ПЕРЕДМОВА

Методичні вказівки для СРС та навчальний матеріал з англійської мови призначені для студентів ***II курсу*** денної форми навчання зі спеціальності «Науки про Землю».

Мета запропонованих методичних вказівок — розвинути навички читання, аналізу, перекладу текстів, а також їх переказу на матеріалі наукової літератури за фахом.

Методичні вказівки складаються з <u>6 уроків</u>, де подано відповідний граматичний матеріал за програмою, а також тексти, що відібрані з оригінальної науково-популярної та наукової літератури.

Тексти А та В призначені для аудиторній роботи студентів: для читання, усного перекладу, аналізу елементів тексту, анотування та переказу; ***тексти С*** тематично пов'язані з текстами А та В, призначені для СРС та тематично-письмового перекладу з подальшою перевіркою на занятті, уточненням значень окремих лексичних одиниць та переказу.

<u>**Лексичні вправи**</u> призначені для вивчення та закріплення лексичного матеріалу кожного уроку та охоплюють лексику основних текстів. Вони можуть бути використані також для контролю (самоконтролю) засвоєння лексичного матеріалу уроку. Під час виконання лексичних вправ рекомендується не тільки підбирати українські або англійські еквіваленти наведених слів та словосполучень, але й знаходити у тексті або складати самостійні речення з зазначеними словами, звертаючи увагу на багатозначність слів.

<u>**Граматичні вправи**</u> спрямовані на аналіз найскладніших граматичних явищ англійської мови, розвиток навичок орієнтування у граматичній структурі англійського речення, що сприяє вірній інтерпретації текстів, уної мови та матеріалів наукорої літератури.

<u>Після вивчення даного курсу студенти повинні знати і вміти:</u>

читати та перекладати науково-технічну англомовну літературу за фахом для отримання необхідної інформації;

розуміти зміст прочитаного та лексико-граматичний матеріал, наданий у методичних вказівках;

розуміти і володіти відповідними граматичними конструкціями та матеріалом;

брати участь в усному спілкуванні англійською мовою в обсязі матеріалу, передбаченого програмою.

LESSON 1

<u>Grammar :</u> The Infinitive

Text A THE IMPORTANCE OF EARTH SCIENCE

Today we live in a time when the Earth and its inhabitants face many challenges. Our climate is changing and that change is being caused by human activity. Earth scientists recognized this problem and will play a key role in efforts to resolve it. We are also challenged to: develop new sources of energy that will have minimal impact on climate; locate new sources of metals and other mineral resources as known sources are depleted; and, determine how Earth's increasing population can live and avoid serious threats such as volcanic activity, earthquakes, landslides, floods and more. These are just a few of the problems where solutions depend upon a deep understanding of Earth science.

<u>Earth science</u>

Earth science or geoscience is an all-embracing term for the fields of science related to the planet Earth. It can be considered to be a branch of planetary science, but with a much older history. There are both reductionist and holistic approaches to Earth sciences. The Earth sciences can include the study of geology, the lithosphere, and the large-scale structure of the Earth's interior, as well as the atmosphere, hydrosphere, and biosphere. Typically, Earth scientists use tools from geography, physics, chemistry, biology, chronology, and mathematics to build a quantitative understanding of how the Earth system works and evolves.

Physical geography, covers aspects of geomorphology, soil study, hydrology, meteorology, climatology, and biogeography.

Geology describes the rocky parts of the Earth's crust (or lithosphere) and its historic development. Major subdisciplines are mineralogy and petrology, geochemistry, geomorphology, paleontology, stratigraphy, structural geology, engineering geology, and sedimentology.

Geophysics and geodesy investigate the shape of the Earth, its reaction to forces and its magnetic and gravity fields. Geophysicists explore the Earth's core and mantle as well as the tectonic and seismic activity of the lithosphere. Geophysics is commonly used to supplement the work of geologists in developing a comprehensive understanding of crustal geology, particularly in mineral and petroleum exploration.

Soil science covers the outermost layer of the Earth's crust that is subject to soil formation processes (or pedosphere). Major subdisciplines include edaphology and pedology.

Ecology covers the interactions between the biota, with their natural environment. This field of study differentiates the study of the Earth, from the study of other planets in the Solar System; the Earth being the only planet teeming with life.

Hydrology (includes oceanography and limnology) describe the marine and freshwater domains of the watery parts of the Earth (or hydrosphere). Major subdisciplines include hydrogeology and physical, chemical, and biological oceanography.

Glaciology covers the icy parts of the Earth (or cryosphere).

Atmospheric sciences cover the gaseous parts of the Earth (or atmosphere) between the surface and the exosphere (about 1000 km). Major subdisciplines include meteorology, climatology, atmospheric chemistry, and atmospheric physics.

Overview of Earth Science

Earth is the mighty planet upon which we all live. Only recently have humans begun to understand the complexity of this planet. In fact, it was only a few hundred years ago that we discovered that Earth was just a tiny part of an enormous galaxy, which in turn is a small part of an even greater universe. Earth Science deals with any and all aspects of the Earth. Our Earth has molten lava, icy mountain peaks, steep canyons and towering waterfalls. Earth scientists study the atmosphere high above us as well as the planet's core far beneath us. Earth scientists study parts of the Earth as big as continents and as small as the tiniest atom. In all its wonder, Earth scientists seek to understand the beautiful sphere on which we thrive.

Because the Earth is so large and science is so complex, Earth scientists specialize in studying just a small aspect of our Earth. Since all of the branches are connected together, specialists work together to answer complicated questions. Let's look at some important branches of Earth Science.

Geology

Geology is the study of the solid matter that makes up Earth. Anything that is solid, like rocks, minerals, mountains, and canyons is part of geology. Geologists study the way that these objects formed, their composition, how they interact with one another, how they erode, and how humans can use them. Geology has so many branches that most geologists become specialists in one area. For example, a mineralogist studies the composition and structure of minerals such as halite (rock salt), quartz, calcite, and magnetite .

A volcanologist braves the high temperatures and molten lava of volcanoes. Seismologists study earthquakes and the forces of the Earth that create them. Seismologists monitor earthquakes worldwide to help protect people and property from harm. Scientists interested in fossils are paleontologists, while scientists who compare other planets' geologies to that of the Earth are called planetary geologists. There are geologists who only study the Moon. Some geologists look for petroleum, others are specialists on soil. Geochronologists study how old rocks are and determine how different rock layers formed. There are so many specialties in geology that there is probably an expert in almost anything you can think of related to the Earth .

Oceanography

Oceanography is the study of everything in the ocean environment. More than 70% of the Earth's surface is covered with water. Most of that water is found in the oceans. Recent technology has allowed us to go to the deepest parts of the ocean, yet much of the ocean remains truly unexplored. Some people call the ocean the last frontier. But it is a frontier already deeply influence by human activity. As the human population gets even bigger, we are affecting the ocean in many ways. Populations of fish and other marine species have plummeted because of overfishing; contaminants are polluting the waters, and global warming caused by greenhouse gases is melting the thick ice caps. As ocean waters warm, the water expands and, along with the melting ice caps, causes sea levels to rise.

Climatologists help us understand the climate and how it will change in the future in response to global warming. Oceanographers study the vast seas and help us to understand all that happens in the water world. As with geology, there are many branches of oceanography. Physical oceanography is the study of the processes in the ocean itself, like waves and ocean currents. Marine geology uses geology to study ocean earthquakes, mountains, and trenches. Chemical oceanography studies the natural elements in ocean water and pollutants.

Climatology and Meteorology

Meteorology is the study of the atmosphere and how processes in the atmosphere determine. Earth’s weather and climate. Meteorology is a very practical science because everyone is concerned about the weather. How climate changes over time in response to the actions of people is a topic of urgent worldwide concern. The study of meteorology is of critical concern for protecting Earth’s environment.

Perhaps this branch of Earth Science is strangely named but it is very important to living creatures like humans. Meteorology includes the study of weather patterns, clouds, hurricanes, and tornadoes. Using modern technology like radars and satellites, meteorologists work to predict or forecast the weather. Because of more accurate forecasting techniques, meteorologists can help us to prepare for major storms, as well as help us know when we should go on picnics.

Climatologists and other atmospheric scientists study the whole atmosphere, which is a thin layer of gas that surrounds the Earth. Most of it is within about 10 - 11 kilometers of the Earth’s surface. Earth’s atmosphere is denser than Mars’s thin atmosphere, where the average temperature is -63° C, and not as thick as the dense atmosphere on Venus, where carbon dioxide in the atmosphere makes it hot and sulfuric acid rains in the upper atmosphere. The atmosphere on Earth is just dense enough to even out differences in temperature from the equator to the poles, and contains enough oxygen for animals to breathe.

Over the last several decades, climatologists studying the gases in our atmosphere have found that humans are putting a dangerous amount of carbon dioxide into the air by burning fossil fuels. Normally, the atmosphere contains only small amounts of carbon dioxide, and too much of it makes it trap heat from the sun, causing the Earth to heat up, an effect we call global warming.

Climatologists can help us better understand the climate and how it may change in the future in response to different amounts of greenhouse gases and other factors.

Astronomy

Astronomers have proven that our Earth and solar system are not the only set of planets in the universe. By 2007, over a hundred planets outside our solar system had been discovered. Although no one can be sure how many there are, astronomers estimate that there are billions of other planets. In addition, the universe contains black holes, other galaxies, asteroids, comets, and nebula. As big as Earth seems to us, the entire universe is vastly greater. Our Earth is an infinitesimally small part of our universe.

Astronomers use resources on the Earth to study physical things beyond the Earth. They use a variety of instruments like optical telescopes and radio telescopes to see things far beyond what the human eye can see. Spacecraft travel great distances in space to send us information on faraway places, while telescopes in orbit observe astronomical bodies from the darkness of space.

Astronomers ask a wide variety of questions. Astronomers could study how an object or energy outside of Earth could affect us. An impact from an asteroid could have terrible effects for life on Earth. Strong bursts of energy from the sun, called solar flares, can knock out a power grid or disturb radio, television or cell phone communications. But astronomers ask bigger questions too. How was the universe created? Are there other planets on which we might live? Are there resources that we could use? Is there other life out there? Astronomy also relies on Earth Science, when scientists compare what we know about life on Earth to the chances of finding life beyond this planet.

Other Branches of Earth Science

Geology, oceanography, and meteorology represent a large part of Earth science, while astronomy represents science beyond Earth. However, there are still many smaller branches of science that deal with the Earth or interact greatly with Earth sciences. Most branches of science are connected with other branches of science in some way or another.

Below are examples of a few branches of science that are directly related to Earth science. Environmental scientists study the ways that humans interact with the Earth and the effects of that interaction. We hope to find better ways of sustaining the environment. Biogeography is a branch of science that investigates changes in populations of organisms in relation to place over time. These scientists attempt to explain the causes of species' movement in history. Ecologists focus on ecosystems, the complex relationship of all life forms and the environment in a given place. They try to predict the chain reactions that could occur when one part of the ecosystem is disrupted.

As opposed to an oceanographer, a limnologist studies inland waters like rivers and lakes. A hydrogeologist focuses on underground water found between soil and rock particles, while glaciologists study glaciers and ice.

None of these scientific endeavors would be possible without geographers who explore the features of the surface and work with cartographers, who make maps. Stratigraphy is another area of Earth science which examines layers of rock beneath the surface. This helps us to understand the geological history of the Earth. There is a branch of science for every interest and each is related to the others.

I. Review Exercises:

1 Define and describe Earth Science as a general field with many branches.

2. Identify the field of geology as a branch of Earth Science that deals with the solid part of the Earth.

3. Describe the field of oceanography as a branch of Earth Science that has several subdivisions that deal with the various aspects of the ocean.

4. Define the field of meteorology as a branch of Earth Science that deals with the atmosphere.

5. Understand that astronomy is an extension of Earth Science that examines other parts of the solar system and universe.

6. List some of the other branches of Earth Science, and how they relate to the study of the Earth.

II. For each term on the left match the definition on the right.

a) Hydrology	describes the rocky parts of the Earth's crust
b) Geology	covers the interaction between the biota
c) Geophysics	cover the gaseous parts of the Earth between the surface and the exosphere
d) Glaciology	describes the hydrosphere
e) Ecology	covers the outermost layer of the Earth's crust
f) Soil science	investigates the shape of the Earth …
g) Atmospheric sciences	covers the icy parts of the Earth

III. Explain the following words:

Lithosphere, limnology, petrology, pedosphere, stratigraphy.

Text B METEOROLOGY

1. Meteorology is the interdisciplinary scientific study of the atmosphere. The study of meteorology dates back millennia, though significant progress in meteorology did not occur until the 18th century. The 19th century saw modest progress in the field after weather observation networks were formed across broad regions. Prior attempts at prediction of weather depended on historical data. It wasn't until after the elucidation of the laws of physics and, more particularly, the development of the computer, allowing for the automated solution of a great many equations that model the weather, in the latter half of the 20th century that significant breakthroughs in weather forecasting were achieved.

Meteorological phenomena are observable weather events that are explained by the science of meteorology. Meteorological phenomena are described and quantified by the variables of Earth's atmosphere: temperature, air pressure, water vapor, mass flow, and the variations and interactions of those variables, and how they change over time. Different spatial scales are used to describe and predict weather on local, regional, and global levels.

Meteorology, climatology, atmospheric physics, and atmospheric chemistry are sub-disciplines of the atmospheric sciences. Meteorology and hydrology compose the interdisciplinary field of hydrometeorology. The interactions between Earth's atmosphere and its oceans are part of a coupled ocean-atmosphere system. Meteorology has application in many diverse fields such as the military, energy production, transport, agriculture, and construction.

The word "meteorology" is from Greek meteoros "lofty; high (in the sky)" (from - meta- "above" and aeiro "I lift up") and -logia "-(o)logy", i.e. "the study of things in the air".

Weather Forecasting

2. Weather forecasts are better than they ever have been. According to the World Meteorological Organization (WMO), a 5-day weather forecast today is as reliable as a 2-day forecast was 20 years ago! This is because forecasters now use advanced technologies to gather weather data, along with the world’s most powerful computers. Together, the data and computers produce complex models that more accurately represent the conditions of the atmosphere. These models can be programmed to predict how the atmosphere and the weather will change. Despite these advances, weather forecasts are still often incorrect. Weather is extremely difficult to predict, because it is a very complex and chaotic system.

Collecting Weather Data

To make a weather forecast, the conditions of the atmosphere must be known for that location and for the surrounding area. Temperature, air pressure, and other characteristics of the atmosphere must be measured and the data collected.

Thermometers measure temperature. One way to do this is to use a temperature-sensitive material, like mercury, placed in a long, very narrow tube with a bulb. When the temperature is warm, the mercury expands, causing it to rise up the tube. Cool temperatures cause the mercury to contract, bringing the level of the mercury lower in the tube. A scale on the outside of the thermometer matches up with the air temperature.

Because mercury is toxic, most meteorological thermometers no longer use mercury in a bulb. There are many ways to measure temperature. Some digital thermometers use a coiled strip composed of two kinds of metal, each of which conducts heat differently. As the temperature rises and falls, the coil unfolds or curls up tighter. Other modern thermometers measure infrared radiation or electrical resistance. Modern thermometers usually produce digital data that can be fed directly into a computer.

Meteorologists use barometers to measure air pressure. A barometer may contain water, air, or mercury. Like thermometers, barometers are now mostly digital. Air pressure measurements are corrected so that the numbers are given as though the barometer were at sea level. This means that only the air pressure is measured instead of also measuring the effect of altitude on air pressure.

A change in barometric pressure indicates that a change in weather is coming. If air pressure rises, a high pressure cell is on the way and clear skies can be expected. If pressure falls, a low pressure is coming and will likely bring storm clouds. Barometric pressure data over a larger area can be used to identify pressure systems, fronts and other weather systems.

Other instruments measure different characteristics of the atmosphere. Below is a list of a few of these instruments, along with what they measures:

anemometers: wind speed
hygrometers: humidity
wind vane: wind direction
rain gauge: the amount of liquid precipitation over a period of time
snow gauge: the amount of solid precipitation over a period of time.

These instruments are placed in various locations so that they can check the atmospheric characteristics of that location. Weather stations are located on land, the surface of the sea, and in orbit all around the world. According to the WMO, weather information is collected from 15 satellites, 100 stationary buoys, 600 drifting buoys, 3,000 aircraft, 7,300 ships and some 10,000 land-based stations.

Instruments are also sent into the atmosphere in weather balloons filled with helium or hydrogen. As the balloon ascends into the upper atmosphere, the gas in the balloon expands until the balloon bursts. The specific altitude at which the balloon bursts depends on its diameter and thickness, but is ordinarily about 40 km (25 miles) in altitude. The length of the flight is ordinarily about 90 minutes. Weather balloons are intended to be used only once, and the equipment they carry is usually not recovered.

Radiosondes are launched from around 800 sites around the globe twice daily (at 0000 and 1200 UTC; UTC is Coordinated Universal Time; it is the same as Greenwich Mean Time—the time in the city of Greenwich, England) at the same time to provide a profile through the atmosphere. Special launches are done when needed for special projects. Radiosondes can be dropped from a balloon or airplane to make measurements as they fall. This is done to monitor storms, for example, since they are dangerous places for airplanes to fly.

Weather information can also come from remote sensing, particularly radar and satellites . Radar stands for Radio Detection and Ranging. In radar, a transmitter sends out radio waves. The radio waves bounce off the nearest object and then return to a receiver. Weather radar can sense many characteristics of precipitation: its location, motion, intensity, and the likelihood of future precipitation. Most weather radar is Doppler radar, which can also track how fast the precipitation falls. Radar can outline the structure of a storm and in doing so estimate the possibility that it will produce severe weather.

Weather satellites have been increasingly important sources of weather data since the first one was launched in 1952. Weather satellites are the best way to monitor large scale systems, like storms. Satellites can also monitor the spread of ash from a volcanic eruption, smoke from fires, and pollution. They are able to record long-term changes, such as the amount of ice cover over the Arctic Ocean in September each year.

Weather satellites may observe all energy from all wavelengths in the electromagnetic spectrum. Most important are the visible light and infrared (heat) frequencies. Visible light images record images the way we would see them, including storms, clouds, fires, and smog. Infrared images measure heat. These images can record clouds, water and land temperatures, and features of the ocean, such as ocean currents. Weather patterns like the El Nino are monitored in infrared images of the equatorial Pacific Ocean.

Two types of weather satellites are geostationary and polar orbiting. Geostationary satellites orbit the Earth at the same rate that the Earth rotates; therefore, they remain fixed in a single location above the equator at an altitude of about 36,000 km (22,000 miles). This allows them to constantly monitor the hemisphere where they are located. A geostationary satellite positioned to monitor the United States will have a constant view of the mainland, plus the Pacific and Atlantic Oceans, as it looks for hurricanes and other potential hazards.

Polar orbiting satellites orbit much lower in the atmosphere, at about 850 km (530 miles) in altitude. They are not stationary but continuously orbit making loops around the poles, passing over the same point at around the same time twice each day. Since these satellites are lower, they get a more detailed view of the planet.

I. Review Exercises.

1. Retell text B(part 1).

2. Translate text “Weather forecasting” : Make up 10 questions to this text.

3. List some of the instruments that meteorologists use to collect weather data.

4. Describe how these instruments are used to collect weather data from many geographic locations and many altitudes.

5. Discuss the role of satellites and computers in modern weather forecasting.

6. Describe how meteorologists develop accurate weather forecasts.

II. Translate the following words and make your own sentences with them:

millennia, modest progress, network, elucidation, breakthrough, spatial scales, evolve , endeavor, bias, current time, weather warning, commodity, utility company, air crew, implication of weather, overlapse, renewable energy.

Text C PRECIPITATION

1. In meteorology, precipitation is any product of the condensation of atmospheric water vapor that falls under gravity. The main forms of precipitation include drizzle, rain, sleet, snow, graupel and hail. Precipitation occurs when a portion of the atmosphere becomes saturated with water vapor, so that the water condenses and "precipitates". Thus, fog and mist are not precipitation but suspensions, because the water vapor does not condense sufficiently to precipitate. Two processes, possibly acting together, can lead to air becoming saturated: cooling the air or adding water vapor to the air. Precipitation forms as smaller droplets coalesce via collision with other rain drops or ice crystals within a cloud. Short, intense periods of rain in scattered locations are called “showers”.

Moisture overriding associated with weather fronts is an overall major method of precipitation production. If enough moisture and upward motion is present, precipitation falls from convective clouds such as cumulonimbus and can organize into narrow rainbands. Where relatively warm water bodies are present, for example due to water evaporation from lakes, lake-effect snowfall becomes a concern downwind of the warm lakes within the cold cyclonic flow around the backside of extratropical cyclones. Lake-effect snowfall can be locally heavy. Thundersnow is possible within a cyclone's comma head and within lake effect precipitation bands. In mountainous areas, heavy precipitation is possible where upslope flow is maximized within windward sides of the terrain at elevation. On the leeward side of mountains, desert climates can exist due to the dry air caused by compressional heating. The movement of the monsoon trough, or intertropical convergence zone, brings rainy seasons to savannah climes.

