A SYSTEM

OF

PHYSICAL GEOGRAPHY;

CONTAINING A DESCRIPTION OF THE

NATURAL FEATURES OF THE LAND AND WATER,

THE

PHENOMENA OF THE ATMOSPHERE,

AND THE

DISTRIBUTION OF VEGETABLE AND ANIMAL LIFE.

TO WHICH IS ADDED,

A TREATISE

ON THE

PHYSICAL GEOGRAPHY OF THE UNITED STATES.

The whole Embellished by Numerous Engravings,

AND ILLUSTRATED BY TWENTY

COPPER-PLATE AND ELECTROTYPED MAPS AND CHARTS.

BY

D. M. WARREN.

REVISED EDITION.

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H. COWPERTHWAIT & CO.

PHILADELPHIA, *May*, 1859.

PREFACE TO THE REVISED EDITION.

THE stereotype plates, from which this volume is printed, had become so much worn by the large number of impressions which have been taken from them, that it became necessary to renew some of them, and repair others. The author has taken advantage of this circumstance to go over the work carefully, and make such corrections as recent geographical discoveries or changes have made necessary. These alterations are, however, few in number, and of such a character as to present no obstacle to the use of the present edition in connection with the former one.

The preparation of the original work was undertaken some four or five years since, at the suggestion of many teachers, who expressed an earnest desire that a text-book should be written, exclusively devoted to the subject of Physical Geography, and adapted to the use of schools. The attention of the public, but more especially of teachers, seems to have been drawn to the subject by the works of Humboldt, Maury, Guyot, Mrs. Somerville, and other writers on Physical Science, which, of late years, have obtained a very wide circulation.

The authorities principally relied upon by the author, in addition to the works of the writers already enumerated, were the magnificent folio edition of Johnston's Physical Atlas (which Sir John F. W. Herschell describes as "a perfect treasure of compressed information"), Ansted's Physical Geography, and the works of Petermann and Milner. The arrangement of the latter authors was generally adopted, and in some cases their language was used. The articles on the Ocean, especially those on the Currents and Navigation, would have been very imperfect without the aid obtained from the investigations of Lieut. Maury, furnished to the world in his "Sailing Directions" and "Physical Geography of the Sea." Interesting deductions on the Winds of the Northern Hemisphere were drawn from the work of Professor Coffin, published by the Smithsonian Institution. Much valuable information for the revised edition has been obtained from recently-published volumes of voyages and travels, such as "Kane's Arctic Explorations," "Barth's Central Africa," and "Livingstone's Southern Africa," as also from the article "Physical Geography," in the Encyclopædia Britannica, written by Sir John F. W. Herschell.

The treatise on the Physical Geography of the United States was new, and entirely original in its arrangement. Much of the information on which it was based, was obtained from the "Army Meteorological Register," compiled by Mr. Lorin Blodgett, and from the "Report of the Explorations and Surveys for the Pacific Railroad." The map to accompany this report, which has been recently published by the United States Government, furnishes information by which we are enabled to correct many errors found in all previously-published maps of the section of country west of the Mississippi River.

The opinion expressed by the author, in the following extract from the Preface to the first edition, as to the interesting character of the study of Physical Geography, has been fully confirmed by numerous letters which he has received from teachers in all parts of the country, as well as by the wide-spread demand for the book itself:

"It is believed that no subject of instruction will be more attractive to the young, or better fitted to elevate and expand the mind, than that of Physical Geography. It treats of the natural adaptation of the earth for the abode of man; — it describes the diversities of the surface of the globe — its divisions of land and water — its mountains and plains; — it draws our attention to the atmosphere, and explains that wonderful process, invisible to us, by which the water of the ocean is lifted into the air, thence to be distributed over the land to form lakes and rivers, and to give life to vegetation, which in its turn sustains animal life. In short, to use the language of another (Alexander Keith Johnston), 'Physical Geography is the history of Nature presented in its most attractive form, the exponent of the wonders which the Almighty Creator has scattered so profusely around us.'"

The author indulges a hope that the improvements in the revised edition of this work may render it even more worthy than before of the generous support of an intelligent public.

PHILADELPHIA, *June* 1, 1859.

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Sarah Gerry.

PHYSICAL GEOGRAPHY.

INTRODUCTORY.—DEFINITIONS.

I. GEOGRAPHY is a description of the Earth.

The term is derived from two Greek words, signifying "the earth," and "to describe," and the great variety of subjects comprehended in this general definition may be considered under the three divisions of Mathematical, Physical, and Political Geography.

II. MATHEMATICAL GEOGRAPHY treats of the form, size, and motions of the earth; of its position among the other bodies of the universe, its divisions by circles, and the representations of the whole or portions of its surface on globes or maps.

III. PHYSICAL GEOGRAPHY treats of the natural divisions of land and water, the phenomena of the atmosphere, and the distribution and arrangement of organic life.

IV. POLITICAL GEOGRAPHY treats of the extent and population of different countries, and the civil and social condition of their inhabitants.

MATHEMATICAL GEOGRAPHY.

I. THE EARTH is that planet which we inhabit.

1. It is variously denominated *terrestrial ball, sphere,* and *globe,* the terms having reference to its form. The form of the earth, in popular language, is expressed as round. More correctly speaking, however, its shape is that of an oblate spheroid—a ball bulging out in the middle, and flattened at the two opposite sides.

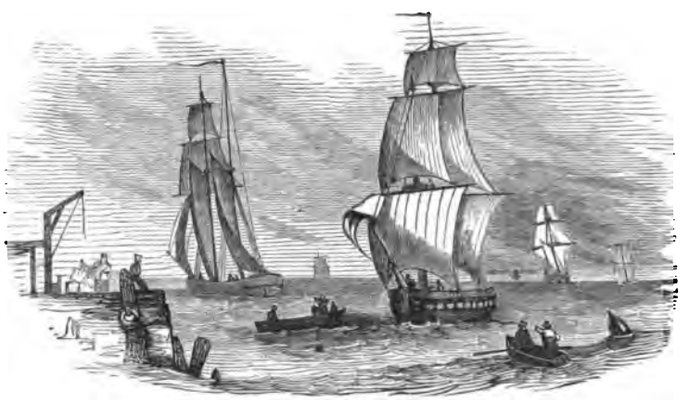


Illustration of one of the proofs that the earth is nearly round.

