горная порода; богатая руда
runoff – сток; объём стока

S
saturation – насыщение, насыщенность
seawater – морская вода
sedimentary rock – осадочная горная порода
shrub – куст, кустарник
snow line – нижняя граница вечных снегов; снеговая граница, линия
soil erosion – эрозия почв
South Pole – Южный полюс
species – вид
spodsols – подзолистые почвы
stratopause – стратопауза
stratosphere – стратосфера

T
tectonic plate – тектоническая платформа или плита
thermosphere – термосфера
thunderstorm – гроза
tide – прилив и отлив
tornado – смерч, торнадо, шквал
tornado alley – аллея торнадо
trade winds – пассаты
tropical rainforest – тропический лес; влажные джунгли
tropopause – тропопауза

troposphere – тропосфера

U
ultraviolet – ультрафиолетовый
Universe – Земля, вселенная
updraft – восходящий поток
upper mantle – верхняя мантия
V
valley – долина; впадина, лощина, низина
vertebrate – позвоночное животное
volcano – вулкан

W
warm front – тёплый фронт
wave – волна
weathering – выветривание, эрозия
westerlies – западные ветры, весты

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