Precipitation is a major component of the water cycle, and is responsible for depositing the fresh water on the planet. Approximately 505,000 cubic kilometres

(121,000 cu mi) of water falls as precipitation each year: 398,000 cubic kilometres (95,000 cu mi) of it over the oceans and 107,000 cubic kilometres (26,000 cu mi) over land. Given the Earth's surface area, that means the globally averaged annual precipitation is 990 millimetres (39 in), but over land it is only 715 millimetres (28.1 in). Climate classification systems such as the Koppen climate classification system use average annual rainfall to help differentiate between differing climate regimes.

Precipitation may occur on other celestial bodies, e.g. when it gets cold, Mars has precipitation which most likely takes the form of frost, rather than rain or snow.

Troposphere

2. The troposphere is the lowest layer of Earth's atmosphere. It extends from Earth's surface to an average height of about 12 km, although this altitude actually varies from about 9 km (30,000 ft) at the poles to 17 km (56,000 ft) at the equator, with some variation due to weather. The troposphere is bounded above by the tropopause, a boundary marked in most places by a temperature inversion (i.e. a layer of relatively warm air above a colder one), and in others by a zone which is isothermal with height.

Although variations do occur, the temperature usually declines with increasing altitude in the troposphere because the troposphere is mostly heated through energy transfer from the surface. Thus, the lowest part of the troposphere (i.e. Earth's surface) is typically the warmest section of the troposphere. This promotes vertical mixing (hence the origin of its name in the Greek word tropos, meaning "turn"). The troposphere contains roughly 80% of the mass of Earth's atmosphere. The troposphere is denser than all its overlying atmospheric layers because a larger atmospheric weight sits on top of the troposphere and causes it to be most severely compressed. Fifty percent of the total mass of the atmosphere is located in the lower 5.6 km (18,000 ft) of the troposphere.

Nearly all atmospheric water vapor or moisture is found in the troposphere, so it is the layer where most of Earth's weather takes place. It has basically all the weather-associated cloud genus types generated by active wind circulation, although very tall cumulonimbus thunder clouds can penetrate the tropopause from below and rise into the lower part of the stratosphere. Most conventional aviation activity takes place in the troposphere, and it is the only layer that can be accessed by propeller-driven aircraft.

Stratosphere

3. The stratosphere is the second-lowest layer of Earth's atmosphere. It lies above the troposphere and is separated from it by the tropopause. This layer extends from the top of the troposphere at roughly 12 km (7.5 mi; 39,000 ft) above Earth's surface to the stratopause at an altitude of about 50 to 55 km (31 to 34 mi; 164,000 to 180,000 ft).

The atmospheric pressure at the top of the stratosphere is roughly 1/1000 the pressure at sea level. It contains the ozone layer, which is the part of Earth's atmosphere that contains relatively high concentrations of that gas. The stratosphere defines a layer in which temperatures rise with increasing altitude. This rise in temperature is caused by the absorption of ultraviolet radiation (UV) radiation from the Sun by the ozone layer, which restricts turbulence and mixing. Although the temperature may be 60 °C (76 °F; 210 K) at the tropopause, the top of the stratosphere is much warmer, and may be near 0 °C.

The stratospheric temperature profile creates very stable atmospheric conditions, so the stratosphere lacks the weather-producing air turbulence that is so prevalent in the troposphere. Consequently, the stratosphere is almost completely free of clouds and other forms of weather. However, polar stratospheric or nacreous clouds are occasionally seen in the lower part of this layer of the atmosphere where the air is coldest. The stratosphere is the highest layer that can be accessed by jet-powered aircraft.

List of cloud types

High: Cirrus, cirrocumulus, cirrostratus.

Middle: Altocumulus, altostratus.

Vertical: Cumulonimbus, cumulus, nimbostratus.

Low: Stratocumulus, small Cu, stratus.

The list of cloud types is a summarisation of the modern systems of cloud classification used in the troposphere, stratosphere, and mesosphere. The ten basic genus-types in the troposphere have Latin names derived from five physical forms. These are, in approximate ascending order of instability or convective activity: stratiform sheets; cirriform wisps and patches; stratocumuliform patches, rolls, and ripples; cumuliform heaps and tufts, and cumulonimbiform towers that often have complex structures. The forms are cross-classified by altitude range or etage into high-level, middle, low, and multi-level. Some of the resultant genus types are common to more than one form or more than one level, as illustrated in the stratocumuliform and cumuliform columns of the classification table below. Most genera are divided into species, some of which are common to more than one genus. Most genera and species can be subdivided into varieties, also with Latin names, some of which are common to more than one genus or species. The essentials of the modern nomenclature system for tropospheric clouds were proposed by Luke Howard, a British manufacturing chemist and an amateur meteorologist with broad interests in science, in an 1802 presentation to the Askesian Society. Since 1890, clouds have been classified and illustrated in cloud atlases. Mesospheric and stratospheric clouds have their own classifications with common names for the major types and alpha-numeric nomenclature for the subtypes.

I. Review Exercises:

1. Make up 10 general questions to Text C (part 1).
2. Make up 10 special questions to Text C (part 2).
3. Make up 10 reflexive questions to Text C (part 3).
4. What cloud types do you know?

II. Translate the following words and expressions:

Diurnal temperature variations, terrestrial plants and animals, large-scale movement, the means, cell, prevalent, nacreous cloud, cyclone's comma head, leeward side, monsoon trough, average annual rainfall, celestial body.

Grammar Exercises

I. Translate the sentences paying attention to the different functions of the Infinitive

1. The thermometer is to be protected from the direct and reflected rays of the sun.
2. Orographic clouds have a strong tendency to become supercooled.
3. To reduce surface temperatures to sea level when estimating the intensity of a front is of great importance.
4. For a cloud to form, the air must first become saturated with respect to water.
5. The ordinary method to be used for observation of wind at heights is that of sending us pilot balloons.
6. Winds tend to blow from areas of high pressure to regions of low pressure.
7. To determine, the state of the atmosphere at any given point, there quantities are to be measured, viz., pressure, temperature and humidity.
8. In order to understand radiation processes it is necessary to know some of the so-called "classic radiation laws".
9. Results of these observations will tend to verify the choice of a particular model of atmosphere in a given region.
10. Our ability to understand and predict the behaviour of hurricanes has, been limited mainly because of lack of observations from the ocean areas.

II. Translate the sentences paying attention to the different functions of the Infinitive

1. Methods to be used in organising precipitation data in preparation for analysis are necessarily dependent on the data themselves and the purposes to be served.
2. To compute the amount of water suspended in the air one must make

observations of humidity.

3. Two things are necessary for the existence of lakes: first there must be a basin to hold the water; and second, there must be a supply of water to fill or partially to fill the basin.

4. He was the first to explain this phenomenon theoretically.

5. To carry out observations aimed at measuring the content of atmospheric water and ice in fog and cloud is very difficult.

6. A great many different units have been used to express stream flow volumes.

7. There are many evidences of the early efforts to obtain supplies of water for community use.

8. His task is to take observations of the water quality in this lake.

9. To complete a hydrographic survey of an area in a short time is very difficult.

10. To ensure uniform water temperature, the liquid should be stirred.

III. Translate the sentences paying attention to the different functions of the Infinitive

1. It is necessary to collect much material for an accurate nautical chart.

2. To compile a nautical chart, it is necessary to locate and obtain the description of numerous topographic features.

3. It is obviously impracticable to measure the depth at every point.

4. A hydrographic survey is considered to be accurate when the depths of many places are known.

5. The bottom in this locality can be supposed to be uniform.

6. The area to be examined by our vessel lies northward of the island.

7. The greatest responsibility of a hydrographer is to make sure that no dangers remained undetected.

8. Every hydrographer is to make sure that no dangers remained undetected.

9. As long as people and goods continue to be carried by sea, nydrographic work must continue.

10. Hydrographic work to be continued in this strait includes air survey.

11. The first real attempt to produce a map on a mathematic projection was done by Mercator.

12. To make a chart of the required accuracy, the hydrographers resounded the area.

13. To supply the mariners with accurate charts is a very important kind of work.

14. This hydrographer is to make a report about the results of the last expedition he took part in.

IV. Translate the sentences paying attention to the different functions of the Infinitive

1. The proportion to be maintained between actual distances and the distances represented on the chart must be known before producing a chart.
2. This particular-scale is to be used for the chart of this harbour.
3. Several surveys of this navigable river have to be made.
4. The scale to be used is usually stated when instructions are issued for the survey.
5. It is difficult to carry out a detailed examination on such a small scale.
6. The normal procedure is to run lines of soundings one inch apart on the plotted sheet.
7. The harbour to be surveyed is surrounded by mountains.
8. The surveyor must be guided by the nature of the area he is going to survey.
9. This shipping channel is known to be irregular in depth and is supposed to be strewn with numbers of small isolated rocks and dangers.
10. It is necessary to double the scale in order to be sure that no dangers remained undetected.
11. To obtain synoptic data needed for definition and movement of cyclones, the national meteorological services were established.
12. Meteorology is interested in the factors that are likely to affect the behavior of the atmosphere.
13. The purpose of this paper is to demonstrate that there is a large amount of fog on the ice-cap and a large amount of blowing snow caused by high-surface wind velocities.
14. Results of these observations will tend to verify the choice of a particular model of atmosphere in a given region.
15. The observed wind is considered to be the representation of the north-westerly wind that existed along the coast.
16. The scientists working at this laboratory may be expected to continue their basic research of different oceanographic and meteorological phenomena.

V. Translate the sentences paying attention to the Subjective Infinitive Construction

1. The air is said to be saturated if it contains all the water vapour that it can hold at the existing temperature and pressure.
2. The average vertical temperature gradient is found to be about 3,5°F per 1000ft.
3. Orographic clouds are believed to cause heavy and continuous rain.
4. Meteorologists are required to report observed weather changes regularly.
5. Heavy icing conditions can be expected to occur in freezing rain.
6. The Beaufort Scale of Wind Force is considered to be rather old for being

used in meteorology.

7. The cold waves reaching Australia seem to originate from latitudes lower than 60°S.

8. The vertical distribution of ozone is likely to be valuable in the study of stratospheric circulation using ozone as a tracer.

9. The total amount of water in and on the earth is believed to remain essentially constant.

10. Some of the water precipitated on all land surfaces is assumed to come from local sources.

11. When the air contains all the water vapour it can possibly hold at a given temperature the air is said to be saturated.

12. Precipitation appears to increase with altitude up to about 3,000 feet and then to decrease.

13. The amount of water vapour in the atmosphere is observed to be continually changing.

VI. Translate the sentences paying attention to the Subjective Infinitive Construction

1. The composition of other planetary atmospheres is known to differ from ours.

2. High temperature, strong wind, low humidity and low pressure are believed to aid evaporation and vice versa.

3. Land and sea breezes are supposed to occur chiefly in tropical countries where the solar heating is powerful.

4. Antarctic weather seems not to have a direct influence on Australian weather.

5. The cold waves reaching Australia seem to originate from latitudes lower than 60°S.

6. The vertical distribution of ozone is likely to be valuable in the study of stratospheric circulation using ozone as a tracer.

7. A few weak cyclonic circulations appeared to form in the thermal trough.

8. The cyclonic centre is supposed to be located farther north at 17°S., 149°E.

VII. Translate the sentences paying attention to the Objective Infinitive Construction

1. The meteorologists considered the data of temperature to be representative for the given area.

2. The ancients already knew weather and temperature changes to be dependent upon advection.

3. Near the equator the heating causes the atmosphere to expand vertically.

4. We know this scientist to have been working at this problem for some years.

5. We suppose the prediction of hurricanes to be limited mainly because of lack of observation from the ocean areas.

6. Scientists know high temperature, strong wind, low humidity and low pressure to aid evaporation and vice versa.

7. Meteorologists found the equations for cyclonic and anticyclonic winds to express the wind speed in terms of pressure distribution.

8. The scientists believe the total quantity of water on and around the earth to have been more or less uniform throughout geologic time.

9. We know the extreme variability in the amount of water vapour in both space and time to be due to water's unique ability to exist in all three states - gas, liquid, and solid - at the temperatures normally found on the earth.

10. We suppose this approach to the problem to be absolutely incorrect.

11. The engineer expected the work to be done in time.

12. We thought these figures to be absolutely wrong.

13. We suppose the prediction of hurricanes to be limited mainly because of lack of observations from the ocean areas.

14. I did not know the humidity condition near the coasts to depend upon whether the wind is on- or off-shore.

15. Meteorologists found the equations for cyclonic and anti- cyclonic winds to express the wind speed in terms of pressure distribution.

VIII. Translate the sentences paying attention to the Infinitive Constructions:

1. For prediction of radiation fogs it is of basic importance to estimate the amount of cooling which is likely to occur.

2. The thunderstorms at Baker Lake appeared to be connected with the passage of minor troughs aloft of surface cold fronts.

3. The chief difficulty to be overcome in any linear problem of the long-range forecasting lies in the determination of variations in time of the circulation index.

4. A cyclone centre is said to deepen when the pressure in the centre decreases while it moves across the chart.

5. The results of previous research seemed to indicate the presence of gas traces in our atmosphere.

6. One of the problems to be investigated with the continuous nucleus counter was the problem of the nucleus variation in air.

7. This force causes the reading of the instrument to be in error by a certain amount.

8. The production of a haze top at 80 km. proves to require the ascent of dust clouds from below.

9. The prevailing winds are also supposed to indicate the presence of two air masses of widely different life history.

LESSON 2

<u>Grammar:</u> **The Gerund**

Text A ATMOSPHERE OF EARTH

1. The atmosphere of Earth is the layer of gases, commonly known as air, that surrounds the planet Earth and is retained by Earth's gravity. The atmosphere of Earth protects life on Earth by absorbing ultraviolet solar radiation, warming the surface through heat retention (greenhouse effect), and reducing temperature extremes between day and night (the diurnal temperature variation).

By volume, dry air contains 78.09% nitrogen, 20.95% oxygen, 0.93% argon, 0.04% carbon dioxide, and small amounts of other gases. Air also contains a variable amount of water vapor, on average around 1% at sea level, and 0.4% over the entire atmosphere. Air content and atmospheric pressure vary at different layers, and air suitable for use in photosynthesis by terrestrial plants and breathing of terrestrial animals is found only in Earth's troposphere and in artificial atmospheres.

The atmosphere has a mass of about 5.1571018 kg, three quarters of which is within about 11 km (6.8 mi; 36,000 ft) of the surface. The atmosphere becomes thinner and thinner with increasing altitude, with no definite boundary between the atmosphere and outer space. The Karman line, at 100 km (62 mi), or 1.57% of Earth's radius, is often used as the border between the atmosphere and outer space. Atmospheric effects become noticeable during atmospheric reentry of spacecraft at an altitude of around 120 km (75 mi). Several layers can be distinguished in the atmosphere, based on characteristics such as temperature and composition.

The study of Earth's atmosphere and its processes is called atmospheric science (aerology).

Atmospheric circulation.

Atmospheric circulation is the large-scale movement of air, and together with ocean circulation is the means by which thermal energy is redistributed on the surface of the Earth.

The Earth's atmospheric circulation varies from year to year, but the large scale structure of its circulation remains fairly constant. The smaller scale weather systems - mid-latitude depressions, or tropical convective cells - occur "randomly", and long range weather predictions of those cannot be made beyond ten days in practice, or a month in theory. The large scale atmospheric circulation of the Earth, however, is an average of its systems and patterns, and is considered stable over longer periods of time.

The Earth's weather is a consequence of its illumination by the Sun, and the laws of thermodynamics. The atmospheric circulation can be viewed, from that standpoint, as a heat engine driven by the Sun's energy, and whose energy sink, ultimately, is the blackness of space. The work produced by that engine causes the motion of the masses of air and in that process it redistributes the energy absorbed by the Earth's surface near the tropics to space and incidentally to the latitudes nearer the poles.

The large scale atmospheric circulation "cells" shift polewards in warmer periods (e.g. interglacials compared to glacials), but remain largely constant as they are, fundamentally, a property of the Earth's size, rotation rate, heating and atmospheric depth, all of which change little. Over very long time periods (hundreds of millions of years), a tectonic uplift can significantly alter their major elements, such as the jet stream, and plate tectonics may shift ocean currents. During the extremely hot climates of the Mesozoic, a third desert belt may have existed at the Equator. But, the overall latitudinal pattern of Earth's climate has not changed.

Review Exercise:

Make up the plan of Text A and retell it.

Text B ENERGY IN THE ATMOSPHERE

1. Wind and precipitation, warming and cooling depend on how much energy is in the atmosphere and where that energy is located. Much more energy from the Sun reaches low latitudes (nearer the equator) than high latitudes (nearer the poles). These energy differences cause the winds, affect climate, and even drive ocean currents. Heat is held in the atmosphere by greenhouse gases.

Energy, Temperature, and Heat.

Every material has energy: All the molecules within it vibrate. Gas molecules contain more energy than an equal number of liquid molecules (under the same temperature and pressure conditions) and move freely. Liquid molecules contain more energy than solids and move more freely than solids.

Energy travels through space or material. You know this because you can stand near a fire and feel the warmth. In this situation, energy is being transferred as invisible waves that can travel through air, glass, and even the vacuum of outer space. These waves have electrical and magnetic properties, so they are called electromagnetic waves. The transfer of energy from one object to another through electromagnetic waves is known as radiation. Different types of electromagnetic waves have different wavelengths. A wavelength is the horizontal distance from trough-to-trough or crest-to-crest of adjacent waves.

Humans are able to see some wavelengths of light, the wavelengths known as ‘visible light’. These wavelengths appear to us as the colors of the rainbow. The longest wavelengths of visible light appear red and the shortest wavelengths appear violet. Wavelengths that are longer than visible red are infrared. Snakes can see infrared energy. We can record this with special equipment. Wavelengths that are shorter than violet are ultraviolet. Infrared and ultraviolet wavelengths of energy are just as important as the wavelengths in visible light; we just can't see them.

Some objects radiate electromagnetic waves in the visible light spectrum. Two familiar sources are the Sun and a light bulb. Some objects radiate electromagnetic waves at wavelengths that we cannot see. The glass of water sitting next to you does not radiate visible light, but it does radiate a tiny amount of heat.

You should be aware that some objects appear to radiate visible light, but they actually do not. The moon and the planets, for example, do not emit light of their own. They reflect the light of the Sun. Reflection is when light bounces back from a surface. Albedo is a measure of how well a surface reflects light. A surface that reflects a high percentage of the light that strikes it has high albedo and one that reflects a small percentage has low albedo.

One important fact to remember is that energy cannot be created or destroyed. It can only be changed from one form to another. In photosynthesis, for example, plants convert the Sun's energy into food energy. They do not create new energy. When energy is transformed, often some becomes heat. Heat transfers between materials easily, from warmer objects to cooler ones. If no more heat is added, eventually all of a material will reach the same temperature.

Temperature is a measure of how fast the atoms in a material are vibrating. High temperature particles vibrate faster than low temperature particles. Rapidly vibrating atoms smash together, which generates heat. As a material cools down, the atoms vibrate more slowly and collide less frequently. As a result, they emit less heat.

What is the difference between heat and temperature? Temperature measures how fast a material's atoms are vibrating. Heat measures the material's total energy. Think of a candle flame and a bathtub full of hot water. Which has a higher heat and which has a higher temperature? Surprisingly, the flame has a higher temperature, but much less heat because the hot region is very small. The bathtub has lower temperature but contains much more heat because it has many more vibrating atoms. Even though it’s at a lower temperature, the bathtub has a greater total energy.

Heat is taken in or released when an object changes state, or changes from a gas to a liquid or a liquid to a solid. This heat is called latent heat. When a substance changes state, latent heat is released or absorbed. A substance that is changing its state of matter does not change temperature. All of the energy that is released or absorbed goes toward changing the material's state.

For example, imagine a pot of boiling water on the stove: that water is at 100°C (212°F). If a cook increases the temperature of the burner beneath the pot, more heat enters the water. But still the water remains at its boiling temperature. The additional energy goes into changing the water from liquid to1 gas. This allows the water to evaporate more rapidly. When water changes from a liquid to a gas it takes in heat. Since evaporation takes in heat, this is called evaporative cooling. Evaporative cooling is an inexpensive way to cool homes in hot, dry areas.

Substances also differ in their specific heat, the amount of energy needed to raise the temperature of one gram of the material by 1.0°C (1.8°F). Water has a very high specific heat, which means it takes a lot of energy to change the temperature of water. Let's compare a puddle and asphalt, for example. If you are walking barefoot on a sunny day, which would you rather walk across, the shallow puddle or an asphalt parking lot? Due to its high specific heat, the water stays cooler than the asphalt, even though it receives the same amount of solar radiation.