The proofs that the earth is nearly round are: 1. The tops of the masts of a ship coming into harbor are always seen before the hull. 2. Navigators starting from a given port, and sailing constantly in the same direction, have at length arrived at the place from which they started; and 3. The shadow cast by the earth on the moon is always circular.

That the earth is slightly flattened at the opposite sides has been demonstrated by eminent French and English astronomers, from measurements of an arc of a meridian at different stations on the globe. The length of a degree was found to increase as they approached the poles. Any part of the circumference of a circle is called an arc.

2. The circumference of the earth is about 25,000 miles; its diameter is about 8000 miles. In exact numbers, the equatorial circumference of the earth is 24,899 miles. The equatorial diameter, carefully computed, is 41,849,548 feet, equal to about 7926 miles. The polar diameter is 41,709,642 feet, equal to about 7899½ miles. It will thus be seen that the distance through the earth from East to West, owing to the flattening at the poles, is 26½ miles greater than the distance through it from North to South.

3. The earth has two motions—the *daily* and the *yearly,*—both of which are from West to East. The daily motion of the earth is its revolution on its axis, causing day and night; the yearly motion is its revolution round the sun, causing the succession of seasons.

The axis of the earth is an imaginary line passing through its centre from North to South, and is the diameter on which the earth is supposed to turn. The northern extremity of the axis is the North Pole—the southern extremity the South Pole.

Until the beginning of the sixteenth century, it was generally supposed that the earth was stationary, and that the heavenly bodies revolved about it once in 24 hours. That the earth, on the contrary, revolves, is *demonstrable* by astronomy; that this is highly probable, apart from scientific proof, appears from the following consideration: 1st. No other supposition accounts for the bulging of the earth at the equator; the centrifugal motion, its revolutions upon its own axis, would produce this effect. 2d. A stone, dropped from the top of a high perpendicular tower, will always fall a short distance to the east of the base; the stone has the motion of the top of the tower, which moves more rapidly than the base. 3d. This supposition alone will account for the equatorial current and the trade winds. At the equator, the rotary velocity of the earth is about 1000 miles an hour.

The annual motion of the earth round the sun is conclusively proved by astronomical observations of the phenomena known as *aberration of light.*

The succession of the seasons is the result of the annual revolution of the earth round the sun, and of the inclination of the earth's axis to the plane of the ecliptic. The angle of inclination is about 23½ degrees. It thus follows that the axis of the earth, though it always points in the same direction, is at every period of its progress around the ecliptic, assuming a different position towards the sun.

Twice in the year, on the 21st of March and 23d of September, the axis is perpendicular to the direction of the sun's rays; these are the equinoxes, (equal nights). On the 21st of June, the North Pole leans towards the sun, bringing the Northern Hemisphere the most under the influence of his rays. On the 21st of December the South Pole leans towards the sun, bringing the Southern Hemisphere the most under this influence; these points in the ecliptic are called the solstices, (sun stands).

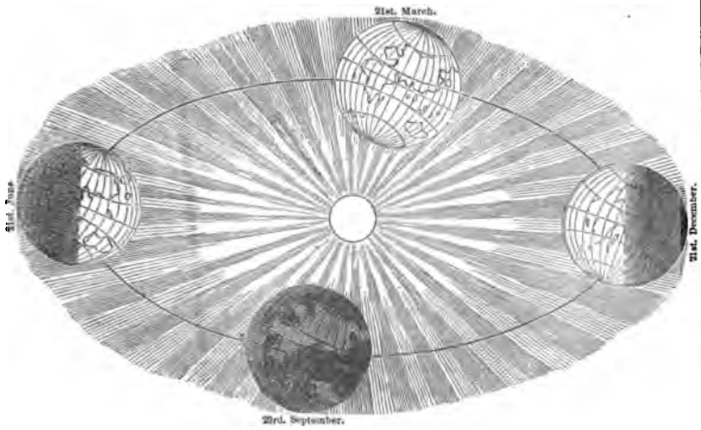
QUESTIONS.—What is Geography?—Under what three divisions may the subject be considered?—Of what does Mathematical Geography treat?—Physical Geography?—Political Geography?

What is the earth?—State some of the names by which it is called.—What is its correct form?—Give some of the proofs of the rotundity of the earth.

QUESTIONS.—State the evidence of the earth's being flattened at the poles.—What is the extent of the circumference of the earth?—Of the diameter of the earth?—How many motions has the earth, and what are they?—What is the axis of the earth?

State some of the reasons which render it probable the earth revolves?—What conclusively proves the annual revolution of the earth?—Explain the succession of seasons

The explanation given on the preceding page will be more clearly understood by an examination of the annexed diagram.



On the 21st of March, one half of both the Northern and Southern Hemispheres is turned towards the sun, and the days and nights are of equal length throughout the entire globe. As the earth continues its revolution round the sun, from March 21st to June 21st, the North Pole is more and more turned towards the sun, and the South Pole is in consequence farther turned from it. The longest day in the Northern Hemisphere, and shortest day in the Southern, is the 21st of June. It is then mid-summer in the Northern Hemisphere, while it is mid-winter in the Southern.

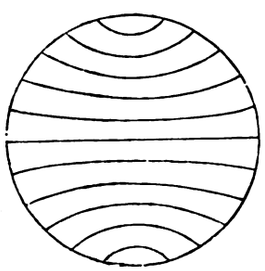
As the earth still continues its course, the length of a day in the Northern Hemisphere decreases, and in the Southern it increases, until on the 23d of September the days and nights are again of equal length. It is then autumn in the Northern Hemisphere, and spring in the Southern.

As the earth still further continues its course, from the 23d of September to the 21st of December, the South Pole is more turned towards the sun, and in consequence the North Pole is turned from it. The longest day in the Southern Hemisphere, and shortest in the Northern, is the 21st of December. It is then mid-summer south of the equator, and mid-winter north of it.

