МІНІСТЕРСТВО ОСВІТИ І НАУКИ УКРАЇНИ
ОДЕСЬКИЙ ДЕРЖАВНИЙ ЕКОЛОГІЧНИЙ УНІВЕРСИТЕТ

МЕТОДИЧНІ ВКАЗІВКИ

до практичних занять з навчальної дисципліни
«Іноземна мова за професійним спрямуванням»
(англійська мова)

для магістрів I року
денної та заочної форм навчання
Спеціальність:103 Науки про Землю
ОПП «Метеорологія і кліматологія»

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Одеса 2021

МІНІСТЕРСТВО ОСВІТИ І НАУКИ УКРАЇНИ
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МЕТОДИЧНІ ВКАЗІВКИ

до практичних занять з навчальної дисципліни
«Англійська мова»
для магістрів І року
денної форми навчання
Спеціальність: «Метеорологія»

Затверджено

на засіданні групи забезпечення спеціальності

Метеорологія

Протокол № _____ від «____» ________202 р.

Одеса – 2021

Методичні вказівки до практичних занять з навчальної дисципліни «англійська мова» для магістрів І року навчання денної форми навчання.

Спеціальність: «Метеорологія»

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ПЕРЕДМОВА

Сучасний етап розвитку міжнародних відносин ставить нові вимоги до особистих і професійних рис майбутнього фахівця – рівня його соціальної адаптації, загальної культури, загальноосвітньої спеціальної підготовки.

Практичне володіння англійської мовою є невід’ємним компонентом сучасної підготовки спеціалістів вищими навчальними закладами. Метою вивчення англійській мови у немовному ВНЗ є підготовка студентів до читання, розуміння та перекладу літератури за фахом, спілкування англійською мовою в різних видах мовної діяльності, можливості її використання у практичних і професійних цілях.

Запропоновані методичні вказівки призначені до практичних занять з навчальної дисципліни “Іноземна мова за професійним спрямуванням” (“Англійська мова”) для студентів РВО магістр І року денної форми навчання за спеціальністю ***“метеорологія”***) ОДЕКУ і спрямовані на вироблення наступних знань і вмінь студента:

– читати і перекладати наукову англомовну літературу за фахом для одержання необхідної наукової інформації;

– розуміти зміст прочитаного, лексичний матеріал, що наданий у методичних вказівках;

– розуміти і володіти відповідним граматичним матеріалом, певними граматичними конструкціями, передбаченими силлабусом;

– брати участь в усному спілкуванні англійською мовою на теми за професійним спрямуванням.

Отже, **мета** методичних вказівок – забезпечити розвиток навичок читання, аналізу, перекладу, спілкування англійською мовою за спеціальністю метеорологія.

Структура. Методичні вказівки складаються з **двох частин**, що містять по чотири уроки (разом вісім уроків) з відповідним граматичним і лексичним матеріалом, що передбачений програмою кожного семестру, а також тексти, що відібрані з оригінальної науково-популярної та наукової літератури. Кожен урок містить по два текста **(тексти А** призначені для читання, усного переказу, анотування та переказу; **тексти В**, тематично зв’язані з текстами А, призначені для письмового перекладу з подальшою перевіркою на практичному занятті, уточненням значень окремих лексичних одиниць).

Лексичні вправи призначено для вивчення та закріплення відповідного лексичного матеріалу кожного уроку, охоплюють лексику основних текстів.

Граматичні вправи подано у вигляді систематизованого комплексу з морфології відповідно до нормативного курсу граматики сучасної англійської мови, спрямовані на аналіз та відпрацювання, закріплення вивченого граматичного матеріалу. Наприкінці кожної частини подано тести-завдання для самоконтролю набутих знань студента в межах кожного семестру.

LESSON 1

I. Translate the texts:

Text A WEATHER FORECASTING

Weather forecasting, the prediction of the weather through application of the principles of physics, supplemented by a variety of statistical and empirical techniques. In addition to predictions of atmospheric phenomena themselves, weather forecasting includes predictions of changes on Earth's surface caused by atmospheric conditions—e.g., snow and ice cover, storm tides, and floods.

Measurements and ideas as the basis for weather prediction

The observations of few other scientific enterprises are as vital or affect as many people as those related to weather forecasting. From the days when early humans ventured from caves and other natural shelters, perceptive individuals in all likelihood became leaders by being able to detect nature's signs of impending snow, rain, or wind, indeed of any change in weather. With such information they must have enjoyed greater success in the search for food and safety, the major objectives of that time.

In a sense, weather forecasting is still carried out in basically the same way as it was by the earliest humans—namely, by making observations and predicting changes. The modem tools used to measure temperature, pressure, wind, and humidity in the 21 st century would certainly amaze them, and the results obviously are better. Yet, even the most sophisticated numerically calculated forecast made on a supercomputer requires a set of measurements of the condition of the atmosphere—an initial picture of temperature, wind, and other basic elements, somewhat comparable to that formed by our forebears when they looked out of their cave dwellings. The primeval approach entailed insights based on the accumulated experience of the perceptive observer, while the modem technique consists of solving equations. Although seemingly quite different, there are underlying similarities between both practices. In each case the forecaster asks "What is?" in the sense of "What kind of weather prevails today?" and then seeks to determine how it will change in order to extrapolate what it will be.

Because observations are so critical to weather prediction, an account of meteorological measurements and weather forecasting is a story in which ideas and technology are closely intertwined, with creative thinkers drawing new insights from available observations and pointing to the need for new or better measurements, and technology providing the means for making new observations and for processing the data derived from measurements. The basis for weather prediction started with the theories of the ancient Greek philosophers and continued with Renaissance scientists, the scientific revolution of the 17th and 18th centuries, and the theoretical models of 20th- and 21st-century atmospheric scientists and meteorologists. Likewise, it tells of the development of the “synoptic” idea—that of characterizing the weather over a large region at exactly the same time in order to organize information about prevailing conditions. In synoptic meteorology, simultaneous observations for a specific time are plotted on a map for a broad area whereby a general view of the weather in that region is gained. (The term synoptic is derived from the Greek word meaning “general or comprehensive view.”) The so-called synoptic weather map came to be the principal tool of 19th-century meteorologists and continues to be used today in weather stations and on television weather reports around the world.

Since the mid-20tn century, digital computers have made it possible to calculate changes in atmospheric conditions mathematically and objectively—i.e., in such a way that anyone can obtain the same result from the same initial conditions. The widespread adoption of numerical weather prediction models brought a whole new group of players—computer specialists and experts in numerical processing and statistics—to the scene to work with atmospheric scientists and meteorologists. Moreover, the enhanced capability to process and analyze weather data stimulated the long-standing interest of meteorologists in securing more observations of greater accuracy. Technological advances since the 1960s led to a growing reliance on remote sensing, particularly the gathering of data with specially instrumented Earth orbiting satellites. By the late 1980s, forecasts of the weather were largely based on the determinations of numerical models integrated by high-speed supercomputers—except for some shorter-range predictions, particularly those related to local thunderstorm activity, which were made by specialists directly interpreting radar and satellite measurements. By the early 1990s a network of next-generation Doppler weather radar (NEXRAD) was largely in place in the United States, which allowed meteorologists to predict severe weather events with additional lead time before their occurrence. During the late 1990s and early 21st century, computer processing power increased, which allowed weather bureaus to produce more-sophisticated ensemble forecasts—that is, sets of multiple model runs whose results limit the range of uncertainty with respect to a forecast.

Practical applications

Systematic weather records were kept after instruments for measuring atmospheric conditions became available during the 17th century. Undoubtedly these early records were employed mainly by those engaged in agriculture. Planting and harvesting obviously can be planned better and carried out more efficiently if long-term weather patterns can be estimated. In the United States, the foundations of the national weather services were laid down by American physicist Joseph Henry, the first head of the Smithsonian Institution. In 1849 Henry created a network of volunteer weather observers to help improve storm prediction in the U.S. The first national weather services were provided by the U.S. Army Signal Corps beginning on February 9, 1870, which also incorporated Henry's volunteer weather observers by 1874. These operations were taken over by the Department of Agriculture in 1891. By the early 1900s free mail service and telephone were providing forecasts daily to millions of American farmers. The U.S. Weather Bureau established a Fruit-Frost (forecasting) Service during World War I, and by the 1920s radio broadcasts to agricultural interests were being made in most states.

Weather forecasting became an important tool for aviation during the 1920s and '30s. Its application in this area gained in importance after Francis W.

Reichelderfer was appointed chief of the U.S. Weather Bureau (USWB) in 1939. Reichelderfer had previously modernized the U.S. Navy's meteorological service and made it a model of support for naval aviation. During World War II the discovery of very strong wind currents at high altitudes (the jet streams, which can affect aircraft speed) and the general susceptibility of military operations in Europe to weather led to a special interest in weather forecasting.

One of the most famous wartime forecasting problems was for Operation Overlord, the invasion of the European mainland at Normandy by Allied forces. An unusually intense June storm brought high seas and gales to the French coast, but a moderation of the weather that was successfully predicted by Col. J.M. Stagg of the British forces (after consultation with both British and American forecasters) enabled Gen. Dwight D. Eisenhower, supreme commander of the Allied Expeditionary Forces, to make his critical decision to invade on June 6, 1944.

The second half of the 20th century saw a reorganization of the country's weather bureau. The USWB was part of the Department of Agriculture until 1940, when it was added to the Department of Commerce. On October 9, 1970, the USWB became the National Weather Service.

In addition, the later part of the 20th century was a time of unprecedented growth of commercial weather-forecasting firms in the United States and elsewhere. Marketing organizations and stores hire weather-forecasting consultants to help with the timing of sales and promotions of products ranging from snow tires and roofing materials to summer clothes and resort vacations. Many oceangoing shipping vessels as well as military ships use optimum ship routing forecasts to plan their routes in order to minimize lost time, potential damage, and fuel consumption in heavy seas. Similarly, airlines carefully consider atmospheric conditions when planning long distance flights so as to avoid the strongest head winds and to ride with the strongest tail winds.

International trading of foodstuffs such as wheat, com (maize), beans, sugar, cocoa, and coffee can be severely affected by weather news. For example, in 1975 a severe freeze in Brazil caused the price of coffee to increase substantially within just a few weeks, and in 2017 Georgia peach growers blamed the combination of warm winter temperatures and a spring freeze on the loss of nearly 80 percent of the state's peach crop. In addition, extreme heat and drought can affect production; one study estimated that 9-10 percent of cereal crops between 1964 and 2007 were lost to these phenomena. Weather-forecasting organizations are thus frequently called upon by banks, commodity traders, and food companies to give them advance knowledge of the possibility of such sudden changes. The cost of all sorts of commodities and services, whether they are tents for outdoor events or plastic covers for the daily newspapers, can be reduced or eliminated if reliable information about possible precipitation can be obtained in advance.

Forecasts must be quite precise for applications that are tailored to specific industries. Gas and electric utilities, for example, may require forecasts of temperature within one or two degrees a day ahead of time, or ski-resort operators may need predictions of nighttime relative humidity on the slopes within 5 to 10 percent in order to schedule snow making.

History of weather forecasting

The Greek philosophers had much to say about meteorology, and many who subsequently engaged in weather forecasting no doubt made use of their ideas. Unfortunately, they probably made many bad forecasts, because Aristotle, who was the most influential, did not believe that wind is air in motion. He did believe, however, that west winds are cold because they blow from the sunset.

The scientific study of meteorology did not develop until measuring instruments became available. Its beginning is commonly associated with the invention of the mercury barometer by Evangelista Torricelli, an Italian physicist-mathematician, in the mid-17th century and the nearly concurrent development of a reliable thermometer. (Galileo had constructed an elementary form of gas thermometer in 1607, but it was defective; the efforts of many others finally resulted in a reasonably accurate liquid-in-glass device.)

A succession of notable achievements by chemists and physicists of the 17th and 18th centuries contributed significantly to meteorological research. The formulation of the laws of gas pressure, temperature, and density by Robert Boyle and Jacques-Alexandre-Cesar Charles, the development of calculus by Isaac Newton and Gottfried Wilhelm Leibniz, the development of the law of partial pressures of mixed gases by John Dalton, and the formulation of the doctrine of latent heat (i.e., heat release by condensation or freezing) by Joseph Black are just a few of the major scientific breakthroughs of the period that made it possible to measure and better understand theretofore unknown aspects of the atmosphere and its behavior. During the 19th century, all of these brilliant ideas began to produce results in terms of useful weather forecasts.

The emergence of synoptic forecasting methods

Analysis of synoptic weather reports

An observant person who has learned nature's signs can interpret the appearance of the sky, the wind, and other local effects and "foretell the weather." A scientist can use instruments at one location to do so even more effectively. The modem approach to weather forecasting, however, can only be realized when many such observations are exchanged quickly by experts at various weather stations and entered on a synoptic weather map to depict the patterns of pressure, wind, temperature, clouds, and precipitation at a specific time. Such a rapid exchange of weather data became feasible with the development of the electric telegraph in 1837 by Samuel F.B. Morse of the United States. By 1849 Joseph Henry of the Smithsonian Institution in Washington, D.C., was plotting daily weather maps based on telegraphic reports, and in 1869 Cleveland Abbe at the Cincinnati Observatory began to provide regular weather forecasts using data received telegraphically.

Synoptic weather maps resolved one of the great controversies of meteorology—namely, the rotary storm dispute. By the early decades of the 19th century, it was known that storms were associated with low barometric readings, but the relation of the winds to low-pressure systems, called cyclones, remained unrecognized. William Redfield, a self-taught meteorologist from Middletown, Conn., noticed the pattern of fallen trees after a New England hurricane and suggested in 1831 that the wind flow was a rotary counterclockwise circulation around the centre of lowest pressure. The American meteorologist James P. Espy subsequently proposed in his *Philosophy of Storms* (1841) that air would flow toward the regions of lowest pressure and then would be forced upward, causing clouds and precipitation. Both Redfield and Espy proved to be right. The air does spin around the cyclone, as Redfield believed, while the layers close to the ground flow inward and upward as well. The net result is a rotational wind circulation that is slightly modified at Earth's surface to produce inflow toward the storm centre, just as Espy had proposed. Further, the inflow is associated with clouds and precipitation in regions of low pressure, though that is not the only cause of clouds there.

In Europe the writings of Heinrich Dove, a Polish scientist who directed the Prussian Meteorological Institute, greatly influenced views concerning wind behavior in storms. Unlike the Americans, Dove did not focus on the pattern of the winds around the storm but rather on how the wind should change at one place as a storm passed. It was many years before his followers understood the complexity of the possible changes.

II. Answer the questions:

1. Why is weather forecasting necessary for mankind?
2. What is the difference between the ways of old and up-to-date measurements of weather?

3. What is the similarity between old and present practices?
4. How did the basis for weather prediction start and how did the synoptic idea develop?
5. When did the so-called synoptic weather map become the principal tool for meteorologists?
6. What had happened since the mid -20th century?
7. What is the chronology of meteorological forecasts and its peculiarities?
8. Why can planting and harvesting be planned much better?
9. What is the history of the US weather forecasting from 1920-s till the second half of the 20nd century?
10. What could the international trading of foodstuffs be affected by?

Text B SURFACE WEATHER ANALYSIS

Surface weather analysis is a special type of weather map that provides a view of weather elements over a geographical area at a specified time based on information from ground-based weather stations.

Weather maps are created by plotting or tracing the values of relevant quantities such as sea level pressure, temperature, and cloud cover onto a geographical map to help find synoptic scale features such as weather fronts.

The first weather maps in the 19th century were drawn well after the fact to help devise a theory on storm systems. After the advent of the telegraph, simultaneous surface weather observations became possible for the first time, and beginning in the late 1840s, the Smithsonian Institution became the first organization to draw real-time surface analyses. Use of surface analyses began first in the United States, spreading worldwide during the 1870s. Use of the Norwegian cyclone model for frontal analysis began in the late 1910s across Europe, with its use finally spreading to the United States during World War II.

Surface weather analyses have special symbols that show frontal systems, cloud cover, precipitation, or other important information. For example, an *H* may represent high pressure, implying clear skies and relatively warm weather. An *L*, on the other hand, may represent low pressure, which frequently accompanies precipitation. Various symbols are used not just for frontal zones and other surface boundaries on weather maps, but also to depict the present weather at various locations on the weather map. Areas of precipitation help determine the frontal type and location.

The use of weather charts in a modern sense began in the middle portion of the 19th century in order to devise a theory on storm systems. The development of a telegraph network by 1845 made it possible to gather weather information from multiple distant locations quickly enough to preserve its value for real-time applications. The Smithsonian Institution developed its network of observers over much of the central and eastern United States between the 1840s and 1860s. The U.S. Army Signal Corps inherited this network between 1870 and 1874 by an act of Congress, and expanded it to the west coast soon afterwards.

The weather data was at first less useful as a result of the different times at which weather observations were made. The first attempts at time standardization took hold in Great Britain by 1855. The entire United States did not finally come under the influence of time zones until 1905, when Detroit finally established standard time. Other countries followed the lead of the United States in taking simultaneous weather observations, starting in 1873. Other countries then began preparing surface analyses. The use of frontal zones on weather maps did not appear until the introduction of the Norwegian cyclone model in the late 1910s, despite Loomis' earlier attempt at a similar notion in 1841. Since the leading edge of air mass changes bore resemblance to the military fronts of World War I, the term "front" came into use to represent these lines.

Despite the introduction of the Norwegian cyclone model just after World War I, the United States did not formally analyze fronts on surface analyses until late 1942, when the WBAN Analysis Center opened in downtown Washington, D.C.. The effort to automate map plotting began in the United States in 1969, with the process complete in the 1970s. Hong Kong completed their process of automated surface plotting by 1987. By 1999, computer systems and software had finally become sophisticated enough to allow for the ability to underlay on the same workstation satellite imagery, radar imagery, and model-derived fields such as atmospheric thickness and frontogenesis in combination with surface observations to make for the best possible surface analysis. In the United States, this development was achieved when Intergraph workstations were replaced by n-AWIPS workstations. By 2001, the various surface analyses done within the National Weather Service were combined into the Unified Surface Analysis, which is issued every six hours and combines the analyses of four different centers. Recent advances in both the fields of meteorology and geographic information systems have made it possible to devise finely tailored weather maps. Weather information can quickly be matched to relevant geographical detail. For instance, icing conditions can be mapped onto the road network. This will likely continue to lead to changes in the way surface analyses are created and displayed over the next several years. The project is an ongoing attempt to gather surface pressure data using smartphones.

When analyzing a weather map, a station model is plotted at each point of observation. Within the station model, the temperature, dewpoint, wind speed and direction, atmospheric pressure, pressure tendency, and ongoing weather are plotted. The circle in the middle represents cloud cover; fraction it is filled in represents the degree of overcast. Outside the United States, temperature and dewpoint are plotted in degrees Celsius. The wind barb points in the direction from which the wind is coming. Each full flag on the wind barb represents 10 knots (19 km/h) of wind, each half flag represents 5 knots (9 km/h). When winds reach 50 knots (93 km/h), a filled in triangle is used for each 50 knots (93 km/h) of wind. In the United States, rainfall plotted in the corner of the station model are in inches. The international standard rainfall measurement unit is the millimeter. Once a map has a field of station models plotted, the analyzing isobars (lines of equal pressure), isallobars (lines of equal pressure change), isotherms (lines of equal temperature), and isotachs (lines of equal wind speed) are drawn. The abstract weather symbols were devised to take up the least room possible on weather maps.

I. Put 15 questions to the text

II. RetelText B according to your own plan

<u>LEXICAL EXERCISES</u>

Exercises 1. Define by what part of speech each attribute is expressed and translate the following sentences:

1. Detailed local climatological studies were presented in the form of notes on the climatology made in the South American Antarctic sector.
2. The last conference drew attention to the increased knowledge to be gained from satellite studies of cloud and pack ice cover in Antarctic and sub-Antarctic regions.
3. The most prolonged heat wave in December for forty-three years persisted over south-east Australia from 24-31 December 1960 with temperatures exceeding 100°F. (38°C) daily in most districts.
4. It was particularly interesting to hear the lectures based on results not yet prepared for publication which were delivered by several meteorologists just back from the Antarctica.
5. Surface conditions, including advection, change very considerably from month to month and from year to year.
6. The quality of the articles presented, and the interesting discussions, have led me to give a short conclusion of the essential points dealt with.
7. Interpretation of cloud photographs will involve not only a study of cloud patterns for models to be associated with various types of fronts and cyclonic vortex-spiral systems, but also an attempt to identify the types of cloud represented and the nature of the cloud producing mechanism, i. e. whether fronts, convergence, turbulence or convection.
8. Meteorology, representing the atmospheric phase of the water cycle, has an important role in studies of water problems on the earth.
9. As a consequence there might be a slight tendency for the average number of anomalies to follow the general shape of the curve showing the number of

records.

10. In the preceding discussion the influence of earth curvature has not been considered.

Exercises 2. Translate the following phrases:

1. The low-level temperature changes.
2. The middle latitude zonal circulation.
3. The very cold Antarctic surface air.
4. Middle latitude westerlies.
5. The five-day mean sea level pressure maps.
6. The temperate latitude large scale weather systems.
7. The infra-red radiation processes.
8. Global wind studies.
9. Pack ice distribution study.
10. The International Antarctic Analysis Centre.
11. Satellite photograph time.
12. Several synoptic case studies

Exercises 3. Translate the following sentences, paying attention to the meanings of "that," "that of," "those" and "those of:"

1. There is a remarkable difference in atmospheric pressure over Europe as contrasted with that over the region of the Great Lakes in North America.
2. The spectral distribution of solar radiation closely approximates that of a black body.
3. This air mass has characteristics and properties quite different from those of such air mass in winter.
4. The trade-winds of the Pacific are somewhat less strong and more variable in direction than those of the Atlantic.
5. The process of condensation is similar to that described in connection with the formation of fog, where it is stated that the presence of hydroscopic nuclei is necessary.
6. The continental cyclones may be divided into those which are most frequent in winter and spring and least in summer, and which originate in North China and Siberia.
7. The forms and codes in general use are those adopted by the International Meteorological Conference held at Copenhagen in September 1929.
8. Depressions fall into two main classes, those of temperate and high latitudes, and those of tropical seas.

<u>GRAMMAR EXERCISES</u>

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

I. Translate the texts:

Text A **CLIMATE**

Climate change includes both **global warming** driven by human emissions of greenhouse gases and the resulting large-scale shifts in weather patterns. Though there have been previous periods of climatic change, since the mid-20th century humans have had an unprecedented impact on Earth's climate system and caused change on a global scale.

The largest driver of warming is the emission of greenhouse gases, of which more than 90% are carbon dioxide (CO_2) and methane. Fossil fuel burning (coal, oil, and natural gas) for energy consumption is the main source of these emissions, with additional contributions from agriculture, deforestation, and manufacturing. The human cause of climate change is not disputed by any scientific body of national or international standing. Temperature rise is accelerated or tempered by climate feedbacks, such as loss of sunlight-reflecting snow and ice cover, increased water vapour (a greenhouse gas itself), and changes to land and ocean carbon sinks.

Temperature rise on land is about twice the global average increase, leading to desert expansion and more common heat waves and wildfires. Temperature rise is also amplified in the Arctic, where it has contributed to melting permafrost, glacial retreat and sea ice loss. Warmer temperatures are increasing rates of evaporation, causing more intense storms and weather extremes. Impacts on ecosystems include the relocation or extinction of many species as their environment changes, most immediately in coral reefs, mountains, and the Arctic. Climate change threatens people with food insecurity, water scarcity, flooding, infectious diseases, extreme heat, economic losses, and displacement. These impacts have led the World Health Organization to call climate change the greatest threat to global health in the 21st century. Even if efforts to minimize future warming are successful, some effects will continue for centuries, including rising sea levels, rising ocean temperatures, and ocean acidification.

Many of these impacts are already felt at the current level of warming, which is about 1.2 °C (2.2 °F). The Intergovernmental Panel on Climate Change (IPCC) has issued a series of reports that project significant increases in these impacts as warming continues to 1.5 °C (2.7 °F) and beyond. Additional warming also increases the risk of triggering critical thresholds called tipping points. Responding to climate change involves mitigation and adaptation. Mitigation – limiting climate change – consists of reducing greenhouse gas emissions and removing them from the atmosphere; methods include the development and deployment of low-carbon energy sources such as wind and solar, a phase-out of coal, enhanced energy efficiency, reforestation, and forest preservation. Adaptation consists of adjusting to actual or expected climate,[16] such as through improved coastline protection, better disaster management, assisted colonization, and the development of more resistant crops. Adaptation alone cannot avert the risk of "severe, widespread and irreversible" impacts.

Under the Paris Agreement, nations collectively agreed to keep warming "well under 2.0 °C (3.6 °F)" through mitigation efforts. However, with pledges made under the Agreement, global warming would still reach about 2.8 °C (5.0 °F) by the end of the century. Limiting warming to 1.5 °C (2.7 °F) would require halving emissions by 2030 and achieving near-zero emissions by 2050.

Climate variability includes all the variations in the climate that last longer than individual weather events, whereas the term **climate change** only refers to those variations that persist for a longer period of time, typically decades or more. In the time since the industrial revolution, the climate has increasingly been affected by human activities that are causing global warming and climate change.

The climate system receives nearly all of its energy from the sun. The climate system also radiates energy to outer space. The balance of incoming and outgoing energy, and the passage of the energy through the climate system, determines Earth's energy budget. When the incoming energy is greater than the outgoing energy, Earth's energy budget is positive and the climate system is warming. If more energy goes out, the energy budget is negative and Earth experiences cooling.

The energy moving through Earth's climate system finds expression in weather, varying on geographic scales and time. Long-term averages and variability of weather in a region constitute the region's climate. Such changes can be the result of "internal variability", when natural processes inherent to the various parts of the climate system alter the distribution of energy. Examples include variability in ocean basins such as the Pacific decadal oscillation and Atlantic multidecadal oscillation. Climate variability can also result from *external forcing*, when events outside of the climate system's components nonetheless produce changes within the system. Examples include changes in solar output and volcanism.

Climate variability has consequences for sea level changes, plant life, and mass extinctions; it also affects human societies.