Energy from the Sun

2. Most of the energy that reaches the Earth's surface comes from the Sun. The Sun emits energy in a continuous stream of wavelengths. These wavelengths include visible light, infrared, ultraviolet radiation, and others. About 44% of solar radiation is in the visible light wavelengths. When viewed together, all of the wavelengths of visible light appear white. But a prism or water droplets, for example, can break the white light into different wavelengths so that you can see separate colors .

Only about 7% of solar radiation is in the ultraviolet (UV) wavelengths. Of the solar energy that reaches the outer atmosphere, UV wavelengths have the greatest energy. There are three types of UV energy: UVC has the shortest wavelengths and is the most energetic; UVA is the longest wavelengths and is the least energetic; and UBV is in the middle of the two. UV radiation will tan or burn human skin. The remaining solar radiation is the longest wavelength, infrared. Most objects radiate infrared energy, which we feel as heat.

Some of the wavelengths of solar radiation traveling through the atmosphere may be lost because they are absorbed by various gases. Ozone, for example, completely removes UVC, most UVB and some UVA from incoming sunlight. O2, CO2 and H2O also filter out other wavelengths from solar energy. Different parts of the Earth receive different amounts of solar radiation. This is because the Sun's rays strike the Earth's surface most directly at the equator. As you move away from the equator, you will notice that different areas also receive different amounts of sunlight in different seasons. But what causes the seasons?

The Earth revolves around the Sun once each year and spins on its axis of rotation once each day. This axis of rotation is tilted 23.5° relative to its plane of orbit around the Sun. The axis of rotation happens to be pointed to the star Polaris , or the North star. As the Earth orbits the Sun, the tilt of Earth's axis stays lined up with the North star. This means that the North Pole is tilted towards the Sun and the Sun's rays strike the Northern Hemisphere more directly in summer. At the summer solstice, June 21 or 22 of each year, the Sun's rays are hit the Earth most directly along the Tropic of Cancer. This is a circle of latitude exactly 23,5 ° north of the equator. When it is summer solstice in the Northern Hemisphere, it is winter solstice in the Southern Hemisphere. Winter solstice for the Northern Hemisphere happens on December 21 or 22. The tilt of Earth's axis points away from the sun in the winter and the Sun's rays strike most directly at the Tropic of Capricorn. The Tropic of Capricorn is a line of latitude exactly 23.5° south of the equator. The light from the Sun gets spread out over a larger area, so that area isn't heated as much. There are also fewer daylight hours in winter, so there is also less time for the Sun to warm that place. When it is winter in the Northern Hemisphere, it is summer in the Southern Hemisphere. Halfway between the two solstices, the Sun's rays shine most directly at the equator. We call these times an 'equinox'.The daylight and nighttime hours are exactly equal on an equinox. The autumnal equinox happens on September 22 or 23 and the vernal or spring equinox happens March 21 or 22 in the Northern Hemisphere. Thus the seasons are caused by the direction Earth's axis is pointing relative to the Sun.

Review Exercises:

1. Give the summary of Text B (part 1) in a written form.
2. What new information have you learnt from Text B (part 2)? Discuss the text.

Text C HEAT TRANSFER IN THE ATMOSPHERE

1. Heat can move in three different ways. We’ve already examined radiation, in which electromagnetic waves transfer heat between two objects. Conduction is a type of heat transfer that occurs when heat moves from areas of more heat to areas of less heat by direct contact. Warmer molecules vibrate more rapidly than cooler molecules. They collide directly with other nearby molecules, giving them some of their energy, which transfers heat. When all the molecules are moving at the same rate, the substance is the same temperature throughout. Heat in the atmosphere is transferred by conduction. This is more effective at lower altitudes where air molecules are packed more densely together. Conduction can transfer heat upward to where the molecules are spread further apart. It can also transfer heat laterally from a warmer to a cooler spot, where the molecules are moving less vigorously.

The most important way heat is transferred in the atmosphere is by convection currents. Convection is the transfer of heat by movement of heated materials. The radiation of heat from the ground warms the air above it. This warmer air is less dense than the air above it and so it rises. As the heated air rises it begins to cool, since it is further from the heat source. As it cools, it contracts, becomes denser and sinks. Air moves horizontally between warm, rising air and cooler, sinking air. This entire structure is a convection cell.

Heat at Earth's Surface

2. Not all energy coming in from the Sun makes it to the Earth's surface. About half is filtered out by the atmosphere. Besides being absorbed by gases, energy is reflected by clouds or is scattered. Scattering occurs when a light wave strikes a particle and bounces off in some other direction. Of the energy that strikes the ground, about 3% is reflected back into the atmosphere. The rest warms the soil, rock or water that it reaches. Some of the absorbed energy radiates back into the air as heat. These infrared wavelengths can only be seen by infrared sensors.

It might occur to you that if solar energy continually enters the Earth's atmosphere and ground surface, then the planet must always be getting hotter. This is not true, because energy from the Earth escapes into space through the top of the atmosphere, just as energy from the Sun enters through the top of the atmosphere. If the amount that exits is equal to the amount that comes in, then there is no increase or decrease in average global temperature. This means that the planet's heat budget is in balance. If more energy comes in than goes out, the planet warms. If more energy goes out than comes in, the planet cools.

To say that the Earth's heat budget is balanced ignores an important point. The amount of incoming solar energy varies at different latitudes. This is partly due to the seasons. At the equator, days are about the same length all year and the Sun is high in the sky. More sunlight hits the regions around the equator and air temperatures are warmer. At the poles, the Sun does not rise for months each year. Even when the Sun is out all day and night in the summer, it is at a very low angle in the sky. This means that not much solar radiation reaches the ground near the poles. Because of this, during a large part of the year, the polar areas are covered with ice and snow. These brilliant white substances have a high albedo and reflect solar energy back into the atmosphere. For all of these reasons, the region around the equator is much warmer than the areas at the poles. The difference in the amount of solar energy that the planet receives at different latitudes drives much of the activity that takes place at the Earth's surface. This includes the wind, water cycle, and ocean currents. The differences in solar energy around the globe drive the way the atmosphere circulates.

The Greenhouse Effect

3. The remaining factor in the Earth's heat budgets the role of greenhouse gases. Greenhouse gases warm the atmosphere by trapping heat. Sunlight strikes the ground, is converted to heat, and radiates back into the lower atmosphere. Some of the heat is trapped by greenhouse gases in the troposphere, and cannot exit into space. Like a blanket on a sleeping person, greenhouse gases act as insulation for the planet. The warming of the atmosphere due to insulation by greenhouse gases is called the greenhouse effect .

The greenhouse effect is very important, since without it the average temperature of the atmosphere would be about -18°C (0°F). With the greenhouse effect, the average temperature of the atmosphere is a pleasant 15°C (59°F).

Without insulation, daytime temperatures would be very high and nighttime temperatures would be extremely low. This is the situation on all of the planets and moons that have no atmosphere. If the Earth did not have insulation, temperatures would likely be too cold and too variable for complex life forms.

There are many important greenhouse gases in the atmosphere including C02, H20, methane, 03, nitrous oxides (NO and N02), and chlorofluorocarbons (CFCs). All of these gases are a normal part of the atmosphere except CFCs, which are human-made. However, human activity has significantly raised the levels of many of these gases; for example, methane levels are about 2 1/2 times higher as a result of human activity.

Different greenhouse gases have different abilities to trap heat. For example, one methane molecule can trap 23 times as much heat as one CO2 molecule. One CFC-12 molecule (a type of CFC) can trap 10,600 times as much heat as one CO2. Still, CO2 is a very important greenhouse gas because it is much more abundant in the atmosphere than the others.

The greenhouse effect is very important for another reason. If greenhouse gases in the atmosphere increase, they trap more heat and warm the atmosphere. If greenhouse gases in the atmosphere decrease, less heat is trapped and the atmosphere cools. The increase or decrease of greenhouse gases in the atmosphere affect climate and weather the world over.

Review Questions:

1. What is the difference between temperature and heat?
2. Give a complete description of these three categories of energy relative to each other in terms of their wavelengths and energy: infrared, visible light, and ultraviolet.
3. Why do the polar regions have high albedo?
4. Give an example of the saying "energy can't be created or destroyed".
5. Describe what happens to the temperature of a pot of water and to the state of the water as the dial on the stove is changed from no heat to the highest heat.
6. Describe where the Sun is relative to the Earth on summer solstice, autumnal equinox, winter solstice and spring equinox. How much sunlight is the North pole getting on June 21? How much is the South pole getting on that same day?
7. What is the difference between conduction and convection?
8. What is a planet's heat budget? Is Earth's heat budget balanced or not?
9. Why is carbon dioxide the most important greenhouse gas?
10. How does the amount of greenhouse gases in the atmosphere affect the atmosphere’s temperature?

Grammar Exercises

Translate the sentences paying attention to the gerunds:

I.

1. Plotting a chart requires much practice.
2. The new meteorologist was given the task of observing the winds.
3. The sun governs the weather changes by heating the atmosphere.
4. Most of the solar radiation passes through the atmosphere without being absorbed.
5. Before analysing the data of pressure the forecaster must reduce them to sea level.
6. In determing the future weather meteorologist must consider the position of the chief pressure system.
7. The observers succeeded in getting new data by means of balloon ascents.
8. For many centuries people have dreamt of flying to the moon and other planets.
9. An instrument for determining the density of liquids is called a hydrometer.
10. The snow storm prevented the travellers from going out.
11. Sublimation is the process of changing water vapour droplets into ice.

II.

1. Many formulas have been proposed for representing the effect of wind velocity on evaporation.
2. In passing through the hydrologic cycle part of the water passes beneath the surface of the earth and remains in storage there for various periods of time.
3. Man does changes which affect local evaporation and transpiration but without affecting appreciably the earth's hydrologic cycle.
4. Water in the liquid state, when sufficiently subjected to heating by solar energy or otherwise, passes into the gaseous state.
5. Cooling by lifting is the cause of rain, snow, sleet and hail.
6. A number of different methods have been utilized for measuring water transfer to the atmosphere.
7. Melting snow can cause a flood without accompanying rainfall.
8. One method of obtaining salt is allowing water to evaporate.
9. There is a wide variety of formulas for measuring transpiration.
10. On solving the problem he proceeded to making experiments.

III.

1. Cartographers ensure safe navigation by compiling accurate charts.
2. On sounding the vicinity of the coral reefs the hydrographers made several corrections in the existing charts.

3. We could not chart these dangers without measuring their depths.

4. In navigating along these shores we made many soundings.

5. They made a more accurate survey by using new instruments and by improving the former methods of work.

6. Painting buoys in different colours serves a double purpose.

7. Navigating along the coasts of Canada in foggy weather is dangerous.

8. The importance of these data in determining the distribution of properties and the character of the circulation around the Antarctica is very great.

9. We began compiling this chart by checking the position of sunken rocks.

10. The variety of ways for measuring the distance between the objects must be studied thoroughly.

11. In projecting the earth, or a part of it, some of the properties of the sphere can be retained but others may be neglected to make possible the preparation of a flat chart.

IV.

1. In discussing the process of evaporation it is more rational to consider not the vapour pressure but the specific humidity.

2. Several terms used for describing the tide have been defined, but a few more must be added.

3. The annual variation of temperature due to processes of heating and cooling is known at all depths.

4. Many devices have been invented for obtaining temperatures at various depths.

5. If the bottles are located at depths of less than about 500 m., their proper function may be checked by touching the wire.

6. A navigator is interested in knowing the direction in which his vessel is carried by the current.

7. Norway is always ice-free except for occasional freezing of the inner parts of the fjords.

8. The present summary will not permit the reader to start making his own ice forecasts.

9. By introducing the concept of eddy viscosity Ekman solved a number of problems.

10. After eliminating the effect of the current Nansen (1902) found that the direction of the drift inclined an average of 28° to the right of the wind direction.

11. The practical problem of measuring wind drift is made more difficult by the presence of tidal currents.

12. Thawing was due to water temperature and to radiation.

13. Direct observations of the temperature of sea water do not show the exact limits of the different currents and a ship may pass the cold region without noticing it at all.

14. The hydrometer changed its reading because of its being placed in the

same vessel with the thermometer.

15. The density of the basin water remains lower than that of the outside water owing to more effective vertical mixing in a restricted region.

16. In its rising and falling the tide does not move at a uniform rate.

V.

1. In studying the production of an air mass we find that the physical properties of an air mass depend solely upon its history.

2. Mixing between horizontally and vertically adjacent air masses may have a considerable influence on the temperature of the free air.

3. The temperature to which humid air can be cooled at constant pressure without causing condensation is called the dew point.

4. The formula is often useful for determining whether the winds are increasing or decreasing or changing in direction.

5. After having drawn the symmetry axes on the map the next step is to choose the appropriate length unit.

6. The effect of horizontal mixing on temperature is but slight as far as changes within the air masses from one map to the next are concerned.

7. There are three possible ways of estimating lake evaporation with an accuracy which is generally satisfactory for engineering requirements.

8. The pressure data used for determining winds are the following.

9. In this paper we describe experimental methods and give some preliminary results of determining two additional parameters of the earthquake focus.

10. The accompanying velocities are quite small, assuming that at 4000 m. the water is at rest.

11. In the Southern Hemisphere the denser water is on the right-hand side when looking in the direction of flow.

12. Following the current around the Antarctic Continent, it is seen that when approaching a submarine ridge the current bends to the left.

13. Along the east coast of South Africa the Agulhas Stream flows south partly turning into the Atlantic Ocean.

14. The deflecting force performs no work because it is always directed at right angles to the velocity.

VI.

1. By picking up such messages as the forecasting centre requires it may construct its own weather chart of the area in which it is interested.

2. Instead of calculating derivatives, we are calculating ratios of finite differences.

3. Before attempting to solve an equation that is complicated, one should attempt to write it in several different forms, choosing the one that seems most suitable.

4. It is not easy to make a reliable measurement of the cloud motion by theodolite, because of the difficulty of finding a suitable detail which retains its identity and sharpness for more than a minute or two.

5. This analysis is obtained by using among other approximations the 24 h. forecast ending at the time of verification.

6. This can be accomplished by replacing cable-lowered instruments transmitting their reading hydroacoustically.

7. To take a clear photograph without disturbing the muddy bottom it is necessary to use an indicator of contact with the bottom.

8. Sampling of sea ice is becoming an important subject in the polar and subpolar seas.

9. The Vostok station is one of the most interesting places for observing magnetic phenomena.

LESSON 3

<u>Grammar:</u> **The Participle**
The Absolute Participle Construction

Text A **AGROMETEOROLOGY**

1. Agrometeorology is the study of weather and use of weather and climate information to enhance or expand agricultural crops and/or to increase crop production. Agrometeorology mainly involves the interaction of meteorological and hydrological factors, on one hand and agriculture, which encompasses horticulture, animal husbandry, and forestry.

It is an interdisciplinary, holistic science forming a bridge between physical and biological sciences and beyond. It deals with a complex system involving soil, plant, atmosphere, agricultural management options, and others, which are interacting dynamically on various spatial and temporal scales. Specifically, the fully coupled soil-plant-atmosphere system has to be well-understood in order to develop reasonable operational applications or recommendations for stakeholders. For these reasons, a comprehensive analysis of cause-effect relationships and principles that describe the influence of the state of the atmosphere, plants, and soil on different aspects of agricultural production, as well as the nature and importance of feedback between these elements of the system is necessary. Agrometeorological methods therefore use information and data from different key sciences such as soil physics and chemistry, hydrology, meteorology, crop and animal physiology and phenology, agronomy, and others. Observed information is often combined in more or less complex models, focused on various components of system parts such as mass balances (i.e. soil carbon, nutrients, and water), biomass production, crop growth and yield, and crop or pest phenology in order to detect sensitivities or potential responses of the soil- biosphere - atmosphere system. However, model applications still involve many uncertainties, which calls for further improvements of the description of system processes.

Agricultural meteorology – its scope and aims.

2. Aims. The primary aim of agricultural meteorology is to extend and fully utilize our knowledge of atmospheric and related processes in order to optimize sustainable agricultural production with maximum use of weather resources and with minimal damage to the environment. This entails improving the quantity and quality of agricultural crops, timber and other forest products (e.g. natural rubber), vegetable fibres (e.g. cotton, flax, sisal), and animal products and byproducts (e.g. hides).

A secondary aim concerns the conservation of natural resources. The climate may place constraints upon a particular resources. The climate may place constraints upon a particular form of land-use at a given place and time. An agricultural meteorologist should be (but often will not be) consulted when questions are being examined of land-use, of the exploitation of resources and of the deployment of technological processes. For example, the short-term benefit from the cultivation of semi-arid grassland has often (e.g. in the former Soviet Union) been gained at the expense of long-term damage from erosion by wind and water. Meteorologists have the advantage of being able to take into consideration processes on very different time-scales.

Range of subject matter.

The subject includes:

(a) The Earth (physical) sciences - specifically the physics of the atmosphere, i.e. meteorology and climatology, but also soil physics and hydrology;

(b) Certain biological sciences - specifically physiology, ecology and pathology of plants and animals, and associated “technologies” of agriculture.

A more detailed statement is given in the opening paragraphs of the WMO Guide to Agricultural Meteorological Practices (WMO-No. 134):

“Agricultural meteorology is concerned with interaction between meteorological and hydrological factors, on the one hand, and agriculture in the widest sense, including horticulture, animal husbandry and forestry, on the other hand. Its object is to discover and define such effects, and thus to apply knowledge of the atmosphere to practical agricultural use. Its field of interest extends from the soil layer of deepest plant and tree roots, through the air layer near the ground in which crops and woods grow and animals live, to the highest levels of interest to aerobiology, the latter with particular reference to the effective transport of seeds, pollen and insects.

In addition to natural climate, and its local variations, agricultural meteorology is also concerned with artificial modifications in environment (as brought about, for example, by windbreaks, soil management, irrigation, glasshouses, etc.); in climatic conditions storage, whether indoors or in field heaps; in environmental conditions, in animal shelters and farm buildings; and during the transport of agricultural produce by land, sea or air."

This compendium considers the relationship between weather and agriculture, and touches upon subjects that may be conveniently classified under seven main headings: soil and water, plants, farm animals, diseases and pests of crops and animals, farm buildings and equipment, farm operations, and artificial modification of the meteorological and hydrological regime. Each of these will be briefly discussed in this chapter.

Soil and water. Weathering is an important factor in creating and then determining the nature of a soil, the organisms it contains and its capacity for retaining and releasing heat, nutrients and moisture. Rainfall not only adds chemical components to the soil, but it also washes out ("leaches") soil nutrients.

The mechanical state of the soil - as it affects the cultivation, pest control and harvesting of crop plants, management of pastures (stocking density, etc.) is greatly influenced by local weather conditions. In these matters the cooperation of environmental scientists is vitally important: meteorologists must not simplify too much the surface aspects of their work, while on the other hand hydrologists should not assume full knowledge of all weather and climate factors. All in all, cooperation between meteorologists, hydrologists and soil scientists needs to be improved.

The water reservoir for plant growth and development is contained in the soil. The amount of water available in soil depends on the effectiveness of precipitation or irrigation, on the one hand, and on soil's physical properties and depth on the other hand. The rate of water loss from the soil depends on the climate, and on the physical properties of the soil and the root system of the plant community. Efficient utilization of soil water and cultivation techniques for preservation of soil moisture are of major concern to agrometeorology, especially in semi-arid areas.

Erosion by wind and water depends on regional and local weather factors. The extent to which a given tract of land suffers from erosive agencies is, moreover, determined by the presence and vigour of the vegetative cover. Excessive concentration of salt at the soil surface may occur in areas especially where there is significant evaporation and drainage is not adequate, particularly when irrigation water is poor quality.

In all regions with a marked seasonal variation in weather, seasonal changes influence soil conditions and hence the farming programme ('calendar') - e.g. the beginning and end of rainy seasons in (sub) tropical countries; in wet climates, the period during which the water content of the upper soil layers exceeds the 'field capacity' ; or the duration of frozen ground in high latitudes.

Review Exercises:

1. What kind of science is agrometeorology?
2. Discuss three main passages of Text A (part 2) and put the questions to each of them.

Text B THE PHYSICAL ENVIRONMENT

The Environment

The environment of plants and animals is the biological and physical system of the medium surrounding them - the biological including microbes, plants, and animals, and the physical including air, soil and water.

Physical medium

Normally, the physical material surrounding crops and livestock is a mixture of air, water, and soil. Air and water are found in the soil; water and soil particles are found in the air. Aeration and soil moisture are phenomena of air and water in the soil, while atmospheric humidity and dust are those of water and soil in the air. The degrees of association of the various constituents comprise different types of physical environments. For example, too much water in a field of crops may cause waterlogging or even a flood, while too little produces drought. Therefore, fundumental concepts of the physical and chemical properties and the interaction of air, water, and soil in association with various forms of energy should be understood.

(a) Air. The air has long been recognized as a colorless, odorless, and tasteless fluid. It is a mixture of gases, present both as single elements and as compounds, and comprises the earth's atmosphere. Some of these gases are inert, others active. The chemical and physical properties of each individual gas differ widely. Information on these can be found in textbooks on physics and chemistry. Here, the composition and distribution of the air in the physical media of crop and livestock will be described briefly.