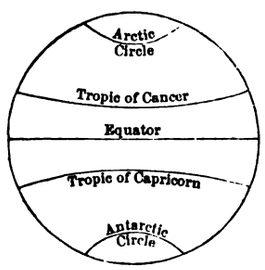
From the 21st of December to the 21st of March, the days increase in length in the Northern Hemisphere, and decrease in the Southern, until on March 21st they are again equal. It is then spring in the Northern Hemisphere, and autumn in the Southern.

The ecliptic is the orbit in which the earth revolves round the sun. It is so called because it is the circle in which eclipses occur. It is the path in which the sun appears to move round the earth.

The velocity of the earth, in its revolution round the sun, exceeds 1000 miles a minute.



Parallels.



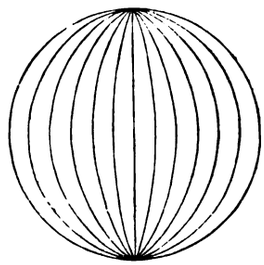
Equator, Tropics, and Polar Circles.

4. For purposes of geographical description, imaginary lines are employed, which divide the earth into different sections. These are the equator, the meridians, the parallels, the tropics, and the polar circles.

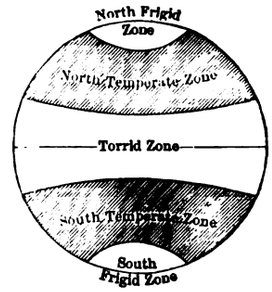
The equator and meridians divide the earth into equal parts, and are called great circles. The tropics, polar circles, and parallels divide the earth into unequal parts, and are called small circles. Every circle is divided into 360 equal parts, called degrees. The length of a degree, on a great circle, is about 69 miles; on small circles, the length of a degree varies with the size of the circle.

Geographers have adopted the measure of a degree, because the length of a mile varies in different countries. A German mile, for example, is equal to more than four English miles.

The equator encircles the earth from east to west, at equal distances from the poles. The tropics, polar circles, and parallels are small circles extending round the earth, parallel with the equator. There are two tropics and two polar circles; the number of parallels is unlimited. The Tropic of Cancer is 23½ degrees north of the equator; the Tropic of Capricorn 23½ degrees south of it. The Arctic circle is 23½ degrees south of the North pole; the Antarctic circle 23½ degrees north of the South Pole. The Meridians are great circles extending round the earth north and south, through the poles; their number is unlimited.



Meridians.



Zones.

5. Zones are divisions of the earth's surface, formed by the tropics and polar circles. They are five in number — two Frigid, two Temperate, and one Torrid. The North Frigid Zone is north of the Arctic Circle; the South Frigid, south of the Antarctic Circle; the North Temperate Zone is between the Arctic Circle and Tropic of Cancer; the South Temperate between the Tropic of Capricorn and Antarctic Circle; the Torrid Zone is between the Tropics.

6. The Latitude and Longitude of a place being known, it is easy to determine its relative position and distance from other places. Latitude is distance from the equator, north or south. Longitude is distance from any given meridian, east or west.

Places north of the equator are in North Latitude; those south of it in South Latitude. The distance from the equator to the poles is 90 degrees; Latitude, therefore, can never exceed 90 degrees. Latitude is measured on great circles (meridians), therefore the length of a degree must be about 69 miles. If a place is said to be in 10 degrees North Latitude, it is understood to be 10 degrees north of the equator, or about 690 miles from it; and a line encircling the earth from east to west, passing through this place, is the 10th parallel of Latitude.

Different nations usually reckon Longitude from the meridians of the capitals of their own countries. Thus, on French maps, Longitude is reckoned from the meridian of Paris. On the maps in this book, Longitude is computed from the meridian of Greenwich, in England. A line passing round the earth, through Greenwich and the North and South poles, is the meridian of Greenwich. All places east of this line are in East Longitude; all west of it, in West Longitude. A degree of Longitude may be measured on any circle extending east and west. On the equator, its length is the same as a degree of Latitude, or 69 miles; proceeding from the equator towards the poles, it diminishes with the size of the circles. On the 30th parallel, it is 60 miles; on the 60th parallel, 34½ miles. Longitude is computed 180 degrees in each direction.

Note.—As many of the principles in this treatise have reference to the foregoing definitions, it is recommended that they be carefully perused before commencing the chapters which follow.

Explain the diagram.—What is the ecliptic?—How great is the velocity of the earth in its revolution round the sun?

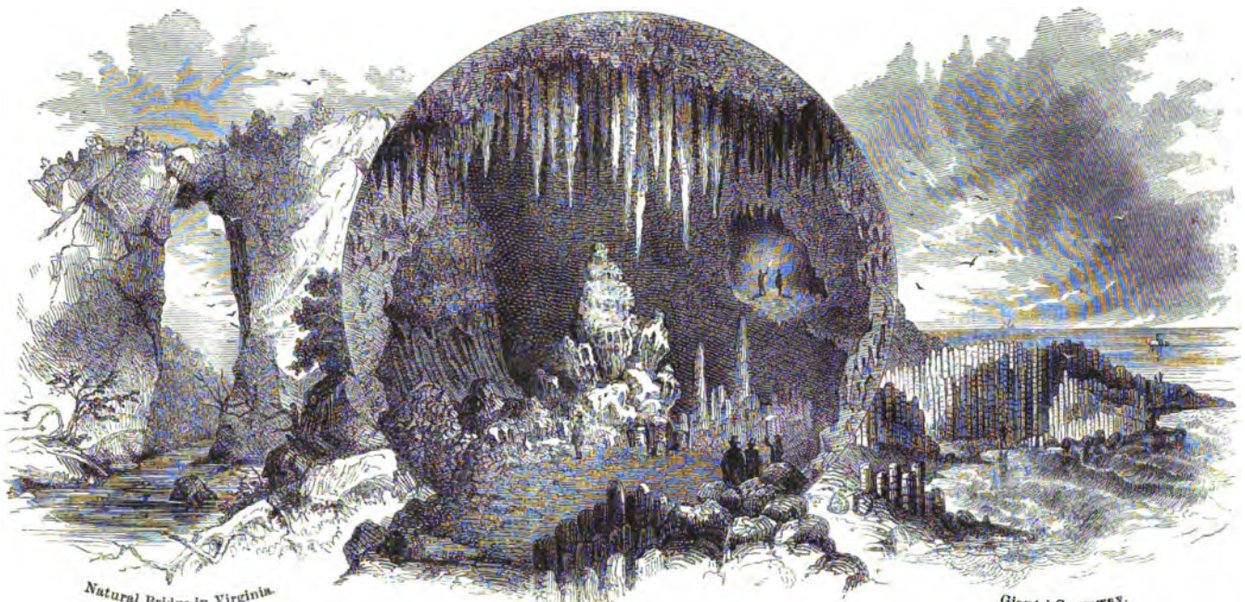
For what purpose are imaginary lines employed? — Name these lines.