Multiple independently produced instrumental datasets show that the climate system is warming, with the 2009–2018 decade being 0.93 ± 0.07 °C (1.67 ± 0.13 °F) warmer than the pre-industrial baseline (1850–1900). Currently, surface temperatures are rising by about 0.2 °C (0.36 °F) per decade, with 2020 reaching a temperature of 1.2 °C (2.2 °F) above pre-industrial. Since 1950, the number of cold days and nights has decreased, and the number of warm days and nights has increased.

There was little net warming between the 18th century and the mid-19th century. Climate proxies, sources of climate information from natural archives such as trees and ice cores, show that natural variations offset the early effects of the Industrial Revolution. Thermometer records began to provide global coverage around 1850. Historical patterns of warming and cooling, like the Medieval Climate Anomaly and the Little Ice Age, did not occur at the same time across different regions, but temperatures may have reached as high as those of the late-20th century in a limited set of regions. There have been prehistorical episodes of global warming, such as the Paleocene–Eocene Thermal Maximum. However, the modern observed rise in temperature and CO2 concentrations has been so rapid that even abrupt geophysical events that took place in Earth's history do not approach current rates.

Evidence of warming from air temperature measurements are reinforced with a wide range of other observations. There has been an increase in the frequency and intensity of heavy precipitation, melting of snow and land ice, and increased atmospheric humidity. Flora and fauna are also behaving in a manner consistent with warming; for instance, plants are flowering earlier in spring. Another key indicator is the cooling of the upper atmosphere, which demonstrates that greenhouse gases are trapping heat near the Earth's surface and preventing it from radiating into space.

While locations of warming vary, the patterns are independent of where greenhouse gases are emitted, because the gases persist long enough to diffuse across the planet. Since the pre-industrial period, global average land temperatures have increased almost twice as fast as global average surface temperatures. This is because of the larger heat capacity of oceans, and because oceans lose more heat by evaporation. Over 90% of the additional energy in the climate system over the last 50 years has been stored in the ocean, with the remainder warming the atmosphere, melting ice, and warming the continents.

The Northern Hemisphere and North Pole have also warmed much faster than the South Pole and Southern Hemisphere. The Northern Hemisphere not only has much more land, but also more seasonal snow areas and seasonal sea ice, because of how the land masses are arranged around the Arctic Ocean. As these surfaces flip from reflecting a lot of light to being dark after the ice has melted, they start absorbing more heat. Localized black carbon deposits on snow and ice also contribute to Arctic warming. Arctic temperatures have increased and are predicted to continue to increase during this century at over twice the rate of the rest of the world. Melting of glaciers and ice sheets in the Arctic also disrupts ocean circulation, including a weakened Gulf Stream, further changing the climate.

The response of the climate system to an initial forcing is modified by feedbacks: increased by self-reinforcing feedbacks and reduced by balancing feedbacks. The main reinforcing feedbacks are the water-vapour feedback, the ice–albedo feedback, and probably the net effect of clouds. The primary balancing feedback to global temperature change is radiative cooling to space as infrared radiation in response to rising surface temperature. In addition to temperature feedbacks, there are feedbacks in the carbon cycle, such as the fertilizing effect of CO2 on plant growth. Uncertainty over feedbacks is the major reason why different climate models project different magnitudes of warming for a given amount of emissions.

As air gets warmer, it can hold more moisture. After an initial warming due to emissions of greenhouse gases, the atmosphere will hold more water. As water vapour is a potent greenhouse gas, this further heats the atmosphere. If cloud cover increases, more sunlight will be reflected back into space, cooling the planet. If clouds become more high and thin, they act as an insulator, reflecting heat from below back downwards and warming the planet. Overall, the net cloud feedback over the industrial era has probably exacerbated temperature rise. The reduction of snow cover and sea ice in the Arctic reduces the albedo of the Earth's surface. More of the Sun's energy is now absorbed in these regions, contributing to amplification of Arctic temperature changes. Arctic amplification is also melting permafrost, which releases methane and CO2 into the atmosphere.

Around half of human-caused CO2 emissions have been absorbed by land plants and by the oceans. On land, elevated CO2 and an extended growing season have stimulated plant growth. Climate change also increases droughts and heat waves that inhibit plant growth, which makes it uncertain whether this carbon sink will continue to grow in the future. Soils contain large quantities of carbon and may release some when they heat up. As more CO2 and heat are absorbed by the ocean, it acidifies, its circulation changes and phytoplankton takes up less carbon, decreasing the rate at which the ocean absorbs atmospheric carbon. Climate change can also increase methane emissions from wetlands, marine and freshwater systems, and permafrost.

Climate sensitivity is a measure of how much the Earth's climate will cool or warm after a change in the climate system, for instance, how much it will warm for doubling in carbon dioxide (CO2) concentrations. In technical terms, climate sensitivity is the average change in the Earth's surface temperature in response to changes in radiative forcing, the difference between incoming and outgoing energy on Earth. Climate sensitivity is a key measure in climate science, and a focus area for climate scientists, who want to understand the ultimate consequences of anthroprogenic climate change.

The Earth's surface warms as a direct consequence of increased atmospheric CO_2, as well as increased concentrations of other greenhouse gases such as nitrous oxide and methane. Increasing temperatures have secondary effects on the climate system, such as an increase in atmospheric water vapour, which is itself also a greenhouse gas. Because scientists do not know exactly how strong these climate feedbacks are, it is difficult to precisely predict the amount of warming that will result from a given increase in greenhouse gas concentrations. If climate sensitivity turns out to be on the high side of scientific estimates, the Paris Agreement goal of limiting global warming to below 2 °C (3.6 °F) will be difficult to achieve.

The two primary types of climate sensitivity are the shorter-term "transient climate response", the increase in global average temperature that is expected to have occurred at a time when the atmospheric CO_2 concentration has doubled; and "equilibrium climate sensitivity", the higher long-term increase in global average temperature expected to occur after the effects of a doubled CO_2 concentration have had time to reach a steady state. Climate sensitivity is typically estimated in three ways; using direct observations of temperature and levels of greenhouse gases taken during the industrial age; using indirectly estimated temperature and other measurements from the Earth's more distant past; and modelling the various aspects of the climate system with computers.

I. Put 20 questions to the text

II. Give a summary of the text in your own words. Not less than 10 sentences

Text B MAKING WEATHER MAPS

When analyzing weather maps, it is necessary to critically review the data plotted on the map, correct errors made during the drawing, or mark (circle with a pencil) erroneous data. Before processing surface weather maps, it is necessary to get acquainted with the history of development of synoptic processes on maps of previous terms, namely: with the location of cyclones, anticyclones, pressure basins, protrusions, atmospheric fronts. Drawing isobars, isogypsum, fronts, as well as the application of all signatures and marks should be done with a black (simple) pencil of medium hardness, the signatures should be clear, the thickness of the lines is not less than 1 mm. When drawing lines, it is necessary to avoid their crossing with the put data; the fronts should be marked accordingly. The analysis of circular surface weather maps includes: conducting isobars, frontal sections, isolines of baric tendencies (isolobar), marking of areas of low and high pressure, precipitation and weather phenomena, drawing trajectories of baric centers. Determining the location of atmospheric fronts is carried out by a set of features on surface maps and maps of pressure topography in their joint analysis. It is necessary to take into account the history of the process, ie, to take into account the position of cyclones, pressure basins and fronts on weather maps for previous periods. The general features, which to some extent are inherent in the atmospheric fronts on the ground maps, are as follows: - the front line runs along the axis of the baric basin; - along the front line there is a convergence of air flows; CD 74.90.14-02572508-006: 2015 15 - when crossing the front line, the values of meteorological elements change abruptly: the temperature contrast during the transition from one air mass to another can reach 8-10 °; - pressure trends in the area of the fronts differ in size and sign: in front of the warm front is the area of pressure drop, behind the cold front - the area of its growth; - the wind always turns clockwise when passing the front; - each front is characterized by a certain type of clouds and precipitation: in front of the warm front there are layered clouds - Cs, As, Ns, which are associated with siege, in the cold front - typical cumulus clouds Cb and rainfall. Clouds and precipitation associated with the occlusion front are located on both sides of it. The front sections are marked according to Table 5.8. If the front is blurred (there is frontolysis), then on the main designation of the front put in different directions from it several arrows: If there is activation of the frontal section (frontogenesis), then on the main designation of the front put several converging arrows: Isobars on the main surface maps of weather and ring F MPK-206 is carried out by a continuous smooth line through 5 hPa (and multiple 5), on ring weather maps F MPK-106 - in 2,5 hPa). With a blurred pressure field, it is recommended to perform a dashed intermediate isobar of any value to more accurately determine the center of the pressure area. All isobars (on F MPK-106 - through one) should be signed by the corresponding number of hectopascals. For example, 990, 995, 1000, etc. Open isobars are signed on both sides, closed ones are torn where it is convenient, and signed in the formed interval. The direction and speed of the wind must be taken into account when conducting the isobar, as it is related to the pressure gradient and, consequently, to the direction and density of the isobar. The influence of fronts and orography on the shape of the isobar must also be taken into account. In mountainous areas, isobars (when held through ridges) can be broken. In such cases, the ends of the corresponding isobars, located on different sides of the spine, are connected by a wavy line (orographic isobar). In the center of the low pressure area put the letter H, high pressure - B. On circular surface maps the isoline of baric tendencies (isolobars) is drawn by a dashed line through 1 hPa. In the case of a strong rise or fall in pressure, when the conduction of isolines through 1 hPa is very overloading the map, you can spend them through 2 hPa (for example: 1, 3, 5 hPa). In case of small pressure changes (up to 1 hPa) it is possible to carry out zero isolobar. In the area of maximum pressure rise is the letter P (blue), the maximum drop - P (red). Next to the letters P and P (the same color) is the value of the maximum pressure change, for example P 3,4; P 3.8. All isolines of baric tendencies are signed by the values of whole hectopascals with a minus sign when the pressure drops and without a sign - when rising.

The daily hydrometeorological bulletin contains: - a map of the actual weather for the past day, on which the maximum and minimum temperature, the amount of precipitation in mm per day, hazardous and natural phenomena (symbols - Table 5.10), as well as the limits of frost ; - schematic map of the prognostic surface field, image from the satellite; - forecast map of meteorological elements and weather phenomena for the next day. 5.3 Altitude weather maps Altitude weather maps are based on data from simultaneous meteorological observations that reflect the conditions in the free atmosphere. Observation data are plotted on a map around the station punch with numbers and symbols. Be sure to check the data that is in doubt. When making an analysis of the figure values of isolines, symbols of weather phenomena, the position of the centers of baric formations should be placed parallel to the latitude of the area. 5.3.1 Maps of absolute pressure topography On maps AT 850, AT 700, AT 500, AT 300, etc. applied: hn hn hn - height of the isobaric surface (in geopotential decameters); Tn Tn Tan - air temperature in whole degrees (Tan - the value of tenths of a temperature, it is not applied to the map, it is used for correct rounding to whole degrees); Dn Dn - dew point deficit (in whole degrees); dn dn - wind direction (hundreds and tens of degrees); fn fn fn - wind speed (in meters per second).

The height of isobaric surfaces 850 and 700 in telegrams is indicated in geopotential meters (gpm), and, when encoding the heights, the figures of thousands of meters are discarded, before drawing on the map it is necessary to add 700 hPa 2 or 3 and round the obtained number to tens of meters. The value 2 is added to the value of the height of the isobaric surface 700 hPa on the left, if the number hn hn hn is numbered 500 and more; if at the place hn hn hn the number is from 000 to 300, add 3. The heights of the isobaric surfaces 500, 400, 300 hPa are given in telegrams in geopotential decameters, so they are plotted on the map without changes. When encoding the heights of isobaric surfaces located above the level of 300 hPa, the numbers of tens of thousands are discarded. Therefore, to the value of the height of the isobaric surface from the coded telegram for surfaces 250, 200, 150 and 100 hPa it is necessary to add the digit 1 on the left, for 50 hPa - 2 or 1 (the digit 1 is added in cases when the first digit of height 9, in all other cases 2). The height of isobaric surfaces of 30 and 20 hPa is always assigned the number 2, to 10 hPa - 3 or 2 (the number 2 is assigned when the first digit of the height is 9, in other cases the figure 3 is added).

On the map of the relative baric topography of the layer bounded by the surfaces of 500 and 1000 hPa (WT 500 1000), to the right and above the punch of the aerological station, H 500 1000 is plotted - the difference between the heights of the surfaces 500 and 1000 hPa in geopotential decameters. Isogypsum of a layer of 500-1000 hPa is carried out by continuous smooth lines in 4 ladies. In addition, it is possible to make a difference between the values of H 500 1000 during the observation period and 12 or 24 hours before it. The resulting difference in geopotential decameters is plotted below the H 500 1000 with a plus (+) sign or red in the case of increasing values or minus (-) or blue in the case of decreasing values. In the center of the region of the maximum value of H 500 1000, T is placed in red, and the minimum value is marked in blue by H. X. It is also possible to obtain a map of the thermobaric field by copying isogips AT 700 in red to the VT 500 1000 map.

Areas of cold are painted yellow, heat - red, and arrows indicate advection: heat - red, cold - blue.

Individual pressure change τ in hectopascals (hPa) is plotted on vertical motion maps for 12 hours. It is advisable to apply τ for surfaces 850 (τ850), 700 (τ700) and 500 hPa (τ500). τ is applied in tens of hPa with a sign (+) if the motions are descending, and with a sign (-) if they are ascending. On the maps of vertical movements calculated from the actual data, the values of individual pressure change at the calculation point on isobaric surfaces 850, 700 or 500 hPa are removed directly from the map. to the value of 100 hPa / 12h), then - after 50 hPa / 12h. At the end of the lines put the value of the pressure change. Ascending movements correspond to an individual drop in pressure, descending - its growth. Isolines corresponding to the ascending movements are drawn in red or a solid black line, the descending movements - a blue pencil or a dashed black line. In the center of the regions put the maximum value of the individual pressure change with a minus sign (-) for ascending movements and with a plus sign (+) for descending. On the maps of the forecast of vertical movements perform the same operations as on the map of the diagnosis. Various thermodynamic graphs, such as emagram, tefigram, shtuvegram and others, are used to analyze the vertical distribution of meteorological quantities at the atmospheric sounding point. In accordance with the recommendations of the World Meteorological Organization (WMO), the work of hydrometeorological organizations uses a thermodynamic graph called the aerological diagram (AD). AD is built in oblique (ADC) and rectangular (ADP) coordinate systems. Forms with an oblique coordinate system are of two types: one of them is designed for the warm period of the year (ADKT), the other - for the cold (ADKH). ADP is used in all seasons. On the HELL, the horizontal axis is a linear temperature scale (X = T), and the vertical axis is the power pressure function (Y = P 0.286). The following curves are plotted on the BP form: - isobars - brown horizontal lines drawn through 10 hPa (near the left and right ends in the form of additional scales - through 5 hPa) for the pressure range from 1050 to 100 hPa. The notation is given near the left and right ends of the isobars after 50 hPa, and near the CA curve - 64 on the ADCT - after 150,100 or 50 hPa; - isotherms - brown straight lines inclined to isobars at an angle of 50 °; carried out after 1 ° C. At the level of 1000 hPa, the temperature range of ADKT from + 40 ° to –25 ° C, of ADKH from + 10 ° to –55 ° C. Isotherms are signed after 10 ° C near isobars of 1050 hPa, 450 hPa and at the upper end of isotherms; CD 74.90.14-02572508-006: 2015 30 - dry adiabats - brown straight lines, inclined to the left; the corresponding values of the potential temperature (in degrees Celsius), multiples of 5, are plotted on the ADCT along the −30 ° C isotherm, and on the ADCC along the −60 ° C isotherm. - wet adiabats - green dashed lines; the values of the pseudopotential temperature (in degrees Kelvin) corresponding to them are given along their upper ends. To the left of these figures are the values of the potential temperature of the wetted thermometer in degrees Celsius; - isograms - green, almost straight, sloping lines to the right, drawn for values of the mixture ratio from 0.02 to 45.0 g / kg on ADCT and from 0.01 to 7.0 g / kg on ADC. The designation of these isolines is given slightly above the 650 hPa isobar and at the upper ends of the isograph; - the scale of corrections for the virtual temperature in the form of green dots is applied at three levels: 900, 720, 520 hPa.

Answer the questions:

1. Why is it necessary to review critically the data plotted on the map?
2. What does the analysis of circular surface weather maps include?
3. How do the values of meteorological elements (temperature, pressure, wind, fronts) change?
4. What is the role of isobars on the weather map?
5. What does the daily hydrometeorological bulletin contain?
6. What are the altitude weather maps based on?
7. What are the maps of relative baric topography?
8. What does a map of vertical moments indicate to?
9. What colour are the ascending and discending isolines?
10. What is the recommendation of the WMO?

LEXICAL EXERCISES

I. Translate the following sentences, paying attention to the use and meanings of "whether," "whether . . . or," "either . . . or," "neither . . . nor:"

1. Whether this value is exact or not is a matter of minor importance.
2. The maximum frequency of fogs is found neither at the extremely high values of the difference in temperature between air and sea, nor at the lowest wind velocities, but somewhere between.
3. Whether these nuclei are within the cloud during formative stages of the rain or whether they are confined to only the lowest regions of a cloud is a question that remains unanswered.
4. It is readily seen that the component of the isallobaric gradient along the isobars will tend to make the isobars rotate; whether the rotation is clockwise or counter-clockwise is readily seen in each particular case.
5. The individual flight sections were studied in order to determine whether the middle and upper cloud masses were related to the frontal surfaces.
6. In some cases there remained doubt as to whether a certain sounding was correct or not.
7. There are certain curves in the pressure distribution along which either the pressure function or some derivative of it remains constant while the curves move relative to the chart.
8. The maximum vapour tension at which condensation takes place can be reached either by adding water vapour to air of a given temperature or by decreasing the temperature of air of a given moisture content.

9. On the remaining days of the twenty-one day period of study the front at one level either lay outside the area or else the flight path cut through the weather system.
10. The vertical thickness of the fog is so great that it is impossible to tell whether there is cloud above it.

II. Translate the following sentences, paying attention to the degrees of comparison of the adjectives:

1. The less the wind, the longer will warm air remain near the ground before being carried away horizontally or vertically by turbulence or convection.
2. The lower the relative humidity of the air, the faster is the rate of evaporation and the lower does the wet bulb read.
3. The more scarce the station network and the tighter the isohypse gradient, the more variable is the analysis.
4. The greater the control, the less will be the effect of friction and the more detailed will be the record of any recording instrument.
5. The speed of the down-slope wind appears to be fairly uniform and smaller in magnitude than the upslope flow.
6. Rains formed near the basis of the orographic clouds are more likely to fall on the lower slopes of the mountain.
7. In any case the control should be such that the maximum effect of the friction should be less that the least change it is desired to record.
8. The usual rule that the areas of rapid cooling and most rapid cyclonic turning of the wind must coincide applies only for cases in which cold air undercuts warm.
9. It is of interest to note that the more crowded the isobars are in advance of the front, the smaller is the velocity of the front.
10. The more unstable the wave is, the greater is the rate at which the cold front overtakes the warm front.

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

I. Translate the texts:

Text A CLOUDS

“An aggregation of minute drops of water suspended in the air at higher altitudes” is called as cloud. A cloud is a visible aggregate of tiny water droplets and/or ice crystals suspended in the atmosphere and can exist in a variety of shapes and sizes. Some clouds are accompanied by precipitation; rain, snow, hail, sleet, even freezing rain. Clouds can occur at any level of the atmosphere wherever there is sufficient moisture to allow condensation to take place. The layer of the atmosphere where almost all cloud exists is the troposphere, although the tops of some severe thunderstorms occasionally pierce the tropopause. A cloud can be defined as hydrometeor consisting of minute particles of liquid water or ice, or of both, suspended in the free air and usually not touching the ground. It may also include larger particles of liquid water or ice as well as non-aqueous or solid particles such as those present in fumes, smoke or dust. DEVELOPMENT OF CLOUDS Water is known to exist in three different states; as a solid, liquid or gas. Clouds, snow, and rain are all made of up of some form of water. A cloud is comprised of tiny water droplets and/or ice crystals, a snowflake is an aggregate of many ice crystals, and rain is just liquid water. Water existing as a gas is called water vapor. When referring to the amount of moisture in the air, we are actually referring to the amount of water vapor. If the air is described as "moist", that means the air contains large amounts of water vapor. Moisture is a necessary ingredient for the production of clouds and precipitation All clouds are a form of water. Clouds are condensed atmospheric moisture in the form of minute water droplets or ice crystals. The creation of a cloud begins at ground level. The sun heats the earth's surface, the warm ground heats the air, which rises. The air contains variable amounts of water, as vapor, that has evaporated from bodies of water and plants. Air at ground level is denser than air higher up, and as the warm air rises, it expands and becomes less dense.

Air rises for three main reasons • Sunshine – heat from the sun or warm ground warms the air and makes it lighter. It therefore rises into the sky. • The terrain – air may rise as it is forced upwards due to changes in the terrain (landscape). This often occurs when wind blows air either over mountains, or over cliffs onto land from the sea. • A front – air can also rise at a weather front. At cold fronts, cold air is pushed under warm air, forcing it upwards and at a warm front, warm moist air is forced up and over the cold air. Expansion cools the air and as the air cools, the water vapor that is present in the air, condenses into tiny microscopic droplets. Cloud formation depends on how much water is in the atmosphere, the temperature, the air current, and topography. If there is no water, no clouds can form. If condensation occurs below the freezing point, the cloud is made of ice crystals. Warm and cold air fronts, as well as topography can control how air rises. Clouds that form during vigorous uplift of air have a tall, stacked appearance and clouds formed by gentle uplift of air currents have a flat or stratified appearance. One can make short-term forecasts by observing clouds, as any change in the way a cloud looks indicates a change in the weather.

After cloud droplets (or ice crystals) form, then what happens to them? One of two things. Either they collide with each other and grow by joining together to such a large size that they fall to the ground as rain or snow, or they evaporate and change back into water vapor. It is estimated that, on average, about one-half of all cloud material eventually falls to the Earth as precipitation, while the other half re-evaporates back into water vapor. DROP SIZE AND CLOUD APPEARANCE The smaller the drops in a cloud the brighter the tops appear (and the darker the bases). Smaller droplets scatter more sunlight, while large drops allow more sunlight to pass through. This explains why the heavily raining part of a shower cloud or thunderstorm is usually brighter than just the cloudy part. The cloud droplets have combined into large raindrops, which allow more sunlight to pass through them. CLOUD CLASSIFICATION A) A scheme of distinguishing and grouping clouds according to their appearance, and, where possible, to their process of formation. The one in general use, based on a classification system introduced by Luke Howard in 1803, is that adopted by the World Meteorological Organization and published in the International Cloud Atlas (1956). This classification is based on the determination: 1) genera - the main characteristic forms of clouds 2) species - the peculiarities in shape and differences in internal structure of clouds 3) varieties - special characteristics of arrangement and transparency of clouds 4) supplementary features and accessory clouds - appended and associated minor cloud forms and 5) mother-clouds - the origin of clouds if formed from other clouds. ¬ The ten cloud genera are cirrus, cirrocumulus, cirrostratus, altocumulus, altostratus, nimbostratus, stratocumulus, stratus, cumulus, and cumulonimbus. ¬ The fourteen cloud species are fibratus, uncinus, spissatus, castellanus, floccus, stratiform, nebulosus, lenticularis, fractus, humilis, mediocris, congestus, calvus, and capillatus. ¬ The nine cloud varieties are intortus, vertebratus, undulatus, radiatus, lacunosus, duplicatus, translucidus, perlucidus, and opacus. ¬ The nine supplementary features and accessory clouds are incus, mamma, virga, praecipitatio, arcus, tuba, pileus, velum, and pannus. (Note: Although these are Latin words, it is proper convention to use only the singular endings, e.g., more than one cirrus cloud is cirrus, not cirri.) B). A scheme of classifying clouds according to their usual altitudes. Three classes are distinguished: high, middle, and low. High clouds include cirrus, cirrocumulus, cirrostratus, occasionally altostratus, and the tops of cumulonimbus. The middle clouds are altocumulus, altostratus, nimbostratus and portions of cumulus and cumulonimbus. The low clouds are stratocumulus, stratus and most cumulus and cumulonimbus bases, and sometimes nimbostratus. C) A scheme of classifying clouds according to their particulate composition, namely, water clouds, ice-crystal clouds, and mixed clouds. The first are composed entirely of water droplets (ordinary and/or supercooled), the second entirely of ice crystals, and the third a combination of the first two. Of the cloud genera, only cirrostratus and cirrus are always ice-crystal clouds; cirrocumulus can also be mixed; and only cumulonimbus is always mixed. Altostratus is nearly always mixed, but can occasionally be water. All the rest of the genera are usually water clouds, occasionally mixed; altocumulus, cumulus, nimbostratus, and stratocumulus. WMO cloud classification The World Meteorological Organisation (WMO) classified the clouds according to their height and appearance into 10 categories. From the height, clouds are grouped into 4 categories (viz., family A, B, C and D) as stated below and there are sub- categories in each of these main categories. The 4 clouds families, which are in different heights of the troposphere are High level clouds (altitudes of 5-13 km) Medium level clouds (2-7 km) Low level clouds (0-2 km) and Clouds with large vertical extending (0-13 km) Family A The clouds in this category are high. The mean lower level is 7 kilometers and the mean upper level is 12 kilometers in tropics and sub-tropics. In this family there are three subcategories. 1. Cirrus (Ci) ϖ In these clouds ice crystals are present. Looks like wispy and feathery. Delicate, desist, white fibrous, and silky appearance. Sun rays pass through these clouds and sunshine without shadow. Does not produce precipitation.

2. Cirrocumulus (Cc) Like cirrus clouds ice crystals are present in these clouds also. Looks like rippled sand or waves of the sea shore. White globular masses, transparent with no shading effect. ϖ Meckerel sky.

3. Cirrostratus (Cs) Like the above two clouds ice crystals are present in these clouds also. ϖ Looks like whitish veil and covers the entire sky with milky white appearance. ϖ Produces “Halo”.