In the first 3.5 miles above the earth's surface - predominant life-zone, the natural atmosphere is generally fresh but not dry or pure. In this life-zone, the dry atmosphere, when measured by volume, is composed of about 78% nitrogen, 21% oxygen, and 1% of a combination of several chemically inert and rare gases (argon, neon, and helium, etc.), and chemically active trace gases (methane, nitrous oxide, ozone, etc.). The degree of variability depends upon the type of chemical elements present, in association with the physical conditions of the atmosphere (radiation, temperature, wind, humidity, etc.). Water vapor, for example, is highly variable. It varies from as little as 0.001 to as much as 0.01

percent in a volume of air. When expressed by weight, it varies from few milligrams to 40 grams per kilogram of dry air. Also, its variation with time and space is much greater than any single constituent of the atmospheric air. Other variable constituents are ozone, nitrogen dioxide, sulfur dioxide, hydrogen sulfide, ammonia, carbon monoxide and a few other elements. The major constituents, namely oxygen and nitrogen, are appreciably constant.

Liquid and solid substances of both organic or inorganic compounds are foreign matters of the atmosphere. There are numerous varieties of such foreign matters, ranging from airborne bacteria and fungi to sea-salt particles and ammonium sulfate.

The average composition of air is different under the surface of the soil, in the water, and in the upper atmosphere (about 30 miles above mean sea level). The vertical gaseous exchange between the interface of the atmosphere and its lower boundaries (the soil, water and vegetation) and its upper boundary (the upper atmosphere), goes on constantly within space and time. Much of the gaseous exchange in the lower boundaries involves living organisms. Some of the exchanges are through such physical mechanisms as turbulence and diffusion. All of these exchanges involve matter in gaseous, liquid, and solid states.

Growth and development in plants

It is necessary to differentiate the word “growth” from “development”, for the two differ basically. Growth refers to an increase in weight or volume of a certain organ of a plant, or a plant as a whole, within the time interval of a certain phase or an entire life span. Development is the appearance of a phase or series of phases during a plant’s life cycle. For example, the flowering of a plant is “development”, while the elongation of a stem is “growth”. In considering the plant-growing season, one can recognize that growth is a continuous function and that development is a discontinuous one. With respect to the chemical and physical changes in plant composition, growth gives quantitative changes but not profound qualitative changes. Development, on the other hand, indicates the progress of a series of qualitative changes (with or without external changes) throughout all different stages until death. Thus, it follows that the growth of a plant can be measured by the elongation of stem and shoot, the increase of dry and fresh weight, and so forth; while development is usually observed by the dates of germination, initiation of floral primordia, inflorescence, and fruiting. In other words, a study of the development of a plant is generally morphological and phenological in approach, but that of growth is generally physiological and ecological.

Plant physiologists may consider growth a complex phenomenon and a process hard to define. For growth connotes all and any of these aspects: reproduction, increase in dimensions, gain in weight and cell multiplication, and others. It depends upon the kind of individual organ taken as a measure of growth. In the case of germinating seeds and sprouting tubers, the total dry weight of the young seedling and seed combined, or of the sprout and tubers, is less than the weight of the original seed or tuber for a short period, due to respiration. However, Miller (1938) has defined growth as a permanent increase in weight, attended by a permanent change in form, induced primarily by an increase in the quantity of protoplasm. In agrometeorology, the best definition of growth is: the increase in weight or dimension of an organ which is most sensitive to environmental changes. In common agricultural practice, vernalization, winter chilling, and the breaking of dormant seeds or buds are problems of development and not growth. When the number of an organ per unit field-area is concerned, it may be considered as either a growth or a development problem, depending upon the kind and stage of the organ. While flower count or fruit count is commonly considered as an indication of the growth, the appearance of the number of leaves at each stage indicates the development. Usually, though physiologically not sound, the number of economic organ available is considered as a growth problem. In short, the number of an organ per unit area is perhaps not a good indicator for differentiating the growth from the development.

The following illustration serves the purpose: Wang (1958, 1960) has studied the morphological development of the subterranean ears of sweet corn at the early vegetative stage in connection with their maturity date. Emphasis was placed in the choice of a significant element out of a group of environmental factors as well as that of a significant period around the seedling stage of sweet corn. A test was set up for ten different sweet corn varieties for a period of 13 years (1938-50) on Ames, Iowa. It was found that the subterranean ears initiated underground on the stem became functioning ears if environmental conditions were favorable. Thus, (a) the time interval for the first 12 days after planting would be the significant period; (b) the soil temperature should be one of the significant elements; and (c) a family of curves, obtained by plotting the mean soil temperature during the significant period against the number of days of growth for each year and for each individual variety, serves as the predictor. In fact, each curve characterizes the varietal differentiation. In short, this method attempts to predict the maturity date of sweet corn about two months or more ahead of time by virtue of the concept of the physiological predetermination through the developmental process. A comparison of this method with that of the heat unit approach has been worked out by Wang (1958); who pointed out that the former is superior to the latter in its accuracy, earliness, and simplicity.

Answer the following questions:

1. Is there any difference between the biological and physical systems of the medium surrounding plants and animals ?

2. What does the physical material surrounding crops and livestock include?

3. What is air ?

4. What is dry atmosphere life-zone composed of ?

5. Does gaseous exchange in the lower boundaries involve living organisms?

6. Is there any difference between the words “growth” and “development”?

7. What does the word "‘growth” refer to ?

8. What does development indicate ?

9. What is the best definition of growth in agrometeorology ?

10. The number of an organ per unit area is not a good indicator for differentiating the growth from the development, is it ?

Text C

USE AND PROVISION OF AGROMETEOROLOGICAL INFORMATION

To illustrate the variety of information requirements in agrometeorology, we will list a few of the categories of users that meteorologists are expected to support, showing how their needs vary. These user groups are not listed in any order of importance and their characteristics, situation and requests may differ from country to country.

Owners of large farms of one km^2 or more are often faced with large investments to be made, in mechanization and sometimes also in (part-time) labour. Generally speaking, they grow a limited number of crops, progressing in some cases to monoculture. In order to run such agricultural factories professionally, they may require extensive weather and climate information for planning, sometimes in a computer-compatible form.

A horticulturist, dealing with high-value crops grown over a very small area, usually controls the climatic conditions as much as possible in a greenhouse or in plastic tunnels. In order to make the necessary adjustments to regulate the radiation passing through his roof and the ventilation air entering below it, he must have quantitative information on e.g. local humidity and cloudiness as a routine matter.

Intermediate in scale between the two above-mentioned market-directed types of farming are family farms. Their main products are usually animals or regional staples - viticulture, cereal, grain or rice, grasses, beans or beets, fruits, sugarcane, vegetables - and some supporting minor crops or animals besides. These farmers are usually avid customers of agro-weather broadcasts (particularly on hazards such as frosts) which guide their short-term operational decisions.

Cattle farmers need weather information to provide winter forage their herds, e.g. to find out when they can make hay. In latitudes without winter, farmers are interested in early warning about impending disasters such as floods or storms.

Government planners (say, from the Ministry of Agriculture) may have the task of forecasting the yield of the next national staple crop harvest, as an 'early warning' of crop failures is necessary information for economic measures. This means that the meteorologist must know about the reliability of existing weather-related crop development models. Another subject for government advice is the climatological suitability of various regions for growing new types of crops.

Agricultural product factories, and other related business involved in processing or transporting food for the market, can use long-term forecasts and climatic information for planning purposes - provided that they are able to use predictions phrased in terms of probability. They prefer statistical climate studies to climate models (Changnon, 1992).

Investigators specialized in related subjects like hydrology and agronomy often ask for meteorological datasets. This should be used to start cooperation.

Agrometeorological service. In order to cope adequately with such varied requests, it is essential to establish an agrometeorological unit - preferably in a National Meteorological Service where, together with forecasting services and a national database, the necessary infrastructure for data collection and analysis is already in existence. In 1980 a WMO working group recommended three subsequent development stages after the establishment of such a unit:

(1) A 'passive' pre-operational stage using available infrastructure, supplying simple climatic information for agriculture more efficiently by assigning this task specifically to a few members of a climatological service. At this stage a national agrometeorological committee, supported by WMO and FAO, should identify local weather-sensitive problems;

(2) A more 'active' stage, in which derived information (e.g. growing degree days, leaf-wetness duration) is provided by a specialized unit. Some countries might stop here;

(3) An operational stage, where advisory services and forecasts are provided, and the necessary research is done to support such problem-oriented services.

Agrometeorology and agroclimatology can assist in two categories of problems which could be designated as the tactics and the strategy of food production. Strategic considerations cover the choice of crop, selection of farm animals, design and extent of farm machinery, and methods of soil cultivation. Strategic planning, in particular, includes the correct choice of land use, production facilities and genetic issues. Likewise, a statistical study of past climates, their variability, the range of possibilities - particularly extremes and sequences which the atmosphere can generate - can prove useful in risk assessment of nature proposals.

Tactical items relate to short-term timing of farm operations, and all that goes to make up good husbandry. Weather forecasts can play a tactical role, always provided that such predictions are reliable and accessible, that they do not omit farming-related weather parameters - and that agricultural effects of approaching weather are either understood by weatherwise farmers, or stated clearly in the forecast.

A forecast can only be useful if there is some action that the recipient can undertake, either to take advantage of favourable circumstances, or to reduce adverse effects. All too often farmers are powerless to act - an aircraft can change course to avoid a hailstorm, but farmers cannot shelter their crops.

Diurnal and annual variations of soil temperature and moisture

Periodic fluctuations of soil temperature are caused by the daily and yearly fluctuations in solar radiation received at the surface. The maximum temperature of the surface is reached when the flow of heat into the soil is exactly equal to the flow outward, and so depends not only on the incoming radiation but also on heat transfer in the soil and in air above the surface. Thus it is not surprising that the incidence of the maximum temperature on the surface occurs some time after local noon. At night the surface usually continues to cool until the fall of temperature is checked by the input of solar radiation after dawn, when the curve of temperature takes an abrupt upward turn. Observations even over a period limited to a calendar year clearly reveal that:

(a) There is a diurnal variation of temperature to a depth of about 0.5m, below which changes become too small to measure with conventional equipment;

(b) This diurnal variation is superimposed on a seasonal variation. Providing there is sufficient depth of soil, the seasonal variation becomes negligibly small at depths between roughly 5 and 20m depending upon the soil type and condition - an average figure of 10m would be reasonable to assume;

(c) Plots of both the daily and the seasonal march of soil temperature shows that:

(i) The amplitude of the fluctuation decreases with increasing depth; typically, it is halved for each 0.1m of descent into the ground.

(ii) With increasing depth, the times at which the maximum and the minimum are registered lag increasingly behind time events at the surface. This is most clearly shown in the annual curve, and least clearly for the diurnal minimum.

(iii) Depending on soil type and structure, soil temperatures remain constant at depths of about 10 metres or more. Ground water with a water table below this depth has a constant temperature, which is approximately the annual mean temperature at the relevant station.

Observations at fixed hours may have a different physical significance according to the time of the year they are taken. At 0.1m depth an observation at 1400 hours (local time) will generally be at, or near, the diurnal maximum. But the minimum is reached some time after sunrise, when the effect of surface warming penetrates downwards and arrests the fall of temperature. Therefore observation made at 0800 hours (local time) will be close to the diurnal minimum in early spring and late autumn - but in summer in temperature latitudes, when sunrise may be at 0400 hours (local time) or earlier, an 0800 hours observation will take place well up on the rising portion of the temperature curve.

In addition to the diurnal and annual courses, temperatures in the upper layers of the soil also show irregular variations due to weather. The exchange of air between atmosphere and soil cannot influence soil temperature much, because of the low density (and hence heat capacity) of air compared with that soil, but the day-to-day variations of radiation are certainly felt in the upper soil.

Also, a sudden fall of soil temperature can be caused by heavy rain or showers. When rain or showers occur, the decrease of the soil temperature in the layers below the water front is more due to the decrease of net radiation than to water. In heavy soils, the percolation speed is only about 0.2-0.3 mm h^{-1}, so only the uppermost soil layers can be cooled directly by rain water. But in sandy soils, where water is able to percolate faster, a cooling effect of rain is frequently measurable, especially after dry spells. The cooling effect of rain lasts often as long as the soil moisture and thus the heat capacity of the soil is changed. The diffusivity for a good moist horticultural soil will be about 0.45mm^2s^{-1}, that for a peat soil about 0.15mm^2s^{-1}, and for dry organic matter 0.l mm^2s^{-1}. In so-called ‘good’ soil, temperature fluctuations reach deeper levels, and more rapidly, than in peaty soils or in organic mulch. Also, given the same net energy at the surface, the surface and near-surface temperature of the dry organic layer (i.e. the layer with poor thermometric conductivity) may reach higher maximum and lower minimum than the ‘good’ soil.

Soil profiles often exhibit markedly different layers. On a daily basis, calculations based on homogeneous soil characteristics may not be useful when, for example, the topsoil has a markedly higher organic content than the subsoil. Similar problems also arise in the analysis of seasonal fluctuations, e.g. when a shallow layer of soil lies on rock, or when a water table occurs at a few metres depth.

When the soil is covered with vegetation, the upper side of the canopy forms a new surface, which absorbs a considerable portion of incoming radiation. The remaining part of radiation goes through the plant cover and is absorbed by the lower leaves, the rest by the soil surface. The radiation reaching the soil surface below a dense plant cover can be diminished to a few per cent of the total. The amount of reduction depends on the so-called ‘leaf area index’, i.e. the ratio of the whole leaf area (one side) to the soil surface.

Review Exercises:

1**.** Put 15 questions to Text C (part 1) .
2. Write a summary of Text C (part 2) in English.

Grammar Exercises

I. Translate the sentences where the participle is (A) - an attribute:

1. The atmosphere is the mass of gases surrounding the earth.
2. The weather map being shown to the meteorologists was a detailed one.
3. The meteorologists working in the Arctic communicate the data of observations to the continent.
4. Meteorologists collect data of warm air penetrating from the Pacific Ocean to the high latitudes.
5. The word "atmosphere" is used to denote the gaseous sphere surrounding the earth.
6. Diurnal changes are those occurring regularly every day, with two maxima and minima every 24 hr.
7. The highest amounts of atmospheric electricity observed occur at temperature not far below freezing.
8. The data sent by the sputnik will be compared with the data collected by ground observers.
9. The work done by expedition helped to understand many secrets of nature in the polar regions.
10. Gold anticyclones are wandering pressure structure seen on most winter weather map.
11. Land and sea breezes are winds caused by the local heating of land and water surfaces.
12. The vertical temperature gradient, generally called the lapse rate is the change in temperature with altitude.
13. The instrument most commonly used to measure the temperature of the atmosphere is the mercury-in-glass thermometer.
14. The wind is simply air in motion, usually measured only in its horizontal component.
15. Dust consists of particles of all kinds of matter distributed be the wind.
16. Heated air increases in volume.

(B) an adverbial modifier:

1. Sending out balloons, meteorologists obtain data about temperature, pressure, etc.
2. Being equipped with all the necessary instruments, the observers could

start this work.

3. Having communicated the weather report, the meteorologists continued to take observations.

4. Having been given all the necessary information the meteorologists began to analyse the data.

5. Being equipped with all the necessary instruments, the satellite can give information about the conditions in the higher atmospheric layers.

6. While observing the temperature of air and the speed of wind, scientists have obtained new data concerning heat exchange between the ocean.

7. Having been made more accurate, weather forecasts are of great help to aviation and navigation.

8. Having in its orbit, the satellite is periodically affected by changing thermal conditions.

9. Many airplanes are struck by lightnings when flying at a level where the temperature is near freezing.

10. When analysed, the data may be used for weather reports.

II. Translate into Ukrainian. State the forms and functions of the Participles:

A. 1. The velocity of flowing water depends upon the slope and character of its channel.

2. Having reached the earth, the precipitated water begins to accumulate additional impurities, both soluble and unsoluble.

3. The rain as it falls, evaporates somewhat adding water particles to the cold air.

4. Being cooled water becomes ice.

5. A portion of the precipitation penetrating the ground surface as infiltration will percolate into the ground.

6. Having great areas the oceans are principal sources of the atmospheric water.

7. Water being a good insulator, prevents the conduction of much heat to any great depth.

8. When freezing water expands by about one-tenth of its volume.

B. 1. The atmospheric water derived from the oceans is mingled with that carried into the air from land surfaces by means of evaporation and transpiration.

2. We are familiar with the cooling effect produced by evaporation.

3. The portion of water vapour derived from evaporation and transpiration is relatively small when compared with that carried into the air from the great areas of oceans.

4. Fog is water evenly distributed through air in minute particles.

5. When fully developed, tropical storms are very dangerous.

6. Being close to the solution of the problem he published the results

received.

7. Ice as deposited by nature is very pure.

8. The relative humidity of the air above the water affects evaporation in so far as, when considered with air temperature, it determines the actual vapour pressure.

III. Define the functions of the particles and translate the following sentences:

1. Considering the atmosphere, we find that unstable conditions occur every day and every hour.

2. In South Africa cumulus clouds are quite often seen to form at the top of smoke column originating from a fire, and cases are on record of copious rain falling from such clouds.

3. Observed data may be plotted on cross-section paper and a smooth curve may be drawn connecting the observed points.

4. Being of a transitory nature, the land and sea breezes do not adjust themselves readily to the pressure gradient and consequently blow more or less directly from sea to land and vice versa.

5. If the slope is covered with snow or ice the descending air is strongly cooled and may attain a considerable speed.

6. These clouds exist at very different levels, but when viewed from above they have a very similar structure, the upper surface having the characteristic rippled aspect.

7. The topographer examining the ground visually must locate all the details on the chart.

8. Sounding this area, the surveying vessel detected several unknown dangers.

9. Tide observations carried out at different stations have a great importance for scientific work.

10. Some topographical features hidden under water are sometimes very dangerous for navigation.

11. Hydrographers describing numerous features must mention those charted by hydrographic offices.

IV. Translate the following sentences, paying attention to the participle constructions:

1. Light-ships lying off the coast use current meters and pressure gauges resting on the bottom, the latter registering the depth of the water, hence the level of the tide.

2. Two high and two low waters occur during each tidal day (24^h50^m), morning and afternoon tides being very much alike.

3. The diurnal inequality in the height of the tide exists almost wholly in

the high waters, the low waters exhibiting very little inequality.

4. The interval between the moon's meridian passage and high or low water is nearly constant, only infrequently varying by as much as an hour from the average value.

5. The duration of rise and the duration of fall are equal, each being about 6 hours 12 minutes or 6.2 hours.

6. The waters surrounding the British Isles are dominated by strong tidal currents.

7. In all problems involving a finite depth of water, Ekman assumed the velocity to be zero at the bottom.

8. Using a theoretical formula mentioned above, Tsurikov (1939) worked out a "coefficient of growth" for the ice at various places in various years.

9. A theoretical formula, taking into account both thickness of snow cover and hydrodynamic effects due to drift, was compared with the average data of three years' observations at one point.

10. No really satisfactory results were obtained, the main disadvantage being that the temperatures related to nearly the same period as the ice information, allowing a forecast to be made at most a few days ahead.

11. The linear distance corresponding to a difference of one degree of latitude would be the same everywhere upon the surface of a sphere.

12. The waters surrounding Antarctica and extending northward as, far as the southern tips of the continent are designated as the Great Southern Ocean or Antarctic Ocean.

13. Having corrected the triangles, we began the calculations.

14. Making a running survey of the simplest kind, it is easier to plot the positions when the sheet is graduated.

15. When replotting from the astronomic positions, distant hills are a great help in a running survey.

16. While making observations of the coast-line, we noticed many conspicuous objects.

17. Being accurate enough for our work, the chart was recommended by our senior hydrographer.

V. Translate the following sentences, paying attention to the participle constructions:

1. Waves set up by the wind pass on to great distances, the length and speed of travel remaining the same, the height diminishing as they proceed.

2. The water flowing into the Mediterranean from the Atlantic has a mean salinity of 36.25‰ while that flowing out of the Mediterranean into the Atlantic has a mean salinity of 37.75 ‰.

3. The forces acting on the water of the sea may be divided into two general classes, viz., "internal and external."

4. The resulting mean velocity would include the oscillating currents associated with the surface waves.

5. The several forms of ice encountered in the area were described, and their origin, seasonal variations, movements and factors influencing the movements were discussed.

6. Working in the Baltic Sea, the Swedish oceanographers made observations on the inertia-currents and they were the first to identify them.

7. While sailing along the Antarctic coast ships were forced to make long northward passages to avoid icebergs.

8. The falling tide behaves in a similar manner as the rising tide, the rate of fall being least immediately after high water, but increasing constantly for about 3 hours.

9. When the moon is on or near the equator the diurnal inequality of the mixed type is at a minimum, the tide at such times resembling the semidiurnal type.