Why have geographers adopted the measure of a degree? — What is the Equator?—What are the Tropics, Polar Circles, and Parallels?—What are the Meridians?

What are Zones? — How many are there? — What is Latitude? — Longitude?

PHYSICAL GEOGRAPHY.

THE matter of which the Earth is composed is collected into a mass of the form of an orange, or an oblate spheroid. Its outside part, or surface, is composed of land and water. Surrounding the earth, and extending to the height of about 45 miles, is the atmosphere. Physical Geography treats of the natural features and laws of the land, the water, the atmosphere, and of the plants and animals which belong to the globe. These subjects will be examined in this work under the general divisions of: — 1st. Geology, or a description of the land; 2d. Hydrography, or a description of the water; 3d. Meteorology, or a description of the atmosphere and its phenomena; 4th. Organic Life, or the arrangement and distribution of vegetable and animal life.



Natural Bridge in Virginia. Grotto of Antiparos. Giants' Causeway.

PART I.

GEOLOGY.

GEOLOGY is that department of Physical Geography which treats of the natural features of the land of the Earth. The subject will be considered under the several divisions of: — 1. General Structure of the Land; 2. Continents; 3. Islands; 4. Mountains and Valleys; 5. Plateaus, or Table-lands; 6. Plains; and 7. Volcanoes and Earthquakes.

State the subjects of which Physical Geography treats? — Under what general divisions will these subjects be examined?

The science of *Geology proper* treats of the formation and general structure of the Earth beneath the surface, and of the changes the globe has undergone; but as a department of Physical Geography, the signification of the term is limited to a description of the more immediate land-surface of the globe, as the form of the land and the diversities of its surface.

Of what does Geology treat? — Under what general divisions will the subject be considered? — Of what does the science of *Geology proper* treat?

CHAPTER I.

GENERAL STRUCTURE OF THE LAND.

1. The subject of which this chapter treats, strictly speaking, belongs to the science of Geology, and not to Physical Geography; but before proceeding to the consideration of the form of the land and the diversities of its surface, some knowledge of its general structure will be found useful.

II. The various substances which constitute the Earth may be divided into *simple* and *compound*. A simple substance, or element, is one which cannot be separated into other component parts. A compound substance is formed by the combination of two or more simple substances or elements.

The entire number of elements yet discovered is sixty-one, of which only fourteen are found in nature in a pure state, and these occur rarely, and in very limited quantities. Gold, silver, and copper are elements, generally found combined with other substances, but frequently discovered in a pure, unmixed state. Granite and limestone are compound substances.

Nearly all the matter of the globe is composed of different combinations of eighteen of these elements; and *no matter* pertaining to the earth, no part of the land or water, no particle of air, no plant or animal, has yet been discovered, which, on being submitted to the analysis of the chemist, is not found to be composed of one, or some combination of two or more of the sixty-one elements first mentioned.

III. On and immediately below the surface of the land will be found, generally speaking, loose or unconsolidated materials, which are called *earths*. The first in order, usually occupying the immediate surface, is composed principally of decayed vegetable and animal substances, and is called *vegetable mould*.

IV. The other earths are composed principally of particles which have been worn off by the atmosphere, the winds, and the rain, from the solid rocks which form the crust of the earth. These are called mineral earths, and bear the names respectively of the minerals which enter most largely into their composition.

Thus, when earths are composed principally of *silex*, or flint, they are called silicious earths (sand is an example); when of *calx*, or lime, calcareous earths; and when of *argilla*, or clay, argillaceous earths.

If there were only silicious earth there could be no vegetation, for it is too porous to retain the moisture. Sandy deserts are examples of tracts of land composed almost wholly of silicious earth. Calcareous earth is too dry and hot for vegetation, and argillaceous earth is too wet and cold. When these earths, however, are mixed together in due proportions, they correct and improve each other, and form the fertile soil of our gardens and fields. Sand corrects the stiffness of clayey land, and lime adds to its warmth.

Without sand, no glass could be made; nor could houses of brick or stone be built, for sand is a necessary ingredient in mortar. Without clay, we should have no springs; for beds of clay, or clayey rocks, alone arrest the downward progress of the water which falls in rain, thus forming the reservoirs from which springs flow.

V. The wearing away of solid rocks, by the influences already enumerated, is not confined exclusively to the particles which form mineral earths. Large fragments are frequently broken off, from which are formed the gravel, pebbles, and rounded stones that are seen on the sea-shore, and in the beds of rivers. At first, these fragments are rough, but when subjected to the rolling of waves on the beach, or to the action of running water in rivers, by rubbing and grinding against each other, they become smooth and rounded.

VI. After digging through the different earths which lie at the surface, we come to hard or consolidated materials, which are called *rocks*. These rocks form what is called the "crust of the earth," and, generally speaking, they are of the same materials as the earths we have just described: the only difference being, that in the earths the materials are loose, or unconsolidated; and in the rocks, hard, or consolidated.

Popularly, the term "rock" is applied only to the more compact and solid portions of the globe, but geologically it extends to every formation; to the loose sands, gravels, and clays, as well as to the limestones and granites.