CIRRUS AND CIRROSTRATUS Cirrus clouds are higher level clouds that develop in filaments or patches. They are virtually brilliant white attributed to their ice crystal composition. However, they lack in contrast between the top and base. They occur in flat sheets with a low height to base ratio and are usually isolated with large breaks of sky. Cirrus also vary dramatically in 'shape' or patterns they portray but these represent the fluctuating wind flow at that level both in the horizontal and vertical direction. Cirrostratus represent clouds that are more widespread than cirrus but containing some similar features. Like cirrus, they are brilliant white and lack in contrast. Sunlight can pass through cirrostratus but this again depends on the varying thickness of the clouds. Both cirrus and cirrostratus clouds vary in thickness. The sun can easily be observed through both types of clouds although the intensity of light that is observed depends on the thickness of their layers. In their thickest form, cirrus and cirrostratus will allow a similar intensity of light to pass through to that of thin altostratus. They do not only develop in one complete layer. It may be difficult to observe because of the lack of contrast but these clouds can consist of several thin layers. Cirrus and cirrostratus tend to move in the direction of the wind at that level which differ to that at the surface. The most common direction of motion of these clouds are from a westerly direction. This varies with factors such as the latitude, weather conditions and time of the year. Their apparent velocities are relatively slow as compared to lower clouds. Both cirrus and cirrostratus can occur in conjunction with any of the other cloud types. Obviously, all the lower and middle level clouds will obscure the view of the higher level clouds, appear to move faster and appear less defined. They can only be observed above other clouds when breaks in the clouds occur. Any type of higher level clouds can develop simultaneously. Cirrus clouds tend to develop on days with fine weather and lighter winds at the surface. cirrostratus can develop on days with light winds but normally increasing in strength. Although both cirrus and cirrostratus tend to develop in fine weather conditions, they also acts as a sign of approaching changes in the weather conditions. Such changes could include any of the various types of cold front situations, thunderstorms or developing and advancing troughs of low pressure, normally with preceding cloud masses. Except in the latter case, cirrus and cirrostratus will typically precede any other types of clouds as part of a cloud band. In fact cirrus normally precedes cirrostratus. Nevertheless, the higher level clouds will persist until the actual change in the weather occurs. The higher clouds can develop from a few hours up to a few days before an actual change in the weather conditions occurs. They may develop during one afternoon and dissipate but redevelop the next day and so on until the actual change occurs. If the amount of moisture in the lower layers of the atmosphere increases, other lower clouds may also develop changing the appearance of the cirrus or the cirrostratus clouds as well as partially or totally hiding them from view. The same situation occurs in the case where cirrus develop ahead of thunderstorms. Cirrus normally precede cirrostratus which are then followed by the anvil of the approaching thunderstorm. In fact, cirrus and cirrostratus in this case are the remnants downwind of the weakening anvil. Both cirrus and cirrostratus can develop and persist after a change has passed through a certain location. In this situation, cloud will decrease within a few hours up to a few days following the change. If it persists for longer periods, a jet stream cloud mass may be involved. Another situation where cirrus and cirrostratus can be observed is when lower cloud breaks or clears during days with showers or rain. This case is far less common but can indicate a few situations. The higher clouds may be the remnants of the cloud mass that produced the actual wet weather. They can also be developing ahead of other cloud masses associated with another system, leading to the situation already discussed above. It all depends on the weather situation at that time but the observation of the movement of the higher level clouds can be critical in determining what weather may follow. Cirrus generally does not produce precipitation except when it results from dissipating thunderstorms. Precipitation from such cirrus usually consists of larger droplets and the cloud normally dissipates and vanishes completely. cirrostratus does not produce precipitation. Cirrus and cirrostratus can develop and persist at any time of the day despite the perception that it tends to occur during the day. This perception arises because it is much easier to observe cirrus during the day as compared to night time. The background darkness and the fact that the stars can easily be observed through cirrus and cirrostratus as thin layers allows them to camouflage from the view of the observer.

Answer the questions:

1. What is called “a cloud”?
2. Where can clouds occur?

3. How can a cloud be defined?
4. What form all the clouds?
5. When does air rise?
6. What cloud classification was adopted by the WMO?
7. On what determination is cloud classification based?
8. What are the ten cloud genera?
9. What are the fourteen cloud species?
10. What are the nine cloud varieties?
11. What are the nine supplementary cloud features?
12. What is the scheme of cloud classification according to their usual altitudes?
13. What is the scheme of cloud classification as to their composition?
14. What are the clouds in family A?
15. Is there any difference between cirrus and cirrostratus?
16. When can cirrus and cirrostratus occur?
17. Where do these clouds tend to move?
18. In what situation can these clouds be observed?
19. When does cirrus produce precipitation?

Text B CIRROCUMULUS

Cirrocumulus is a higher level cloud that is brilliant white but with a spotty appearance created by the many small turrets. The turrets indicate vertical turbulence within the cloud. Despite this spotty appearance, cirrocumulus contains many features associated with cirrostratus discussed above. It moves in directions similar to that of the other higher clouds. This cloud can develop in conjunction with any other clouds as well as with cirrostratus clouds. In Sydney, cirrocumulus is not as common as the other high clouds and mainly develops during the winter times with west to south westerly air streams. The development of cirrocumulus sometimes occurs in conditions similar to those associated with the development lenticular altocumulus. cirrocumulus clouds do not produce precipitation and are normally associated with fine weather. Family B The clouds in this category are middle clouds. Middle level clouds are those clouds that develop in the middle layers of the atmosphere. These clouds are brighter and less fragmented in appearance due to their distance from the ground and the higher composition of ice crystals. Middle level clouds vary in thickness from relatively flat sheets of cloud to a more cumuliform appearance. In fact, the sun (and moon) can be observed through some thin middle level clouds. The mean lower level is 2.5 kilometers and the mean upper level is 7 kilometers in tropics and sub-tropics. Middle level clouds tend to have apparent speeds slower than the lower level clouds. They move in the direction of the wind at that level which does not necessarily be the same of that at the surface. In this family there are 2 sub-categories as details below: 1. Altocumulus (Ac) ϖ In these clouds ice water is present. ϖ Greyish or bluish globular masses. ϖ Looks like sheep back and also known as flock clouds or wool packed clouds.

2. Alto-stratus (As) ϖ In these clouds water and ice are present separately. ϖ Looks like fibrous veil or sheet and grey or bluish in colour. ϖ Produces coronos and cast shadow. ϖ Rain occurs in middle and high latitudes.

Altocumulus Altocumulus refers to the middle level cloud that exhibit to some extent the features normally associated with cumulus. This includes cumuliform tops and bases that are usually relatively darker than the tops. This cloud type can be widespread or patchy depending on the conditions. It can vary in appearance from broken to smooth, and vary in thickness. Altocumulus can vary in its apparent movement (speed) depending on the wind and direction at that level. However, since altocumulus (like most other cloud types) represents an ever changing system, an observer must be careful in determining cloud motion. On some days, altocumulus continuously develop as it moves in the direction of the wind. Upstream, more altocumulus may develop giving the impression that the cloud is progressing slower than its actual speed. This process can occasionally create an illusion in terms of direction. Considering an example of altocumulus observed moving to the south east, because of development on the north and north-eastern side of the cloud band, the apparent direction may be more to the east. Altocumulus can develop in more than one layer and also in conjunction with other cloud types. The lower layer will obscure part or all of the higher altocumulus cloud layer. This situation also applies to higher level clouds. Higher level clouds will be obscured by the altocumulus. Lower level clouds, however, will obscure part or all of the altocumulus cloud layer. ALTOSTRATUS Altostratus refers to middle level cloud that appears as a flat, smooth dark grey sheet. These clouds are most often observed as large sheets rather than isolated areas. However, in the process of development, altostratus may develop in smaller filaments and rapidly develop to larger sheets. These types of clouds in certain conditions normally indicate an approaching cloud mass associated with a cold front, a trough system or a jet stream. Altostratus can develop into a thick or thin layer. As a thin layer, the sun can be observed through the cloud. In its thinner form, the developing altostratus can sometimes be confused with approaching cirrostratus. In its thicker form, the sun can only occasionally be observed through the thinner sections if not at all. Obviously, the thicker the altostratus, the darker it becomes. When observed closely, it becomes apparent that altostratus is not just one complete layer but a composition of several thin layers. Altostratus can produce precipitation. It will normally develop and then thicken. The precipitation is observed as relatively thick dark sections since precipitation cascades are very difficult to observe with the same colour in the background. In this situation, rain will develop as a light shower and gradually increase to showers, light rain or moderate rain. Family C The clouds in this category are lower clouds. The height of these clouds extends from ground to upper level of 2.5 kilometers in tropics and sub-tropics. Lower level clouds consist of those clouds in the lower layers of the atmosphere. Because of the relatively low temperatures at this level of the atmosphere, lower level clouds usually reflect lower amounts of light and therefore usually exhibit low contrast. The clouds at this level also appear not as well defined.

When observed closely, it is easy to observe the turbulent motions and hence the everchanging structure. Being closer to the ground, lower level clouds appear to move or progress faster than other clouds. The clouds generally move in the direction of the wind very similar to the direction of the wind on the ground. The most efficient method used to recognise lower clouds is when observed in conjunction with other clouds. The lower clouds will obscure part or all the view of the upper level clouds if they pass in between the observer's line of sight.

1. Strato cumulus (Sc) These clouds are composed of water. Looks soft and grey, large globular masses and darker than altocumuls. Long parallel rolls pushed together or broken masses. The air is smooth above these clouds but strong updrafts occur below.

2. Stratus (St) These clouds are also composed of water. Looks like for as these clouds resemble grayish white sheet covering the entire portion of the sky (cloud near the ground). Mainly seen in winter season and occasional drizzle occurs.

3. Nimbostratus (Ns) These clouds are composed of water or ice crystals. Looks thick dark, grey and uniform layer which reduces the day light effectively. Gives steady precipitation. Sometimes looks like irregular, broken and shapeless sheet like.

Stratocumulus Stratocumulus are low clouds that generally move faster than cumulus and are not as well defined in appearance (recall the techniques of observing clouds). They tend to spread more horizontally rather than vertically. Depending on the weather conditions, stratocumulus can appear like cumulus since stratocumulus can develop from cumulus. They may also appear as large flat areas of low, grey cloud. Sometimes stratocumulus appear in the form of rolling patches of cloud aligned parallel to each other. Stratocumulus can also appear in the form of broken clouds or globules. The sun, moon and generally the sky can be observed through the breaks in broken stratocumulus clouds. Of course, this depends on how large the breaks are, how high the clouds rise and the angle of elevation of the breaks with respect to the observer. This generally applies to all clouds but is more notable with clouds in broken form. Stratocumulus mostly develop in wind streams moving in the direction of the wind similar to the direction of the wind at the surface. The friction created by the earth causes turbulence in the form of eddies. With sufficient moisture, condensation will occur in the lower layers of the atmosphere visible as clouds. The amount of stratocumulus covering the sky depends on the amount of moisture concentrated at that level of the atmosphere. The speed that the cloud moves varies according to the wind Stratus Stratus is defined as low cloud that appears fragmented and thin. It can also occur in the form of a layer or sheet. The sun, moon and generally the sky can usually be observed through stratus clouds, especially at a steep angle of elevation. Stratus lacks the vertical growth of cumulus and stratocumulus, and therefore lacks the contrast. This is more evident when observed as one layer as compared to patchy stratus. Being closest to the ground, stratus clouds normally move fairly rapidly in the direction of the wind depending of course on the wind speed. Like stratocumulus, stratus develops under several conditions or weather situations. Stratus mostly develop under the influence of wind streams where moisture condenses in the lower layers of the atmosphere. Wind changes during the summer months often lead to the development of stratus as the wind evaporates moisture from the ocean and condensing as turbulence mixes the surface air with the cooler air above. In these conditions, stratus develop in patches and gradually may become widespread forming into stratocumulus.

Family D These clouds form due to vertical development i.e., due to convection. The mean low level is 0.5 and means upper level goes up to 16 kilometers. In this family two sub-categories are present. 1. Cumulus (Cu) These clouds are composed of water with white majestic appearance with flat base. Irregular dome shaped and looks like cauliflower with wool pack and dark appearance below due to shadow. ϖ These clouds usually develop into cumuolo-nimbus clouds with flat base.

2. Cumulonimbus (Cb) The upper levels of these clouds possess ice and water is present at the lower levels. These clouds have thunder head with towering envil top and develop vertically. These clouds produce violent winds, thunder storms, hails and lightening, during summer.

Cumulus are cauliflower-shaped low level clouds with dark bases and bright tops. When observing cumulus, you are actually observing the condensation process of rising thermals or air bubbles at a certain level in the atmosphere known as the condensation level. The air rising above this level condenses and cloud is observed. Since the height of this level is fairly constant at any particular time, then the bases of cumulus are usually flat.

I. Discuss this text in your group

II. Summarize all information about the clouds

<u>LEXICAL EXERCISES</u>

I. Translate the following sentences, paying attention to the degrees of comparison of the adjectives:

1. It is of interest to note that the colder of the two adjacent air masses will normally be less stable than the warmer mass.
2. The least stable mass will usually be more turbulent than the more stable one.
3. The temperature of the free atmosphere is the more conservative the smaller the wind velocity.
4. The temperature of any level is the more conservative the closer the air temperature is to the temperature of the underlying surface.
5. Differences up to 2T. may exist without destroying the strength of the rising air, owing to the greater humidity and therefore lesser density within the cloud.

6. At lower temperature the frequency of ice accretion falls off rapidly and practically ceases al 0°F.
7. 4. Clouds formed in the cold air of the upper atmosphere are less dense than the clouds formed in the warmer air of the lower strata.
8. We should therefore expect that ice accretion would be less the lower the temperature.
9. The tornado is in fact the most violent and destructive of all meteorological phenomena.
10. This effect is more pronounced with blue light for which the wave-length is shorter than with red light for which the wavelength is longer.
11. The lighter areas indicate parts of the atmosphere illuminated by sunshine, the darker areas indicate those from which the sunshine is cut off by intervening mountains or by clouds.

II. Define by what part of speech each attribute is expressed and translate the following sentences:

1. Since the tornado never exists for more than a few hours at the most the area affected is a small and narrow belt.
2. When the inversion is high, the layer to be heated is deep, and the diurnal amplitude decreases accordingly.
3. Rainbows are circular arcs of coloured light centred at the anti-solar point of the celestial sphere.
4. The principles of modern methods of air mass analysis are based on the fact that the tropospherical circulation has a tendency to produce vast bodies of air whose physical properties vary but slightly within each body.
5. A beam of white light passing through air loses the constituents of shorter wave-length and becomes yellow, then orange and finally red.
6. The data to be included into the following tables show no significant differences between the value of the 700- and 500-mb. levels in hurricane forecasting.
7. The following are the regions in which tropical cyclones- occur and the names by which they are known.
8. It will be seen from the above that the only ocean bordering on the equator in which tropical storms never occur is the South Atlantic.
9. This table shows the number of occurrences of tropical cyclones reported over various periods for different parts of the world.
10. The data to be presented by the forecaster show that, over periods of time as long as a month, the amount of moisture in the air can vary over wide limits.

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

I. Translate the texts:

Text A FORMATION AND DISSIPATION OF FOG

The name fog is given to any cloud that envelops the observer and reduces the horizontal range of visibility to 1000 metres or less. If, under similar conditions, the horizontal range of visibility exceeds 1000 metres, the phenomenon is called mist. This definition of fog is adequate at sea and over level ground, but it is inconsistent in hilly country, where the clouds may touch the hillsides without touching the lowland. In such cases, an observer in the lowland would report stratus while an observer at an. elevated station would report fog. It is necessary to bear this distinction in mind both when analysing weather charts and when predicting fogs.

Here, we must discuss the formation of such fogs that may form in contact with the sea surface or level ground. Non-saturated air may become saturated in three different ways, viz.: (a) by evaporation of water into the air; (b) by mixing between horizontally or vertically adjacent air masses; and (c) by cooling.

When fogs form, it is necessary that these processes should take place at the surface of the earth. In most cases of fog formation, the three processes operate together. We shall, however, first discuss each of them separately, and afterwards analyse their various combinations.

The evaporation of water, either from the underlying surface or from rain falling through the air, is proportional to the saturation vapour pressure corresponding to the temperature of the liquid water, and to the actual water vapour pressure of the air. As the actual water vapour pressure of the air increases and approaches the saturation vapour pressure, the evaporation decreases and approaches zero. In the case when the air temperature is higher than that of the liquid water, balance is reached when the saturation vapour pressure corresponding to the temperature of the liquid water is equal to the actual water vapour pressure of the air and is less than the saturation water vapour pressure, and the evaporation from the liquid water ceases before the air becomes saturated, because the saturation water vapour pressure of the air is higher than the saturation pressure corresponding to the temperature of the liquid water. If evaporation takes place from a terrestrial source of water, the heat of vaporization is supplied mostly by the water, and the air temperature remains unchanged. It follows then that such evaporation will not cause condensation in the air. If evaporation occurs from falling rain, the heat of vaporization is supplied mostly by the air, which is then cooled. Through continued evaporation, the air temperature will approach the wet-bulb temperature, which remains constant during the process. The air is then saturated with water vapour and no further evaporation is possible from the falling rain. As a fog consists not only of saturated air, but of air that contains a considerable amount of condensed water, it is evident that, when the temperature of the air is higher than that of the liquid water, a fog cannot form because of evaporation only.

The conditions described above apply when the air is warmer than the underlying surface, and also when rain from colder air aloft falls through the warmer air below. The latter case is the normal occurrence in the atmosphere. Thus, when the air temperature decreases along the vertical, the falling rain-drops will be colder than the air through which they fall; the air will then remain non-saturated until it has been cooled to its wet-bulb temperature, after which no further evaporation will occur.

In the case when the temperature of the air equals that of the liquid water the balance is reached when the air has become saturated. As above, it is evident that evaporation alone will not cause condensation to occur in the rain.

In the case when the temperature of the air is lower than that of the liquid water, the water will evaporate into the air until the saturation vapour pressure corresponding to the temperature of the liquid water is equal to the actual water vapour pressure of the air and this is more that the saturation water vapour pressure of the air. If no condensation nuclei are present in the air, supersaturation will occur; but if such nuclei are present in sufficient amounts, the superfluous water will be condensed. In such cases, a fog, or a cloud, may result through condensation only. When the air temperature increases along the vertical, (e. g. in inversion layers or along pronounced frontal surfaces), the falling rain-drops may be slightly warmer than the air through which they fall. If the air is not saturated, its wet-bulb temperature will be lower than the air temperature, and thus considerably lower than the temperature of the falling rain-drops. Through evaporation of.the falling rain, the air is cooled to its wet-bulb temperature, condensation will then occur, and if the wet-bulb temperature of the air is sufficiently below the temperature of the falling rain-drops, condensation will occur on the condensation nuclei, and the droplets thus formed may grow in number and size to such an extent that the horizontal range of visibility is reduced 1000 metres or less. The cloud-layer, from which the rain falls, then builds downwards and may eventually touch the earth's surface, and hence a fog results. Such fogs may form under pronounced frontal surfaces when the temperature of the air above the frontal surface is much higher than the temperature of the air below it (frontal fogs). The same applies when rain from a cloud system aloft falls through a layer of cold air under a ground inversion.

It should be borne in mind that fogs formed by evaporation of rain from warm air aloft falling into cold air below can only occur when the temperature difference is sufficiently large, and when none of the fog-dissolving processes overcompensate the effect of evaporation. Fogs are sometimes observed when cold air streams over a water surface the temperature of which is very much higher/ than the air temperature. These fogs are known as Steam Fogs, or Arctic Sea Smoke. The cause of formation of such fogs is the intense evaporation from the water surface. For example, a water surface of 10°C. would have a saturation vapour pressure of 12.3 mb. If the air above the water had a temperature of 5°C. and a relative humidity of 100 per cent, the vapour pressure of the air would be 8.7 mb., and the difference in water vapour pressure between the surface and the air would be 3.6 mb. Water would evaporate quickly and fill the air with vapour, steam would pour forth from the surface, and the air be filled with a steam fog.,

It is important to bear in mind that extreme temperaturemf- ferences are required to produce a steam fog. This condition is due to the circumstance that the cold air above a warm surface will be heated from below to such an extent that the air becomes unstable. Through instability, vertical mixing sets in and prevents the steam from accumulating in the air. In general, light winds and a strong pre-existing inversion near the sea surface are necessary for the steam to accumulate in the surface layer. In extreme cases, steam fogs are known to occur in strong winds. Thus, during a cold spell in February of 1934, steam fogs occurred at the harbour of East Boston; the air temperature was then about —28°C, probably 30°C. lower than the sea surface temperature. Steam fogs are most frequently observed along the Arctic coasts and in the fjords of cold continents (e. g. Norway, where they are called "frostrok"[1] (frost—smoke); they may also occur in the autumn in cold continental air masses over lakes and rivers.

Turbulence is a factor of basic importance, inasmuch as the vertical mixing which results from turbulence is highly effective in counteracting the fog producing agencies. The intensity of turbulence depends mainly on two factors: the stability of the air and the velocity of the wind. The intensity of turbulence increases with the speed of the wind; and when the wind increases beyond a certain value (which depends on the stability of the air) the fog may be dissipated or develop into a layer of stratus. It will be noted that the maximum frequency is found neither at the extremely high values -of the difference in temperature between air and sea, nor at the lowest wind velocities, but somewhere between. This condition is due to the following circumstances: great temperature difference occurs only when the air moves rapidly across the isotherms of the surface; but in such cases fogs are rare on account of intense mixing. On the other hand, when the wind velocity is slight, the difference in temperature is also slight; the air is then less stable, and even slight turbulence suffices to dissipate the fog Thus, sea fogs (which are advection fogs) are most likely to form when the wind speed is moderate and when it is blowing more or less directly across the isotherms of the water surface. Fogs may sometimes persist in air that is slightly colder than the sea surface. This only happens in almost still air. Such fogs must have formed while the air was blowing from warm towards colder sea. Over land it is difficult to distinguish between advection fog and radiation fog. The land fogs are mostly radiation fogs, which cannot form unless the wind is slight, while the sea fogs are advection fogs, which require a certain wind velocity to bring the air across the isotherms of the underlying surface. Whether the fog is produced by radiation, advection,' or any of the adiabatic processes, the forecaster will have to estimate the amount of cooling that is likely to occur within the forecasting period. Whether the expected cooling suffices to produce a fog or not, depends on the humidity of the air. It should be borne in mind that fog is not merely saturated air, but air which contains an amount of liquid water sufficient to reduce the horizontal range of visibility to 1000 metres or less.

The visibility is primarily a function of the amount of liquid water, but it also depends on the size of the droplets and the pollution. As it is known that the amount of liquid water in fogs and clouds may vary between 0.1 and 5.0 grammes per cubic metre, it seems probable that a moderate fog would not contain less than 0.5 grammes of liquid water per cubic metre. Whether this value is exact or not is a matter of minor importance. What we wish to emphasize here is that after the air has become saturated, a certain amount of cooling is necessary in order to produce so much condensed water that the horizontal visibility is reduced to 1000 metres or less. While the air is being cooled, it will be misty, but a real fog would not develop until the amount of liquid water has reached a certain value. It is of interest to note that the mist interval is very small when the air temperature is high, and it increases as the temperature decreases. When the temperature approaches —28°C., the mist interval widens rapidly, because almost the total amount of aqueous vapour in the air must then be condensed in order to produce a sufficient amount of liquid water. Thus, at —25°C., saturated air must be cooled by about 9°C. for 0.5 gr. of water to be condensed, whereas at +20°C., a cooling of 0.4°C. produces the same effect. It follows that at low temperatures, the amount of cooling necessary to produce a fog becomes greater than the diurnal amplitude of temperature, and no fog will form solely as a result of nocturnal cooling. The drying influence of the snow has a tendency to counteract the formation of fog over snow-covered ground, and to dissipate fog that is transported to such areas.

For prediction of radiation fogs it is of basic importance to estimate the amount of cooling which is likely to occur. As radiation fogs do not form when the wind velocity is high, or when the sky is cloudy, it suffices to consider the conditions when the cloudiness is small and when the wind velocity is slight or moderate.

It is well known that the diurnal amplitude of temperature for any given locality is greater on warm days (in the warm season) than on cold days (in the cold season). The normal fall in temperature on almost calm and clear nights must be determined statistically for representative stations.

II. Answer the questions

1. Is the name “fog” given to any cloud?
2. How may non-saturated air become saturated?
3. How does the process of water saturation take place?
4. What happens when the air temperature is higher than that of the liquid water?
5. When does the air temperature remain unchanged?
6. The fog cannot form because of evaporation only, can it?
7. What happens when the air temperature is lower than that of the liquid water?
8. When will super saturation occur?
9. What should be borne in mind?
10. What is important to keep in mind?
11. What does the intensity of turbulence depend on?
12. When do great and light differences of temperature occur?
13. Is it difficult to distinguish between advection and radiation fog?
14. What is the difference between the land and the sea fogs?
15. What is the amount of liquid water in fogs?
16. In what temperature is the mist interval smaller?

17. What can you say about the radiation fogs?

Text B **FOG TYPES**

Fog is often described as a stratus cloud resting near the ground. Fog forms when the temperature and dew point of the air approach the same value (i.e., dew-point spread is less than 5 °F) either through cooling of the air (producing advection, radiation, or upslope fog) or by adding enough moisture to raise the dew point (producing steam or frontal fog). When composed of ice crystals, it is called ice fog.

Advection fog. Advection fog forms due to moist air moving over a colder surface, and the resulting cooling of the near-surface air to below its dew-point temperature. Advection fog occurs over both water (e.g., steam fog) and land.

Radiation fog (ground or valley fog).

Radiational cooling produces this type of fog. Under stable nighttime conditions, long-wave radiation is emitted by the ground; this cools the ground, which causes a temperature inversion. In turn, moist air near the ground cools to its dew point. Depending upon ground moisture content, moisture may evaporate into the air, raising the dew point of this stable layer, accelerating radiation fog formation.

Upslope fog (Cheyenne fog). This type occurs when sloping terrain lifts air, cooling it adiabatically to its dew point and saturation. Upslope fog may be viewed as either a stratus cloud or fog, depending on the point of reference of the observer. Upslope fog generally forms at the higher elevations and builds downward into valleys. This fog can maintain itself at higher wind speeds because of increased lift and adiabatic cooling. Upslope winds more than 10 to 12 knots usually result in stratus rather than fog. The east slope of the Rocky Mountains is a prime location for this type of fog.