10. The tidal streams in the bay are weak and usually less than one knot, the general direction being to the north-east.

VI. Translate the following sentences, paying attention to the absolute constructions:

1. The soundings within the 100-fathom contour line decrease eastward, the depth being almost uniformly about 60 fathoms.

2. The bed of the sea being hidden from view, its form can only be determined by systematic soundings over the whole water area of the survey.

3. This area being surveyed a long time ago, our task was to resound it accurately.

4. The depth increasing, the normal interval between the soundings can be extended.

5. Sounding being the most important part of the surveyor's work, every hydrographer must know different modern methods and instruments used in this work.

6. The nature of the ground being, as a rule, uniform, we did not use the lead while approaching the nearest port.

7. Nearly all the horizontal layers of the Adriatic are composed of the same matter, little difference existing between these layers and the matter of the surrounding islands and rocks.

8. The sand near the beach being fine and mixed with mud and the depth permitting, we could drop anchor.

9. The base having been measured, we could begin plotting the coast survey.

10. There are different kinds of marine surveys, the boundaries between these being not strongly marked.

11. Most parts of the world have their coasts mapped, there still remaining portions of our globe the coast-lines of which are not marked at all.

12. A preliminary survey does not pretend to accuracy, a detailed survey being accurately constructed from the very beginning.

13. It is very difficult to lay down rules for marine surveying, experience alone dictating what should be done in each particular case.

14. The accuracy of the main triangles being most important, all work depends on them, and if they are incorrect, nothing will be satisfactory afterwards.

VII. Translate the following sentences paying attention to the absolute constructions:

1. The pressure may be predicted from the surrounding pressure field with an accuracy depending upon a number of factors, the principal one being the length of the forecast period.

2. A great number of thunderstorms occurred at inland stations, three being observed in the vicinity of our station and no less than eight were observed by some other stations.

3. The relationship between ozone deviations and frontal systems have been studied and it was shown that the low ozone values appeared in the warm sector and in the region covered by the warm front surface, the fall in ozone content often extending several hundred kilometres ahead of the surface warm front.

4. The diurnal variation of relative humidity is determined by absolute humidity and temperature, the latter being the controlling factor.

5. The weight of the air column depends upon its height, its temperature and its pressure, the last two factors affecting density.

6. The simplest form of wind rose is the wind rose in which the number or proportion of winds blowing from each of the principal eight points of the compass is represented by lines converging towards a small circle, the proportion of winds from each direction being represented by varying length of the lines.

7. In valleys into which the cold air blows, the surface winds often bear no relation to the pressure gradient, the upper wind gliding over the cold air without disturbing it.

8. In both cases the speed of the surface wind is less than that of the upper wind, and its direction is backed from that of the upper wind, the reproduction in speed and the amount of the backing being greater for the lower degree of turbulence.

9. In the high levels of the atmosphere the trade winds undergo complete reversal, the upper currents being known as the antitrades.

10. The narrow water, such as the Strait of Dover and Thames estuary, are

especially liable to be thus affected by radiation fog, the drift of which taking place from both shores.

VIII. Translate into Ukrainian paying attention to the Absolute Participle Construction :

1. The water having been precipitated to the earth, part of it enters the ground.
2. The lakes had no outlet, their inflow evidently being lost by percolation.
3. Water exists as ice at low temperatures and as steam at higher temperatures, with the temperature depending upon pressure.
4. Computers represent a completely new branch of science, the first of them having appeared not so long ago.
5. The density of surface water having been increased by cooling and evaporation, a mass of surface water sinks until it meets water of the same density.
6. Evaporation from sea water is about five per cent less than from fresh water, other conditions being the same.
7. The laboratory being provided with necessary instruments, they could carry out the work successfully.
8. The energy-budget method being used, accuracy of estimates of evaporation is highly dependent upon the reliability and preciseness of measurement data.
9. Other conditions being equal, the runoff characteristics of a given watershed express its infiltration capacity.
10. With the weather being windy, we did not risk to cross the river.

IX. Analyse the following sentences. State whether the ing-form are participles, gerunds, or verbal nouns. Define their form and function. Translate the sentences into Ukrainian:

1. The sole aim of this expedition was obtaining new data about the river bottom.
2. Oceans affect man in many ways, furnishing the vapour for most of the rain; tempering the climate of the land; serving as carriers of commerce and supplying food, some minerals and raw materials.
3. There are two established methods of measuring snowfall with the standard 8-in. rain gauge depending on whether the measurement is based on the catch of snow as it fells, or on a section cut out of the snow cover.
4. The rate of precipitation exceeding the rate at which water may infiltrate into the soil (infiltration capacity), surface runoff usually occurs.
5. The statistical probability of precipitation is often studied by assuming rainfall amounts to be random variables.
6. Depending on its concentration in the zone, soil moisture occurs in three

states.

7. The weathering of solid rock masses into loose debris and the direct transport of materials out of the soil mantle in the form of soil particles, solutes, and colloids are affected by the soil moisture content.

8. For practical purposes of water supply, hydrologists are concerned with measuring the amount of water reaching the earth's surface.

9. In many instances lake evaporation is determined from pan evaporation simply by applying a coefficient (pan coefficient equal to the ratio of lake evaporation to pan evaporation) to the readings taken from the pan.

10. While moving in thin sheets, surface runoff cannot attack soil protected by vegetation.

LESSON 4

Grammar: **The Conditional Sentences**
The Subjunctive Mood

Text A HYDROMETEOROLOGY

1. Hydrometeorology, branch of meteorology that deals with problems involving the hydrologic cycle, the water budget, and the rainfall statistics of storms. The boundaries of hydrometeorology are not clear-cut, and the problems of the hydrometeorologist overlap with those of the climatologist, the hydrologist, the cloud physicist, and the weather forecaster. Considerable emphasis is placed on determining, theoretically or empirically, the relationships between meteorological variables and the maximum precipitation reaching the ground. These analyses often serve as the bases for the design of flood-control and water - usage structures, primarily dams and reservoirs. Other concerns of hydrometeorologists include the determination of rainfall probabilities, the space and time distribution of rainfall and evaporation, the recurrence interval of major storms, snow melt and runoff, and probable wind tides and waves in reservoirs. The whole field of water quality and supply is of growing importance in hydrometeorology.

Hydrology

Hydrology is the scientific study of the movement, distribution, and quality of water on Earth and other planets, including the water cycle, water resources and environmental watershed sustainability. A practitioner of hydrology is a hydrologist, working within the fields of earth or environmental science, physical geography, geology or civil and environmental engineering.

Hydrology subdivides into surface water hydrology, groundwater hydrology (hydrogeology), and marine hydrology. Domains of hydrology include hydrometeorology, surface hydrology, hydrogeology, drainage-basin management and water quality, where water plays the central role.

Oceanography and meteorology are not included because water is only one of many important aspects within those fields.

Hydrological research can inform environmental engineering, policy and planning.

Branches

Chemical hydrology is the study of the chemical characteristics of water.

Ecohydrology is the study of interactions between organisms and the hydrologic cycle.

Hydrogeology is the study of the presence and movement of groundwater.

Hydroinformatics is the adaptation of information technology to hydrology and water resources applications.

Hydrometeorology is the study of the transfer of water and energy between land and water body surfaces and the lower atmosphere.

Isotope hydrology is the study of the isotopic signatures of water.

Surface hydrology is the study of hydrologic processes that operate at or near Earth's surface.

Drainage basin management covers water-storage, in the form of reservoirs, and flood-protection.

Water quality includes the chemistry of water in rivers and lakes, both of pollutants and natural solutes.

Hydrology is concerned with the quantities of water in the hydrosphere that are distributed in several hydrologic environments. Precipitation, evaporation, transpiration and infiltration, each of which is a component of the hydrologic cycle, will be discussed in turn.

Precipitation

Precipitation is the primary input vector of the hydrologic cycle. Its primary forms are rain, snow, and hail and several variations of these forms such as drizzle and sleet. Precipitation is derived from atmospheric water, its form and quantity thus being influenced by the action of other climatic factors such as wind, temperature, and atmospheric pressure. Atmospheric moisture is a necessary but not sufficient condition for precipitation.

Precipitation is produced as a result of condensation that occurs when air is cooled to its dew-point temperature and suitable nuclei are present to initiate the process of droplet formation. Two processes are considered to be capable of supporting the growth of droplets of sufficient mass to overcome air resistance and consequently fell to the earth as precipitation. These are known as the ice crystal process and the coalescence process.

In the study of precipitation, basic information is supplied by rain gauges and climatological stations. From these data, usually on a daily basis statistics of the average monthly and annual precipitation, the degree of seasonal and annual variability, and the number of rainy days are compiled. Invaluable as such records are, it is essential in hydrologic studies to know more about the characteristics of individual rainstorms.

The study of precipitation may include investigation of cyclic, secular, seasonal, and diurnal variations and trends of precipitation. Many attempts have been made to determine the cycle variations of precipitation from studies of annual totals. Accurate information on such variations would be extremely useful in the planning and management of water-resources projects, such as in forecasting floods, droughts, and the availability of water supply in future years.

Precipitation types

Dynamic or adiabatic cooling is the primary cause of condensation and is responsible for most rainfall. Thus it can be seen that vertical transport of air masses is a requirement for precipitation. Precipitation may be classified according to the conditions which generate vertical air motion. In this respect, the three major categories of precipitation type are conventional, orographic, and cyclonic.

Convective Precipitation. Convectional precipitation is typical of the tropics and is brought about by heating of the air at the interface with the ground. This heated air expands with a resultant reduction in weight. During this period, increasing quantities of water vapour are taken up, the warm moisture-laden air becomes unstable, and pronounced vertical currents are developed. Dynamic cooling takes place, causing condensation and precipitation. Convective precipitation may be in the form of light showers or storms of extremely high intensity.

Orographic Precipitation. Orographic precipitation results from the mechanical lifting of moist horizontal air currents over natural barriers such as mountain ranges.

Cyclonic Precipitation. Cyclonic precipitation is associated with movements of air masses from high-pressure regions to low-pressure regions. These pressure differences are created by the unequal heating of the earth's surface.

Cyclonic precipitation may be classified as frontal or nonfrontal. Any barometric low can produce nonfrontal precipitation as air is lifted through horizontal convergence of the inflow into a low pressure area. Frontal precipitation results from the lifting of warm air over cold air at the contact zone between air masses having different characteristics. If the air masses are moving so that warm air replaces colder air, the front is known as a warm front; if, on the other hand, cold air displaces warm air, the front is said to be cold. If the front is not in motion, it is said to be a stationary front.

I. Answer the questions:

1. What is hydrometeorology?
2. What is hydrology?
3. What does hydrology subdivise into?
4. Why aren't oceanography and meteorology included into aspects of hydrology?
5. What are the branches of hydrology?
6. When does condensation occur?
7. What are the ice crystal and the coalescence processes?
8. For what is basic information from rain gauges and climatologically stations needed?
9. What may the study of precipitation include?

II. a) Give English equivalents for the following:

Утворення крапель, посуха, опір повітря, забезпеченість водою, кліматичні фактори, температура точки роси, дощомір, у результаті, мінливість, добові коливання, віковий, тенденція.

b) Find the equivalents in the text for the following:

1. fall of rain, sleet, snow, or hail; 2. condensed vapour on a surface;
3. the mixture of gases that surrounds the earth and which we breathe;
4. to collect materials into a volume; 5. continuous period of dry weather.

III. Translate into Ukrainian. Mind the different meanings of the word "but": a) preposition (*окрім, за винятком);* b) conjunction *(але)*; c) adverb *(тільки, лише):*

1. Day after day, and night after night we could hear nothing but the wind and the noise of the water.
2. Where the port had once been, now there was nothing but march.
3. The degree of influence of lakes on climate is not so large as that of high mountain ranges, but in the case of large lakes it exceeds the influence of local topography.
4. Diurnal variation of rainfall has much in common with that of cloudiness, but it is less pronounced.

IV. Translate the words in the brackets and read the passage:

When water vapour in the atmosphere is cooled, (конденсація) results, and when the resulting water droplets obtain a sufficient (розміри) they fall as rain. If the raindrops pass through zones of temperature (нижче замерзання), hail results. If condensation (відбувається) at temperatures below freezing, snow is formed. If condensation of water vapour takes place (безпосередньо) on a surface cooler than the air, either (роса) or (паморозь) is formed, depending upon the temperature at which condensation occurs is (вище) or (нижче) freezing.

V. Read the following abbreviations in English:

c.c.; cfc; i.e.; L.C.T.; L.M.T.; L.S.T.; m.p.h.; WMO.

Text B EVAPORATION

Evaporation is the process by which water is transferred from land and water masses of the earth to the atmosphere. Because there is a continuous exchange of water molecules between an evaporating surface and its overlying atmosphere, it is common in hydrologic practice to define evaporation as the net rate of vapour transfer. It is a function of solar radiation, which differences in vapour pressure between a water surface and the overlying air, temperature, wind, atmospheric pressure, and quality of evaporating water. Conversion of snow or ice into water vapour is in reality sublimation rather than evaporation, since water molecules do not pass through a liquid phase. Otherwise the effects of these two processes are the same.

At every free water surface, whether it is a lake, a wet field, or a droplet on the leaf of a plant there is a continuous interchange of molecules of water. The more rapidly moving molecules escape from the water into the air; other molecules from the air caught in the water and augment the mass. When the sum total of the interchange represents a loss of molecules from the water, there is evaporation. The opposite condition prevailing, there is condensation. When the interchange of molecules is equal, evaporation is zero. The mere fact that relative humidity in the open air above a water surface is 100 per cent does not mean that evaporation is zero, as vapour pressure gradients cause a flow of water vapour, even at 100 per cent relative humidity. Furthermore, water vapour weighs only 0,6 times as much as the dry gases of the atmosphere and continually tends to rise. Atmospheric turbulence, however, is the principal cause of vapour transfer in the atmosphere above land and water surface.

There are several methods to be used to estimate the amount of evaporation from a free water surface. In general these may be grouped into the following categories: 1) mass transfer methods, 2) energy budget methods, 3) water budget, 4) empirical formulae, or 5) measurements from evaporation pans, etc.

Numerous investigations have been undertaken in an attempt to relate the amounts of evaporation from free water surfaces or potential evapotranspiration with measurements taken from various types of pans and atmometers.

A wide variety of atmometers or small-plate evaporimeters such as the Wilde, Piche, Bellani and Alundun disc have been used throughout the world for measuring water loss by evaporation. The most commonly used evaporimeters are the Bellani plate and the Piche. The Bellani plate consists of a thin, porous, black ceramic disc, 7.5cm in diameter, fused to the large end of the funnel from a burette which acts as a reservoir and measuring device. The Piche evaporimeter consists of a 11-mm diameter glass tube open at one end and graduated to read directly the depth of water evaporated. The evaporating surface is of blotting paper approximately 3cm in diameter which gives a total evaporating surface of approximately 11 cm^2. It is obvious that losses of water from atmometers provide an index of the evaporative ability of the atmosphere or “latent evaporation”.

The use of atmometers has increased materially during recent years. The primary reasons for this increased use may be attributed to the fact that the instruments are portable, inexpensive, easily installed, maintained and standardised and that they do not require large amounts of water. Nevertheless, there is considerable indecision among workers as to the value of these instruments for estimating evaporation from free water surface.

1) Atmometer observations are difficult to interpret. 2) Different conversion factors may be required with atmometers for different ranges of evaporation amounts as well as for different locations. 3) A class “A” type of larger pan would appear preferable to atmometers for use in estimating evaporation from lake surface.

Transpiration

Root systems of plants absorb water in varying quantities. Most of this water is transmitted through the plant and escapes through pores in the leaf system. This is known as stomatal transpiration. Transpiration is basically a process by which water is evaporated from the air-spaces in plant leaves. Therefore it is controlled essentially by the same factors which dominate evaporation, namely, solar radiation, temperature, wind velocity, and vapour pressure gradients. In addition, transpiration is affected to some degree by the character of the plant density.

Soil moisture content, when reduced to the wilting point (stage at which plants wilt and do not recover in a humid atmosphere) also affects transpiration. The effects of decreased soil moisture above the wilting point are not clearly established and somewhat controversial. Nevertheless, it appears that as long as soil moisture lies between the limits of the wilting point and field capacity (amount of water retained in a soil against gravity after percolation ceases) transpiration is not materially affected. Saturated soils can sometimes adversely affect plant life.

Diffusion of water vapour from plant leaves to the atmosphere is proportional to the vapour pressure gradient at the leaf-atmosphere interface. Upon absorbing solar radiation, leaves tend to become warmer than the surrounding air (often by as much as 5 to 10°F). The amount of water vapour held by the air at the leaf-air interface thus increases, more rapid water losses are favoured, and transpiration follows a diurnal cycle which is approximately that of light intensity. Below a temperature of about 40°F the amount of water transpired is considered negligible.

Interception

A portion of the precipitation falling to the earth's surface may be stored on the vegetal cover and subsequently lost thorough evaporation. The volume of water caught by the vegetation is called interception. The amount stored and eventually lost through evaporation may be called the interception loss. The effect of interception is usually insignificant in studies of major storm events and floods, however, interception by some types of cover can amount to a considerable percentage of the annual rainfall. The interception may be 10 inches annually for a forested region in a humid climate and commonly is about 25 per cent of the annual precipitation for forested regions or areas of dense cover. A large amount of data has been accumulated by numerous investigators on interception loss but because of the difficulties of measuring interception and because of varying definitions of interception, correlations are difficult to obtain. Fortunately on many occasions an extremely accurate assessment of interception is not required; it should be recognized as a part of the hydrologic process, however, otherwise this loss may be erroneously considered as part of some other process such as infiltration. If there is a vegetative cover over the soil surface, then any precipitation will be caught and redistributed as through fall stemflow and evaporation (interception loss) from the vegetation. The effect of wind may be to increase or decrease the interception loss depending on the wind velocity, the duration and amount of rain and the humidity of the air. In general, wind will increase total interception loss for a long storm and decrease it for a storm of short duration. The rate of evaporation per unit surface area is normally quite small during storms because of low vapour pressure differences but when this is multiplied by large vegetal surface area the evaporation can be appreciable.

I. Answer the questions:

1. What process do we call “evaporation”?
2. How does hydrology define “evaporation”?
3. What is conversion of snow or ice into water vapour?
4. Why does sublimation occur?
5. Where is there a continuous interchange of molecules of water?
6. Describe this process.
7. When is evaporation zero?
8. What is the principal cause of vapour transfer in the atmosphere above land a and water surface?
9. Do root systems of plants absorb water in varying quantities ?
10. What happens to this water?
11. What do we call such a process?

12. What is transpiration?
13. What factors is transpiration controlled by?
14. Does the character of the plant and plant density affect transpiration?
15. What do we mean by the wilting point?
16. Can saturated soils sometimes adversely affect plant life?

II. a) Give English equivalents for the following:

Вільна водна поверхня, переніс водяної пари, насправді, метод теплового балансу, випарник, атмосферна турбулентність, інакше, постійний обмін, збільшувати, кількість, крім того, сумарна швидкість.

b) Write out the equivalents in pairs:

To transfer, continuous, humidity, to define, above, rapidly, exchange, to carry, in reality, to estimate, quickly, to determine, over, in fact, prolonged, interchange, moisture, to evaluate.

III. Translate into Ukrainian paying attention to the construction "the more ... the better":

1. The lower the pressure of the air above the water, the greater will be evaporation.
2. The greater the depth of lakes, the lower their temperature and the smaller the evaporation loss.
3. The nearer the air above the water approaches saturation, the less rapid will be the net loss from the water.
4. Over ocean surfaces, the more the vertical gustiness of the wind, the greater will be the evaporation.
5. The shallower the lake, the higher the water temperature and the greater the rate of evaporation.

IV. Translate the words in the brackets and read the passage:

Evaporation is the (зміна) of state from a liquid to a gas. The process (відбувається) when water molecules, which are in constant (русі), possess sufficient energy to break through the (водну поверхню) and escape into the atmosphere. Similarly, some of the water molecules contained in the water vapour in the atmosphere, which are also in motion may (проникати) the water surface and (залишатись) in the liquid. The net (обмін) of water molecules per unit time at the liquid surface (визначає) the rate of evaporation. Further, continued evaporation can take place only when there is a supply of (енергії) to provide the latent heat of evaporation, and there is some mechanism to remove the (пару) (таким чином щоб) the vapour pressure of the water vapour in the moist (шарі) adjacent to the liquid surface be less than the saturated vapour pressure of the liquid.

Text C **RUNOFF**

The movement of the water over the surface of the Earth under the influence of gravity, in channels ranging from tiny streams to large rivers, is called runoff. Considering the hydro-logic cycle over a drainage basin or watershed, runoff is a residual of the hydrologic process, because it represents the excess of precipitation over evapotranspiration when allowance is made for storage on and under the ground surface. When precipitation is spasmodic and irregular in space, time and amount, runoff from the land surface is usually low and becomes a comparatively constant factor. This contrast between runoff and precipitation, from which the former is derived, results mainly from the storage capacity of the surface layers of the Earth, by which much of the excess precipitation is held back and released only gradually into the streams. It has been estimated that one foot of soil normally holds more water than in the entire overlying atmospheric column.