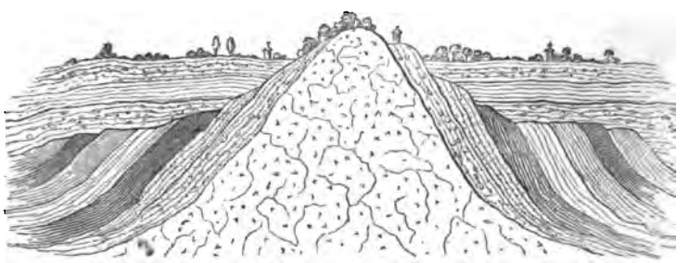
Our positive knowledge of the formations constituting the interior of the earth is very limited, the labors of the miner having extended to but comparatively a short distance below the surface of the earth, and scarcely 2000 feet below the level of the sea.

The greatest depth below the level of the sea yet reached by man is probably the bore of the new salt works, at Minden, Prussia; which, in June, 1844, reached the depth of 1993 feet, or, from the mouth of the mine, 2231 feet. Probably the deepest mine in the world, though not now worked, is that of Kuttenberg, in Bohemia, which has an absolute depth of 3778 feet. It does not, however, extend so far below the level of the sea as that of Minden. The deepest mine in America is the silver-mine of Valenciana, near Guanaxuato, in Mexico, which has a depth of 1887 feet; yet the bottom of this mine is more than 5000 feet above the level of the sea.

VII. All rocks may be classified—

1. As Stratified, or Unstratified;
2. As Fossiliferous, or Non-fossiliferous;
3. As Igneous, Metamorphic, or Aqueous.

VIII. Stratified rocks are found in the regular form of beds or layers, varying in depth from the thickness of a sheet of paper to many feet. These beds are sometimes arranged horizontally, but oftener inclined at various angles to the horizon. This class of rocks is estimated to occupy about nine-tenths of the land surface of the earth, and to have an average depth of eight or ten miles.



Stratified and Unstratified Rocks.

IX. Unstratified rocks are irregular masses, the lowest of all rocks, forming the basis or bed on which the others rest. But while they thus form this basis or bed, they are frequently pressed up through the stratified rocks, constituting in many places the

What is a simple substance?—What is a compound substance?—What name is given to the soil which occupies the immediate surface?—What are mineral earths?—Describe silicious earths.—Calcareous earths.—Argillaceous earths.—Could there be any vegetation if there were only silicious earth?—Why?—Of what should we be deprived if there were no silicious earth?

What difference do you observe between the substances at the surface of the earth and those below it?—What is the difference between the popular and geological signification of the term "rock?"—How far below the surface does our knowledge of the formations extend?—How may all rocks be classified?—What are stratified rocks?—What are unstratified rocks?

summits of lofty mountains. They do not probably occupy more than one-tenth part of the earth's surface, but we have reason to suppose they constitute the internal parts of the globe to a great depth.

VII. Fossiliferous rocks contain, in a petrified state, the remains of plants and animals, sometimes in small, but often in enormous quantities. The fossiliferous rocks are stratified. A part of the non-fossiliferous rocks are stratified — a part are unstratified.

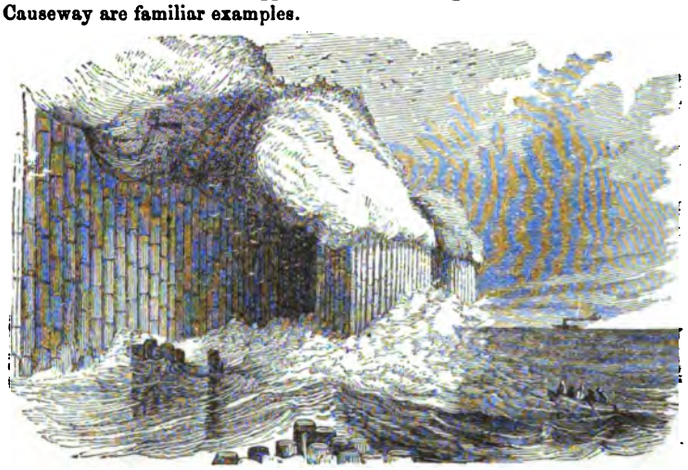
1. Prof. Hitchcock infers that two-thirds of the surface of the existing continents are composed of fossiliferous rocks, and they are often several thousand feet in thickness. The quantity of microscopic shells discovered by the great Prussian naturalist, M. Ehrenberg, in rocks of this formation, is most wonderful. Shells not larger than a grain of sand form entire mountains. In one place in Germany he discovered a bed fourteen feet thick, made up of the shells of minute animals, so small that he estimated that forty millions of them would be required to form a cubic inch.

2. The quantity of fossil remains is so great, that with the exception of the metals, and some of the older rocks, probably not a particle of matter exists on the surface of the earth that has not at some time formed part of a living creature.

VIII. Igneous rocks, or those which are supposed to owe their origin to fire, are sub-divided into Plutonic and Volcanic rocks. They are unstratified and non-fossiliferous.

1. Plutonic rocks, it is supposed, were formed of melted matter, cooled and consolidated at a great depth, and under an enormous pressure, and then thrown up by the elastic force of internal heat. Volcanic rocks are the products of ancient volcanic eruptions.

2. Granite and its varieties constitute the principal plutonic rocks. Basalts and green-stone are among the principal volcanic rocks. From their frequent arrangement in the form of steps, they are often called "trap rocks," from the Swedish *trappa*, "a stair." Fingal's Cave and the Giant's Causeway are familiar examples.



Fingal's Cave.

3. The theory of the igneous formation of rocks, of which we have positive proof by observation in the case of volcanic rocks, pre-supposes the earth to have been originally in a melted state, and that its centre now, excluding a crust only from 20 to 50 miles in thickness, is a sea of fire. Additional evidence of this is found in the fact, that the temperature of the earth regularly increases one degree for every 54 feet of descent beneath its surface. At this rate of increase, a heat sufficient to melt all known rocks would be reached at a depth of between 40 and 50 miles.

Describe the Fossiliferous rocks.— Into what two classes are Igneous rocks divided? Of what is it supposed Plutonic rocks were formed? — Of what are volcanic rocks the products?

What does the theory of the igneous formation of rocks presuppose?