Steam fog (arctic sea smoke). In northern latitudes, steam fog forms when water vapor is added to air that is much colder, then condenses into fog. It is commonly seen as wisps of vapor emanating from the surface of water. This fog is most common in middle latitudes near lakes and rivers during autumn and early winter, when waters are still warm and colder air masses prevail. A strong inversion confines the upward mixing to a relatively shallow layer within which the fog collects and assumes a uniform density. Under these conditions, the visibility is often 3/16 mile (300 meters) or less.

Frontal fog. Associated with frontal zones and frontal passages, this type of fog can be divided into three types: warm-front pre-frontal fog; cold front post-frontal fog; and frontal-passage fog. Pre and post-frontal fog are caused by rain falling into cold stable air thus raising the dew point. Frontal passage fog can occur in a number of situations: when warm and cold air masses, each near saturation, are mixed by very light winds in the frontal zone; when relatively warm air is suddenly cooled over moist ground with the passage of a well marked precipitation cold front; and in low-latitude summer, where evaporation of frontal-passage rain water cools the surface and overlying air and adds sufficient moisture to form fog.

Ice fog. Ice fog is composed of ice crystals instead of water droplets and forms in extremely cold, arctic air (~29°C (-20°F) and colder). Ice fog of significant density is found near human habitation, in extremely cold air. and where burning of hydrocarbon fuels adds large quantities of water vapor to the air. Steam vents, motor vehicle exhausts, and jet exhausts are major sources of water vapor that produce ice fog. A strong low level inversion contributes to ice fog formation by trapping and concentrating the moisture in a shallow layer.

In summary, the following characteristics are important to consider when forecasting fog:

Synoptic situation, time of year, and station climatology.

Thermal (static) stability of the air, amount of air cooling and moistening expected, wind strength, and dew-point depression.

Trajectory of the air over types of underlying surfaces (i.e., cooler surfaces or bodies of water).

Terrain, topography, and land surface characteristics.

Fog Characteristics

A general summary of characteristics important to fog formation and dissipation are given here. This is followed by general fog forecasting guidance and guidance specific to advection, radiation, and frontal fogs.

Formation. Fog forms by increasing moisture and/or cooling the air. Moisture is increased by the following:

Precipitation.

Evaporation from wet surfaces.

Moisture advection.

Cooling of the air results from the following:

Radiational cooling.

Advection over a cold surface.

Upslope flow.

Evaporation.

Dissipation. Removing moisture and/or heating the air dissipates fog and stratus. Moisture is decreased by the following:

Turbulent transfer of moisture downward to the surface (e.g., to form dew or frost).

Turbulent mixing of the fog layer with adjacent drier air.

Advection of drier air.

Condensation of the water vapor to clouds.

Heating of the air results from the following:

Turbulent transport of heat upward from air in contact with warm ground.

Advection of warmer air.

Transport of the air over a warmer land surface.

Adiabatic warming of the air through subsidence or downslope motion.

Turbulent mixing of the fog layer with adjacent warmer air aloft.

Release of latent heat associated with the formation of clouds.

General Forecasting Guidance. In general:

Fog may thin after sunrise when the lapse rate becomes moist adiabatic in the first few hundred feet above ground.

Fog lifts to stratus when the lapse rate approaches dry adiabatic.

Marked downslope flow prevents fog formation.

The moister the ground, the higher the probability of fog formation.

Atmospheric moisture tends to sublimate on snow, making fog formation less likely.

Rapid formation or clearing of clouds can be decisive in fog formation. Rapid clearing at night after precipitation is especially favorable for the formation of radiation fog.

The wind speed forecast is important because speed decreases may lead to the formation of radiation fog. Conversely, increases can prevent fog. dissipate radiation fog, or increase the severity of advection fog.

A combination advection-radiation fog is common at stations near warm water surfaces.

In areas with high concentrations of atmospheric pollutants, condensation into fog can begin before the relative humidity reaches 100 percent.

The visibility in fog depends on the amount of water vapor available to form droplets and on the size of the droplets formed. At locations with large amounts of combustion products in the air, dense fog can occur with a relatively small water vapor content.

After sunrise, the faster the ground temperature rises, the faster fog and stratus clouds dissipate.

Solar insolation often lifts radiation fog into thin multiple layers of stratus clouds.

If solar heating persists and higher clouds do not block surface heating, radiation fog usually dissipates.

Solar heating may lift advection fog into a single layer of stratus clouds and eventually dissipate the fog if the insolation is sufficiently strong.

(4) Specific Forecasting Guidance. Consider the following when faced with advection, radiation, or frontal fog situations.

Advection Fog Advection fog is relatively shallow and accompanied by a surface based inversion. The depth of this fog increases with increasing wind speed. Other favorable conditions include:

Light winds, 3 to 9 knots. Greater turbulent mixing associated with wind speeds more than

9 knots usually cause advection fog to lift into a low stratus cloud deck.

Coastal areas where moist air is advected over water cooled by upwelling. During late afternoon, such fog banks may be advected inland by sea breezes or changing synoptic flow. These fogs usually dissipate over warmer land; if they persist through late afternoon, they can advect well inland after evening cooling and last until convection develops the following morning.

In winter when warm, moist air flows over colder land. This is commonly seen over the southern or central United States and the coastal areas of Korea and Europe. Because the ground often cools by radiation cooling, fog in these areas is called advection-radiation fog, a combination of radiation and advection fogs.

Warm, moist air that is cooled to saturation as it moves over cold water forms ***sea fog'.***

• If the initial dew point is less than the coldest water temperature, sea fog formation is unlikely. In poleward-moving air, or in air that has previously traversed a warm ocean current, the dew point is usually higher than the cold water temperature.

• Sea fog dissipates if a change in wind direction carries the fog over a warmer surface.

• An increase in the wind speed can temporarily raise a surface fog into a stratus deck. Over very cold water, dense sea fog may persist even with high winds.

• The movement of sea fog onshore to warmer land leads to rapid dissipation. With heating from below, the fog lifts, forming a stratus deck. With further heating, this stratus layer changes into a stratocumulus cloud layer and eventually into convective clouds or dissipates entirely.

Radiation Fog. Radiation fog occurs in air with a high dew point. This condition ensures radiation cooling lowers the air temperature to the dew point. The first step in making a good radiation fog forecast is to accurately predict the nighttime minimum temperature. Additional factors include the following:

Air near the ground becomes saturated. When the ground surface is dry in the early evening, the dew-point temperature of the air may drop slightly during the night due to condensation of some water vapor as dew or frost.

In calm conditions, this type of fog is limited to a shallow layer near the ground; wind speeds of 2-7 knots bring more moist air in contact with the cool surface and cause the fog layer to thicken. A stronger breeze prevents formation of radiation fog due to mixing with drier air aloft.

Constant or increasing dew points with height in the lowest 200 to 300 feet, so that slight mixing increases the humidity.

III. Answer the questions

1. When does the fog form?
2. What are the radiation and upslope fogs?
3. How do the advection and steam fogs form?
4. How can the frontal fog be divided into?
5. What are the reasons of fog formation?
6. What is dissipation?
7. What can you say about general forecasting guidance?
8. What is the advection fog?
9. When does the radiation fog occur?
10. How does the frontal fog form?

LEXICAL EXERCISES

I. Translate the following sentences, paying attention to the use and meanings of the verbs "to have" and "to be:"

1. Although the position of this front may be sketched on the maps, its character and exact position will have to be determined in greater detail as the analysis proceeds.
2. This procedure has been justified in an investigation con-firming that the isobars give a close approximation to the wind at 2000 feet, by comparison of observed and computed winds.
3. It has long been recognized that the land and sea breezes in a coastal area such as exist in Southern California tend to oppose each other.
4. The pronounced bend in the coastline and the presence of the bay almost certainly have some effect on The sea breeze.
5. Such a column of air has no real existence.
6. The very high winter mean sea level pressures over Siberia and relatively low pressures occurring on hot days over the elevated regions of Spain and Africa are to be attributed in part at least to the method of reduction to mean sea level.

II. Translate the following sentences, paying attention to the use and meanings of the word "one:"

1. One can see that lapse-rates are greater than dry adiabatic during the hottest part of the day.
2. One of the first duties of the forecaster as soon as the observations are plotted on the charts is to examine the condi-tions to estimate the probability of strong winds which may be dangerous to shipping.
3. One sometimes encounters also a damp layer of great verti-cat extent, containing a complicated series of thin cloud layers. often of limited area, one above the other.
4. Hydrology and meteorology have many points in contact, some of the more important ones having been discussed.
5. One should expect that these data should fit the curve for continental air masses.
6. One of 'the four sensors in the electronic weather reporting system was tested in late March.

TESTS FOR SELF-CONTROL

Complex Object / (Causative Verbs) / Make / Let

Test 1 Tick off the variant that is impossible in English.

1. A) I saw her entering the room.
   B) I saw her enter the room.
   C) I saw her to enter the room.

2. A) Many people found him be innocent.
   B) Many people found him innocent.
   C) Many people found him to be innocent.

3. A) When came nearer I heard somebody playing the piano.
   B) When came nearer I heard somebody play the piano.
   C) When came nearer I heard somebody to play the piano.

4. A) Do you want to make me some tea?
   B) Do you want me make you some tea?
   C) Do you want some tea made for you?
   D) Do you want me to make you some tea?

5. A) They watched him getting off the bus and crossing the road.
   B) They watched him get off the bus and cross the road.
   C) They watched him to get off the bus and cross the road.

6. A) I don't consider him be an honest man.
   B) I don't consider him an honest man.
   C) I don't consider him to be an honest man.

7. A) He expected us to come on Sunday.
   B) He expected us come on Sunday.
   C) He expected that we would come on Sunday.

8. A) Would you like them change their mind?
   B) Would you like them to change their mind?
   C) Would you like to change their mind?

9. A) They expect themselves to be invited.
   B) They expect to be invited.
   C) They expect that they will be invited.
   D) They expect they will be invited.

10. A) Do you feel her watching you?
    B) Do you feel her watch you?
    C) Do you feel her to watch you?

11. A) They considered themselves to be right.

B) They considered to be right.
C) They considered that they were right.

12. A) He ordered that the execution should be postponed.
B) He ordered the execution to be postponed.
C) He ordered the execution be postponed.

Test 2 Right / wrong – complex object / let / have. Find the mistake and correct it.

A) right B) wrong

1. The manager asked for the letter to send off at once.
2. I find her a very smart girl.
3. I rely on you do it in time.
4. Jack got his dog to bring him his slippers.
5. Jane was having her hair to cut when somebody called her.
6. We want you explain this rule to us once more.
7. Harry has had his sister type the report.
8. Can you help me pack my things?
9. Have you had your luggage registered yet?
10. It's impossible to make my parents to tidy up my room.
11. I want you to go to the library yourself and find what you need.
12. Could you make your son be quiet?
13. My parents never let me coming back home late.
14. My father likes dinner be in time.
15. Let us know when they will go on a hike.
16. The teacher helped the students correct all the mistakes.
17. He ordered the documents to be check carefully.
18. Seeing her enter the room everybody stood to greet her.
19. Have you ever seen a television throw through the window?
20. I heard his name mentioned several times.
21. The Greens always let their children to see the New Year in with them.

Test 3 Gerund / Infinitive (1). Write what each word or expression is followed by.

A) to + verb B) verb + -ing C) both are possible

1. want	2. would like	3. sorry
4. decide where	5. begin	6. get used to
7. continue	8. pleased	9. regret
10. suggest	11. love	12. start
13. used	14. mind	15. go on
16. enjoy	17. remember	18. suspect of
19. hate	20. would prefer	21. would love

Test 4 Gerund / Infinitive (2). Put the verb in brackets into correct form, gerund or infinitive.

A) to + verb B) verb + -ing

1. I'm thinking of (go) to Brazil.
2. You cannot live without (do) such stupid things.
3. He isn't good at (drive) his car.
4. Try to avoid (lose) your temper.
5. He seems (know) everything about it.
6. It's no use (cry) over spilt milk.
7. Would you mind (repeat) your threat?
8. You should practice (say), "Red little lorry, yellow little lorry."
9. It's useless (argue) with him. He won't listen to any reason.
10. They were advised (take) a packed lunch.
11. Do you think it's worth (see) this film?
12. If you want (lose) weight, try (eat) less.
13. It's forbidden (smoke) here.
14. I'm not keen on (work) late.
15. I'm not very fond of (shop).
16. He managed (calm) her by promising to return soon.
17. Mary is crazy about (take) photographs.
18. In Arabia the usual way of (travel) is by camel.
19. You needed (add) some more sugar to that.

Test 5 Gerund / Infinitive (3). Put the verb in brackets into correct form, gerund or infinitive.

1. Why don't you stop (watch) TV? I don't think it's harm¬less.
2. Please try (come) a little bit earlier next time.
3. I don't remember (see) Tom.
4. I've forgotten (buy) cheese. Let's go without it.
5. She regrets (tell) you that lie about John.
6. I don't think this work needs (correct).
7. They stopped (discuss) where to go now.
8. If you want to have a lot of money, try (rob) a bank.
9. The boys went on (look for) the money they'd lost.
10. I'll never forget (visit) Paris.
11. After describing the situation in general, he went on (talk) about details.
12. She regrets (say) she won Ч come to you.
13. Shall I help you (carry) that box?
14. Did you remember (say) good-bye to everybody?
15. He didn't need (be reminded) about his promise.

16. We can't help laughing (look) at them.

Test 6 Participle I / Participle II. Put the Participle in the form suitable for the noun.

A) Participle I (doing) B) Participle II (done)

1. (grow) interest 2. a (complicate) explanation
3. an (excite) child 4. a (terrify) experiment
5. (worry) problem 6. (well-pay) job
7. a (pass) bus 8. a (burn) barn
9. an (excite) story 10. a (steal) car
11. (fly) fish 12. (run) water
13. a (freeze) lake 14. (blind) light
15. a (break) heart 16. a (die) soldier
17. a (cheer) crowd 18. a (swim) lesson
19. a (destroy) church 20. (longplay) records
21. the (follow) chapter

Test 7 Participle I / Participle II. Choose the form of the Participle in each sentence.

A) Participle I B) Participle II

1. I must have the mixer (fixing, fixed).
2. I don't find this story (amusing, amused).
3. My room is a mess: I really must get it (tidying, tidied) up.
4. I would stay at home after such a (tiring, tired) day.
5. Uncle Frank has a gentle old horse (naming, named) Pete on his farm.
6. Can you smell something (burning, burned)?
7. He opened the letter with (shaking, shaken) fingers.
8. She had rather a (pleasing, pleased) look on her face.
9. Deeply (shocking, shocked) I left them.
10. When (answering, answered) your question yesterday I forgot this fact.
11. He walked along the road with his collar (turning, turned) up, hands in pockets.
12. I didn't enjoy the party because I was (boring, bored) there.
13. Why not throw away the (breaking, broken) umbrella we are not likely to repair it.
14. She didn't pay any attention to the (ringing, rung) tele¬phone.
15. Don't you think your hair needs (cutting, cut)?

LESSON 5

I. Translate the texts:

TEXT A

FRONTS and AIRMASSES

A high-pressure center, or high (H), often contains an airmass of well-defined characteristics, such as cold temperatures and low humidity. When different airmasses finally move and interact, their mutual border is called a front, named by analogy to the battle fronts of World War I. Fronts are usually associated with low-pressure centers, or lows (L). Two fronts per low are most common, although zero to four are also observed. In the Northern Hemisphere, these fronts often rotate counterclockwise around the low center like the spokes of a wheel, while the low moves and evolves. Fronts are often the foci of clouds, low pressure, and precipitation. Anticyclones are favored locations for airmass formation. Covered next are fronts in the bottom, middle, and top of the troposphere. Factors that cause fronts to form and strengthen are presented. This chapter ends with a special type of front called a dry line.

Characteristics & Formation

High-pressure centers, or highs, are identified on constant altitude (e.g., sea-level) weather maps as regions of relative maxima in pressure. The location of high-pressure center is labeled with "H". High centers can also be found on upper-air isobaric charts as relative maxima in geopotential height. When the pressure field has a relative maximum in only one direction, such as east-west, but has a horizontal pressure-gradient in the other direction, this is called a high-pressure ridge. The ridge axis is labeled with a zigzag line. The column of air above the high center contains more air molecules than neighboring columns. This causes more weight due to gravity, which is expressed in a fluid as more pressure. Above a high center is often downward motion (subsidence) in the mid-troposphere, and horizontal spreading of air (divergence) near the surface. Subsidence impedes cloud development, leading to generally clear skies and fair weather. Winds are also generally calm or light in highs, because gradient-wind dynamics of highs require weak pressure gradients near the high center. The diverging air near the surface spirals outward due to the weak pressure-gradient force. Coriolis force causes it to rotate clockwise (anticyclonically) around the high-pressure center in the Northern Hemisphere, and opposite in the Southern Hemisphere. For this reason, highpressure centers are called anticyclones. Downward advection of dry air from the upper troposphere creates dry conditions just above the boundary layer. Subsidence also advects warmer potential temperatures from higher in the troposphere. This strengthens the temperature inversion that caps the boundary layer, and acts to trap pollutants and reduce visibility near the ground.

Subsiding air cannot push through the capping inversion, and therefore does not inject free-atmosphere air directly into the boundary layer. Instead, the whole boundary layer becomes thinner as the top is pushed down by subsidence. This can be partly counteracted by entrainment of free atmosphere air if the boundary layer is turbulent, such as for a convective mixed layer during daytime over land. However, the entrainment rate is controlled by turbulence in the boundary layer, not by subsidence.

Five mechanisms support the formation of highs at the Earth's surface:

• Global Circulation: Planetary-scale, semi-permanent highs predominate at 30° and 90° latitudes, where the global circulation has downward motion. The subtropical highs centered near 30° North and South latitudes are 1000-km-wide belts that encircle the Earth. Polar highs cover the Arctic and Antarctic. These highs are driven by the global circulation that is responding to differential heating of the Earth. Although these highs exist year round, their locations shift slightly with season. • Monsoons: Quasi-stationary, continentalscale highs form over cool oceans in summer and cold continents in winter. They are seasonal (i.e., last for several months), and form due to the temperature contrast between land and ocean. • Transient Rossby waves: Surface highs form at mid-latitudes, east of high-pressure ridges in the jet stream, and are an important part of mid-latitude weather variability. They often exist for several days. • Thunderstorms. Downdrafts from thunderstorms create meso-highs roughly 10 to 20 km in diameter at the surface. These might exist for minutes to hours. • Topography/Surface-Characteristics: Mesohighs can also form in mountains due to blocking or channeling of the wind, mountain waves, and thermal effects (anabatic or katabatic winds) in the mountains. Sea-breezes or lake breezes can also create meso-highs in parts of their circulation. The actual pressure pattern at any location and time is a superposition of all these phenomena.

The location difference between surface and upper-tropospheric highs can be explained using gradient-wind and thickness concepts. Because of barotropic and baroclinic instability, the jet stream meanders north and south, creating troughs of low pressure and ridges of high pressure, as discussed in the General Circulation chapter. Gradient winds blow faster around ridges and slower around troughs, assuming identical pressure gradients. The region east of a ridge and west of a trough has fast-moving air entering from the west, but slower air leaving to the east. Thus, horizontal convergence of air at the top of the troposphere.

West of surface highs, the anticyclonic circulation advects warm air from the equator toward the poles. This heating west of the surface high causes the thickness between isobaric surfaces to increase, as explained by the hypsometric equation. Isobaric surfaces near the top of the troposphere are thus lifted to the west of the surface high. These high heights correspond to high pressure aloft; namely, the upper-level ridge is west of the surface high. The net result is that high-pressure regions tilt westward with increasing height. Deepening low-pressure regions also tilt westward with increasing height, at mid-latitudes. Thus, the mid-latitude tropospheric pressure pattern has a consistent phase shift toward the west as altitude increases.

An airmass is a widespread (of order 1000 km wide) body of air in the bottom third of the troposphere that has somewhat-uniform characteristics. These characteristics can include one or more of: temperature, humidity, visibility, odor, pollen concentration, dust concentration, pollutant concentration, radioactivity, cloud condensation nuclei (CCN) activity, cloudiness, static stability, and turbulence. Airmasses are usually classified by their temperature and humidity, as associated with their source regions. These are usually abbreviated with a twoletter code. The first letter, in lowercase, describes the humidity source. The second letter, in upper-case, describes the temperature source. Table 12-1 shows airmass codes. Examples are maritime Tropical (mT) airmasses, such as can form over the Gulf of Mexico, and continental Polar (cP) air, such as can form in winter over Canada. After the weather pattern changes and the airmass is blown away from its genesis region, it flows over surfaces with different relative temperatures. Some organizations append a third letter to the end of the airmass code, indicating whether the moving airmass is (w) warmer or (k) colder than the underlying surface. This coding helps indicate the likely static stability of the air and the associated weather. For example, "mPk" is humid cold air moving over warmer ground, which would likely be statically unstable and have convective clouds and showers.

An ainnass can form when air remains stagnant over a surface for sufficient duration to take on characteristics similar to that surface. Thus, many of the airmass genesis (formation) regions correspond to the planetary- and continental-scale high-pressure regions described in the previous section. Airmasses form as boundary layers. During their residence over a surface, the air is modified by processes including radiation, conduction, divergence, and turbulent transport between the ground and the air.

When air moves over a colder surface such as arctic ice, the bottom of the air first cools by conduction, radiation, and turbulent transfer with the ground. Turbulence intensity then decreases within the increasingly statically-stable boundary layer, reducing the turbulent heat transport to the cold surface. However, direct radiative cooling of the air, both upward to space and downward to the cold ice surface, chills the air at rate 2°C day—I (averaged over a 1 km thick boundary layer). As the air cools below the dew point, water-droplet clouds form. Continued radiative cooling from cloud top allows ice crystals to grow at the expense of evaporating liquid droplets, changing the cloud into an ice cloud. Radiative cooling from cloud top creates cloudy "thermals" of cold air that sink, causing some turbulence that distributes the cooling over a deeper layer.

Turbulent entrainment of air from above cloud top down into the cloud allows the cloud top to rise, and deepens the incipient airmass. The ice crystals within this cloud are so few and far between that the weather is described as cloudless ice-crystal precipitation. This can create some spectacular halos and other optical phenomena in sunlight (see the Atmospheric Optics chapter), including sparkling ice crystals known as diamond dust. Nevertheless, infrared radiative cooling in this cloudy air is much greater than in clear air, allowing the cooling rate to increase to 3°C day—I over a layer as deep as 4 km.

During the two-week formation of this continental- polar or continental-arctic airmass, most of the ice crystals precipitate out leaving a thinner cloud of 1 km depth. Also, subsidence within the high pressure also reduces the thickness of the cloudy airmass and causes some warming to partially counteract the radiative cooling. Above the final fog layer is a nearly isothermal layer of air 3 to 4 km thick that has cooled about 30°C. Final air-mass temperatures are often in the range of —30 to —50 °C, with even colder temperatures near the surface.

While the Arctic surface consists of relatively flat sea-ice (except for Greenland), the Antarctic has mountains, high ice-fields, and significant surface topography. As cold air forms by radiation, it can drain downslope as a katabatic wind (see the Regional Winds chapter). Steady winds of 10 m s-1 are common in the Antarctic interior, with speeds of 50 m s-1 along some of the steeper slopes.

Airmasses do not remain stationary over their birth place forever. After a week or two, a transient change in the weather pattern can push the airmass toward new locations. When airmasses move, two things can happen: (1) As the air moves over surfaces with different characteristics, the airmass begins to change. This is called ainnass modification, and is described in the next subsection. (2) An airmass can encounter another airmass. The boundary between these two airmasses is called front, and is a location of strong gradients of temperature, humidity, and other airmass characteristics. Fronts are described in detail later. Tall mountain ranges can strongly block or channel the movement of airmasses, because airmasses occupy the bottom of the troposphere. For example, in the middle of North America, the lack of any major east-west mountain range allows the easy movement of cold polar air from Canada toward warm humid air from the Gulf of Mexico. This sets the stage for strong storms. The long north-south barrier of mountains (Rockies, Sierra Nevada, Cascades, Coast Range) along the west coast of North America impedes the easy entry of Pacific airmasses toward the center of that continent. Those mountains also help protect the west coast from the temperature extremes experienced by the rest of the continent. In Europe, the mountain orientation is the opposite. The Alps and the Pyrenees are east-west mountain ranges that inhibit movement of Mediterranean airmasses from reaching northward. The lack of major north-south ranges in west and central Europe allows the easy movement of maritime airmasses from the Atlantic to sweep eastward, bringing cool wet conditions. One of the greatest ranges is the Himalaya Mountains, running east-west between India and China. Maritime tropical airmasses moving in from the Indian Ocean reach these mountains, causing heavy rains over India during the monsoon. The same mountains block the maritime air from reaching further northward, leaving a very dry Tibetan Plateau and Gobi Desert in its rain shadow. The discussion above focused on blocking and channeling by the mountains. In some situations air can move over mountain tops. When this happens, the the airmass is strongly modified, as described next.

Surface Fronts

Surface fronts mark the boundaries between airmasses at the Earth's surface. They usually have the following attributes:

• strong horizontal temperature gradient
• strong horizontal moisture gradient
• strong horizontal wind gradient

• strong vertical shear of the horizontal wind
• relative minimum of pressure
• high vorticity
• confluence (air converging horizontally)
• clouds and precipitation
• high static stability
• kinks in isopleths on weather maps

In spite of this long list of attributes, fronts are usually labeled by the surface temperature change associated with frontal passage. Some weather features exhibit only a subset of attributes, and are not labeled as fronts. For example, a trough (pronounced like "trof') is a line of low pressure, high vorticity, clouds and possible precipitation, wind shift, and confluence. However, it often does not possess the strong horizontal temperature and moisture gradients characteristic of fronts. Another example of an airmass boundary that is often not a complete front is the dryline. It is discussed later in this chapter. Recall from the Weather Reports and Map Analysis chapter that fronts are always drawn on the warm side of the frontal zone. The frontal symbols are drawn on the side of the frontal line toward which the front is moving. For a stationary front, the symbols on both sides of the frontal line indicate what type of front it would be if it were to start moving in the direction the symbols point. Fronts are three dimensional. To help picture their structure, we next look at horizontal and vertical cross sections through fronts.