The rate or discharge of runoff is usually expressed as a volume per unit of time. When the water discharge is plotted against the time, the plot is called a hydrograph. Analysis of the hydrograph can reveal much about the watershed characteristics that affect the disposal of precipitation and, consequently, the apportioning of surface and groundwater runoff. Hydrologic studies of runoff are important in various respects. The study of runoff over the land and in the channel is necessary for the development of land drainage and river-engineering works. A study of the short-term runoff patterns involves the analysis of flood hydrographs, flood frequencies, flood forecasting, and routing floods through the river channels. There are basic in flood-control engineering and flood-plan regulation. A study of the annual runoff characteristics and long-term trends of runoff involves the analysis of river regimes; basin geomorphology and theoretical probability analyses are required for the planning and development of irrigation, waterpower, water supply, and other water-resources projects. Modern engineers and planners of such projects require a thorough understanding of the quantitative as well as qualitative nature of the runoff.

Runoff represents precipitation returning to the sea or to the inland bodies of water. It is that portion of the precipitation that appears in surface streams. It consists, in ever varying proportions, of both surface runoff and ground-water runoff, or effluent seepage. There has been considerable difference in the use of terms relating to runoff, but it is suggested that the "overland runoff' be used to designate the water flowing over the land surface before it reaches a definite stream channel; the term ''surface runoff " to designate the water that reaches the stream as overland runoff, in contrast to the groundwater runoff; and the term "direct runoff " to designate the surface runoff that has not been retarded by storage on the surface as snow or ice or in a lake or other body of standing water.

Runoff from the land area of the earth represents the excess of evaporation from the ocean area over precipitation upon that area. Unless the two are equal, water vapour is continually escaping from the outer atmosphere and the ocean level is progressively lowering. Temporarily excess evaporation from the ocean may be store on the land as snow and ice and as ground and surface storage. It cannot be stored in the atmosphere, because the air can seldom hold more than 2 to 3 days' evaporation from a water surface in a given locality. Water evaporated from the ocean is in part precipitated on the ocean and in part carried inland by air currents, to be precipitated on the land. Of the moisture precipitated on the land area: a) some is evaporated and carried back over the ocean area by the winds to be reprecipitated or to be returned to the land area; b) some returns to the sea as surface runoff; c) some seeps into the ground to reappear in streams as ground-water runoff; d) some is evaporated from the ground surface and the surface of vegetation; e) some is temporarily stored in the soil to be reevaporated and reprecipitated; f) some is absorbed by the roots of growing plants and transpired into the atmosphere to be reprecipitated; g) some enters into the plant fiber to remain until the plant is desiccated or destroyed.

Groundwater zones

Subsurface water occurs in the interstices of the rock between the surface of the ground and the lower limits of porous water bearing rock formations, this interval being divided into two zones - the upper, or "zone of aeration" and the lower, or "zone of saturation"

Water occurring in the zone of aeration is acted upon by the opposing forces of gravity and of molecular attraction. In some areas there may be practically no zone of aeration, the water table being at, or close to the ground surface. The zone of aeration is divided into three belts: a) the belt of soil water, b) the intermediate belt, c) the capillary fridge.

Soil water held against gravitational action may later pass into the atmosphere by transpiration or soil evaporation. It is then replaced by the next downward flow of water from the surface.

The intermediate belt, ranging in thickness from nothing to several hundred feet, extends downward to the top of the capillary fridge. The capillary fridge, which lies above the zone of saturation, contains water that is held above this zone by capillary force.

The zone of saturation lies below the zone of aeration. Its thickness varies greatly, extending downward to depth where the interstices have been closed. All interstices in the zone of saturation are completely filled with water under hydrostatic pressure. It is in this zone that groundwater storage occurs. Where the upper surface of the zone of saturation is under atmospheric pressure, and is free to rise and fall with changes in volume of stored water, it is referred to as the " water table". Water occuring under these conditions is called "free", or "unconfined" groundwater. Where the upper surface of this zone is under hydrostatic pressure, due to a more or less impermeable overlying formation, the water is termed "confined" groundwater, or "artesian water".

Groundwater flow

Geohydrology is concerned with the movement and storage of water beneath the earth's surface, generally within the zone of saturation. Groundwater is an integral part of the hydrologic cycle. The void spaces in the soil and rock down to very great depths function as a tremendously large reservoir to which water is continuously being discharged by direct outflow and by evapotranspiration. Because of its size, the groundwater reservoir is only slightly influenced by short-period fluctuations in the amount of infiltration.

Groundwater will move from a region of higher fluid potential toward a region of lower fluid potential, following a path which offers the minimum resistance to flow. The rate of groundwater movement is slow; under naturally occurring gradients it may be expected to range from about 5 feet per day to about 5 feet per year. Water, which infiltrates to the water table in an upland area (a region of higher fluid potential) will move downward and laterally, and will eventually be discharged back to the ground surface in a topographically lower area (a region of lower fluid potential). In such a medium there is no lower limit to the depth of gravitational flow of ground water.

In nature, flow media are neither homogeneous nor isotropic with respect to permeability. Instead, geological processes tend to create heterogeneity. Before one can study groundwater flow under natural conditions, however, the geology of the flow media should be first properly examined and understood.

I. Answer the questions:

1. What is called groundwater?
2. What is the water table?
3. Why is groundwater trapped under pressure?
4. When is groundwater under gravity condition?
5. Where does groundwater exist?
6. What may be the aquifer?
7. Does all groundwater originate as surface water?
8. What do principal sources of natural recharge include?
9. What does artificial discharge result from?
10. What water are also useful for artificial recharge?
11. Where does subsurface water occur ?
12. What two zones divide the interval between the surface of the ground and the lower limits of porous water bearing rock formation ?
13. What forces act upon water in the zone of aeration ?

14. What belts divide the zone of aeration ?
15. What can you say about: a) soil water, b) the intermediate belt ?
16. Where does the capillary fringe lie ?
17. What water fills all interstices in the zone of saturation ?
18. Does groundwater storage occur in the zone of saturation ?
19.Where does a water table occur ?

II. Fill in the blanks with appropriate words from the list below and translate the sentences into Ukrainian:

<u>SURFACE RUNOFF.</u> The rate of ... exceeding the rate at which water may ... into the soil (infiltration capacity), surface runoff usually occurs. This part of precipitation after filling the surface ... finds its way over the surface of the ... until it reaches the beginning of a definite stream channel system, through which it ... and is discharged ultimately into the ... or some inland water body. There is some ... in transit because of... to the atmosphere and infiltration to the ... and side of the channel, the latter varying from practically ... to nearly 100%.

depressions, ocean, passes, precipitation, zero, evaporation, ground, infiltrated, bottom, loss

III. Explain the meaning of "rather" in these sentences:

1. The rather poor quality of soil in the area combined with a fairly short growing season limit the usage of underground water for irrigation purposes.
2. In the zone of cyclonic movements any changes on the earth's surface produced by man in areas of relatively high precipitation which would result in returning the precipitated water as runoff to the sea rather than under natural conditions might, and probably would reduce the precipitation to some extent over the inland areas of lesser precipitation.

IV. Complete the following sentences:

1. Subsurface water is known to occur ... .
2. Water in the zone of aeration is believed to be acted upon ... .
3. All interstices in the zone of saturation arc considered to be filled ... .
4. The water table is known to occur ... .
5. The capillary fringe is started to lie ... .

Grammar Exercises

I. Translate the following sentences, paying attention to the conditional clauses:

1. If convection within the cloud becomes active, these minute water particles will be carried higher up.
2. If there were no vertical velocity in the air, the front would move in a direction normal to itself with a speed that is equal to the speed of the wind.
3. If the isobars around the centre are circular, any line through the centre will be a symmetry line.
4. If an anticyclone advances towards a tropical cyclone, the latter will generally either turn away from the advancing high-pressure area or will cease to move.
5. If a seaman believes in the approach of a tropical cyclone, he should at once determine the bearing of the centre, estimate its distance and plot its apparent path.
6. If a front lies along the isobars, it will remain more or less stationary.
7. Were the atmosphere static, the steady-state activities at any latitude and altitude would be in equilibrium.

II. Translate the different types of conditional sentences. Pay attention to the conjunctions, introducing English conditional clauses:

1. I shall not go out tomorrow, if the weather is bad.
2. I could do this work in case I got the necessary tools.
3. They would have stayed in town, unless the weather had been warm.
4. He will come to see you, provided he knows your address.
5. Had they seen you yesterday, they would have certainly told you about our plans.
6. Were it not for your help, he would not finish the work.
7. But for your advice, I should have acted differently.
8. If the dew point passed, condensation would begin.
9. Were it not for the protective ozone layers, life upon the earth might have been impossible.
10. Were the vapour cooled below its dew point, some of it would become liquid.
11. Had the air contained only very small dust particles, condensation would have been delayed.
12. If the vertical extent of the clouds is rather limited, very little activity may be expected.
13. If the air is not saturated, its wet-bulb temperature will be lower than the air temperature.
14. Invisible water vapour may become visible provided it is transformed

into clouds, rain, hail, snow, sleet, dew or frost.

15. The vertical movements of the atmosphere usually pass unnoticed by most people, unless those movements are specially vigorous.

III. Translate the sentences paying attention to the conditional sentences:

1. The view was wonderful. If I'd had a camera I would have taken some photographs.
2. If we'd had more time, we would have prepared a more interesting report.
3. If he had been looking where he was going, he wouldn 't have walked into a wall.
4. The students wouldn't have got bad marks in geography if they had revised.
5. If she hadn't failed one of her final exams she wouldn't have had to spend part of the summer in college.
6. The first motorways would never have been built if more people had been concerned about pollution in the 1960s.
7. If people had realized that smoking was dangerous when they were young they wouldn't be having serious health problem now.
8. The seeds wouldn't have died if the schoolchildren had remembered to water them.
9. Many unique plants and animals wouldn't have become extinct, if people hadn't cut down rainforests.
10. I would be able to concentrate if I had gone to bed earlier.

IV. Translate paying attention to Conditional Clauses:

1. You will get good results if you apply this method of calculation.
2. If they find the exact meanings of these words, they will understand the text easily.
3. If the wind were favourable, the ship would reach the port of destination early in the morning.
4. If a drop of water, so small as to be scarcely visible, were introduced into the vacuum over the mercury of the barometer at a temperature of 80°F, the water would turn into vapour and depress the mercury column about 1 inch.
5. The results of the experiment would have been much better it he had used the new equipment.
6. Had the urgent measures not been taken to prevent the overflow of the river, the embankments would have been flooded.
7. Were the vapour cooled below its dew point, some of it would become liquid.
8. Most lakes and rivers would dry up if they depended solely upon precipitation for their store water.

9. If all the atmospheric moisture were precipitated it would create a layer averaging only one inch in depth over the entire globe.

10. A great disaster might have occurred had not the vessel changed its course.

V. Translate the following sentences, paying attention to the conditional clauses:

1. If these air temperatures were higher than usual, ice conditions would be better.

2. Were any attempts made to find a correlation between sea temperatures and the amount of sea ice, satisfactory results would be easily obtained.

3. If the salinity and the fall of sea-water temperature are known, it will be possible to predict ten to fifteen days ahead the date on which water of given salinity will freeze.

4. Had predictions of temperature conditions been made from the average charts, then, in general, they would have given temperatures above the thermocline within 2°F.

5. Provided depths of isotherms differ by no more than 15 feet from the average, the difference will not be considered significant.

6. Should the difference in salinity cease, the double current would be discontinued.

7. If the daily constituent has much the greater range, the tide will be of the daily type, with but one high and one low water in a day.

8. Unless weather reconnaissance flights were in continuous progress, no other ice islands would be discovered.

9. Should the expedition arrange reconnaissance flights to explore the land masses bordering the Arctic Ocean they will know the more accurate position of a new ice island.

VI. Translate the following sentences, paying attention to the conditional clauses:

A. 1. If the northern part of the Gulf Stream is warm, the winter will be warm in Europe and cold in Greenland, the difference being more pronounced the warmer the Gulf Stream is.

2. If an observer faces the wind, the centre of a cyclone will bear approximately 120°.

3. If all observing stations had perfect exposures to the wind, with no mountains and few trees or houses in the vicinity, the difficulty would not arise, but this ideal is rarely attainable, and in practice all observing stations, including ships at sea, have obstructions to the free flow of air in one or more directions.

4. Provided the force of the gradient wind in any synoptic situation can be correctly determined, comparison with the values given in this table will show whether such winds are above or below normal.

5. If the air were true tropical air it would almost certainly be saturated.

6. Had it rained without a break for two hours it should undoubtedly have been described as "continuous rain."

7. A westerly gale may certainly be expected if the wind shifts from north to N.W., and the barometer, in winter, falls below 1,007 mb.

8. Unless one carried out a great number of observations, it would be extremely difficult to come to a certain conclusion concerning the factors influencing the weather.

9. If the air were saturated adiabatically and with constant moisture content, it would become saturated at its condensation level.

VII. Translate the sentences into Ukrainian, paying attention to the forms of Subjunctive Mood:

A. 1. He looks as if he were very tired.

2. It is necessary that the type of the reaction be determined.

3. He would come to see us if he had time.

4.I should give you a lot of examples.

5. It is unlikely that they should come in time.

6. It is better to take the bus lest you should be late.

7. However far this place might be, you could get there by bus in an hour.

8. They propose that he should work at their office.

9. There would be no life without water.

10. It is apparent that moisture and temperature distributions that would cause a layer to gain heat are also possible.

11. Slight though the absorption of solar radiation might be, it is nevertheless important.

12. Many insects use the surface of water as if it were a solid surface, moving around on it.

B. 1. The absolute zero is the temperature at which an ideal gas would have zero volume at any finite pressure.

2. It is necessary that atomic energy should be used for industrial purposes.

3. No fuel would burn in an atmosphere deprived of its oxygen.

4. It seems necessary that reliable knowledge of mountain wind patterns be obtained soon.

5. Whether the air motion be upward or downward precipitation elements will always fall with respect to the air and the smaller cloud elements.

6. It is necessary that these processes should take place at the surface of the earth.

7. Frictional drag would be expected to cause some reduction in velocity.

8. The downward flux of moisture would continue until the relative humidity has been lowered to the limited value.

9. It’s probably true that clear ice would be encountered only in precipitating clouds or in rain at freezing temperatures.

10. In order to maintain saturation, the advection of warmer air would have to be strong to overcompensate the loss of moisture toward the snow.

VIII. Translate into Ukrainian:

1. If the sea ice, which at present reflects much of the solar radiation is lost, this will lead to positive feedback mechanism and enhanced global warming. The man global temperature is expected to increase 1.4 to 5.8°C by 2100.

2. If the entire ice cap of Greenland melts, the sea level will rise 7m. Many researchers claim that if the temperature increases more than 3°C, such large sea level rises will be experienced .

3. If precipitation increases over land at high altitudes in the northern hemisphere, especially during the cold season , such extreme weather events will be expected to occur more frequently than previously.

4. If climate change causes loss of sea ice habitats, it will threaten the existence of polar bears and other ice-associated animals.

5. If the ice melting continues, the Barents Sea will probably be ice-free year- round by 2050 with the detrimental consequences for the productive marginal ice flora and fauna.

6. The 48 acre dam, in Kalush known as Number Two, can hold another 100,000 cubic meters of matter before it spills over into the field below. If the dam breaks, it will flood the factories and homes in the area.

7. This dam is old and crumbling and if it overflows, the industrial deposits it contains will poison drinking water for millions of people in Ukraine and Moldova.

8. If in the Arctic, loss of permafrost regions triggers erosion and subsidence, reduces the stability of slopes, will threaten oil pipelines and all structures that are built on permafrost.

9. If the environment is not protected from pollution, its damage will extract its cost from those living-in the vicinity or others living at a distance or even from those coming generations.

10.If projections of approximately 5°C warming in this century (the upper end of the range) are realised, then the Earth will have experienced about the same amount of global mean warming as it did at the end of the last ice age; there is no evidence that this rate of possible future global change was matched by any comparable global temperature increase of the last 50 million years.

IX. Translate into Ukrainian. Don’t forget to put a comma when time clause comes first:

1. Як тільки ми отримаємо цю інформацію, ми зробимо доповідь.

2. Ми не почнемо робити експерименти, доки не приїде професор Браун.

3. Твій друг приїде, коли він отримає запрошення від тебе.

4. Літаки не злітатимуть, доки погода не покращиться.

5. Як тільки вітер змінить напрямок, море заспокоїться.

6. Студенти почнуть виконувати вправи після того, як знайдуть усі незнайомі слова у словнику.

7. Після того, як професор зробить доповідь, він відповість на всі запитання своїх співробітників.

8. Доки вони не матимуть результатів експериментів, вони не зможуть зробити висновків.

9. Якщо уряд буде приділяти увагу проблемам споживання води, то деякі області не будуть страждати від нестачі води протягом засушливого літнього періоду.

10. Якщо кожна людина буде старатись доцільно витрачати природні ресурси, то ми зможемо зберегти планету для майбутніх поколінь.

X. Translate into Ukrainian:

1. If the climate were not the most important regulator of earth processes and a change in climate properties it wouldn't have a major impact on all the living, from plants to humans.

2. If in the Arctic, loss of permafrost regions didn't change hydrologic processes and didn't increase incidences of clides and avalanches, melting permafrost wouldn't cause great structure damage to roads and buildings in Alaskan and Siberian areas.

3. If there weren't change in weather patterns, it wouldn't cause massive storms and subsequent floods and wouldn't increase the wave storms and the wave height in the North Atlantic Ocean.

4. If the continents were at one time united, this should be indicated in the rocks that were formed prior to the breakup.

5. Were the composition of sea water determined, we should be able to make certain conclusions concerning the amount of magnetism in it.

6. If the calculation were correct, the heat weather in Europe would be greater the warmer the Gulf Stream was.

7. If the Greenland ice sheet which contains nearly three million cubic kilometers of ice were to melt, sea level around the world would rise by about 7 meters.

8. The dissolved oxygen might be saturated, if there were no biochemical oxygen consumption in the sea.

9. Some models carried out at the Hadley Center earlier showed that once Greenland begins to melt, it wouldn't be possible to ever regrow it to its present size, even if CO_2 was reduced to pre-industrial concentrations.

10. If ocean warming penetrated sufficiently deeply to destabilize even a small fraction of the methane locked up in methane hydrates and release it into the atmosphere, it could lead to a rapid increase in greenhouse warming.

XI. Translate into Ukrainian:

1. Pollutants not dispersed by winds and rain may reach lethal concentrations. If industrial smog had been dispersed in London in 1952, 4.000 people wouldn't have died.
2. If the progressive scientists in the world hadn't started informing the society of the harm of imbalanced approaches to nature, people wouldn't have started thinking of careful use of natural resources.
3. Had it rained without a break for two hours, it should have been described as "continuous rain".
4. If predictions of temperature conditions had been made from the average charts than in general, they would have given temperatures above the thermocline within 2°F.
5. If these air temperatures hadn't been higher than usual, ice conditions would have been better.
6. If the group of scientists had had enough time during the conference last month, they would have discussed more serious items with their colleagues from other countries.
7. Water and life have existed on this planet for long ages, which they couldn't have done if temperatures had been markedly higher or lower than at present.
8. If the ship had followed this pattern of movement relative to the wind, it would have passed the North Pole on the Alaskan side and the men would have reached the shores of Canada.
9. If the scientists hadn't started using the method of computer modeling a few years ago, they wouldn't have estimated the future rate of global warming and wouldn't have warned the society of its harmful effects.
10. If the scientists had analyzed the data on precipitation in details, they would have warned the population of the region about the possible flood event.

XII.
A. Translate the sentences:

1. I wish I'd known that Gary was ill. I would have gone to see him.
2. I feel sick. I wish I hadn't eaten so much cake.
3. I wish I had studied science instead of languages.
4. The weather was cold while we were away. I wish it had been warmer.
5. I wish I had taken the camera. The view was spectacular!

B. Imagine that you are in these situations. Write a sentence with *I wish*:

1. You've eaten too much and now you feel sick. You say: I wish....
2. There was a job advertised in the newspaper. You decided not to apply for it. Now you think that your decision was wrong. You say: I wish....
3. When you were younger, you didn't learn to play a musical instrument. Now you regret this. You say: I wish....
4. You've painted the door red. Now you think that it doesn't look very nice. You say: I wish....
5. You are walking in the country. You would like to take some photographs but you didn't bring your camera. You say: I wish....
6. You spent a lot of money on eating in restaurants. Now you have to pay a house rent but you don't have enough money. You say: I wish....
7. You were late for work. Your manager was angry. You say: I wish....