IX. Metamorphic rocks are supposed to have been formed in regular beds or layers, of the sediment of water, but having been deposited near the place where plutonic rocks were generated, their character has been changed by the immense heat, and they have become as highly crystallized as granite itself, without losing their regular form. They are stratified, and non-fossiliferous.

1. Gneiss, a very common rock in some parts of the United States, especially in New England, and often so nearly resembling granite, as hardly to be distinguished from it even by a practised eye, is a metamorphic rock.

X. Aqueous rocks appear to have been formed by the gradual deposit of sedimentary matter in water, which has become more or less hardened into solid rocks. They are stratified and fossiliferous.

1. They are variously subdivided by different geologists with reference to their age, and the depth at which they are found from the surface, into numerous groups and orders. Groups found at the greatest depth, and containing the remains of the earliest formed animals, are regarded as the oldest; those containing the remains of animals similar to those now living, are deemed to be of the most recent formation.

2. Aqueous rocks constitute by far the greatest portion of the exposed crust of the earth. The various kinds of soils, gravels, sands, clays, limestone, coal, sandstone, and some slates, are the principal rocks of this class.

XI. All stratified rocks maintain a regular order of succession; that is, if an older rock is at the surface, we may be assured none of later formation is underneath it. Thus, no geologist would expect to find beds of coal underneath strata of talcose slate, the latter being an older formation; yet this slate has been bored into, at great labor and with much expense, in search for coal.

XII. The crust of the earth is undergoing incessant change. The atmosphere, the ocean, and rivers, are agents constantly acting upon the land, and removing its particles into the sea; while, as if to compensate for this gradual wearing away of the land, at intervals of time, volcanic eruptions elevate enormous masses of matter, sometimes forming new islands in the midst of the ocean. Yet these changes are trivial, compared with those which geology teaches us must have taken place to fit the earth for the abode of man.

XIII. *Recapitulation.* — It will thus be seen that the matter of which the earth is composed, is constituted of a comparatively limited number of simple elements;—

That the crust of the earth is composed of rocks arranged, *according to their form and position*, into stratified, lying in horizontal or inclined layers, and unstratified, lying nearest the centre;—

According to their character, into fossiliferous, containing organic remains of plants and animals; and non-fossiliferous, containing no such remains,—

And *according to their origin*, into Igneous, formed by the direct agency of fire; Metamorphic, formed by internal heat and pressure; and Aqueous, formed by deposits of sedimentary matter in water.

It will also be seen that the crust of the earth is undergoing constant changes.

How are Metamorphic rocks supposed to have been formed? — How do Aqueous rocks appear to have been formed?

What is said of the order of succession maintained by Aqueous rocks?—What of the changes going on in the crust of the earth?—Recapitulate the subjects of this chapter.

CHAPTER II.

CONTINENTS.

I. CONTINENTS, of which there are only two on the earth, are those great masses of connected land, one of which is in the Eastern and one in the Western Hemisphere. They differ from islands only in their greater extent, both being entirely surrounded by water.

1. The island of Australia, on account of its great size, is, by some geographers, regarded as a continent. It is generally ranked, however, among islands.

2. On many maps of the world, constructed in the interval of time between the discovery of the South Seas and their navigation by Captain Cook, an immense continent, stretching out from the South Pole, and filling the Antarctic regions, figures under the name of *Terra Australis Incognita*, (unknown southern land). No evidence of the existence of such a continent could be adduced, but speculative geographers believed that such a mass of land must exist in these regions, to balance the greater known quantity of the Northern Hemisphere.

The researches of Captain Cook banished the dreams of those who expected to find here habitable countries, but left unsettled the question whether there might not be vast tracts of land in the frozen regions near the South Pole. This question was settled by the United States' Exploring Expedition in 1840, and the British Expedition in 1841, and the existence of such tracts was satisfactorily proved. But it has not yet been determined whether the respective districts are continuous, so as to form what may be called an Antarctic continent.

3. In the Northern Hemisphere, Greenland, now known not to be a part of the main land of America, may be the projection of an Arctic continent extending around the North Pole.

II. The great Eastern continent extends through upwards of two hundred degrees of longitude, from Cape Verd, the most westerly point of Africa, 17° 33′ west, to East Cape, the eastern extremity of Asia, 190° east (170° west). It embraces upwards of a hundred and ten degrees of latitude, from Cape Severo Vostochnoi, in Siberia, 78° 16′ north, to Cape Agulhas, S. E. of the Cape of Good Hope, 34° 50′ south. Its area may be stated at about 31,000,000 square miles.

III. This continent has a maritime coast-line of more than 60,000 miles, and attains its greatest elevation in Central Asia, the land here reaching the enormous height of nearly five and a half miles, the culminating point of the globe. Its greatest depression is the shore of the Dead Sea, which, at the water level, is more than 1300 feet below the surface of the Mediterranean Sea.

1. Of the three divisions of the continent, Europe comprises somewhat less than one-eighth of its entire area, Africa more than one-third, and Asia more than one-half. Africa is about three times, and Asia more than four times, the size of Europe.

2. Africa, the south-western member of the continent, differs in many respects from the other portions. Externally, a comparatively unbroken coast-line; and, in the interior, a deficient water communication, and great deserts, mark the contrast. Asia and Europe exhibit repeated examples of deeply-indented shores, and both are abundantly supplied with great river systems.

IV. The Western continent, inferior in size, extends through upwards of a hundred and thirty degrees of longitude, from Cape St. Roque, in Brazil, 35° west, to Cape Prince of Wales, the most westerly point of North America, 168° west. It embraces upwards of one hundred and twenty degrees of latitude, from Point Barrow, the most northern point of the Continent of America, 72° north, to the Straits of Magellan, 54° south. Its entire area may be stated at about 14,500,000 square miles.

V. This continent has a maritime coast-line of about 37,500 miles. Its greatest elevation is nearly four and a half miles, a mile below the culminating point of the Eastern continent. Of the two divisions of the continent, North and South America, the former comprises about five-ninths of its area. The entire continent is less in extent than Asia, and hardly equal to Africa and Europe combined.