Cold Fronts In central N. America, winds ahead of cold fronts typically have a southerly component, and can form strong low-level jets at night and possibly during day. Warm, humid, hazy air advects from the south. Sometimes a squall line of thunderstorms will form in advance of the front, in the warm air. TheseMsquall lines can be triggered by wind shear and by the kinematics (advection) near fronts. They can also consist of thunderstorms that were initially formed on the cold front, but progressed faster than the front. Along the front are narrow bands of towering cumuliform clouds with possible thunderstorms and scattered showers. Along the front the winds are stronger and gusty, and pressure reaches a relative minimum. Thunderstorm anvils often spread hundreds of kilometers ahead of the surface front. Winds shift to a northerly direction behind the front, advecting colder air from the north. This air is often clean with excellent visibilities and clear blue skies during daytime. If sufficient moisture is present, scattered cumulus or broken stratocumulus clouds can form within the cold airmass. As this airmass consists of cold air advecting over warmer ground, it is statically unstable, convective, and very turbulent. However, at the top of the airmass is a very strong stable layer along the frontal inversion that acts like a lid to the convection. Sometimes over ocean surfaces the warm moist ocean leads to considerable post-frontal deep convection. The idealized picture presented in Fig. 12.11 can differ considerably in the mountains.

Warm Proms In central N. America, southeasterly winds ahead of the front bring in cool, humid air from the Atlantic Ocean, or bring in mild, humid air from the Gulf of Mexico. An extensive deck of stratiform clouds (called a cloud shield) can occur hundreds of kilometers ahead of the surface front. In the cirrostratus clouds at the leading edge of this cloud shield, you can sometimes see halos, sundogs, and other optical phenomena. The cloud shield often wraps around the poleward side of the low center. Along the frontal zone can be extensive areas of low clouds and fog, creating hazardous travel conditions. Nimbostratus clouds cause large areas of drizzle and light continuous rain. Moderate rain can form in multiple rain bands parallel to the front. The pressure reaches a relative minimum at the front. Winds shift to a more southerly direction behind the warm front, advecting in warm, humid, hazy air. Although heating of air by the surface might not be strong, any clouds and convection that do form can often rise to relatively high altitudes because of weak static stabilities throughout the warm airmass.

The net movement is westward and upward along the 35°C isentrope. Air parcels that are forced to rise along isentropic surfaces can form clouds and precipitation, given sufficient moisture. Similarly, air blowing eastward would move downward along the sloping isentrope. In three dimensions, you can picture isentropic surfaces separating warmer 0 aloft from colder 0 below. Analysis of the flow along these surfaces provides a clue to the weather associated with the front. Air parcels moving adiabatically must follow the "topography" of the isentropic surface. Within about 200 m of the surface, there are appreciable differences in frontal slope. The cold front has a steeper nose (slope z 1 : 100) than the warm front (slope z- 1 : 300), although wide ranges of slopes have been observed. Fronts are defined by their temperature structure, although many other quantities change across the front. Advancing cold air at the surface defines the cold front, where the front moves toward the warm airmass. Retreating cold air defines the warm front, where the front moves toward the cold airmass. Above the frontal inversion, if the warm air flows down the frontal surface, it is called a katafront, while warm air flowing up the frontal surface is an anafront. It is possible to have cold katafronts, cold anafronts, warm katafronts, and warm anafronts. Frequently in central N. America, the cold fronts are katafronts. For this situation, warm air is converging on both sides of the frontal zone, forcing the narrow band of cumuliform clouds that is typical along the front. It is also common that warm fronts are anafronts, which leads to a wide region of stratiform clouds caused by the warm air advecting up the isentropic surfaces. A stationary front is like an anafront where the cold air neither advances nor retreats.

Answer the questions:

1. What do the high-pressure centers mean?

2. What mechanisms support the formation of highs at the Earth’s surface?

3. What can you say about the vertical structure?

4. How are air masses usually classified?

5. When can an air mass form?

6. What happens when air moves over a cold surface?

7. When is the weather described as cloudless ice-crystal precipitation?

8. How do the mountains influence the movement of air masses?

9. What can happen with air masses?

10. What are the characteristics of surface fronts?

11. Give the characteristics of cold fronts.

12. Give the characteristics of warm fronts.

13. What is the principle action of vertical structure?

TEXT B AIRCRAFT ICING

Aircraft icing is the accretion of supercooled water onto an airplane during flight. Accreted ice adversely affects flight, thus, it is an important component of an aviation weather forecast. Meteorology associated with inflight icing begins with the microscale, addressing growth of water drops and their collision with and adhesion to airframes. Cloud-scale and mesoscale processes control the amount and distribution of water drops while synoptic weather patterns, which produce what was generally refered to as 'weather', govern the location and movement of icing environments. Diagnosing and forecasting inflight icing involve the development and use of numerical weather prediction models as well as in situ and remote sensors. Carburetor icing and precipitation or frost adhering to the wings of an airplane prior to takeoff are not covered here.

Meteorologists, aerospace engineers, and pilots need and want information about icing because it can adversely affect the flight characteristics of an aircraft. Icing can increase drag, decrease lift, and cause control problems. The added weight of the accreted ice is generally a factor only for light aircraft. Aircraft can fly safely in icing conditions, but to do so legally they must complete a certification process. To certify a particular type of airplane, it must be flown in a range of natural icing conditions and demonstrated that these conditions result in no significant effect on the airplane's ability to fly. The range was developed from measurements obtained in the 1940s to envelop 99.9% of icing conditions found in stratiform clouds. More recent studies have confirmed that these provide reasonable limits for certification, although they do not address the problem of large supercooled drops (such as freezing drizzle or rain) or mixed-phase (supercooled liquid drops and ice crystals) conditions. Certified aircraft are commonly equipped with devices that either prevent ice from adhering to the airframe or remove it once it has been adhered. Such anti- or de-icing equipment can either be deployed manually or through an automatic system triggered by an icing detection probe and includes pneumatic 'boots', heat, and liquids. These are usually applied to the leading edges of the wings and tail and occasionally to the propellers.

Tailplane icing is a subset of icing and refers to icing that accretes on the vertical and horizontal stabilizers of specific airplane types. It is not necessarily caused by unique atmospheric conditions, but is usually referred separately because it results in vastly different response of the airplane than does icing which affects the wings. Thus, pilots require special training for this hazard. Icing tends to affect general aviation more than commuter or air carrier operations. The smaller aircraft included in the general aviation category tends to fly at lower altitudes where icing is more prevalent. Those aircraft may have less deicing capability and reserve power in case of encountering icing conditions, and their pilots may have less experience operating icing. Air carriers tend to quickly penetrate icing-bearing clouds on ascent and descent fromairports and cruise at altitudes far above thosewhere icing resides. Commuter aircraft are caught in themiddle both in terms of their ability to handle ice and the altitudes they fly.

Icing is currently classified into four severity categories: trace, light, moderate, and severe. The most important atmospheric parameters determining severity are the liquid water content, outside air temperature, and drop size. The more water there is, the more is available to accrete on the airframe, thus higher liquid water contents are usually associated with more severe conditions. Temperature influences what happens to that liquid once it impacts the airframe — either it freezes in place or runs aft along the surface before freezing to unprotected areas. Drop size controls the collection efficiency of those drops onto the airframe. Drop size is not as important as liquid water content or temperature in determining severity until drops reach drizzle sizes, with diameters exceeding —50 mm. Research is being conducted to determine appropriate limiting values for these parameters to define severity categories. The definitions must relate atmospheric conditions to observable information as well as effect on flight in order to be useful.

There are two main physical types of icing: glaze and rime. Mixed icing is a combination of the two. Rime ice is brittle and opaque and tends to grow into the airstream. It is formed as the drops freeze immediately upon impact. Glaze icing, sometimes referred to as clear icing, can be nearly transparent and has a smoother surface, sometimes with a waxy appearance. It is formedwhen the drops deform and/or flow along the surface prior to freezing. Glaze icing can be more serious to the aircraft than rime since it tends to run back along the airframe, covering more surface area than rime icing, perhaps flowing and adhering to unprotected areas. Glaze icing also can be hard to see from inside the aircraft and the pilot may be unaware of ice buildup. Mixed icing often occurs in layers, as a transition from rime to clear conditions is encountered. These icing types are illustrated in Figure 2. The type of icing is related to the air temperature, the liquid water content, and the size of the drops. Glaze (rime) is generally associated with higher (lower) temperatures, higher (lower) liquid water contents, and larger (smaller) drops. There are also effects dependent on the airplane itself, including its wing shape and airspeed.

Icing-related fatal aircraft accidents average —20-40 per year in the United States, with the highest incidence in the winter months. Alaska has by far the highest accident rate, followed by the Northwest, Great Lakes, western Pacific states, and the centre United States. In North America, icing conditions are most common along the Pacifi Coast from Alaska to Oregon and in a large swath from the Canadian Maritimes to th Midwest. Prime locations migrate seasonally, moving south in the summer an retreating to the north in winter. The average altitude of pilot report of icing is —10 000 ft MSL, with few encounters above 20 000 ft. Frequency of icing encounters by aircraft based on time of day is a direct reflection of the frequency of flights, with few reports ovemio weekly pattern also follows air traffic trends, with most reports on Tuesday Thursday. Light icing is the most frequent severity category reported by pilots, 6 all reports. Severe icing, which indicates a condition which cannot sust reported only a few percent of the time. Rime icing is reported much more than glaze or mixed, comprising ~70-75% of reports. For both icing type and severity, the largest joint frequency is for light rime icing, which covers nearly half of all reports.

The presence of supercooled liquid water in clouds results from production and depletion processes. •Production: Liquid water is produced by bringing the air to >100% relative humidity (supersaturation), which usually results from cooling the air by lifting. •Depletion: Liquid is depleted by mechanisms that erode the cloud, such as entrainment of dry air, or through precipitation processes. In the majority of mid-latitude clouds and storms, the precipitation process is heavily dependent upon the ice phase. Regions ahead of or near surface warm fronts are favorable icing regions since they provide widespread lifting of generally moist air. Cold fronts also provide opportunities for icing, with narrower bands of more intense lift near the surface front Moist, maritime air masses are associated with higher frequencies of icing conditions, whereas continental air masses, especially those well behind arctic fronts, have fewer reports. Topography also influences icing, providing a local source of lift. For example, cold fronts progressing southward through the central United States often provide widespread icing conditions along the front range of the Rocky Mountains from Wyoming through New Mexico. In these situations, which may also occur along the Appalachians in the eastern United States, cold, moist air is forced up the gentle slope leading to the steep mountain range. Or, orographic clouds may be isolated and associated with mountain peaks and ridges. Precipitation-forming processes tend to deplete liquid water from clouds. Once drops reach a diameter of -20 m, they begin to collide with one another and coalesce. The increased mass of the resulting larger drop subsequently increases its fall speed, leading to more collisions, etc., depleting the liquid that existed in small drops as it falls out of the cloud. Similarly, once ice crystals are formed in a cloud, they also fall and collect cloud drops in a process referred to as riming. This tends to deplete liquid - much like the accretion of the supercooled drops onto an airplane. Although it is often assumed that icing will not be present aloft where there is significant precipitation at the surface, examinations of pilot reports of icing have not borne this out. Chances are about even that one of these reports will be associated with surface snow or rain as opposed to no precipitation. If lift within a cloud is strong enough, water can still be condensed onto existing drops, or new drops may be formed, thus continuing the icing condition.

Supercooled large drops (SLDs), which are those with diameters exceeding 50 mm, can pose an especially serious threat to flight. Their larger sizemeans that they are not as likely as small drops to be carried around the airframe with the airstream but will more readily impact on the airframe. They can impact farther aft than small drops, or flow along the aircraft surface before freezing, which means that they may accrete onto areas not usually protected by de-or anti-icing devices. Roughness resulting fr type of ice accretion can create a high amount of drag. Cases of increased per degradation due to flight in SLD conditions are well documented from aircraft.

There are two general situations for formation of SLD. The first is the classic freezing rain process, by which snow forms aloft, falls into an intruding warm (T > 0 °C) layer, melts, continues to fall into lower cold air (T < 0 °C), and becomes supercooled, ready to adhere to an airplane. This is a relatively easy forecast problem since it requires a specific thermodynamic profile. The other general case is the formation of SLD by coalescence of liquid drops and is not so easily recognized using operationally available data sets. Wind shear (differences in wind speed and/or direction) at cloud top in stratiform clouds may encourage the formation of SLD there. There is some evidence that minimum thresholds of liquid water content must be exceeded for drizzle formation to occur; 0.2-0.25 g M-3 in continental and around 0.1 g m-3 in maritime clouds. This difference emphasizes the need for the inclusion of realistic regional microphysics parameterizations in numerical weather prediction models. The observation of freezing precipitation - freezing drizzle, freezing rain or ice pellets - at the ground can provide an important clue for SLD conditions aloft. This makes physical sense since all three are supercooled (or already frozen) large drops -if they are present at the surface, they must be present for some depth above the surface. The more difficult part of using this to diagnose SLD conditions aloft is to determine how far aloft the SLD extend. Knowledge of the moisture and thermal structure of the atmosphere are needed to infer this depth.

Answer the questions:

1. Why do meteorologists need the information about icing?

2. What are the main physical types of icing?

3. What kind of icing is more serious to the aircraft?

4. What is the difference between types of icing?

5. What are the conditions for icing?

6. What is associated with higher frequencies of icing conditions?

7. What is the supercooled large drop icing?

8. What is the situation for SLD formation?

LEXICAL EXERCISES

I. Translate the following sentences, paying attention to the -'use and meanings of "should:"

1. It should be noted that almost all types of stratilorm clouds can occur within a warm sector, so that the existence of altostratus and nimbostratus is only significant for weather in advance of a warm front when accompanied by the other signs.
2. The forecasts should contain some indication of the certainty of prediction both as far as weather phenomena and the time of occurrence are concerned.
3. We should now try to determine the position and the properties of the air mass that is going to pass over the forecasting district during the forecasting period.
4. Should the centre of a storm pass over a vessel the wind, after blowing furiously in one direction, ceases for a time, and then blows with equal fury from the opposite direction.
5. It was known that we should carry out such observations at stations with similar illumination conditions and include a re-cording of the presence, and absence of the clouds as well as unfavourable viewing conditions.
6. Were this formula used to evaluate the height of the tops of cumulus and cumulo-nimbus, we should obtain an accuracy of ±25 mb. in about 55% of the cases, and an accuracy of ±55 mb. would be obtained in about 80% of the cases.
7. Only a few years ago we could not imagine that we should be able to get to the Antarctic by air and to do intensive research work during the short Antarctic summer.
8. Should the humidity be less than that indicated in Fig. 6, the line CB would be found further to the left and the level 8' would be representative.

II. Define the functions of the verb "to have" and translate the following sentences:

1. The forecaster will have to estimate the amount of cooling that is likely to occur within the forecasting period.
2. Such fogs must have formed while the air was blowing from warm towards colder sea.
3. This barometer has to pass the following tests before being accepted.
4. Levels have been selected from both the upper wind diagrams and from the thermodynamic diagrams in such a way that linear interpolation between levels will give an accurate representations of both winds and thermodynamic structure.

5. When the foregoing points have been completed, it is well to re-examine the weather charts in order to ascertain whether any phenomenon or alternative has been overlooked.
6. We have some doubt whether the samples obtained in this area are necessary for compiling these diagrams.
7. If a reading of the record has to be obtained at the same time as the time mark, it should be made just before the time mark and not after it.
8. These records are much more comp recorder and have to be treated with special care.
9. The values of some observed quant with corresponding forecast values.
10. Owing to the greater uniformity of the surface in the southern, as compared with the northern hemisphere, -the winds have comparatively little seasonal fluctuation.

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. 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.

VII. 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.

VIII. 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

I. Translate the texts:

Text A EXTRA TROPICAL CYCLONES

A synoptic-scale weather system with low pressure near the surface is called a "cyclone". Horizontal winds turn cyclonically around it (clockwise/counterclockwise in the Southern/ Northern Hemisphere). Near the surface these turning winds also spiral towards the low center. Ascending air in the cyclone can create clouds and precipitation. Other names for extratropical cyclones are lows or low-pressure centers. Low-altitude convergence draws together airmasses to form fronts, along which the bad weather is often concentrated. These lows have a short life cycle (a few days to a week) as they are blown from west to east and poleward by the polar jet stream.

Cyclogenesis & Cyclolysis

Cyclones are bom and intensify (cyclogenesis) and later weaken and die (cyclolysis). During cyclogenesis the (1) vorticity (horizontal winds turning around the low center) and (2) updrafts (vertical winds) increase while the (3) surface pressure decreases.

The intertwined processes that control these three characteristics will be the focus of three major sections in this chapter. In a nutshell, updrafts over a synoptic-scale region remove air from near the surface, causing the air pressure to decrease. The pressure gradient between this low-pressure center and the surroundings drives horizontal winds, which are forced to turn because of Coriolis force. Frictional drag near the ground causes these winds to spiral in towards the low center, adding more air molecules horizontally to compensate for those being removed vertically.

If the updraft weakens, the inward spiral of air molecules fills the low to make it less low (cyclolysis). Cyclogenesis is enhanced at locations where one or more of the following conditions occur:

(1) east of mountain ranges, where terrain slopes downhill under the jet stream.

(2) east of deep troughs (and west of strong ridges) in the polar jet stream, where horizontal divergence of winds drives mid-tropospheric updrafts.

(3) at frontal zones or other baroclinic regions where horizontal temperature gradients are large.

(4) at locations that don’t suppress vertical motions, such as where static stability is weak.

(5) where cold air moves over warm, wet surfaces such as the Gulf Stream, such that strong evaporation adds water vapor to the air and strong surface heating destabilizes the atmosphere.

(6) at locations further from the equator, where Coriolis force is greater.

If cyclogenesis is rapid enough (central pressures dropping 2.4 kPa or more over a 24-hour period), the process is called explosive cyclogenesis (also nicknamed a cyclone bomb). This can occur when multiple conditions listed above are occurring at the same location (such as when a front stalls over the Gulf Stream, with a strong amplitude Rossbywave trough to the west). During winter, such cyclone bombs can cause intense cyclones just off the east coast of the USA with storm-force winds, high waves, and blizzards or freezing rain.

Cyclone evolution

Although cyclones have their own synoptic-scale winds circulating around the low-pressure center, this whole system is blown toward the east by even larger-scale winds in the general circulation such as the jet stream.

One condition that favors cyclogenesis is a baroclinic zone — a long, narrow region of large temperature change across a short horizontal distance near the surface. Frontal zones such as stationary fronts are regions of strong baroclinicity.

Above (near the tropopause) and parallel to this baroclinic zone is often a strong jet stream, driven by the thermal-wind effect. If conditions are right, the jet stream can remove air molecules from a column of air above the front. This lowers the surface pressure under location, causing cyclogenesis at the surface. Namely, under location is where you would expect a surface low-pressure center to form.

The resulting pressure gradient around the surface low starts to generate lower-tropospheric winds that circulate around the low. This is the spin-up stage — so named because vorticity is increasing as the cyclone intensifies. The winds begin to advect the warm air poleward on the east side of the low and cold air equatorward on the west side, causing a kink in the former stationary front near the low center. The kinked front is wave shaped, and is called a frontal wave. Parts of the old front advance as a warm front, and other parts advance as a cold front. Also, these winds begin to force some of the warmer air up over the colder air, thereby generating more clouds.

If jet-stream conditions continue to be favorable, then the low continues to intensify and mature. As this cyclogenesis continues, the central pressure drops (namely, the cyclone deepens), and winds and clouds increase as a vortex around the low center. Precipitation begins if sufficient moisture is present in the regions where air is rising.

The advancing cold front often moves faster than the warm front. Three reasons for this are:

(1) The Sawyer-Eliassen circulation tends to push near-surface cold air toward warmer air at both fronts.

(2) Circulation around the vortex tends to deform the frontal boundaries and shrink the warm air region to a smaller wedge shape east and equatorward of the low center. This wedge of warm air is called the warm-air sector.

(3) Evaporating preciptation cools both fronts (enhancing the cold front but diminishing the warm front). These combined effects amplify the frontal wave.

At the peak of cyclone intensity (lowest central pressure and strongest surrounding winds) the cold front often catches up to the warm front near the low center. As more of the cold front overtakes the warm front, an occluded front forms near the low center. The cool air is often drier, and is visible in satellite images as a dry tongue of relatively cloud-free air that begins to wrap around the low. This marks the beginning of the cyclolysis stage. During this stage, the low is said to occlude as the occluded front wraps around the low center.

As the cyclone occludes further, the low center becomes surrounded by cool air. Clouds during this stage spiral around the center of the low — a signature that is easily seen in satellite images. But the jet stream, still driven by the thermal wind effect, moves east of the low center to remain over the strongest baroclinic zone (over the warm and cold fronts, which are becoming more stationary).

Without support from the jet stream to continue removing air molecules from the low center, the low begins to fill with air due to convergence of air in the boundary layer. The central pressure starts to rise and the winds slow as the vorticity spins down.

As cyclolysis continues, the low center often continues to slowly move further poleward away from the baroclinic zone. The central pressure continues to rise and winds weaken. The tightly wound spiral of clouds begins to dissipate into scattered clouds, and precipitation diminishes.

But meanwhile, along the stationary front to the east, a new cyclone might form if the jet stream is favorable.

In this way, cyclones are bom, evolve, and die. While they exist, they are driven by the baroclinicity in the air (through the action of the jet stream). But their circulation helps to reduce the baroclinicity by moving cold air equatorward, warm air poleward, and mixing the two airmasses together. As described by le chatelier's principle, the cyclone forms as a response to the baroclinic instability, and its existence partially undoes this instability. Namely, cyclones help the global circulation to redistribute heat between equator and poles. Cyclone tracks

Extratropical cyclones are steered by the global circulation, including the prevailing westerlies at mid-latitudes and the meandering Rossby-wave pattern in the jet stream. Multiyear climate variations in the global circulation, such as associated with the El Nino / La Nina cycle or the North Atlantic Oscillation (NAO), can alter the cyclone tracks. Mid-latitude cyclones are generally stronger, translate fasterand are further equatorward during winter than in summer.

One favored cyclogenesis region is just east of large mountain ranges. Other cyclogenesis regions are over warm ocean boundary currents along the western edge of oceans, such as the gulf stream current off the east coast of N. America, and the Kuroshio current off the east coast of Japan. During winter over such currents are strong sensible and latent heat fluxes from the warm ocean into the air, which adds energy to developing cyclones. Also, the strong wintertime contrast between the cold continent and the warm ocean current causes an intense baroclinic zone that drives a strong jet stream above it due to thermal wind effects.

Cyclones are often strengthened in regions under the jet stream just east of troughs. In such regions, the jet stream steers the low center toward the east and poleward. Hence, cyclone tracks are often toward the northeast in the N. Hemisphere, and toward the southeast in the S. Hemisphere.

Cyclones in the Northern Hemisphere typically evolve during a 2 to 7 day period, with most lasting 3-5 days. They travel at typical speeds of 12 to 15 m s-1 (43 to 54 km h-1), which means they can move about 5000 km during their life. Namely, they can travel the distance of the continental USA from coast to coast or border to border during their lifetime. Since the Pacific is a larger ocean, cyclones that form off of Japan often die in the Gulf of Alaska just west of British Columbia (BC), Canada — a cyclolysis region known as a cyclone graveyard (G).

In the Southern Hemisphere, cyclones are more uniformly distributed in longitude and throughout the year, compared to the N. Hemisphere. One reason is the smaller area of continents in Southern-Hemisphere mid-latitudes and subpolar regions. Many propagating cyclones form just north of 50°S latitude, and die just south.

The region with greatest cyclone activity (cyclogenesis, tracks, cyclolysis) is a band centered near 60°S. These Southern Hemisphere cyclones last an average of 3 to 5 days, and translate with average speeds faster than 10 m s-1 (= 36 km h-1) toward the east-south-east. A band with average translation speeds faster than 15 m s-1 (= 54 km h-1; or > 10° longitude day-1) extends from south of southwestern Africa eastward to south of western Australia. The average track length is 2100 km. The normal cyclone graveyard (G, cyclolysis region) in the S. Hemisphere is in the circumpolar trough (between 65°S and the Antarctic coastline).

Seven stationary centers of enhanced cyclone activity occur around the coast of Antarctica, during both winter and summer. Some of these are believed to be a result of fast katabatic (cold downslope) winds flowing off the steep Antarctic terrain. When these very cold winds reach the relatively warm unfrozen ocean, strong heat fluxes from the ocean into the air contribute energy into developing cyclones. Also the downslope winds can be channeled by the terrain to cause cyclonic rotation. But some of the seven stationary centers might not be real — some might be caused by improper reduction of surface pressure to sea-level pressure.

Tilting

Lows at the bottom of the troposphere always tend to kill themselves. The culprit is the boundary layer, where turbulent drag causes air to cross isobars at a small angle from high toward low pressure. By definition, a low has lower central pressure than the surroundings, because fewer air molecules are in the column above the low. Thus, boundary-layer flow will always move air molecules toward surface lows. As a low fills with air, its pressure rises and it stops being a low.

Such filling is quick enough to eliminate a low in less than a day, unless a compensating process can remove air more quickly.

Such a compensating process often occurs if the axis of low pressure tilts westward with increasing height. The jet stream is slower around troughs than ridges. This change of wind speed causes divergence aloft; namely, air is leaving faster than it is arriving. Thus, with the upper-level trough shifted west of the surface low (L), the divergence region (D) is directly above the surface low, supporting cyclogenesis. Details are explained later in this Chapter. But for now, you should recognize that a westward tilt of the low-pressure location with increasing height often accompanies cyclogenesis.

I. Put 20 questions on the text (all kinds of questions)

II. What new information have you learnt ?

III. What is the most impressive information for you?

Text B TRANSPORT AND MIXING IN THE LOWERMOST STRATOSPHERE

The transport and mixing of mass and chemical species between the stratosphere and troposphere is referred to as Stratosphere-Troposphere Exchange (STE). The process of STE is central to many aspects of atmospheric science, particularly as they relate to climate. Important examples of this include the impact of aircraft emissions on the ozone layer, the vertical structure of greenhouse gas distributions in the upper troposphere/lower stratosphere region, and midlatitude ozone depletion.