XIII. Translate the sentences with "I wish":

1. I wish I had a camera. The view was spectacular!
2. The weather was cold while we were away. I wish it had been warmer.
3. I wish I had studied science instead of languages.
4. I feel sick. I wish I hadn't eaten so much cake.
5. I have tailed the exam. I wish I hadn't watched TV too much before the exam.
6. I was late for classes again. I wish I hadn't been so slow in the morning.
7. I wish I hadn't painted the door red. I doesn't look very nice.
8. I wish I hadn't sold my car. I could give it my son.
9. It was a difficult question. I wish I had known the answer.
10. We didn't have time to see all around in London last year. I wish we'd had more time.

LESSON 5

<u>Grammar:</u> **Modal Verbs**

Text A OCEANOGRAPHY

Oceanography (compound of the Greek words meaning "ocean" and meaning "write"), also known as oceanology, is the branch of geography that studies the ocean. It covers a wide range of topics, including ecosystem dynamics; ocean currents, waves, and geophysical fluid dynamics; plate tectonics and the geology of the sea floor; and fluxes of various chemical substances and physical properties within the ocean and across its boundaries. These diverse topics reflect multiple disciplines that oceanographers blend to further knowledge of the world ocean and understanding of processes within: astronomy, biology, chemistry, climatology, geography, geology, hydrology, meteorology and physics. Paleoceanography studies the history of the oceans in the geologic past.

Branches

The study of oceanography is divided into these four branches:

Biological oceanography, or marine biology, investigates the ecology of marine organisms in the context of the physical, chemical, and geological characteristics of their ocean environment and the biology of individual marine organisms. Chemical oceanography and ocean chemistry, are the study of the chemistry of the ocean. Whereas chemical oceanography is primarily occupied with the study and understanding of seawater properties and its changes, focuses ocean chemistry primarily on the geochemical cycles.

Geological oceanography, or marine geology, is the study of the geology of the ocean floor including plate tectonics and paleoceanography.

Physical oceanography, or marine physics, studies the ocean's physical attributes including temperature-salinity structure, mixing, surface waves, internal waves, surface tides, internal tides, and currents.

Ocean current

An ocean current is a continuous, directed movement of seawater generated by forces acting upon this mean flow, such as breaking waves, wind, the Coriolis effect, cabbeling, temperature and salinity differences, while tides are caused by the gravitational pull of the Sun and Moon. Depth contours, shoreline configurations, and interactions with other currents influence a current's direction and strength.

Ocean currents flow for great distances, and together, create the global conveyor belt which plays a dominant role in determining the climate of many of the Earth’s regions. More specifically, ocean currents influence the temperature of the regions through which they travel. For example, warm currents traveling along more temperate coasts increase the temperature of the area by warming the sea breezes that blow over them. Perhaps the most striking example is the Gulf Stream, which makes northwest Europe much more temperate than any other region at the same latitude. Another example is Lima, Peru where the climate is cooler (sub-tropical) than the tropical latitudes in which the area is located, due to the effect of the Humboldt Current.

Terminology

World Ocean - the single connected salty body of water that covers the majority of Earth's surface.

Ocean - the four to seven largest named bodies of water in the World Ocean, all of which have "Ocean" in the name. See borders of the oceans for details.

Sea has several definitions:

A marginal sea - a marginal sea is a division of an ocean, partially enclosed by islands, archipelagos, or peninsulas, adjacent to or widely open to the open ocean at the surface, and/or bounded by submarine ridges on the sea floor.

A division of an ocean, delineated by landforms, currents (e.g. Sargasso Sea), or specific latitude or longitude boundaries. This includes but is not limited to marginal seas, and this is the definition used for inclusion in this list.

The World Ocean. For example, the Law of the Sea states that all of the World Ocean is "sea", and this is also common usage for "the sea".

Any large body of water with "Sea" in the name, including lakes.

Strait - a narrow area of water connecting two wider areas of water.

There are several terms used for bulges of ocean that result from indentations of land, which overlap in definition:

Bay - generic term; though most features with "Bay" in the name are small, some are very large.

Gulf - a very large bay, often a top-level division of an ocean or sea.

Fjord - a long bay with steep sides, typically formed by a glacier.

Bight - a bay that is typically shallower than a sound.

Sound - a large, wide bay which is typically deeper than a bight, or a strait.

Cove - a very small, typically sheltered bay.

Many features could be considered to be more than one of these, and all of these terms are used in place names inconsistently; especially bays, gulfs, and bights which can be very large or very small. This list includes large areas of water no matter the term used in the name.

Answer the questions:

1. What is oceanography?
2. What are the branches of oceanography?
3. What is the ocean current?
4. What is the role of ocean current for the globe?
5. Study the terminology of the water resources of the Earth.

Text B **INTRODUCTION TO THE OCEANS**

Have you ever heard the Earth called the "Blue Planet"? This term makes sense, because over 70% of the surface of the Earth is covered with water. The vast majority of that water (97.2%) is in the oceans. Without all that water, our world would be a different place. The oceans are an important part of Earth: they help to determine the make-up of the air, they help determine the weather and temperature, and they support great amounts of life. The composition of ocean water is unique to its location and depth. Just as Earth's interior is divided into layers, the ocean separated into different layers, called the water column.

How the Oceans Formed

Scientists have developed a number of hypotheses about how the oceans formed. Though these hypotheses have changed over time, one idea now has the wide support of Earth scientists, called the volcanic outgassing theory. This means that water vapor given off by volcanoes erupting over millions or billions of years, cooled and condensed to form Earth's oceans.

Creation and Collection of Water

When the Earth was formed 4.6 billion years ago, it would never have been called the Blue Planet. There were no oceans, there was no oxygen in the atmosphere, and no life. But there were violent collisions, explosions, and eruptions. In fact, the Earth in its earliest stage was molten. This allowed elements to separate into layers within the Earth — gravity pulled denser elements toward the Earth's center, while less dense materials accumulated near the surface. This process of separation created the layers of the Earth as we know them.

As temperatures cooled, the surface solidified and an atmosphere was created. Volcanic eruptions released water vapor from the Earth's crust, while more water came from asteroids and comets that collided with the Earth . About 4 billion years ago, temperatures cooled enough for oceans to begin forming.

Present Ocean Formation

As you know, the continents were not always in the same shape or position as they are today. Because of tectonic plate movements, land masses have moved about the Earth since they were created. About 250 million years ago, all of the continents were arranged in one huge mass of land called Pangea . This meant that most of Earth's water was collected in a huge ocean called Panthalassa. By about 180 million years ago, Pangea had begun to break apart because of continental drift. This then separated the Panthalassa Ocean into separate but connected oceans that are the ocean basins we see today on Earth.

Significance of the Oceans

The Earth's oceans play an important role in maintaining the world as we know it. Indeed, the ocean is largely responsible for keeping the temperatures on Earth fairly steady. It may get pretty cold where you live in the wintertime. Some places on Earth get as cold as -70°C. Some places get as hot as 55°C. This is a range of 125°C. But compare that to the surface temperature on Mercury: it ranges from - 180°C to 430°C, a range of 610°C. Mercury has neither an atmosphere nor an ocean to buffer temperature changes so it gets both extremely hot and very cold.

Coral reefs are amongst the most densely inhabited and diverse areas on the globe.

On Earth, the oceans absorb heat energy from the Sun. Then the ocean currents move the energy from areas of hot water to areas of cold water, and vice versa. Not only does ocean circulation keep the water temperature moderate, but it also affects the temperature of the air. If you examine land temperatures on the Earth, you will notice that the more extreme temperatures occur in the middle of continents, whereas temperatures near the water tend to be more moderate. This is because water retains heat longer than land. Summer temperatures will therefore not be as hot, and winter temperatures won't be as cold, because the water takes a long time to heat up or cool down. If we didn’t have the oceans, the temperature range would be much greater, and humans could not live in those harsh conditions.

The ocean is home to an enormous amount of life. This includes many kinds of microscopic life, plants and algae, invertebrates like sea stars and jellyfish, fish, reptiles, and marine mammals. The many different creatures of the ocean form a vast and complicated food web, that actually makes up the majority of all biomass on Earth. (Biomass is the total weight of living organisms in a particular area.) We depend on the ocean as a source of food and even the oxygen created by marine plants. Scientists are still discovering new creatures and features of the oceans, as well as learning more about marine ecosystems.

Finally, the ocean provides the starting point for the Earth's water cycle. Most of the water that evaporates into the atmosphere initially comes from the ocean. This water, in turn, falls on land in the form of precipitation. It creates snow and ice, streams and ponds, without which people would have little fresh water. A world without oceans would be a world without you and me.

Composition of Ocean Water

Water has oftentimes been referred to as the "universal solvent", because many things can dissolve in water. Many things like salts, sugars, acids, bases, and other organic molecules can be dissolved in water. Pollution of ocean water is a major problem in some areas because many toxic substances easily mix with water.

Perhaps the most important substance dissolved in the ocean is salt. Everyone knows that ocean water tastes salty. That salt comes from mineral deposits that find their way to the ocean through the water cycle. Salts comprise about 3.5% of the mass of ocean water. Depending on specific location, the salt content or salinity can vary. Where ocean water mixes with fresh water, like at the mouth of a river, the salinity will be lower. But where there is lots of evaporation and little circulation of water, salinity can be much higher. The Dead Sea, for example, has 30% salinity—nearly nine times the average salinity of ocean water. It is called the Dead Sea because so few organisms can live in its super salty water.

The density (mass per volume) of seawater is greater than that of fresh water because it has so many dissolved substances in it. When water is more dense, it sinks down to the bottom. Surface waters are usually lower in density and less saline. Temperature affects density too. Warm water is less dense and colder waters are more dense. These differences in density create movement of water or deep ocean currents that transport water from the surface to greater depths.

I. Review Questions

1. What was the name of the single continent that separated to form today's continents?
2. From what three sources did water originate on Earth?
3. What percent of the Earth's surface is covered by water?
4. How do the oceans help to moderate Earth's temperatures?
5. Over time, the Earth's oceans have become more and more salty. Why?
6. What is the most common substance that is dissolved in ocean water? What is density?
7. Compare and contrast the photic and aphotic zones.
8. Describe the types of organisms found in the intertidal, neritic, and oceanic zones.

9 Give examples of a life form you think might be found in each.

II. Make a summary of Text A.

Text C OCEAN MOVEMENTS

Ocean water is constantly in motion. From north to south, east to west, and up and down the shore, ocean water moves all over the place. These movements can be explained as the result of many separate forces, including local conditions of wind, water, the position of the moon and Sun, the rotation of the Earth, and the position of land formations.

Waves

A wave is a disturbance that transfers energy through matter or empty space. Sound waves move through the air, earthquakes send powerful waves through solid earth, spacecraft radio waves travel across millions of miles through the vacuum of empty space, and ocean waves move through water. All of these types of waves are able to transfer energy over great distances. The size of a wave and the distance it travels depends on the amount of energy that the wave carries.

The most familiar waves occur on the ocean's surface. It is upon these waves that surfers play and boogie boarders ride. These waves are mostly created by the wind. There are three factors wind that determine the size of the wave: 1) the speed of the wind, 2) the distance over which the wind has blown, and 3) the length of time that the wind has blown. The greater each of these factors, the bigger the wave.

Waves can be measured by their amplitude, a distance measured vertically from the crest (the top of the wave) to the trough (the bottom of the wave). They can also be measured by their wavelength, which is the horizontal distance between crests. When wind blows across the water surface, energy is transferred to the water. The transfer of that energy may create tiny ripples that disappear when the wind dies down, or it may create larger waves that continue until they reach the shore. Most waves reach the shore.

Scientists sometimes describe waves by measuring the speed of a wave. A wave's speed is determined by measuring the time it takes for one wavelength to pass by. Interestingly, particles in the ocean are not significantly moved by waves; although they are bobbled around by the waves, the particles tend to stay where they are.

Waves can also form when a rapid shift in ocean water is caused by underwater earthquakes, landslides, or meteors that hit the ocean. These waves, called tsunami, can travel at speeds of 800 kilometers per hour (500 miles per hour). Tsunami have small, often unnoticeable wave heights in the deep ocean. However as a tsunami approaches the continental shelf, wave height increases. The wave speed is also slowed by friction with the shallower ocean floor, which causes the wavelength to decrease, creating a much taller wave. Many people caught in a tsunami have no warning of its approach. Tsunami warning systems are important for protecting for coastal areas and low-lying countries.

Waves break when they get close to the shore. That is due to the wave's interaction with the sea floor. When the wave hits the shore, the energy at the bottom of the wave is transferred to the ocean floor, which slows down the bottom of the wave. The energy at the top of the wave, in the crest, continues at the same speed, however. Since the top of this wave is going faster than the bottom, the crest falls over and crashes down.

Tides

Wind is the primary force that causes ocean surface waves, but it does not cause the tides. Tides are the daily changes in the level of the ocean water at any given place. The main factors that causes tides are the gravitational pull of the Moon and the Sun.

How does the Moon affect the oceans? Since the Moon is a relatively large object in space that is very close to the Earth, its gravity actually pulls Earth's water towards it. Wherever the moon is, as it orbits the Earth, there is a high tide 'bulge' that stays lined up with the Moon. The side of the Earth that is furthest from the Moon also has a high tide 'bulge'. This is because the Earth is closer to the moon than the water on its far side. The Moon's gravity pulls more on the planet than the water on the opposite side. These two water bulges on opposite sides of the Earth aligned with the Moon are the high tides. Since ocean water is pulled higher in the areas of the two high tides, there is less water in between the two high tides. These areas are the low tides.

The tidal range is the difference between the ocean level at high tide and the ocean at low tide. Some places have a greater tidal range than others. High tides occur about twice a day, about every 12 hours and 24 minutes.

He Moon's gravity is mostly responsible for our tides, but the Sun also plays a role. The Sun is much larger than our Moon. It has a mass about 27,500,000 times greater than the Moon. A very large object like the Sun would produce tremendous tides if it were as near to Earth as the Moon. However it is so far from the Earth that its effect on the tides is only about half as strong as the Moon's. When both the Sun and Moon are aligned, the effect of each is added together, producing higher than normal tides called spring tides.

Spring tides are tides with the greatest tidal range. Despite their name, spring tides don't just occur in the spring; they occur throughout the year whenever the Moon is in a new-moon or full-moon phase, or about every 14 days.

Neap tides are tides that have the smallest tidal range, and occur when the Earth, the Moon, and the Sun form a 90° angle. They occur exactly halfway between the spring tides, when the Moon is at first or last quarter. This happens because the Moon's high tide occurs in the same place as the Sun's low tide and the Moon's low tide is added to by the Sun's high tide.

I. Review Questions

1. What factors of wind determine the size of a wave?
2. Define the crest and trough of a wave.
3. Why does a hurricane create big waves?
4. Tsunami are sometimes incorrectly called "tidal waves". Explain why this is not an accurate term for tsunami.
5. What is the principal cause of the tides?
6. What is a tidal range?
7. Why do you think that some places have a greater tidal range than other places?
8. Which has a greater tidal range, spring tides or neap tides? Explain.

II. Make a summary of Text B.

Lesson Summary.

Our oceans originally formed as a water vapor released by volcanic outgassing cooled and condensed.

The oceans serve the very important role of helping to moderate Earth's temperatures.

The oceans are home to a tremendous diversity of life, and algae which are all photosynthetic organisms.

The main elements dissolved in seawater are chlorine, sodium, magnesium, sulfate and calcium.

Usual salinity for the oceans is about 3.5% or 35 parts per thousand.

Some regions in areas of high evaporation, like the Dead Sea, have exceptionally high salinities.

The photic zone is the surface layer of the oceans, down to about 200m, where there is enough available light for photosynthesis.

Below the photic zone, the vast majority of the oceans lies within the aphotic zone, where there is not enough light for photosynthesis.

On average, the ocean floor is about 3,790m but there are ocean trenches as deep as 10,910m.

The ocean has many biological zones determined by availability of different abiotic factors.

Neritic zones are nearshore areas, including the intertidal zone. Oceanic zones are offshore regions of the ocean.

Grammar Exercises

I. Complete the sentences with a form of *can, could, be able to, manage to.* Some of the sentences are negative:

1. Speak up! I ... hear you!
2. ... I borrow your dictionary?
3. I'd love … help you, but I can't. I'm sorry.
4. I… get into my house last night because I had lost my key.
5. Women ... vote in England until 1922.
6. I'm learning Spanish because I want ... speak to people when I'm in Mexico.
7. The doctor says I ... walk again in two weeks' time.
8. I asked the teacher if I ... open the window, but she said I ... because it would be too noisy.
9. I'm sorry, but I ... come to your party next week.
10. I love driving! ... drive has changed my whole life.
11. Jane and John saved and saved, and finally they ... buy the house of their dreams.

12. I phoned you yesterday, but I ... get an answer. Where were you?
13. ... you speak French before moved to Paris?
14. ... you ... find all the things you wanted at the shops?
15. The police ... find the man who had stolen my car. He was sent to prison.
16. When we got to the top of the mountain we ... see for miles.

II. Choose the correct verb form: *mustn't* or *don't / doesn't have to* and write down the sentences:

1. We have a lot of work tomorrow. You mustn't / don't have to be late.
2. You mustn't / don't have to tell Mary what I told you. It's a secret.
3. The museum is free. You mustn't / don't have to pay to get in.
4. Children mustn't / don't have to tell lies. It's very naughty.
5. Terry is a millionaire. He mustn't / doesn't have to go to work.
6. I mustn't / don't have to do my washing. My mother does it for me.
7. We mustn't / don't have to rush. We've got plenty of time.
8. You mustn't / don't have to play with guns. They're dangerous.
9. This is my favourite pen. You can borrow it, but you mustn't / don't have to lose it.
10. "Shall I come with you?" - "You can if you want, but you mustn't / don't have to ".
11. Don't make so much noise. We mustn't / don't have to wake the baby.
12. You mustn't / don't have to be a good player to enjoy a game of tennis.
13. I can stay in bed tomorrow morning because I mustn't / don't have to go to work.
14. You mustn't / don't have to forget what I told you. It's very important.
15. There's a lift in the building, so we mustn't / don't have to climb the stairs.

III.

a) Translate the sentences with *can* and *to be able to*:

1. You can't park here . There's heavy traffic in this street.
2. I'm sorry sir, but customers aren't allowed in without a tie.
3. You are allowed to bring in 250 cigarettes and a bottle of spirits.
4. You can't talk in here. People are studying.
5. You can take your safety belt off now and walk around, but you aren't allowed to smoke in the toilets, and you can't use personal computers.
6. We're allowed to make one phone call a week, and we can go to the library, but we spend most of the time in our cells.

b) Think of some things that you *can* and *can't do* in the following places. Write down the sentences:

Example: *a church* **-** *You aren 't allowed to ride a bike in a church.*
You can light a candle and say a prayer.

1. a hospital
2. a museum
3. a swimming pool
4. a park
5. a theatre

IV. Translate into Ukrainian:

1. Climate may be defined as the summation of weather conditions in historical times.
2. The importance of climate in the affairs of man cannot be doubted.
3. The fluctuations of short duration are evidently to be regarded as characteristic behavior and not as climate changes.
4. Unfortunately we are not able to use as short a period as the past few thousand years to determine the climate of a region.
5. Mariners could determine the latitude of any point on the surface of the earth using the method introduced by Pytheas.
6. Shortly after leaving port, the ships had to put pack to repair a top mast.
7. Baffin Bay in Canada was explored by Sir John Ross in 1817 and 1818 and he was able to measure the depth of the sea.
8. This submergence must have been caused by a subsidence of the continent, a rise in a sea level, or a combination of the two.
9. We should begin our discussion with those aspects of the universe which we can readily observe and describe.
10. Climatic conditions must be taken into account in the planning of farm buildings and, particularly, in the design of animal housing and stores for agricultural products.

V. Translate into English:

1. Сьогодні науковці повинні приділяти велику увагу безвідходному виробництву.
2. Зразки повинні були бути досліджені в нашій лабораторії.
3. Інфрачервоні хвилі можуть бути зупинені склом.
4. Можливо важко повірити, але в наш час половина населення землі страждає від нестачі води.
5. Гості Криму зможуть взяти участь в дослідницьких експедиціях і археологічних розкопках споруд півострова.

6. Кожен еколог має знати це правило.

7. Вам слід користуватись цими інструментами дуже обережно.

8. Біологічне різноманіття повинно розглядатися як глобальний ресурс, як атмосфера або океани.

VI. Complete the following sentences in your own words. Keep in mind the sentences beginning with the pronoun "one":

one must one has to (to) one ought (to) one should	**потрібно }необхідно слід**	**one can one may**	**}можна**
		one could one might	**}можна було б**

1.One should know .... 2.One may think ....

3.One ought to remember… 4.One can understand ....

5.One could provide .... 6.One has to be careful with ...