VI. A striking dissimilarity appears in the general contour or outline of the two continents. In the Eastern continent, the prevailing direction of the land is from east to west, or, more correctly, south-west to north-east. In the Western continent it is directly the reverse, or from south-east to north-west.

VII. The Western continent exhibits a simpler outline than the Eastern. Its maritime coast has a less proportion of indentations, none of consequence appearing on the Pacific coast, except the Gulf of California. The eastern sea-board of South America is also comparatively unbroken.

1. Of all the divisions of the globe, Europe is most deeply indented by seas, bays, and gulfs. This is strikingly shown in the following table, which exhibits the area, the extent of coast-line, and the proportion of square miles of surface to one mile of coast for each of the grand divisions:—

Name of Divisions.	Area in Square Miles.	Extent of Coast-line.	Proportion of Sq. Miles of surface to one mile of Coast-line.
Europe	3,760,000	17,000	221
North America	7,980,000	24,000	332
South America	6,500,000	13,500	481
Asia	16,300,000	31,000	526
Africa	10,930,000	14,000	781

View of Cape Horn.

VIII. The two continents have some points of resemblance Both terminate in pointed projections towards the south America, with the rocky precipices of Cape Horn; Africa, with

What are continents? — Describe the great Eastern Continent. — Its highest elevation.—Its greatest depression.—State the extent of its coast-line.—What portion of its area does Europe comprise? — Africa? — Asia? — In what respects does Africa differ from Europe and Asia?

Describe the Western Continent. — Its highest elevation. — State the extent of its coast-line. — How do its two divisions compare in size?

State some of the points of dissimilarity between the two Continents. — In which division is the coast-line most deeply indented?

its Table Mountain rising to the height of about 3500 feet. Their limits to the north have nearly the same latitude, generally that of about 70 degrees. An important member of each continent is almost isolated: a narrow isthmus connects Africa with Asia, and another one unites North and South America.

1. Descending to detail, we find the northerly projection of the Peninsula of Jutland repeated in the Peninsula of Yucatan, in Central America, the only important exceptions to the southerly direction of peninsulas. The deep bend in the western coast of South America, south-west of Peru, is repeated in Africa by the Gulf of Guinea.

2. East of the southern part of each continent is a large island, or group of islands: as Madagascar, east of Africa — and the Falkland Islands, east of South America. The remarkable fiords or crevices of the coast of Norway, are repeated on the south-west coast of South America.

IX. Comparing the two sides of the Atlantic Basin, a mutual disposition to unite may be observed in the advancing and retreating nature of the coast-lines of the land. The great projection of Western Africa is opposite the indentation of the Gulf of Mexico, and the projection of the Brazilian shore is opposite the indentation of the Gulf of Guinea.

1. The bold conception has been entertained from this peculiar outline, that the two continents once formed an undivided territory, which some great convulsion separated, creating the Atlantic valley, into which the ocean poured.

X. The mean height of continents, or their average elevation above the level of the sea, is a subject investigated by Humboldt, with somewhat surprising results. He finds that the mean height depends not so much upon the mountain-chains, as upon the table-lands, plateaus, and plains.

1. He estimates that if the Pyrenees were spread over Europe, they would raise the land scarcely 6 feet; and the Alps, about 22 feet; while the plateau of Spain would produce an average elevation of 76 feet. If the Andes were pulverized, and spread over the plains of South America, the effect would be to raise the surface 518 feet. The average elevation of Europe, above the level of the sea, is estimated at 670 feet; of North America, 750 feet; of South America, 1130 feet; and of Asia, 1150 feet.

CHAPTER III.

ISLANDS.

I. Islands are masses of land, greatly varying in size, entirely surrounded by water. They rarely occur alone in the midst of a wide expanse of ocean, but usually form groups and archipelagoes contiguous to the main land.

1. Islands may be divided into two classes: Continental, and Pelagic, (belonging to the sea). Continental islands are those which lie along the coasts of continents. They are generally long and narrow, with their extremities pointing towards each other. Of this class are the Japanese, and other islands that extend along the coast of Asia; the British Isles, and the West Indies. Those which are found in the midst of the sea, generally of a round or elliptical form, are Pelagic — as the Sandwich Islands, and St. Helena.

State some of the points of resemblance between the two continents.—What may be observed with reference to the coast-lines of the land on the two sides of the Atlantic Basin?—What bold conception has been entertained from their peculiar outline?

Relate the results of Humboldt's observations on the mean height of continents.

What are islands? — Into what two classes may they be divided?—What are Continental islands?—Pelagic islands?

2. Solitary isles are commonly small, and of volcanic origin. Ascension Island is an example, 1450 miles from the coast of Africa, 680 from St. Helena, and 520 miles from the Island of St. Matthew, the nearest point of land. St. Helena is another example, 1800 miles from the coast of Brazil, and 1200 from the shores of Africa, Ascension Island being its nearest neighbor. Both these islands are of volcanic formation.

Island of St. Helena.

3. Rockall, a granite block, scarcely a hundred yards in circumference, situated in the Atlantic Ocean, three hundred miles west of Scotland, and St. Paul's Rocks, also in the Atlantic, seven hundred miles east of Brazil, are remarkable exceptions to the general characteristic of solitary islands.

II. Some islands are simple masses of sand deposited by the ocean, and just rising above high water mark; others are tracts, more or less extensive, having a general resemblance, in their mountains, plains, lakes, rivers, and variable climates, to the adjacent continent.

III. The geographical position and geological character of many islands render it highly probable that they were formerly a portion of the neighboring continent, the connecting parts being at a lower level, and submerged by water.

1. Thus the crystalline mountains of Corsica and Sardinia extend in the same direction, and are of similar formation to the maritime Alps, of which they undoubtedly form a part. The Japanese Islands are a continuation of the Peninsula of Kamtschatka. The West India Islands seem to have been rendered insular by the incursions of the ocean.

2. It can hardly be doubted that the island of Great Britain has been detached from the main land of Europe, the sea having cut its way through an isthmus which once connected England with France, and formed the Straits of Dover.

IV. A great number of islands are of volcanic origin, on some of which the volcanoes are still active. Though distributed through all latitudes, from the island of Jan Mayen, 72° north, to the Antarctic Land, they are most numerous in the Indian and Pacific Oceans.