Until very recently, STE was regarded as a problem of tropopause dynamics, with attention focused almost exclusively on the mesoscale phenomenology of strong mixing events such as midlatitude tropopause folds and deep tropical convection (e.g. WMO, 1986). Most observational and modelling efforts on STE had therefore reflected this emphasis. However, over the last five years or so it has been explicitly recognized that STE is just one aspect of a global picture of transport and mixing of mass and chemical species, which is constrained by the dynamics of the whole stratosphere (Holton et al., 1995). The present paper summarizes recent progress in the area of STE, and identifies several outstanding issues.

The Global View. It has long been recognized that tropospheric air enters the stratosphere mainly in the tropics, and that this air moves polewards in the stratosphere. By mass conservation, this Brewer-Dobson circulation must close by stratospheric air returning to the troposphere in midlatitudes. It is quite true that a considerable part of the actual mass exchange across the tropopause appears to be accomplished by the mesoscale mixing phenomena mentioned above. However, in considering the global budget of long-lived chemical species, it has to be recognized that the STE occurring in the tropical and midlatitude tropopause regions is constrained by the transport achieved in the BrewerDobson circulation. Put simply, in order to achieve any mixing of chemical species in STE, a contrast between tropospheric and stratospheric air must exist, and the nature of this contrast involves the slower dynamics of the stratosphere itself.

Two new concepts lie at the heart of this current, more global view of STE. The first is the distinction between the stratospheric "overworld" and the "lowermost stratosphere". To a first approximation, transport timescales in the overworld are determined largely by the slow diabatic circulation, with something like a two-year overturning timescale, while transport timescales in the lowermost stratosphere are determined by more rapid quasi-horizontal isentropic mixing by large-scale eddies. The lowermost stratosphere itself should be regarded as a set of quasi-horizontal outcropping layers, ventilated by the troposphere. The second new concept is the distinction between tropical and midlatitude air in the overworld, clearly seen in aerosol concentrations and in chemical correlations. The sharpness of the transition suggests the existence of a subtropical mixing barrier, and allows for the relatively undiluted tropical ascent seen in water vapour measurements. This has led to a new conceptual model of straatospheric transport known as the "tropical pipe" (Plumb, 1996).

3. Tropical Ascent and Extratropical Descent

The rising tropical branch of the Brewer-Dobson circulation is clearly seen in chemical tracers such as N20 and water vapour. The quantification of this upwelling is an important issue. The Lagrangian ascent is closely linked to the residual circulation, which is itself closely linked to the (transient) diabatic circulation. Since the atmospheric residual circulation cannot be reliably measured, there have been a number of attempts to estimate it from diabatic heating. However, it is well known that this calculation has certain difficulties, and the estimates therefore remain uncertain. (See Beagley et al. (1996) for an example of the ill-conditioned nature of the usual iterative method.)

The mean tropical upwelling is balanced by diabatic heating: the tropical lower stratosphere is cooled below radiative equilibrium. The associated poleward mass flux in the extratropical stratosphere is balanced by wave drag. Yulaeva et al. (1994) have thus argued that the annual cycle in lower stratosphere tropical temperatures is controlled by the annual cycle in extratropical wave drag, and some diagnostic support for this connection has been provided by Rosenlof (1995). However, a detailed quantitative theoretical between extratropical wave drag and tropical temperatures remains lacking.

The extratropical branch of the Brewer-Dobson circulation descends through the lowermost stratosphere. The long radiative timescales in this region of the atmosphere mean that the steady-state, "downward controlled" limit is not achieved on seasonal timescales, and there is therefore likely to be a lag between the extratropical wave drag and the down welling through the extratropical tropopause. In addition, the mass of the stratosphere itself undergoes a seasonal "breathing" as the tropopause moves up and down. These processes has been quantified by Appenzeller et al. (1999). In the Northern Hemisphere, they find a lag between the maximum mass flux into and out of the lowermost stratosphere, which appears to explain the known seasonal cycle of STE based on radioactive tracers. Note that cycle is in marked contrast with the seasonal cycle of the rate of tropopause folds, confirming the global rather than local view of STE.

4. Mixing and Filamentation

The mean residual circulation described above is only part of what determines chemical transport; mixing is also important. It is believed that quasi-horizontal, nearly-isentropic motions are the dominant contributor to mixing in the stratosphere, and recent attention has focused on two regions. The first is the edge of the tropics. A number of recent studies have shown that the tropical pipe is very leaky below about 22 km or so, yet a quasi-barrier is still evident in chemical tracer correlations. This means that the tracers can be used to infer mixing rates. For example, there is a clear imprint of the tropospheric annual cycle in CO2 in the lowermost stratosphere (Boering et al., 1994), implying significant detriment of the tropical upwelling, and a "shortcircuiting" of the Brewer-Dobson circulation; a similar conclusion has been reached on the basis of water vapour measurements by Dessler et al. (1995). Entrainment into the tropics has also been inferred from chemical profiles, and has been quantified by using a variety of chemical species with different lifetimes (Volk et al., 1996); these studies conclude that up to 50% of the ascending tropical air at 21-22 km is of extratropical origin. Much effort is now being exerted to better quantify the leakiness of the tropical pipe, as it has significant implications for the impact of aircraft Nox emissions on the ozone layer.

The other region of great interest is the lowermost stratosphere. Laminae seen in vertical profiles of 03 and other tracers, previously attributed to inertiagravity waves, are now clearly linked to filamentation processes. These filaments/laminae are respectively the horizontal/vertical manifestations of sloping sheets of tracer, arising from the combined effects of horizontal strain and vertical shear (a generic result of layerwise quasi-two-dimensional turbulence). The process has been quantified theoretically by Haynes and Anglade (1996), who argue that for conditions characteristic of the lower stratosphere, the ratio of horizontal to vertical length scales should be expected to be around 250. (It is a coincidence that ratio is close to Prandtl's ratio N/f.) The limiting process is small-scale vertical diffusion. Balluch and Haynes (1996) use the observed horizontal scale of tracer filaments to infer a vertical diffusivity of no greater than 10' m2s-I, which is much smaller than estimates from radars. A global climatology of lamination rates has been estimated from horizontal gradients of temperature and tracer, and shows that the process occurs year-round in the lowermost stratosphere.

This view of mixing is very different from classical diffusion, and exhibits several characteristic features of chaotic advection. The underlying process is that of large eddies acting on a sharp tracer gradient, i.e. "stirring". Homogenization occurs first at large scales; the process of mixing is analogous to shuffling a deck of cards. (Or to paraphrase Garrett (1983), if one releases red dye, one sees red streaks rather than a pink cloud.) Thus advective development of small scales is a precondition for mixing. (It follows that simulation models with insufficient horizontal resolution of tracers will require unrealistically large horizontal diffusivities to achieve a given flux.)

Answer the questions:

1. Does the process of STE central to many aspects of atmospheric science?
2. What has to be recognized in considering the global budget of long-lived chemical species?
3. What is the first new conception ?
4. What is the second new conception?
5. How is the mean tropical upwelling balanced?
6. What does the mass of stratosphere itself undergo to?
7. What is the other region of great interest?
8. When does homogenization occur?

<u>LEXICAL EXERCISES</u>

I. Translate the following sentences, paying attention to the use and meanings of "that," "that of," "those," "those of," "these:"

1. On the average, the pressure at this level is 25 mb. higher than that at the top of the cloud.

2. The same could also be said regarding fronts at middle lat-itudes, and, perhaps, the main value of the preceding paragraphs has been to put on record the fact that frontal phenomena as complex and occasionally sharp as those noted at middle latitudes can be found in Arctic regions in summer.

3. If the scale of the initial error field were appreciably greater than that of the true fluctuations, the error would increase rapidly and the predictability of the winds would correspondingly decrease.

4. In the case when the temperature of the air is lower than that of the liquid water, the water will evaporate into the air.

5. The trade-winds of the Pacific are somewhat less strong and more variable in direction that those of the Atlantic.

6. Barometric tendencies are generally small and positive to the north, south and south-east of the centre; only immediately north of the front there are negative tendencies, and these are attributed to frontal movement.

7. Bearing in mind, that the minimum values are likely to be more significant, I have used a value of 16 km. in the following calculations.

8. The new method that has shown some promise in the previ-ous work has recently been used by several forecasters.

9. The pressure at the destination is lower than that at the point of departure.

10. The chief advantage is that the corrections for deviations of temperature from the isothermal law can be easily calculated.

II. Define what part of speech each of the words in bold type is and translate the following sentences:

1. The assumption on which these methods rest is not accept-able in the study of local convection.

2. Only the main series of observations were used in compiling weather charts, while the rest of them were neglected.

3. All the members of the expedition were working day and night without any rest in order to carry out the programme of the ICY in time.

4. The winds need not parallel the front, but only the parallel component has the special property mentioned above.

5. Several weather stations are located along the same parallel.

6. The sudden wind shift and abrupt temperature change that marks a sharp surface front are rarely, if ever, encountered aloft

7. However, there were also a number of cases in which temperature and humidity change, winds shift and pressure characteristics were not synchronized in the usual way.

8. A number of diagrams will be used in the report of our professor who will number and send Them to the conference to be held in the nearest future.

9. What causes additional changes in the density distribution?

10. The causes of sudden weather changes were thoroughly investigated.

11. When the displacement results in condensation of aqueous vapour, the latent heat of vaporization is liberated.

12. Meteorologists of the whole world are interested in the results of the investigations carried out at the Antarctic stations.

13. It is of interest to note that any displaced parcel is sup-posed to assume the pressure of its environment.

14. A note describing gale and temperature data is given at the bottom of this chart.

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 7

I. Translate the texts:

Text A **TORNADO**

A **tornado** is a violently rotating column of air that is in contact with both the surface of the Earth and a cumulonimbus cloud or, in rare cases, the base of a cumulus cloud. The windstorm is often referred to as a **twister**, **whirlwind** or **cyclone**, although the word cyclone is used in meteorology to name a weather system with a low-pressure area in the center around which, from an observer looking down toward the surface of the earth, winds blow counterclockwise in the Northern Hemisphere and clockwise in the Southern. Tornadoes come in many shapes and sizes, and they are often visible in the form of a condensation funnel originating from the base of a cumulonimbus cloud, with a cloud of rotating debris and dust beneath it. Most tornadoes have wind speeds less than 110 miles per hour (180 km/h), are about 250 feet (80 m) across, and travel a few miles (several kilometers) before dissipating. The most extreme tornadoes can attain wind speeds of more than 300 miles per hour (480 km/h), are more than two miles (3 km) in diameter, and stay on the ground for dozens of miles (more than 100 km).

Various types of tornadoes include the multiple vortex tornado, landspout, and waterspout. Waterspouts are characterized by a spiraling funnel-shaped wind current, connecting to a large cumulus or cumulonimbus cloud. They are generally classified as non-supercellular tornadoes that develop over bodies of water, but there is disagreement over whether to classify them as true tornadoes. These spiraling columns of air frequently develop in tropical areas close to the equator and are less common at high latitudes. Other tornado-like phenomena that exist in nature include the gustnado, dust devil, fire whirl, and steam devil.

Tornadoes occur most frequently in North America (particularly in central and southeastern regions of the United States colloquially known as tornado alley), Southern Africa, northwestern and southeast Europe, western and southeastern Australia, New Zealand, Bangladesh and adjacent eastern India, and southeastern South America. Tornadoes can be detected before or as they occur through the use of Pulse-Doppler radar by recognizing patterns in velocity and reflectivity data, such as hook echoes or debris balls, as well as through the efforts of storm spotters.

There are several scales for rating the strength of tornadoes. The Fujita scale rates tornadoes by damage caused and has been replaced in some countries by the updated Enhanced Fujita Scale. An F0 or EF0 tornado, the weakest category, damages trees, but not substantial structures. An F5 or EF5 tornado, the strongest category, rips buildings off their foundations and can deform large skyscrapers.

The similar TORRO scale ranges from T0 for extremely weak tornadoes to T11 for the most powerful known tornadoes. Doppler radar data, photogrammetry, and ground swirl patterns (trochoidal marks) may also be analyzed to determine intensity and assign a rating.

A tornado is not necessarily visible; however, the intense low pressure caused by the high wind speeds (as described by Bernoulli's principle) and rapid rotation (due to cyclostrophic balance) usually cause water vapor in the air to condense into cloud droplets due to adiabatic cooling. This results in the formation of a visible funnel cloud or condensation funnel.

There is some disagreement over the definition of a funnel cloud and a condensation funnel. According to the *Glossary of Meteorology,* a funnel cloud is any rotating cloud pendant from a cumulus or cumulonimbus, and thus most tornadoes are included under this definition. Among many meteorologists, the 'funnel cloud' term is strictly defined as a rotating cloud which is not associated with strong winds at the surface, and condensation funnel is a broad term for any rotating cloud below a cumuliform cloud.

Tornadoes often begin as funnel clouds with no associated strong winds at the surface, and not all funnel clouds evolve into tornadoes. Most tornadoes produce strong winds at the surface while the visible funnel is still above the ground, so it is difficult to discern the difference between a funnel cloud and a tornado from a distance.

Occasionally, a single storm will produce more than one tornado, either simultaneously or in succession. Multiple tornadoes produced by the same storm cell are referred to as a "tornado family". Several tornadoes are sometimes spawned from the same large-scale storm system. If there is no break in activity, this is considered a tornado outbreak (although the term "tornado outbreak" has various definitions). A period of several successive days with tornado outbreaks in the same general area (spawned by multiple weather systems) is a tornado outbreak sequence, occasionally called an extended tornado outbreak.

Most tornadoes take on the appearance of a narrow funnel, a few hundred yards (meters) across, with a small cloud of debris near the ground. Tornadoes may be obscured completely by rain or dust. These tornadoes are especially dangerous, as even experienced meteorologists might not see them. Tornadoes can appear in many shapes and sizes.

Small, relatively weak landspouts may be visible only as a small swirl of dust on the ground. Although the condensation funnel may not extend all the way to the ground, if associated surface winds are greater than 40 mph (64 km/h), the circulation is considered a tornado. A tornado with a nearly cylindrical profile and relative low height is sometimes referred to as a "stovepipe" tornado. Large tornadoes which appear at least as wide as their cloud-to-ground height can look like large wedges stuck into the ground, and so are known as "wedge tornadoes" or "wedges". The "stovepipe" classification is also used for this type of tornado if it otherwise fits that profile. A wedge can be so wide that it appears to be a block of dark clouds, wider than the distance from the cloud base to the ground. Even experienced storm observers may not be able to tell the difference between a low-hanging cloud and a wedge tornado from a distance. Many, but not all major tornadoes are wedges.

Tornadoes in the dissipating stage can resemble narrow tubes or ropes, and often curl or twist into complex shapes. These tornadoes are said to be "roping out", or becoming a "rope tornado". When they rope out, the length of their funnel increases, which forces the winds within the funnel to weaken due to conservation of angular momentum. Multiple-vortex tornadoes can appear as a family of swirls circling a common center, or they may be completely obscured by condensation, dust, and debris, appearing to be a single funnel.

In the United States, tornadoes are around 500 feet (150 m) across on average and travel on the ground for 5 miles (8.0 km). However, there is a wide range of tornado sizes. Weak tornadoes, or strong yet dissipating tornadoes, can be exceedingly narrow, sometimes only a few feet or couple meters across. One tornado was reported to have a damage path only 7 feet (2.1 m) long. On the other end of the spectrum, wedge tornadoes can have a damage path a mile (1.6 km) wide or more. A tornado that affected Hallam, Nebraska on May 22, 2004, was up to 2.5 miles (4.0 km) wide at the ground, and a tornado in El Reno, Oklahoma on May 31, 2013 was approximately 2.6 miles (4.2 km) wide, the widest on record.

In terms of path length, the Tri-State Tornado, which affected parts of Missouri, Illinois, and Indiana on March 18, 1925, was on the ground continuously for 219 miles (352 km). Many tornadoes which appear to have path lengths of 100 miles (160 km) or longer are composed of a family of tornadoes which have formed in quick succession; however, there is no substantial evidence that this occurred in the case of the Tri-State Tornado. In fact, modern reanalysis of the path suggests that the tornado may have begun 15 miles (24 km) further west than previously thought.

Tornadoes can have a wide range of colors, depending on the environment in which they form. Those that form in dry environments can be nearly invisible, marked only by swirling debris at the base of the funnel. Condensation funnels that pick up little or no debris can be gray to white. While traveling over a body of water (as a waterspout), tornadoes can turn white or even blue. Slow-moving funnels, which ingest a considerable amount of debris and dirt, are usually darker, taking on the color of debris. Tornadoes in the Great Plains can turn red because of the reddish tint of the soil, and tornadoes in mountainous areas can travel over snow-covered ground, turning white.

Lighting conditions are a major factor in the appearance of a tornado. A tornado which is "back-lit" (viewed with the sun behind it) appears very dark. The same tornado, viewed with the sun at the observer's back, may appear gray or brilliant white. Tornadoes which occur near the time of sunset can be many different colors, appearing in hues of yellow, orange, and pink.

Dust kicked up by the winds of the parent thunderstorm, heavy rain and hail, and the darkness of night are all factors that can reduce the visibility of tornadoes. Tornadoes occurring in these conditions are especially dangerous, since only weather radar observations, or possibly the sound of an approaching tornado, serve as any warning to those in the storm's path. Most significant tornadoes form under the storm's *updraft base*, which is rain-free, making them visible. Also, most tornadoes occur in the late afternoon, when the bright sun can penetrate even the thickest clouds. Night-time tornadoes are often illuminated by frequent lightning.

There is mounting evidence, including Doppler on Wheels mobile radar images and eyewitness accounts, that most tornadoes have a clear, calm center with extremely low pressure, akin to the eye of tropical cyclones. Lightning is said to be the source of illumination for those who claim to have seen the interior of a tornado.

Tornadoes normally rotate cyclonically (when viewed from above, this is counterclockwise in the northern hemisphere and clockwise in the southern). While large-scale storms always rotate cyclonically due to the Coriolis effect, thunderstorms and tornadoes are so small that the direct influence of the Coriolis effect is unimportant, as indicated by their large Rossby numbers. Supercells and tornadoes rotate cyclonically in numerical simulations even when the Coriolis effect is neglected. Low-level mesocyclones and tornadoes owe their rotation to complex processes within the supercell and ambient environment.

Approximately 1 percent of tornadoes rotate in an anticyclonic direction in the northern hemisphere. Typically, systems as weak as landspouts and gustnadoes can rotate anticyclonically, and usually only those which form on the anticyclonic shear side of the descending rear flank downdraft (RFD) in a cyclonic supercell. On rare occasions, anticyclonic tornadoes form in association with the mesoanticyclone of an anticyclonic supercell, in the same manner as the typical cyclonic tornado, or as a companion tornado either as a satellite tornado or associated with anticyclonic eddies within a supercell.

Tornadoes emit widely on the acoustics spectrum and the sounds are caused by multiple mechanisms. Various sounds of tornadoes have been reported, mostly related to familiar sounds for the witness and generally some variation of a whooshing roar. Popularly reported sounds include a freight train, rushing rapids or waterfall, a nearby jet engine, or combinations of these. Many tornadoes are not audible from much distance; the nature of and the propagation distance of the audible sound depends on atmospheric conditions and topography.

The winds of the tornado vortex and of constituent turbulent eddies, as well as airflow interaction with the surface and debris, contribute to the sounds. Funnel clouds also produce sounds. Funnel clouds and small tornadoes are reported as whistling, whining, humming, or the buzzing of innumerable bees or electricity, or more or less harmonic, whereas many tornadoes are reported as a continuous, deep rumbling, or an irregular sound of "noise".

Since many tornadoes are audible only when very near, sound is not to be thought of as a reliable warning signal for a tornado. Tornadoes are also not the only source of such sounds in severe thunderstorms; any strong, damaging wind, a severe hail volley, or continuous thunder in a thunderstorm may produce a roaring sound.

Tornadoes also produce identifiable inaudible infrasonic signatures.

Unlike audible signatures, tornadic signatures have been isolated; due to the long-distance propagation of low-frequency sound, efforts are ongoing to develop tornado prediction and detection devices with additional value in understanding tornado morphology, dynamics, and creation. Tornadoes also produce a detectable seismic signature, and research continues on isolating it and understanding the process.

Tornadoes emit on the electromagnetic spectrum, with sferics and E-field effects detected. There are observed correlations between tornadoes and patterns of lightning. Tornadic storms do not contain more lightning than other storms and some tornadic cells never produce lightning at all. More often than not, overall cloud-to-ground (CG) lightning activity decreases as a tornado touches the surface and returns to the baseline level when the tornado dissipates. In many cases, intense tornadoes and thunderstorms exhibit an increased and anomalous dominance of positive polarity CG discharges. Electromagnetics and lightning have little or nothing to do directly with what drives tornadoes (tornadoes are basically a thermodynamic phenomenon), although there are likely connections with the storm and environment affecting both phenomena.

Luminosity has been reported in the past and is probably due to misidentification of external light sources such as lightning, city lights, and power flashes from broken lines, as internal sources are now uncommonly reported and are not known to ever have been recorded. In addition to winds, tornadoes also exhibit changes in atmospheric variables such as temperature, moisture, and pressure. For example, on June 24, 2003 near Manchester, South Dakota, a probe measured a 100 mbar (hPa) (2.95 inHg) pressure decrease. The pressure dropped gradually as the vortex approached then dropped extremely rapidly to 850 mbar (hPa) (25.10 inHg) in the core of the violent tornado before rising rapidly as the vortex moved away, resulting in a V-shape pressure trace. Temperature tends to decrease and moisture content to increase in the immediate vicinity of a tornado.

Tornadoes often develop from a class of thunderstorms known as supercells. Supercells contain mesocyclones, an area of organized rotation a few miles up in the atmosphere, usually 1–6 miles (1.6–9.7 kilometres) across. Most intense tornadoes (EF3 to EF5 on the Enhanced Fujita Scale) develop from supercells. In addition to tornadoes, very heavy rain, frequent lightning, strong wind gusts, and hail are common in such storms.

Most tornadoes from supercells follow a recognizable life cycle which begins when increasing rainfall drags with it an area of quickly descending air known as the rear flank downdraft (RFD). This downdraft accelerates as it approaches the ground, and drags the supercell's rotating mesocyclone towards the ground with it.

As the mesocyclone lowers below the cloud base, it begins to take in cool, moist air from the downdraft region of the storm. The convergence of warm air in the updraft and cool air causes a rotating wall cloud to form. The RFD also focuses the mesocyclone's base, causing it to draw air from a smaller and smaller area on the ground. As the updraft intensifies, it creates an area of low pressure at the surface. This pulls the focused mesocyclone down, in the form of a visible condensation funnel. As the funnel descends, the RFD also reaches the ground, fanning outward and creating a gust front that can cause severe damage a considerable distance from the tornado. Usually, the funnel cloud begins causing damage on the ground (becoming a tornado) within a few minutes of the RFD reaching the ground.

Initially, the tornado has a good source of warm, moist air flowing inward to power it, and it grows until it reaches the "mature stage". This can last from a few minutes to more than an hour, and during that time a tornado often causes the most damage, and in rare cases can be more than one mile (1.6 km) across. The low pressured atmosphere at the base of the tornado is essential to the endurance of the system. Meanwhile, the RFD, now an area of cool surface winds, begins to wrap around the tornado, cutting off the inflow of warm air which previously fed the tornado.

As the RFD completely wraps around and chokes off the tornado's air supply, the vortex begins to weaken, becoming thin and rope-like. This is the "dissipating stage", often lasting no more than a few minutes, after which the tornado ends. During this stage the shape of the tornado becomes highly influenced by the winds of the parent storm, and can be blown into fantastic patterns. Even though the tornado is dissipating, it is still capable of causing damage. The storm is contracting into a rope-like tube and, due to conservation of angular momentum, winds can increase at this point.

As the tornado enters the dissipating stage, its associated mesocyclone often weakens as well, as the rear flank downdraft cuts off the inflow powering it. Sometimes, in intense supercells, tornadoes can develop cyclically. As the first mesocyclone and associated tornado dissipate, the storm's inflow may be concentrated into a new area closer to the center of the storm and possibly feed a new mesocyclone. If a new mesocyclone develops, the cycle may start again, producing one or more new tornadoes. Occasionally, the old (occluded) mesocyclone and the new mesocyclone produce a tornado at the same time.

Although this is a widely accepted theory for how most tornadoes form, live, and die, it does not explain the formation of smaller tornadoes, such as landspouts, long-lived tornadoes, or tornadoes with multiple vortices. These each have different mechanisms which influence their development—however, most tornadoes follow a pattern similar to this one.

A *multiple-vortex tornado* is a type of tornado in which two or more columns of spinning air rotate about their own axes and at the same time revolve around a common center. A multi-vortex structure can occur in almost any circulation, but is very often observed in intense tornadoes. These vortices often create small areas of heavier damage along the main tornado path. This is a phenomenon that is distinct from a satellite tornado, which is a smaller tornado which forms very near a large, strong tornado contained within the same mesocyclone. The satellite tornado may appear to "orbit" the larger tornado (hence the name), giving the appearance of one, large multi-vortex tornado. However, a satellite tornado is a distinct circulation, and is much smaller than the main funnel.

A *waterspout* is defined by the National Weather Service as a tornado over water. However, researchers typically distinguish "fair weather" waterspouts from tornadic (i.e. associated with a mesocyclone) waterspouts. Fair weather waterspouts are less severe but far more common, and are similar to dust devils and landspouts. They form at the bases of cumulus congestus clouds over tropical and subtropical waters. They have relatively weak winds, smooth laminar walls, and typically travel very slowly. They occur most commonly in the Florida Keys and in the northern Adriatic Sea. In contrast, tornadic waterspouts are stronger tornadoes over water. They form over water similarly to mesocyclonic tornadoes, or are stronger tornadoes which cross over water. Since they form from severe thunderstorms and can be far more intense, faster, and longer-lived than fair weather waterspouts, they are more dangerous. In official tornado statistics, waterspouts are generally not counted unless they affect land, though some European weather agencies count waterspouts and tornadoes together.