7.One might calculate 8.One must measure…

VII. Translate into Ukrainian paying attention to the modal verbs:

1. One cannot doubt the importance of meteorology to the national economy.
2. Further tests are to be made to determine the possibility of using the new method.
3. You should follow all the scientific researches in your field of knowledge.
4. He has to analyse many weather forecasts compiled by students.
5. The laboratory was to make an important experiment in a very short time.
6. Clouds are to be considered as a result of water vapour in the atmosphere.
7. You might use all the new equipment for your experiment.
8. The importance of climate in the affairs of man cannot be doubted.
9. A whirl or eddy may be as large as a continent (macroscale), the size of a few thunderstorms (mesoscale), or smaller than a city (microscale).
10. In micrometeorology, the scale of interest is limited to a few square kilometers, and the Carioles force can usually be neglected.
11. On cloudless days solar radiation can pass through the atmosphere with little reduction in strength.
12. It is to be noted that the strongest horizontal temperature gradient are in the middle latitudes, corresponding to the region of greatest scope of the tropopause.
13. Clouds consisting of large-sized water drops or ice particles can be

viewed by radar to obtain direction and speed motion.

14. The rate of heat loss must exactly balance over a long period of time the amount of heat received from the sun.

15. In the cosmic sense, radiation is the only means of maintaining a complete heat balance, because it is only by radiation that the energy can be transferred through space.

16. Not only must there be a balance between the earth's surface and the incoming radiation, but also a balance must exist that includes the atmosphere.

17. Slight through the absorption of solar radiation might be, it is nevertheless important.

VIII. Translate the sentences. Pay attention to the function of "would" and "should":

A.

1. We decided that we should make our experiments out of doors.
2. This probably should be classified as advection-radiation fog.
3. The student should be careful to distinguish between the words "weather" and "climate".
4. In order to obtain the true temperature of the air it is necessary that reliable thermometers should be employed and that they should be properly and read.
5. Ice formation should be observed mainly in ascending air.
6. The weather officer has demanded that all the instruments should be inspected regularly.
7. Wind measurements should not be taken close to mountains or valleys.

B.

1. The weather bureau reported that it would rain next day.
2. No forecaster would be accurate without the correct observation and interpretation of cloud forms.
3. If the rain stopped, they would continue their observations.
4. I would like to say that the scientific work of the expedition was successful.
5. The world-wide system of winds would not exist without the transfer of heat.
6. If you had made more experiments, you would have obtained all the necessary data.
7. Any decrease of wind velocity in the evening would cause rapid decrease of turbulence.

IX. Translate the following sentences, paying attention to the different ways in which obligation is expressed:

1. The oxygen minimum is to be attributed mainly to the vertical variation in the rate of biochemical consumption of oxygen and the distribution of organic matter.

2. We should determine the correlation between the seasonal change of planktonic population and the dissolved oxygen in the same area.

3. One has to compare the level of biological productivity by calculating the oxygen consumption in water columns down to a certain depth in different areas and seasons.

4. The salinity observations had to be made at several coastal stations in the Gulf of Bothnia.

5. It should be pointed out that the problem is not so simple as it appeared at the very beginning.

6. On the whole, the results were very satisfactory and the harmonic values must therefore be considered as quite representative of the period investigated.

7. The speed and simplicity of this method ought to encourage its usage in the determination of magnesium in sea water.

8. It is assumed that the sea operation will have to be combined with an air operation for exploration in high latitudes

LESSON 6

GRAMMAR REVISION

I. Use the bare infinitive or the to-infinitive where necessary.

1. I'd like ... dance.
2. She made me ... repeat my words several times.
3. I saw him ... enter the room.
4. She did not let her mother ... go away.
5. Do you like ... listen to good music?
6. Would you like ... listen to good music?
7. That funny scene made me ... laugh.
8. I like ... play the guitar.
9. My brother can ... speak French.
10. We had ... put on our overcoats because it was cold.
11. They wanted ... cross the river.

12. It is high time for you ... go to bed.
13. May I... use your telephone?
14. They heard the girl ... cry out with joy.
15. I would rather ... stay at home today.
16. He did not want ...play in the yard any more.
17. Would you like ... go to England?
18. You look tired. You had better... go home.
19. I wanted ... speak to Nick, but could not... find his telephone number.
20. It is time ... get up.

II. Memorize the following sentences:

I have nothing to read.	Мені нічого читати.
She has nobody to speak with.	Їй ні з ким поговорити.
What is to be done?	Що робити?
Who is to blame?	Хто винен?
I am not to blame.	Я не винен.
To see is to believe.	Бачити значить вірити.
He was the first (last) to come.	Він прийшов першим(останнім).
It is out of the question to go there.	Не може бути і мови про те, щоб іти туди.

III. Translate into Ukrainian paying attention to the use of the Active Infinitive and the Passive Infinitive.

1. To play chess was his greatest pleasure.
2. The child did not like to be washed.
3. Isn't it natural that we like to be praised and don't like to be scolded?
4. Which is more pleasant: to give or to be given presents?
5. Nature has many secrets to be discovered yet.
8. To improve your phonetics you should record yourself and analyse your speech.
7. This is the book to be read during the summer holidays.
8. To be instructed by such a good specialist was a great advantage.
9. He is very forgetful, but he doesn't like to be reminded of his duties.

IV. Translate into Ukrainian paying attention to the use of the Perfect Infinitive.

1. The child was happy to have been brought home.
2. Jane remembered to have been told a lot about Mr. Rochester.
3. The children were delighted to have been brought to the circus.
4. I am sorry to have spoilt your mood.
5. Maggie was very sorry to have forgotten to feed the rabbits.
6. I am awfully glad to have met you.

7. Sorry to have placed you in this disagreeable situation.
8. I am very happy to have had the pleasure of making your acquaintance.
9. I am sorry to have kept you waiting.
10. Clyde was awfully glad to have renewed his acquaintance with Sondra.
11. Sorry not to have noticed you.
12. I am sorry to have added some more trouble by what I have told you.
13. When Clyde looked at the girl closely, he remembered to have seen her in Sondra's company.
14. I remembered to have been moved by the scene I witnessed.

V. Complete the following sentences concentrating on the use of the Complex Object.

• **E.g.** "Bring me a book," said my brother to me. My brother **wanted <u>me</u> <u>to bring</u>** him a book.

1. The teacher said to the pupils: "Learn the rule." — The teacher wanted...
2. "Be careful, or else you will spill the milk," said my mother to me. — My mother did not want...
3. "My daughter will go to a ballet school," said the woman. — The woman wanted ... .
4. The man said: "My son will study mathematics." — The man wanted ...
5. "Oh, father, buy me this toy, please," said the little boy. — The little boy wanted ... .
6. "Wait for me after school," said Ann to me. — Ann wanted ...
7. "Fix the shelf in the kitchen," my father said to me. - My father wanted...
8. "It will be very good if you study English," said my mother to me. — My mother wanted ....
9. "Bring me some water from the river, children," said our grandmother. -Our grandmother wanted ...
10. "Come to my birthday party,"said Kate to her classmates.-Kate wanted...

VI. Translate the following sentences into English concentrating on the use of the Complex Object.

1. Я хочу, щоб ці книги були повернені.
2. Дощ примусив нас повернути назад.
3. Вона відчула, як хтось торкнуся її руки.
4. Ми почули, як задзвонив дзвінок.
5. Хвороба брата примусила її поїхати до Києва.
6. Холодний вітер примусив його надіти пальто.
7. Мій друг хоче, щоб я до нього прийшов.
8. Я знаю, що ваш друг – дуже майстерний фотограф.
9. Ми розраховуємо, що ви візьмете участь в концерті.

10. Я знаю, що ти мій друг.

VII. Translate the following sentences into English concentrating on the use of the Complex Subject.

1. Many books are known to be published in our country every year.
2. You are supposed to graduate in four years.
3. Radium is said to be very radioactive.
4. This device was known to have been designed in that laboratory.
5. His invention is considered to be of great importance.
6. The sun is known to represent a mass of compressed gases.
7. The new rocket is reported to go into operation next year.
8. This type of rocket is supposed to have many advantages.
9. For a long time the atom was thought to be indivisible.
10. The helium atom was found to have two electrons.
11. I did not know what I was expected to say to that, so I said nothing.
12. He was said to be one of the most promising nuclear physicists.
13. He is said to be a good translator.
14. Roberta was known to be an honest and hardworking girl.
15. Clyde was expected to arrive at the weekend.

VIII. Translate into Ukrainian paying attention to the use of *to be likely to, to be sure to.*

1. We most of us want a good many things that we are not likely to get.
2. He is sure to tell me all about this even if I don't ask him.
3. When Sondra said that they were sure to meet again, she saw Clyde's face suddenly brighten.
4. If we go on arguing, we are sure to quarrel.
5. They are sure to acknowledge your talent.
6. He is sure to give us some useful information.
7. The article is likely to appear in the next issue of the journal.

IX. Translate into Ukrainian paying attention to the use of various forms of the Participle.

1. Being very ill, she could not go to school.
2. The first rays of the rising sun lit up the top of the hill.
3. The tree struck by lightning was all black and leafless.
4. Being busy, he postponed his trip.
5. The door bolted on the inside could not be opened.
6. Having been shown the wrong direction, the travellers soon lost their way.
7. The room facing the garden is much more comfortable than this one.

8. Having descended the mountain they heard a man calling for help.

9. Flushed and excited, the boy came running to his mother.

10. He stood watching the people who were coming down the street shouting and waving their hands.

11. The boy lay sleeping when the doctor came.

12. The broken arm was examined by the doctor.

13. While being examined, the boy could not help crying.

14. Having prescribed the medicine, the doctor went away.

15. The medicine prescribed by the doctor was bitter.

X. Use the required forms of the Participle for the verbs in brackets

1. (to phone) the agency, he left (to say) he would be back in two hours.

2. (to write) in very bad handwriting, the letter was difficult to read.

3. (to write) his first book, he could not help worrying about the reaction of the critics.

4. (to spend) twenty years abroad, he was happy to be coming home.

5. (to be) so far away from home, he still felt himself part of the family.

6. She looked at the enormous bunch of roses with a happy smile, never (to give) such a wonderful present.

7. (not to wish) to discuss that difficult and painful problem, he changed the conversation.

8. (to translate) by a good specialist, the story preserved all the sparkling humour of the original.

XI. Translate into Ukrainian concentrating on the use of the Nominative Absolute Particilial Construction.

1. You can set your 'mind at ease, **all being well.**

2. **There being no chance of escape,** the thief was arrested on the spot.

3. Oliver knocked weakly at the door and, **all his strength failing him,** sank near the door.

4. **The bridge having been swept away by the flood,** the train was late.

5. **There being little time left,** they hired a cab to get to the theatre in time.

6. **It being cold and damp,** a fire was lighted for the weary travellers to warm themselves by.

7. **It being pretty late,** they decided to postpone their visit.

8. **The hour being late,** she hastened home.

9. **The sun having set an hour before,** it was getting darker.

10. **The weather being cold,** he put on his overcoat.

11. **The weather having changed,** we decided to stay where we were.

12. **The weather being very warm,** the closet window was left open.

13. **And the wind having dropped,** they set out to walk.

14. **The vessel being pretty deep in the water and the weather being calm,** there was but little motion.

15. **The resistance being very high,** the current in the circuit was very low.

XII. Translate into Ukrainian. Pay attention to the form of the Gerund.

1. Repairing cars is his business.
2. It goes without saying.
3. Living in little stuffy rooms means breathing poisonous air.
4. Iron is found by digging in the earth.
5. There are two ways of getting sugar: one from beet and the other from sugarcane.
6. Jane Eyre was fond of reading.
7. Miss Trotwood was in the habit of asking Mr. Dick his opinion.
8. Have you finished writing?
9. Taking a cold shower in the morning is very useful.
10. I like skiing, but my sister prefers skating.
11. She likes sitting in the sun.
12. It looks like raining.
13. My watch wants repairing.
14. Thank you for coming.
15. I had no hope of getting an answer before the end of the month.

XIII. Translate into Ukrainian. Pay attention to the form of the Gerund.

1. He keeps insisting on my going to the south.
2. Oh please do stop laughing at him.
3. Do you mind my asking you a difficult question?
4. Would you find coming again in a day or two?
5. I don't mind wearing this dress.
6. She could not help smiling.
7. I cannot put off doing this translation.
8. Though David was tired, he went on walking in the direction of Dover.
9. I avoided speaking to them about that matter.
10. She burst out crying.
11. They burst out laughing.
12. She denied having been at home that evening.
13. He enjoyed talking of the pleasures of travelling.
14. Excuse my leaving you at such a moment.
15. Please forgive my interfering.

XIV. Memorize the following verbs and word combinations which are always followed by the Gerund:

to accuse of	**to insist on**
to agree to	**to look forward to**
to approve of	**to object to**
to be afraid of	**to persist in**
to congratulate on	**to prevent from**
to depend on	**to succeed in**
to dream of	**to suspect of**
to feel like	**to thank for**
to give up the idea of	**to think of**

XV. Select the sentences where:

a) the ***ing-form*** *functions as a* ***Participle****;*

b) the ***ing-form*** *functions as a* ***Gerund****.*

1. He was looking at the plane flying overhead.
2. Wishing to learn to skate, she bought herself a pair of skates.
3. Just imagine his coming first in the race!
4. The children were tired of running.
5. Being frightened by the dog, the cat climbed a high fence.
6. It is no use going there now.
7. Coming out of the wood, the travellers saw a ruined castle in the distance.
8. My greatest pleasure is travelling.
9. Growing tomatoes need a lot of sunshine.
10. Growing corn on his desert island, Robinson Crusoe hoped to eat bread one day.
11. Growing roses takes a lot of care and attention.
12. Having prepared all the necessary equipment, they began the experiment.
13. Mary will stop for a few days at the seaside before going back home.
14. While translating the text I looked up many words in the dictionary.
15. I usually help mother by washing the dishes and doing the rooms.

XVI. Put the verbs in brackets into the correct form.

1. If he reads fifty pages every day, his vocabulary (to increase) greatly.
2. If they (to know) it before, they would have taken measures.
3. If I (to get) this book, I shall be happy.
4. If you really loved music, you (to go) to the Philharmonic much more often.
5. If you had not wasted so much time, you (not to miss) the train.

6. If you (not to miss) the train, you would have arrived in time.

7. You (not to miss) the teacher's explanation if you had arrived in time.

8. You would have understood the rule if you (not to miss) the teacher's explanation.

9. If you (to understand) the rule, you would have written the test paper successfully.

10. If you had written the test paper successfully, you (not to get) a "two".

11. Your mother (not to scold) you if you had not got a "two".

12. If your mother (not to scold) you, you would have felt happier.

13. If she (to ask) me yesterday, I should certainly have told her all about it.

14. If you (to do) your morning exercises every day, your health would be much better.

15. If he is mot very busy, he (to agree) to go to the museum with us.

16. If I (not to be) present at the lesson, I should mot have understood this difficult rule.

XVII. Put the verbs in brackets into the correct form.

1. If you were on a hijacked plane, you (to attack) the hijackers?

2. If they were on a hijacked plane, they (to stay) calm and probably (to survive).

3. If my friend had been trying harder, he (to succed).

4. If I (to live) in 1703,I shouldn't (wouldn't')[I] have had a computer.

5. If she (to smell) smoke in the middle of the night, she would telephone the fire brigade and run into the street and shout "Fire!"

6. If he (to invite), he would have come to the party last night.

7. If the driver in front hadn't stopped suddenly, the accident (not to happen).

8. If you (not to know) how to play, my sister will explain the rules to you.

9. If she had told them it was her birthday, "they (to give) her a birthday present.

10. If I had more time, I (to read) more books.

11. If their TV had been working, they (to watch) the President's speech last night.

12. If my T-shirt hadn't been 100 percent cotton, it (not to shrink) so much.

13. How can you become more popular in your class: if you (to get) the top mark in mathematics or English or if you (to be) good at sports?

14. If they (to go) by car, they would have saved time.

15. If I (to be) a bird, I would[1] be able to fly.

XVIII. Make Conditional Sentences of your own.

1. He is busy and does not come to see us. If...
2. The girl did not study well last year and received bad marks. If ...
3. He broke his bicycle and so he did not go to the country. If...
4. He speaks English badly: he has no practice. If...
5. I had a bad headache yesterday, that's why I did not come to see you. If...
6. The ship was sailing near the coast, that's why it struck a rock. If ...
7. He was not in town, therefore he was not present at our meeting. If...
8. The pavement was so slippery that I fell and hurt my leg. If...
9. The sea is rough, and we cannot sail to the island. If...
10. They made a fire, and the frightened wolves ran away. If...
11. It is late, and I have to go home. If...
12. I was expecting my friend to come, that's why I could not go to the cinema with you. If …
13. He always gets top marks in mathematics because it is his favourite subject and he works a lot at it. If...
14. I did not translate the article yesterday because I had no dictionary. If...
15. We lost our way because the night was pitch-dark. If...
16. The box was so heavy that I could not carry it. That's why I took a taxi. If...

XIX. Open the brackets to use the appropriate verb forms in Object Clauses after the Verb 'to wish'.

1. I wish I (can) give up smoking.
2. She wishes she (to see) him at yesterday's party.
3. I wish I (to pass) my driving test last Monday.
4. I wish I (not to forget) my friend's birthday yesterday.
5. The boy is sad. He wishes he (not to break) the window.
6. My aunt wishes she (to stay) at home last weekend.
7. He wishes he (to know) something about cars.
8. I wish it (to be) sunny.
9. I wish it (to be) sunny during our picnic last Saturday.
10. She wishes she (to live) in the Crimea.
11. My friend wishes he (not to do) that last night.
12. I wish I (to bring) my camera last summer.

XX. Rewrite the following sentences substituting *to be able to for can* where it seems appropriate.

1. They can (never) appreciate your kindness.
2. I was sure you could translate that article (after you had translated so

many texts on physics).

3. You can go to the country (when you have passed your last examination).

4. We can pass to the next exercise (when we have done this one).

5. I can give you my book for a couple of days (after I have read it).

6. He can ski (for ten years).

7. We knew that she could swim (since a child).

8. You cannot take part in this serious sport competition (until you have mastered good skills).

9. I could not solve the problem (before he explained it to me).

XXI. Fill in the blanks with '*to have to'* or '*to be to'*.

1. The agreement was that if Johnny: White could not repay the money he had borrowed, then Luke Flint... to have the right to sell the land.

2. If I don't ring up before six o'clock, then you ... to go to the concert hall alone and wait for me at the entrance. Is that clear?

3. The planters ... to gather their cotton at once, as they had been warned that heavy rains were expected.

4. I ... to wear glasses as my eyesight is very weak.

5. Johnny White ... to borrow from Luke Flint at a high interest, for there was no one else in the district who lent money.

6. "Cheating is a very nasty thing," said the teacher, "and we ... to get rid of it."

7. She ... to send a telegram because it was too late to send a letter.

8. They decided that she ... to send them a telegram every tenth day.

9. You ... to learn all the new words for the next lesson.

10. Do you know this man? He … to be our new teacher of history.

XXII. Fill in the blanks with 'can',' may, 'must' or 'need'

1. Peter ... return the book to the library. We all want to read it.

2. Why ... not you understand it? It is so easy.

3. ... we do the exercise at once? — Yes, you .... do it at once.

4. ... you pronounce this sound?

5. You ... not have bought this meat: we have everything for dinner.

6. I ... not go out today: it is too cold.

7. ... I take your pen? — Yes, please.

8. We ... not carry the bookcase upstairs: it is too heavy.

9. We ... not carry the bookcase upstairs ourselves: the workers will come and do it.

10. When ... you come to see us? — I... come only on Sunday.

11. Shall I write a letter to him? — No, you ... not, it is not necessary.

12. ... you cut something without a knife?
13. Everything is clear and you ... not go into details now.
14. He ... not drink alcohol when be drives.
15. Don't worry! I... change a light bulb.
16. By the end of the week I... have finished writing my book.
17. She ... not call the doctor again unless she feels worse.

XXIII. Translate the following sentences into English concentrating on the use of *must, may,* and *can't.*

1. Поспішай: ти можеш спізнитися на потяг.
2. Він, можливо, захворів.
3. Він, можливо, хворіє.
4. Не може бути, що він забув купити квіти.
5. Не може бути, що він посварився з нею.
6. Наверное, вона дізналася про це від Маші.
7. Це, мабуть, була дуже важка задача.
8. На вулиці повинно бути дуже холодно.
9. Вона, мабуть, зустріла їх по дорозі додому.
10. Не може бути, що вони продали свій будинок.
11. Вони, можливо, приїдуть завтра.
12. Моя сестра, мабуть, зараз в бібліотеці.
13. Не може бути, що він зайняв перше місце.
14. Можливо, він і чув про це (хоча навряд).
15. Мама, мабуть, купила цукерки.
16. Вона, можливо, дзвонила мені вчора, а мене не було вдома.
17. Можливо, він і в школі зараз (хоча навряд).
18. Не може бути, що вона така молода. Їй повинне бути не менше тридцяти років.
19. Мабуть, навкруги вашого села ростуть густі ліси.
20. Не може бути, що він написав листа так швидко.
21. Можливо, ми підемо на пляж: погода чудова.
22. Це, очевидно, дуже стародавній рукопис.
23. Давайте подзвонимо Роберту: нам може знадобитися його порада.

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