A *landspout,* or *dust-tube tornado,* is a tornado not associated with a mesocyclone. The name stems from their characterization as a "fair weather waterspout on land". Waterspouts and landspouts share many defining characteristics, including relative weakness, short lifespan, and a small, smooth condensation funnel which often does not reach the surface. Landspouts also create a distinctively laminar cloud of dust when they make contact with the ground, due to their differing mechanics from true mesoform tornadoes. Though usually weaker than classic tornadoes, they can produce strong winds which could cause serious damage.

A *gustnado,* or *gust front tornado,* is a small, vertical swirl associated with a gust front or downburst. Because they are not connected with a cloud base, there is some debate as to whether or not gustnadoes are tornadoes. They are formed when fast moving cold, dry outflow air from a thunderstorm is blown through a mass of stationary, warm, moist air near the outflow boundary, resulting in a "rolling" effect (often exemplified through a roll cloud). If low level wind shear is strong enough, the rotation can be turned vertically or diagonally and make contact with the ground. The result is a gustnado. They usually cause small areas of heavier rotational wind damage among areas of straight-line wind damage.

A *dust devil* (also known as a whirlwind) resembles a tornado in that it is a vertical swirling column of air. However, they form under clear skies and are no stronger than the weakest tornadoes. They form when a strong convective updraft is formed near the ground on a hot day. If there is enough low level wind shear, the column of hot, rising air can develop a small cyclonic motion that can be seen near the ground. They are not considered tornadoes because they form during fair weather and are not associated with any clouds. However, they can, on occasion, result in major damage.

I. Give the summary of this text in a written form

II. Put 15 questions on the text

Text B TORNADO

Small-scale, tornado-like circulations can occur near any intense surface heat source. Those that occur near intense wildfires are called *fire whirls*. They are not considered tornadoes, except in the rare case where they connect to a pyrocumulus or other cumuliform cloud above. Fire whirls usually are not as strong as tornadoes associated with thunderstorms. They can, however, produce significant damage.

A *steam devil* is a rotating updraft between 50 and 200 meters wide that involves steam or smoke. These formations do not involve high wind speeds, only completing a few rotations per minute. Steam devils are very rare. They most often form from smoke issuing from a power plant's smokestack. Hot springs and deserts may also be suitable locations for a tighter, faster-rotating steam devil to form. The phenomenon can occur over water, when cold arctic air passes over relatively warm water.

The United States has the most tornadoes of any country, nearly four times more than estimated in all of Europe, excluding waterspouts. This is mostly due to the unique geography of the continent. North America is a large continent that extends from the tropics north into arctic areas, and has no major east–west mountain range to block air flow between these two areas. In the middle latitudes, where most tornadoes of the world occur, the Rocky Mountains block moisture and buckle the atmospheric flow, forcing drier air at mid-levels of the troposphere due to downsloped winds, and causing the formation of a low pressure area downwind to the east of the mountains. Increased westerly flow off the Rockies force the formation of a dry line when the flow aloft is strong, while the Gulf of Mexico fuels abundant low-level moisture in the southerly flow to its east. This unique topography allows for frequent collisions of warm and cold air, the conditions that breed strong, long-lived storms throughout the year. A large portion of these tornadoes form in an area of the central United States known as Tornado Alley. This area extends into Canada, particularly Ontario and the Prairie Provinces, although southeast Quebec, the interior of British Columbia, and western New Brunswick are also tornado-prone. Tornadoes also occur across northeastern Mexico.

The United States averages about 1,200 tornadoes per year, followed by Canada, averaging 62 reported per year. NOAA's has a higher average 100 per year in Canada. The Netherlands has the highest average number of recorded tornadoes per area of any country (more than 20, or 0.0013 per sq mi (0.00048 per km^2), annually), followed by the UK (around 33, or 0.00035 per sq mi (0.00013 per km^2), per year), although those are of lower intensity, briefer and cause minor damage.

Tornadoes kill an average of 179 people per year in Bangladesh, the most in the world. Reasons for this include the region's high population density, poor construction quality, and lack of tornado safety knowledge. Other areas of the world that have frequent tornadoes include South Africa, the La Plata Basin area, portions of Europe, Australia and New Zealand, and far eastern Asia.

Tornadoes are most common in spring and least common in winter, but tornadoes can occur any time of year that favorable conditions occur. Spring and fall experience peaks of activity as those are the seasons when stronger winds, wind shear, and atmospheric instability are present. Tornadoes are focused in the right front quadrant of landfalling tropical cyclones, which tend to occur in the late summer and autumn. Tornadoes can also be spawned as a result of eyewall mesovortices, which persist until landfall.

Tornado occurrence is highly dependent on the time of day, because of solar heating. Worldwide, most tornadoes occur in the late afternoon, between 3 pm and 7 pm local time, with a peak near 5 pm. Destructive tornadoes can occur at any time of day. The Gainesville Tornado of 1936, one of the deadliest tornadoes in history, occurred at 8:30 am local time.

The United Kingdom has the highest incidence of tornadoes per unit area of land in the world.[86] Unsettled conditions and weather fronts transverse the British Isles at all times of the years, and are responsible for spawning the tornadoes, which consequently form at all times of the year. The United Kingdom has at least 34 tornadoes per year and possibly as many as 50. Most tornadoes in the United Kingdom are weak, but they are occasionally destructive. For example, the Birmingham tornado of 2005 and the London tornado of 2006 both registered F2 on the Fujita scale and both caused significant damage and injury.

Associations with various climate and environmental trends exist. For example, an increase in the sea surface temperature of a source region (e.g. Gulf of

Mexico and Mediterranean Sea) increases atmospheric moisture content. Increased moisture can fuel an increase in severe weather and tornado activity, particularly in the cool season.

Some evidence does suggest that the Southern Oscillation is weakly correlated with changes in tornado activity, which vary by season and region, as well as whether the ENSO phase is that of El Niño or La Niña. Research has found that fewer tornadoes and hailstorms occur in winter and spring in the U.S. central and southern plains during El Niño, and more occur during La Niña, than in years when temperatures in the Pacific are relatively stable. Ocean conditions could be used to forecast extreme spring storm events several months in advance.

Climatic shifts may affect tornadoes via teleconnections in shifting the jet stream and the larger weather patterns. The climate-tornado link is confounded by the forces affecting larger patterns and by the local, nuanced nature of tornadoes. Although it is reasonable to suspect that global warming may affect trends in tornado activity, any such effect is not yet identifiable due to the complexity, local nature of the storms, and database quality issues. Any effect would vary by region.

Today most developed countries have a network of weather radars, which serves as the primary method of detecting hook signatures that are likely associated with tornadoes. In the United States and a few other countries, Doppler weather radar stations are used. These devices measure the velocity and radial direction (towards or away from the radar) of the winds within a storm, and so can spot evidence of rotation in storms from over one hundred miles (160 km) away. When storms are distant from a radar, only areas high within the storm are observed and the important areas below are not sampled.[96] Data resolution also decreases with distance from the radar. Some meteorological situations leading to tornadogenesis are not readily detectable by radar and tornado development may occasionally take place more quickly than radar can complete a scan and send the batch of data. Doppler radar systems can detect mesocyclones within a supercell thunderstorm. This allows meteorologists to predict tornado formations throughout thunderstorms.

In the mid-1970s, the U.S. National Weather Service (NWS) increased its efforts to train storm spotters so they could spot key features of storms that indicate severe hail, damaging winds, and tornadoes, as well as storm damage and flash flooding. The program was called **Skywarn**, and the spotters were local sheriff's deputies, state troopers, firefighters, ambulance drivers, amateur radio operators, civil defense (now emergency management) spotters, storm chasers, and ordinary citizens. When severe weather is anticipated, local weather service offices request these spotters to look out for severe weather and report any tornadoes immediately, so that the office can warn of the hazard.

Spotters usually are trained by the NWS on behalf of their respective organizations, and report to them. The organizations activate public warning systems such as sirens and the Emergency Alert System (EAS), and they forward the report to the NWS. There are more than 230,000 trained Skywarn weather spotters across the United States.

In Canada, a similar network of volunteer weather watchers, called **Canwarn**, helps spot severe weather, with more than 1,000 volunteers. In Europe, several nations are organizing spotter networks under the auspices of Skywarn Europe and the Tornado and Storm Research Organisation (TORRO) has maintained a network of spotters in the United Kingdom since 1974.

Storm spotters are required because radar systems such as NEXRAD detect signatures which suggest the presence of tornadoes, rather than tornadoes as such. Radar may give a warning before there is any visual evidence of a tornado or an imminent one, but ground truth from an observer can give definitive information.[104] The spotter's ability to see what radar can't is especially important as distance from the radar site increases, because the radar beam becomes progressively higher in altitude further away from the radar, chiefly due to curvature of Earth, and the beam also spreads out.

Storm spotters are trained to discern whether or not a storm seen from a distance is a supercell. They typically look to its rear, the main region of updraft and inflow. Under that updraft is a rain-free base, and the next step of tornadogenesis is the formation of a rotating wall cloud. The vast majority of intense tornadoes occur with a wall cloud on the backside of a supercell.

Evidence of a supercell is based on the storm's shape and structure, and cloud tower features such as a hard and vigorous updraft tower, a persistent, large overshooting top, a hard anvil (especially when backsheared against strong upper level winds), and a corkscrew look or striations. Under the storm and closer to where most tornadoes are found, evidence of a supercell and the likelihood of a tornado includes inflow bands (particularly when curved) such as a "beaver tail", and other clues such as strength of inflow, warmth and moistness of inflow air, how outflow- or inflow-dominant a storm appears, and how far is the front flank precipitation core from the wall cloud. Tornadogenesis is most likely at the interface of the updraft and rear flank downdraft, and requires a balance between the outflow and inflow.

Only wall clouds that rotate spawn tornadoes, and they usually precede the tornado between five and thirty minutes. Rotating wall clouds may be a visual manifestation of a low-level mesocyclone. Barring a low-level boundary, tornadogenesis is highly unlikely unless a rear flank downdraft occurs, which is usually visibly evidenced by evaporation of cloud adjacent to a corner of a wall cloud. A tornado often occurs as this happens or shortly afterwards; first, a funnel cloud dips and in nearly all cases by the time it reaches halfway down, a surface swirl has already developed, signifying a tornado is on the ground before condensation connects the surface circulation to the storm. Tornadoes may also develop without wall clouds, under flanking lines and on the leading edge. Spotters watch all areas of a storm, and the cloud base and surface.

The tornado which holds most records in history was the Tri-State Tornado, which roared through parts of Missouri, Illinois, and Indiana on March 18, 1925. It was likely an F5, though tornadoes were not ranked on any scale in that era. It holds records for longest path length (219 miles; 352 km), longest duration (about 3.5

hours), and fastest forward speed for a significant tornado (73 mph; 117 km/h) anywhere on Earth. In addition, it is the deadliest single tornado in United States history (695 dead). The tornado was also the costliest tornado in history at the time (unadjusted for inflation), but in the years since has been surpassed by several others if population changes over time are not considered. When costs are normalized for wealth and inflation, it ranks third today.

The deadliest tornado in world history was the Daultipur-Salturia Tornado in Bangladesh on April 26, 1989, which killed approximately 1,300 people. Bangladesh has had at least 19 tornadoes in its history that killed more than 100 people, almost half of the total in the rest of the world.

The most extensive tornado outbreak on record was the 2011 Super Outbreak, which spawned 360 confirmed tornadoes over the southeastern United States, 216 of them within a single 24-hour period. The previous record was the 1974 Super Outbreak which spawned 148 tornadoes.

While direct measurement of the most violent tornado wind speeds is nearly impossible, since conventional anemometers would be destroyed by the intense winds and flying debris, some tornadoes have been scanned by mobile Doppler radar units, which can provide a good estimate of the tornado's winds. The highest wind speed ever measured in a tornado, which is also the highest wind speed ever recorded on the planet, is 301 ± 20 mph (484 ± 32 km/h) in the F5 Bridge Creek-Moore, Oklahoma, tornado which killed 36 people. The reading was taken about 100 feet (30 m) above the ground.

Storms that produce tornadoes can feature intense updrafts, sometimes exceeding 150 mph (240 km/h). Debris from a tornado can be lofted into the parent storm and carried a very long distance. A tornado which affected Great Bend, Kansas, in November 1915, was an extreme case, where a "rain of debris" occurred 80 miles (130 km) from the town, a sack of flour was found 110 miles (180 km) away, and a cancelled check from the Great Bend bank was found in a field outside of Palmyra, Nebraska, 305 miles (491 km) to the northeast. Waterspouts and tornadoes have been advanced as an explanation for instances of raining fish and other animals.

Though tornadoes can strike in an instant, there are precautions and preventative measures that can be taken to increase the chances of survival. Authorities such as the Storm Prediction Center advise having a pre-determined plan should a tornado warning be issued. When a warning is issued, going to a basement or an interior first-floor room of a sturdy building greatly increases chances of survival. In tornado-prone areas, many buildings have underground storm cellars, which have saved thousands of lives.

Some countries have meteorological agencies which distribute tornado forecasts and increase levels of alert of a possible tornado (such as tornado watches and warnings in the United States and Canada). Weather radios provide an alarm when a severe weather advisory is issued for the local area, mainly available only in the United States. Unless the tornado is far away and highly visible, meteorologists advise that drivers park their vehicles far to the side of the road (so as not to block emergency traffic), and find a sturdy shelter. If no sturdy shelter is nearby, getting low in a ditch is the next best option. Highway overpasses are one of the worst places to take shelter during tornadoes, as the constricted space can be subject to increased wind speed and funneling of debris underneath the overpass.

Folklore often identifies a green sky with tornadoes, and though the phenomenon may be associated with severe weather, there is no evidence linking it specifically with tornadoes. It is often thought that opening windows will lessen the damage caused by the tornado. While there is a large drop in atmospheric pressure inside a strong tornado, it is unlikely that the pressure drop would be enough to cause the house to explode. Opening windows may actually increase the severity of the tornado's damage. A violent tornado can destroy a house whether its windows are open or closed.

Another commonly held misconception is that highway overpasses provide adequate shelter from tornadoes. This belief is partly inspired by widely circulated video captured during the 1991 tornado outbreak near Andover, Kansas, where a news crew and several other people take shelter under an overpass on the Kansas Turnpike and safely ride out a tornado as it passes by. However, a highway overpass is a dangerous place during a tornado, and the subjects of the video remained safe due to an unlikely combination of events: the storm in question was a weak tornado, the tornado did not directly strike the overpass, and the overpass itself was of a unique design. Due to the Venturi effect, tornadic winds are accelerated in the confined space of an overpass. Indeed, in the 1999 Oklahoma tornado outbreak of May 3, 1999, three highway overpasses were directly struck by tornadoes, and at each of the three locations there was a fatality, along with many life-threatening injuries.[118] By comparison, during the same tornado outbreak, more than 2,000 homes were completely destroyed and another 7,000 damaged, and yet only a few dozen people died in their homes.

An old belief is that the southwest corner of a basement provides the most protection during a tornado. The safest place is the side or corner of an underground room opposite the tornado's direction of approach (usually the northeast corner), or the central-most room on the lowest floor. Taking shelter in a basement, under a staircase, or under a sturdy piece of furniture such as a workbench further increases chances of survival.

There are areas which people believe to be protected from tornadoes, whether by being in a city, near a major river, hill, or mountain, or even protected by supernatural forces. Tornadoes have been known to cross major rivers, climb mountains, affect valleys, and have damaged several city centers. As a general rule, no area is safe from tornadoes, though some areas are more susceptible than others.

Meteorology is a relatively young science and the study of tornadoes is newer still. Although researched for about 140 years and intensively for around 60 years, there are still aspects of tornadoes which remain a mystery. Scientists have a fairly good understanding of the development of thunderstorms and mesocyclones, and the meteorological conditions conducive to their formation. However, the step from supercell, or other respective formative processes, to tornadogenesis and the prediction of tornadic vs. non-tornadic mesocyclones is not yet well known and is the focus of much research.

Also under study are the low-level mesocyclone and the stretching of low-level vorticity which tightens into a tornado, in particular, what are the processes and what is the relationship of the environment and the convective storm. Intense tornadoes have been observed forming simultaneously with a mesocyclone aloft (rather than succeeding mesocyclogenesis) and some intense tornadoes have occurred without a mid-level mesocyclone.

In particular, the role of downdrafts, particularly the rear-flank downdraft, and the role of baroclinic boundaries, are intense areas of study.

Reliably predicting tornado intensity and longevity remains a problem, as do details affecting characteristics of a tornado during its life cycle and tornadolysis. Other rich areas of research are tornadoes associated with mesovortices within linear thunderstorm structures and within tropical cyclones.

Scientists still do not know the exact mechanisms by which most tornadoes form, and occasional tornadoes still strike without a tornado warning being issued. Analysis of observations including both stationary and mobile (surface and aerial) in-situ and remote sensing (passive and active) instruments generates new ideas and refines existing notions. Numerical modeling also provides new insights as observations and new discoveries are integrated into our physical understanding and then tested in computer simulations which validate new notions as well as produce entirely new theoretical findings, many of which are otherwise unattainable. Importantly, development of new observation technologies and installation of finer spatial and temporal resolution observation networks have aided increased understanding and better predictions.

Research programs, including field projects such as the VORTEX projects (Verification of the Origins of Rotation in Tornadoes Experiment), deployment of TOTO (the TOtable Tornado Observatory), Doppler on Wheels (DOW), and dozens of other programs, hope to solve many questions that still plague meteorologists. Universities, government agencies such as the National Severe Storms Laboratory, private-sector meteorologists, and the National Center for Atmospheric Research are some of the organizations very active in research; with various sources of funding, both private and public, a chief entity being the National Science Foundation. The pace of research is partly constrained by the number of observations that can be taken; gaps in information about the wind, pressure, and moisture content throughout the local atmosphere; and the computing power available for simulation.

Solar storms similar to tornadoes have been recorded, but it is unknown how closely related they are to their terrestrial counterparts.

I. Write down the plan to the text

II. Give the main idea of the text

LEXICAL EXERCISES

I. Translate the following sentences, paying attention to the "fuse and meanings of the word "no:"

1. No physical property of the air is strictly conservative.
2. Ii no heat is supplied to, or withdrawn from, the air from some external source, it follows that the air temperature in any level is the more conservative for vertical mixing the closer the lapse rate is to the adiabatic rate.
3. No interchange of heat is assumed to take place between the parcel of air and its environment.
4. The fluctuations are extremely irregular, and appear to bear no definite relation to one another.
5. The wet-bulb thermometer assumes a constant temperature, indicating that there is no net gain or loss of heat.
6. If there is no subsidence the lapse-rate is nearly dry-adia-batic in the upper levels.
7. The cloud known as altostratus (or nimbostratus) has a great vertical extension but no great opacity.
8. Stratus seen from the ground shows no definite structure because the observer is too near the cloud layer.
9. No precise figures have been laid down, but a depression in which the pressure at the centre is less than 990 mb. may be called deep; one in which the central pressure is above 1,010 mb. may be called shallow.
10. Intermediate between the two types of occlusion there is the case where no marked contrast in temperature exists between the two air masses.

II. Translate the following sentences, paying attention to the words and phrases in bold type:

1. The property of an air mass must remain conservative for at least 12 hr. as far as the surface observations are concerned and for about 24 hr. with regard to the upper air observations.
2. In view of the character of the data available, it is first necessary to make the following remarks regarding the cloud distribution presented in this paper before discussing conclusions.
3. Owing to its continental origin, the winter monsoon is a cold dry wind.
4. The properties of the lowest layers of air are subject to rather rapid modification and are therefore dependent to a large extent upon the immediate past history of the air.
5. Continental tropical air is generally of low relative humidity, for even if it acquires

moisture from the Mediterranean, most of this is deposited on the mountains of southern Europe.
6. Thanks, however, to low humidity of continental polar air there is little convection, and over land and near the coast the air mass is characterized by clear skies or only a few cumulus clouds.
7. In winter, owing to the coldness of the sea surf ace, the temperature of the air is little above the freezing-point, but upper air observations show that there is often an inversion of temperature aloft, probably due to subsidence.
8. The damage caused by tornado is nevertheless serious owing to the high wind speeds, exceeding 200 knots, which occur within it.
9. Although the detailed meteorological problems described in

GRAMMAR EXERCISES

Exercise 1. Make up sentences using Subjunctive II:

I		you (to meet) us at the station.
He	Wish	we (to take) a porter. The luggage is heavy.
She	Wishes	they (to send) for a doctor at once.
We	Wished	she (to tell) her friends everything.
They		they (to be) frank with us.

Exercise 2. Fill in the blanks using the corresponding Mood form:

1. I wish you ... this film (saw, had seen). I am sure you would like it. 2. I wish you ... earlier (came, had come). You should have gone to the museum together. 3. I wish you ... time to read this article (had, had come). Now you would able to answer all the questions. 4. I wish you … my friend (saw, had seen).

Exercise 3. Using the corresponding Mood form instead of the infinitive in brackets:

Model: *1) I wish you (to go) for a walk late in the evening.*
I wish you did not go for walk late in the evening.
2) I wish I never (to buy) that terrible raincoat.
I wish I had never bought that terrible raincoat.

1. I wish I (to buy) that grey hat instead of this one. It was more expensive, but the quality was much better. 2. It looks like raining, I wish we (to take) our umbrellas. 3. The child is crying, I wish I (to know) how to calm her. 4. I wish you (to finish) your work already. We could go for a walk now. 5. I wish I (to know) it was your favourite writer. I would have bought the book for you.

Exercise 4. Complete the following sentences:

1. If I were not so busy ... 2. The weather is so fine today. I wish ... 3. Our tram is starting. Make haste lest ... 4. Had he been informed about her arrival ... 5. If it were not raining now ... 6. Should he bring you up ... 7. It is annoying that ... 8. I should have taken part in the discussion ... 9. Had he been more attentive ... 10. The teacher recommended that ... 11. Wind your watch lest ... 12. If he were not so derisive ... 13. They would have met us at the airport ... 14. It takes me much time to get to my office. I wish ... 15. She looks pale and tired as if .... 16. My friend insisted that ... 17. If you had followed your friend's advice ... 18. Evidently the letter upset him. I wish ... 19. He dropped his eyes as though ... 20. It is important that ... 21. If I were …

Exercise 5. Translate the following sentences and analyze the use of Subjunctive II:

1. They walked together just as if they had done it scores of times before. 2. Lord Henry struck a light on a dainty silver case, and began to smoke a cigarette with a self-conscious and satisfied air, as if he had summed up the world into phrase. 3. He turned away as if he had never noticed her. 4. The room looked as if it had not been lived in for years. 5. Even if she were there I would be unlikely to find her.

Exercise 6. Open the brackets using necessary Subjunctive form after "I wish" and translate:

1. I wish I (to know) French.
2. She fell and broke her leg. I wish she (to be) more careful.
3. I wish you (to read) more English books in future.
4. I feel sick. I wish I (not to eat) all the ice cream.
5. They need a singer for the choir. I wish I (can) sing.
6. My parrot has died. I wish I (to look after) it better.
7. I can't remember her telephone number. I wish I (can).
8. I wish I (not to lend) him my car: he has broken it.
9. My watch has stopped. I wish I (to have) a better watch.
10. I feel so tired. I wish I (not to stay up) so late last night.
11. My apartment is rather small. I wish I (to have) a bigger one.
12. I wish I (not to spend) all my money last night.
13. I wish I (to know) the answer to this question.
14. I wish you (to phone) me yesterday.
15. I wish I (to know) then what I know now.

Exercise 7. Paraphrase the sentences using "I wish" and translate.

1. I am not very fit. 2. We weren't together. 3. He was too upset that day. 4. They

couldn't come here. 5. It's very hot today. 6. My parents are abroad. 7. It's snowing. 8. He has read my letter. 9. She doesn't know enough English. 10. My son didn't take my advice. 11. His room is untidy. 12. They wasted much time watching TV. 13. He doesn't have a lot of friends. 14. I can't swim.

LESSON 8

I. Translate the text:

Text A THE PARIS CLIMATE AGREEMENT OF THE UNITED NATIONS

The Paris Agreement (L'accord de Paris) is an agreement within the framework of the United Nations Framework Convention on Climate Change (UNFCCC) on the regulation of measures to reduce carbon dioxide emissions from 2020. The Paris Charter should replace the Kyoto Protocol. The text of the agreement was agreed upon at the 21st Conference of UNFCCC participants in Paris and accepted by consensus on December 12, 2015. The conference chairman, Laurent Fabius, French Foreign Minister, said that this "ambitious and balanced" plan was a "historic turning point" in the goal of reducing rates global warming. The agreement came into force on November 4, 2016. Unlike the Kyoto Protocol, the Paris Climatic Agreement provides that all countries will take on commitments to reduce harmful emissions in the atmosphere, regardless of the degree of their economic development. The main objective of the Paris Agreement is to prevent the growth of the global average temperature above 2 ° C (if possible - not more than 1.5 ° C) relative to the preindustrial era. Probably, we are talking about the historical period until the 1750s -before England's industrial revolution, which later swept through the countries of Europe, began. Then humanity began to burn a huge amount of fossil fuels, which led to climate change. For more than 250 years, the global average temperature has gradually increased. At the time of the agreement, researchers from the American Meteorological Society have suggested that in 2015, the average temperature on the planet for the first time increased by more than 1 ° C compared with the pre-industrial period. The second objective of the contract is to reduce greenhouse gas emissions to the atmosphere to zero in the second half of the XXI century. Each country committed itself to make contributions to achieve these two goals, the so-called "nationally defined contributions". The contract says that these deposits should be ambitious and grow over time. Every five years, States would report on contributions made to the UNFCCC Secretariat and set new goals. The first report of the country should be provided in 2023.

Sounds good, but there is a nuance criticized by the Paris Agreement - it does not imply any sanctions on countries that could not (or did not want to) make the promised contributions. Instead, within the framework of the treaty there will be a system of "naming and shaming". Thus, the goals are purely voluntary, and if a country is not afraid of losing reputation, it is rather unlikely. In any event, the deal was called a historic and critical one. The fact is that this is the first agreement on climate so large a scale - it was signed by 195 states and the EU. But, in fact, they ratified 175. But among them, all of the top 5 "polluters" except Russia, whose administration stated the need to "seek new recipes" in combating atmospheric emissions. Humanity really needs a global climate deal. Global warming entails a number of problems, including raising the sea level (which greatly increases the risk of floods and storms), drought, increasing the number and intensity of hurricanes and the disappearance of certain species of plants and animals. Also, climate change will complicate the process of growing edible products - especially in Africa; supplies of drinking water will also be reduced. In addition, scientists argue that global environmental change can lead to the largest refugee crisis in human history. Not surprisingly, according to a 2016 poll conducted by the World Economic Forum, most respondents identified the major risks of the next ten years, namely, the massive flows of refugees and the lack of progress in combating global warming. In this regard, developed countries began to introduce "competitive" techniques for saving electricity - both in households and in companies. Scientists and psychologists in the video from "Vox" told about this and also about the ozone layer and the danger of carbon dioxide. If the treaty does not provide for sanctions, countries can safely withdraw from it. And this opportunity has already been used by the president of the USA - in the winter of 2017 Trump declared the country's withdrawal from the agreement. And here is an interesting point - the Paris Treaty stipulates that the withdrawal of the state can be made only four years after the entry into force of the treaty; that is, the United States will cease to be a membe, ove er 4 2020 one day after the US presidential election, which This move by the United States administration has outraged other contracting parties. At one of the press conferences, Emmanuel Macron appealed to US citizens: "Scientists, engineers, entrepreneurs and responsible citizens who were upset by the decision of the president of the United States, will find in France a second home country. Come and work here with us. I assure you, France will not leave this struggle. " Residents of the United States were really not so enthusiastic about such developments. The governors of several states have created a Climate Change Alliance, whose members have pledged to pursue the objectives of the Paris Agreement, despite the Trump decision. At present, the Alliance has 16 states, accounting for more than 40% of the US population. Trump's speeches rarely withstand even the most superficial faktuchkings, and his application for withdrawal from the treaty is not an exception. Among the reasons for the release, the president of the United States identified "draconian financial and economic commitments" that will restrain the development of the country's economy. If we take into account the fact that the participating States individually define their goals and will not bear any legal punishment in case of noncompliance, the words of Donald Trump sound at least strange. Another "reason" to stop is that other countries will use this agreement to become more economically strong, and the US does it "forbidden". China will be able to build hundreds of new coal stations. That is, we can not build stations, and they are - yes. Under the agreement, India will be allowed to double coal mining by 2020. And we have to stop. Can someone within the framework of an agreement "allow" China to build coal stations, if their goals are determined by the treaty, in fact, the Chinese government? The country needs these stations, because, unlike the United States, it does not have access to cheap natural gas. However, already in 2017, China abolished plans for the construction of hundreds of coal stations. India, however, pledged to receive 40% of its energy from renewable sources by 2020. Analysts argue that since the signing of the agreement, both countries have made significant progress in reducing greenhouse gas emissions; in this way, they will not only fulfill the goals set by the governments, but overcome them. The latest UN report indicates that the targets set by States are only 1/3 of the required amount of emission reductions by 2030. This means that after the first review of contributions, each state should set a much higher threshold for the next five years. The Paris agreement came into force a year ago, but we still do not even do enough to protect hundreds of millions of people from the miserable future, commented Eric Solheim, the head of the UN ecological group. The report provides climate experts with practical (albeit well-known) advice on how to solve the problem: implement environmental technologies in construction and transport, encourage the private sector to participate in the implementation of the agreement and change national legislation by introducing more stringent environmental requirements. It will be possible to assess in detail the contribution of each country in 2023, when governments provide the first reports on the work done. So far, let's hope for the best result. The purpose of the agreement is to "strengthen the implementation of the Framework Convention on Climate Change by": (a) maintaining the growth of the average world temperature at a level well below + 2 ° C from preindustrial levels and directing efforts to limit the temperature rise to + 1.5 ° C from preindustrial levels, as this will significantly reduce the risks and impacts of climate change; (b) increasing the ability to adapt to the negative impacts of climate change, support for climate change mitigation, and the development of low greenhouse gas emissions in a way that does not endanger food production; (c) Harmonization of financial flows through climate change mitigation and low greenhouse gas emissions. " In addition, countries will try to achieve "a turning point in greenhouse gas emissions as soon as possible" (since greenhouse gas emissions are sustained in the atmosphere for a long time, and the development and growth of the welfare of the poor and the poorest countries leads to an increase in their greenhouse gas emissions, there is a cumulative effect, levels of greenhouse gas accumulation will reach a turning point - the peak, after which the fall will be, the greater will be the negative impact on climate, and accordingly, the heavier and more expensive efforts to minimize the impact). The participation of each individual country in the achievement of the global goal is determined individually by it and it is called "nationally determined contribution" (NDC). The agreement requires that such participation be "ambitious" and established "in order to achieve the purpose of the Agreement". As regards participation, the country reports and is reviewed every 5 years. Participation of the country is registered with the Secretariat of the Framework Convention. Each of the following parameters of participation should be more ambitious than previous ones. Countries can co-operate and combine their nationally defined participation options. During the UN Conference on Climate Change 2015, States Parties have committed themselves to the "Intended Nationally Determined Contribution" ("Intended Nationally Determined Contribution"), which will serve as the initial nationally determined participation, unless otherwise provided by the country in the order established by the Agreement. The level of nationally determined participation of each country will set a binding goal, as was the case in the Kyoto Protocol. However, there will be no mechanism to force a country to set a goal in its nationally defined participation until a certain date or effects, unless such a goal is achieved in nationally defined participation; there will be only a system of "naming and shaming". Execution of the Agreement by all signatories will generally be evaluated every 5 years; the first such assessment will be in 2023. The evaluation results will be used to establish a new nationally determined participation of participating countries for the next period. A global review will not test the individual participation / achievements of individual countries, but will be an analysis that has been globally achieved and what else to do. Within the framework of the UN Framework Convention on Climate Change, it is permissible to adopt legal instruments to achieve the objectives of the Convention.

For 2008-2012, the GHG emission reduction measures were agreed upon by the Kyoto Protocol in 1997. The volume of the protocol was extended to 2020 by the Board's change from 2012. During the 2011 United Nations Conference on Climate Change, the Durban Platform was adopted (and the Ad Hoc Working Group on the Durban Platform for Enhanced Action was established) to coordinate the legal instrument for managing climate change mitigation measures after 2020; the tool was set up to 2015. At the conclusion of the 21st Conference on Climate Change on December 12, 2015, the final text of the Paris Agreement was agreed by consensus of all 195 signatories of the Framework Convention and the European Union with a view to reducing emissions as part of the effort to reduce unbundled greenhouse gas emissions. On the 12 pages of the Agreement, the participants promised to reduce their carbon emissions "as soon as possible" and make maximum efforts to limit global warming at "significantly below + 2 ° C." It is not an official part of the Paris Agreement, and therefore legally non-binding, an agreement on (obligatory) intentions to provide annually 100 billion dollars to developing countries to implement new procedures to minimize climate change. The agreement became available for signature in April 2016 for all 197 members of the UN Framework Convention on Climate Change (all United Nations and Cook Islands, Niue, Palestine and European Union). The deal will only come into force if it is ratified / approved by at least 55 countries that produce at least 55% of global greenhouse gas emissions. However, it is not currently known which countries will sign and / or ratify the agreement, including among the countries with the highest volumes of annual emissions. For example, while US President Barack Obama approves of the agreement as "ambitious" and "historic," the US Congress or new president may have another opinion after the election (it is known that the United States signed but never ratified the Kyoto Protocol).

As of July 26, 2016, the agreements were signed by 177 countries and the European Union. 22 of these countries have ratified the agreement. Ukraine signed the agreement on April 22, 2016 in New York. The Verkhovna Rada of Ukraine ratified it on July 14, 2016. President of Ukraine Petro Poroshenko signed the law "On Ratification of the Paris Agreement" on August 1, 2016. The agreement came into force on November 4, 2016, after Canada, Bolivia,)1 Nepal, the European Union and a number of EU member states acceded to it on October 5. At that time, the agreement was ratified by 72 countries, accounting for more than 56% of greenhouse gas emissions in the world. The condition for the entry into force of the agreement was the ratification by 55 countries, which account for at least 55% of global emissions of greenhouse gases. Although the agreement was approved by many, including UN Secretary-General Ban Ki-moon, criticism also appeared. So Professor James Hansen, a former scientist at NASA and an expert on climate change, expressed his anger at the fact that most of the Agreement consists of "promises" or goals, and not from hard installations. Al Gore noted that "no deal is perfect, and this must eventually be made more rigorous, but now groups in every sector of society will begin to reduce the risk of carbon contamination under this agreement."

Answer the questions

1. What kind of agreement is the Paris Agreement?
2. What is the main objective of the Paris Agreement?
3. What is the second objective of the contract?
4. How many countries signed this agreement?
5. What are the main problems of global warming?
6. Can the global environmental change lead to the largest refugee crisis?
7. Why do you think the president of the USA D.Trump withdrawaled from the agreement?
8. What have some governors of several states created?
9. How does the agreement influence such countries as China, India?
10. What is the purpose of this agreement?
11. What will the countries try to achieve?
12. What is the “nationally determined contribution”?
13. When did Ukraine sign this agreement?

TEXT B CURRENT AND FUTURE IMPACT ON UKRAINE'S ECONOMY

The Paris Agreement is a treaty signed by Ukraine within the framework of the UN Convention on Climate Change. The agreement implies a dramatic reduction of carbon emissions in the air to prevent global warming. November 4 The agreement comes into force: it was ratified by both the EU and the United States. To fulfill its demands, Ukraine must radically revise its energy strategy. What did we promise? This February in Ukraine, at 6.2 ° C, was wanner than the climate norm. This February in Ukraine, at 6.2 ° C, was wanner than the climate norm. According to the Intergovernmental Panel on Climate Change, human activities (with a probability of 95%) are the dominant cause of global warming. The warming observed since the middle of the twentieth century, accompanied by an increase in the temperature in the atmosphere and oceans, a decrease in the mass of snow and ice, rising sea levels and an increase in the concentration of greenhouse gases (GFIGs). And although climate change is a long-term problem that needs to be addressed at least until the middle, and possibly by the end of the twenty-first century, it already requires urgent action, taking into account the pace and extent of GEIG accumulation in the atmosphere and the danger of temperature increase on Earth more than 2 ° WITH. For example, according to the American National Aeronautics and Space Administration (NASA), the average surface temperature of the Earth was 1.35 ° C higher than in 1951-1980. And according to observations of the Central Geophysical Observatory of the SSU of Ukraine this year's February, as much as 6.2 ° C, it was warmer than the climatic norm (average temperature in Kyiv was + 2.0 ° C), and the meteorological winter in Ukraine was the second fastest after the winter of 1989-1990 It lasted only from December 29 to February 21 - only 55 days.

From the point of view of energy, temperature increase and shorter winter time can be (at first glance) called "pluses": it contributes to better crop yields, reduction of energy needs for heating premises, etc. However, we all see the real consequences: reducing the frequency and intensity of precipitation, unstable snow cover, increasing the value and duration of extreme temperatures, increasing the number of natural disasters (storms, abnormal showers, flooding, etc.). All this ruthlessly can close all the "pluses" for agriculture, such as energy.

Reducing the frequency and intensity of precipitation significantly affects the water level in the rivers, the water of which is used both for the production of electricity (HPP, PSP), and for the safe operation (cooling) of thermal power plants (NPPs, TPPs, CHPPs). Increasing the values and duration of extreme temperatures is a significant challenge for domestic energy, since during this period the demand for energy resources is sharply and significantly increasing.

We are watching it now. Since late June there has been a sharp increase in electricity consumption due to the high temperature and, in particular, the massive inclusion of air conditioners has prompted our country to seek Russia's help, since its capabilities have been exhausted.

It is energy responsible for most greenhouse gas emissions in the atmosphere. Fighting climate change is impossible without industry reforms. Power engineering is the main source of climate change. In the world up to 70% of all of the world is produced (produced) from the combustion of carbon-intensive types of energy resources (first of all, coal, gas, oil, petroleum products), as well as in their production (production), processing, storage, transportation and consumption of fuel in all sectors of the economy. greenhouse gas emissions. In Ukraine, the situation is similar to the world. In the period from 1990 to 2014, GFIG emissions from the Energy sector amounted to 67.7-75.7% of all GHG emissions (excluding their absorption), and together with the sector "Industrial Processes" - 84.4-90 , 0%. Energy should go to the use of "clean" and safe resources: the energy of wind, sun, earth, biomass. Energy sector's impact on total greenhouse gas emissions is so high as coal, oil and gas (which have the highest carbon content) make up about 86% of the world's energy balance. In Ukraine, this figure is about 80% due to the fact that we have a significant share of electricity generated at NPPs. For the immediate fight against climate change, which is a potentially irreversible threat to humanity and the planet, all countries in the world signed a so-called Paris Agreement in December 2015, in which they will try to respond effectively and effectively to the problem of global greenhouse gas emissions. The goal is to keep the average temperature increase on the planet well below 2 ° C (compared to the pre-industrial level) and to endeavor to limit the temperature rise to 1.5 ° C.

In addition, signatories are invited to prepare their low carbon development strategies for the period up to 2050, with the goal of which should be a significant reduction in greenhouse gas emissions, while simultaneously ensuring economic growth, improving the well-being of citizens, etc. That is to say, this should be a strategy for introducing a "green" model of the economy, which generates a quantity of greenhouse gas emissions that does not exceed the amount of their absorption or capture and storage. Obviously, energy will play a key role in this strategy, which should move from using carbon-based energy sources to clean and safe: the energy of wind, sun, land, biomass, etc. At the same time, it is necessary to significantly increase the level of energy efficiency and energy saving, introducing a system of energy management and intellectualization (smart grids, etc.), expanding the area and number of forests, greening the city and much more.

Reducing emissions is not just abandoning coal, oil or gas, it's also new equipment and energy efficiency investments. For Ukraine, this is perhaps the most important challenge facing the future (after the restoration of territorial integrity). After all, the high continuous increase in the level of depreciation of fixed assets in Ukraine reduces the opportunities for economic growth in the absence of sufficient investment volumes. If Ukraine does not change the model of socio-economic development, and preserves the problem (lack of significant structural changes in both the economy and energy), we are waiting for an increase in technological risks and threats and contradictory tendencies in the economically developed countries to increase energy needs. At the same time, the need for financial resources to ensure the reliability of the functioning of the energy sector will increase substantially.

In order to achieve emission reductions with economic growth, Ukraine needs to adopt a comprehensive development strategy. For the introduction of low carbon development it is necessary to involve in the economy of Ukraine 75-100 billion euros by 2030. Nevertheless, Ukraine makes a definite move towards low carbon development. So, on April 22, 2016 on the Earth Day, a representative of our country signed the Paris Agreement at the UN headquarters in New York. In record terms, as for Ukraine, the Verkhovna Rada of Ukraine ratified it on July 14, 2016, becoming the 20th among all those who did it and the 2nd European country (after Norway). This should have a significant impact on the goals and priorities of the new Energy Strategy of Ukraine for the period up to 2035, the process of which has been significantly delayed and insufficiently public. According to the State Enterprise "Institute of Economics and Forecasting of the National Academy of Sciences of Ukraine", carried out within the framework of the project of the United States Agency for International Development "Municipal Energy Reform in Ukraine", for the introduction of low carbon development it is necessary to attract extremely large investment resources to the Ukrainian economy -75-100 billion Euros to 2030 which are economically feasible and will ensure the country's economic growth and a significant increase in the welfare of the population of Ukraine. One of the main sources of such investments for Ukraine should be the Paris Agreement, as it provides for developing countries, besides commitments, also the possibility of obtaining financing that should facilitate the implementation of their policies, strategies, regulatory norms, plans of action and measures combating climate change in order to contribute to the achievement of the global goal. The sources of funding should be developed countries, which must mobilize at least $ 100 billion by 2025. US per year, taking into account the needs and priorities of developing countries. The bodies entrusted with the management of financial mechanisms will be the Green Climate Fund and the Global Environment Facility, as well as the Least Developed Countries Fund and the Special Climate Change Fund. In addition, scientists from the Institute of Economics and Forecasting of the National Academy of Sciences of Ukraine, using the experience of the European Union and taking into account the Paris Agreement, proposed the main goals (criteria) of Ukraine's energy policy by 2050, which could be the basis of the new Energy Strategy of Ukraine for period up to 2035.

Major Goals by 2020:

• Enhancing energy efficiency by 9% in accordance with the National Energy Efficiency Action Plan by 2020.

• Ensuring the share of RES in gross final consumption at 11% according to the National Renewable Energy Action Plan by 2020.

• Compliance with the Kyoto Protocol (greenhouse gas emissions will not exceed 76% of 1990 levels).

The main coals for 2035 are:

• Increase energy efficiency by at least 19.5%.

• Ensuring the share of RES in gross final consumption is at least 21.5%. Gradual and steady reduction of emissions of sulfur dioxide (S02), nitrogen oxides (NOx), and substances in the form of suspended solids, not differentiated by composition (dust), from large combustion plants with a total rated thermal power of 50 MW or more, which will lead to to comply with the requirements of Directive 2010/75 / EC.

Not exceeding 43% (level 2012-2013) of the level of greenhouse gas emissions in 1990, which will provide the "decoupling" effect in the development of the Ukrainian economy.

The main goal by 2050: • GHG emission reductions from the functioning of Ukraine's energy sector to 30% of 1990 levels (or at least 25% less than 2012) in 2050 or earlier. Decoupling is the distinction between economic growth and environmental pressures. Decoupling effect - emission reduction with GDP growth. Ensuring the "decoupling" effect in Ukraine's economic development is quite real, as evidenced by the experience of the Eastern European neighbors, as well as its own experience. In the period from 2000 to 2008, Ukraine managed to achieve decoupling by changing the structural proportions in the economy and GDP growth was not accompanied by a corresponding increase in energy consumption and greenhouse gas emissions. Important for the implementation of the Paris Agreement and the implementation of the policy of low carbon development, the Government of Ukraine should provide strong support and stimulate domestic research in this area, which should result in own innovative, efficient technologies for various sectors of the economy. This should be one of the most important tasks (or even the responsibility) of the Government, so that Ukraine does not become a technologically dependent country, while we have a significant scientific potential for this. Technological dependence of the state is more disgraceful in contrast to the energy dependence. It is obvious that the Government and other branches of government must pay special attention to working with the public. It is the society that can catalyze the processes of combating climate change, introducing and implementing a low carbon development policy. But lack of communication can lead to the fact that the public, on the contrary, will stop the processes, due to rising cost of energy resources and services, at least in the near future.

I. Put 15 questions to this text (general, alternative, reflexive, special)

<u>LEXICAL EXERCISES</u>

I. Define the functions of the words in bold type and translate the following sentences:

1. Over the open sea the wind blows at nearly the same speed both day and night **provided** the pressure gradient remains un-altered.

2. A wooden box is **provided** in which to keep the barometer when it is not in use or when it has to be moved

3. **Provided** that the instrument is treated carefully little maintenance is required, except of wiping over occasionally with soft cloth to remove dust.

4. An ideal frontal zone may be described as a layer which contains large horizontal temperature gradients and large cyclonic wind shears and which

slopes upward from ground to tropopause with cold air below and warm air above.

5. The highest frequency of fog over snow-covered **slopes** of the ground in spring will be observed when the air temperature is close to 0°C.

6. The warm mass **streams** slowly northward and will be cooled from below.

7. The cold air from the Arctic and north Canada streams southward, and meets with the tropical maritime air from the Atlantic subtropical anticyclone along the polar front which is approximately in its normal position

8. Since a frontal surface is a boundary between adjacent air masses, the movement of the front must be determined by the movement of the adjacent air **streams**.

9. The frontal surface would approach the horizontal close to the earth's surface if there were no mixing between the cold and warm air.

10. The forecasting recorded the **approach** of the cold front.

II. Translate the following sentences, paying attention to the use and meanings of the word "that:"

1. Cloud base at the coast was equal to that of the seaward cumuli, which were most frequently based at 2000 to 3000 ft.
2. It can be verified theoretically that no oscillations could occur unless the area of the free surfaces of the reservoirs is sufficiently large.
3. That these factors are important in the prediction of the atmosphere is doubtless.
4. In order to develop that method it is necessary to introduce mathematical characteristics for the curves and points in the pressure field that can be identified during their motion across the chart.
5. In order to obtain analytical expressions for the velocities and accelerations, it is convenient to consider the pressure variations in two systems of coordinates: one that is fixed to the map, and one that moves with the pressure system.
6. It is easier to predict the movement of a pronounced centre than that of a weak one.
7. The case discussed in that article is therefore one that occurs frequently.
8. One can say that unless the actual winds show the type of variation, the frontal structure is diffuse.
9. It is the thermometer that should register the current temperature.
10. It is the type of climate that should be paid attention to when describing any region from meteorological point of view.

GRAMMAR EXERCISES

TESTS FOR SELF-CONTROL

Conditional Sentences / Subjunctive Mood II

Test 1 Fill in the suitable words:

A) will **B) won't** **C) would** **D) wouldn't**

1. What ______ you do if you won lots of money?
2. If the students were studying, ______ you disturb them?
3. If you make so much noise, I ______ be able to sleep.
4. They ______ have to hurry or they ______ miss the train.
5. They ______ have missed the last bus if they had hurried.
6. If I were you, I ______ buy a new bicycle.
7. If she had locked all the doors, the burglars ______ have got in.
8. If my train is late, I ______ take a taxi.
9. He must build a strong boat, otherwise he ______ be able to sail round the world.
10. If you are a good girl, I ______ buy you some chocolate.
11. I ______ finish the work if you don't help me.
12. If only they ______ arrive on time.
13. You ______ understand unless you listen carefully.
14. If he hadn't cut his finger, it ______ not have hurt for weeks.
15. I ______ give you $5 if you do me a favour.
16. If Chris didn't fall in love with Jane, he ______ give her flowers.

Test 2 Fill in:

A) would **B) have** **C) had**

1. If she ______ not driven so fast, she ______ not ______ crashed her car.
2. I wish I ______ washed my clothes yesterday.
3. If he ______ finished his medical studies, he ______ be a doctor now.
4. If they ______ not been late, the teacher ______ not be angry with them.
5. I only wish I ______ just a little bit more money.
6. If he ______ failed his exams, he couldn't study at the university.
7. If they ______ locked up the chickens at night, the fox ______ not ______ eaten them and the chickens ______ be alive now.

8. We ______ been here earlier if the train ______ been on time.
9. If I saw a mouse in the kitchen, I ______ try to catch it.
10. If you ______ a video, you could record it yourself.
11. I wish I ______ an elephant. I could travel through the jungle.
12. I wish they ______ stop making so much noise so that I could concentrate.
13. ______ we known your address, we ______ written a letter to you.
14. If it ______ not been for your help, we ______ got into real trouble.

Test 3 Match the sentences on the left with the suitable one on the right:

1. If you eat more than you need,	A) she wouldn't sing in the bath.
2. If the dog keeps barking,	B) what would you do?
3. If I were you,	C) he would never get this job.
4. If he had driven carefully,	D) the extra calories turn into fat.
5. If you are not doing anything later,	E) we will go to the theatre.
6. Had the ice not melted	F) he might have avoided that accident.
7. Henry spoke to his dog as if	G) the neighbours will complain.
8. I wish	H) we would have been here earlier.
9. If it were not for your uncle,	I) why don't you buy a computer?
10. If I have time,	J) it could understand him.
11. If I met a fairy one day,	K) I wouldn't buy these jeans.
12. If I had known you were coming,	L) we could go skating.
13. If you were in my shoes,	M) come and see us.
14. But for the traffic jam	N) I would make a wish.
15. If you have enough money,	O) I could have met you at the station.

Test 4 Right / wrong – conditionals. Find the mistake and correct it:

A) right **B) wrong**

1. What would you do if you live here all the time, as we do?
2. If we met Captain Hook in open fight, leave me to deal with him.
3. If he hadn't come by 6 o'clock, he won't come at all.
4. If you eat less than you need, the body burns fat to get energy and you loses weight.
5. If you have finished your homework, you might be able to help us.
6. I could understand your friend from Italy if he spoken more slowly.
7. If my cat were sick, I would have taken it to the vet.
8. I wish you would give me this book for a while.
9. What will the kitchen look like if we painted it green?
10. Even if he did say so, we cannot be sure that he was telling the truth.
11. If you have been walking all the night, you probably need a rest.

12.If you went to London, you might have seen the Queen.
13.If they are promising to be here, they will certainly come.
14.Even if my parents disapproved of my plans, I wouldn't had given them up.
15.I wish the weather wouldn't be so dreadful today.

Test 5

1. You will … speak Spanish in another few months.
a) can
b) be able to
c) ought
d) have

2. Don't you see I am tired? You … me …, you know.
a) might have … helped
b) could … help
c) may … help
d) must … help

3. I'd like … skate.
a) to can
b) to be able to
c) to have to
d) could

4. My sight is getting worse. Next year, I am afraid, I … read without glasses.
a) can't
b) may not
c) won't be able to
d) must not

5. Nobody answer the phone. They … be out.
a) should
b) would
c) can
d) must

6. You … take care of your parents.
a) should
b) ought to
c) are to
d) must

7. I'm sorry, I … have phoned to tell you I was coming.
a) should to
b) ought to
c) had to
d) could

8. The power of knowledge … placed in the hands of people.
a) should be
b) ought to be
c) need to be
d) can be

9. We … commemorate great people.
a) must
b) need to
c) may
d) would

10. … you mind passing me sault.
a) Will
c) Should

b) Could d) Would

11. As you remember … I was always interested in economics.
a) may c) must
b) have to d) ought to

12. … you … get up early yesterday to meet the delegation at the airport?
a) Did … have to c) Have … had to
b) Had … to d) Must … to

13. Little children like books with large print. They … read more easily.
a) should c) can
b) must d) have to

14. The leopard … not change hos spots.
a) need c) ought
b) can d) may

15. Our plan … be changed.
a) must c) ought
b) may d) should

16. We … learn it by heart.
a) need c) ought
b) can d) would

17. You … enter the club without a card.
a) can c) could not
b) be able to d) could

18. No museum ever … by even one painting by this artist.
a) has … been able to c) has … been allowed to
b) might … have d) can … been able to

19. … I speak to your manager, please?
a) Could c) Must
b) Shall d) Ought

20. The news … be true! I don't believe you.
a) must c) be able to
b) can't d) may

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