V. The formation of new islands by sub-marine volcanic action, though of rare occurrence, is a phenomenon of which we have many well-authenticated records. Some of these remarkable creations have entirely disappeared beneath the surface of the sea; others have slightly subsided, forming dangerous shoals; while others again have continued permanent.

Of what origin, commonly, are solitary islands?—Give some examples.—Name some remarkable exceptions.—To what do some islands bear a general resemblance?

What is rendered highly probable, from the geographical position and geological character of many islands?—Illustrate your statement.

Where are volcanic islands most numerous?—What can you say of the formation of new islands?

The following are well-authenticated accounts of such creations in different localities:—

1. *The Azores.*—New islands appeared in connection with this group in 1538, 1587, and 1720; but the best-known example occurred in 1811, when the temporary island of Sabrina rose off the coast of St. Michael. It attained the height of 300 feet, was about a mile in circumference, but gradually subsided, and wholly disappeared by the close of February, 1812. In 1813, the water at this spot was 500 feet deep.

2. *Coast of Iceland.*—The island of Nyöe, or New Island, was erupted in 1783, and formally claimed by the court of Denmark; but in a few months the sea regained possession of the site.

3. *Aleutian Isles.*—A new island was added to this group in the year 1806, upwards of four geographical miles in circumference; and a second appeared in 1814, which rose to the height of 3000 feet, then slightly subsiding. Both have since remained firm.

4. *Coast of Sicily.*—Hotham or Graham Island arose in the year 1831. On the 19th of July, in that year, the crater of the volcano which formed it had arisen a few feet above the level of the sea, and was in great activity; emitting vast volumes of steam, ashes, and dust. The island increased in all its dimensions from that time until August, when its circumference was about 3240 feet, and its height 107 feet. From August until October, various changes took place, and in December it entirely disappeared. In 1846, it formed a shoal with 210 feet of water upon it.

VI. Coralline islands, among the most interesting and wonderful operations of nature, are the work of minute animals, which exist in countless numbers in the tropical parts of the Indian and Pacific Oceans. These little creatures secrete from their food and from the surrounding sea-water a mass of matter which becomes rock. These rocks, elevated to the surface, are broken up by the elements, and exposed to the atmosphere. The winds and the currents convey to them from a distance numerous seeds and plants, vegetation springs up; and thus, after a time, coral islands become fitted for the habitation of man.

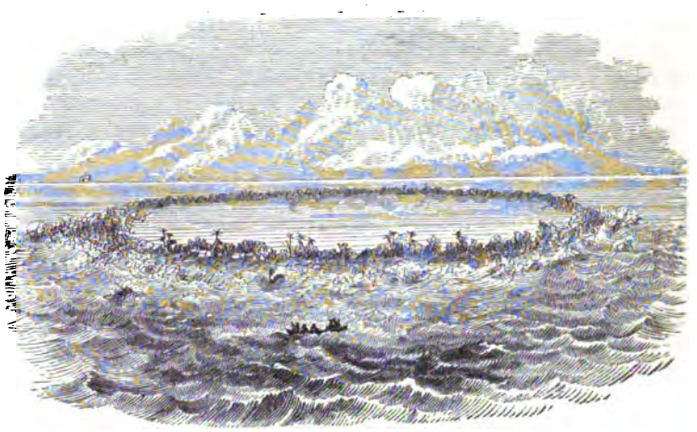
The coral insect cannot exist if left dry, nor at a greater depth than from 150 to 200 feet. It always commences building its stony habitation on submarine land, and ceases its labor in an upward direction on reaching the surface of the water. The occurrence of coral below the depth mentioned can only be explained on the supposition that the foundation on which the insect commenced to build has subsided; while all the coral above the surface has either been washed up by the stormy swell of the ocean, or elevated by volcanic action or other internal forces.

VII. Coralline Formations are distributed into the four great classes of Lagoon-islands, to which their Indian name of Atolls is generally applied, Encircling-reefs, Barrier-reefs, and Fringing-reefs.

1. Lagoon-islands, or atolls, consist of a belt of coral enclosing a lagoon, or vacant space of the ocean. The coral above the surface of the water is usually less than a quarter of a mile in breadth, and so low, that it would not be perceptible at a very small distance, but for its vegetable clothing of cocoa-nuts and palms. The lagoons themselves, or enclosed spaces, vary in extent from a few square miles to enormous areas. The depth of water in the lagoons ranges from 100 to 300 feet.

The atolls are variously circular, oval, and irregular in shape. They occur singly and in groups. Dangerous Archipelago, east of the Society Islands, is an assemblage of 80 atolls, mostly circular, subject to strong currents and squalls. The surf is said to beat on them with such violence as to be heard for a distance of 8 miles. Many of the islets are inhabited. The Caroline Archipelago, north of New Guinea, the largest of all, comprises 60 groups of atolls about 1000 miles in length. Many are of great size, and all are beaten by a tempestuous sea and occasional hurricanes.

Says Mr. Darwin, in describing Whitsunday Island, a sketch of which, taken from Beechey's Voyage, is presented below:—"The immensity of the ocean, the fury of the breakers, contrasted with the lowness of the land and the smoothness of the bright green water within the lagoon, can hardly be imagined without having been seen."



View of Whitsunday Island.

2. Encircling-reefs differ only from the atolls in having one or more islands within the central expanse. The coral belt is commonly at the distance of two or three miles from the enclosed shore. Tahiti, the principal of the Society group, is a fine example; an island rising in mountains 7000 feet high, surrounded by a lagoon, like an enormous moat, from half a mile to three miles broad, and 200 feet deep, which is separated from the out-lying ocean by a reef of coral. The coral, both in the case of atolls and encircling reefs, has openings or channels in its circuit, by which ships enter the lagoons, where they find excellent harborage.

3. Barrier-reefs extend in straight lines in front of the shores of a continent, or of a large island, frequently at a considerable distance from the land. New Caledonia has a reef of this kind 400 miles long; but the grandest example of coral formation known is the great Australian reef. Externally it rises with little inclination from a fathomless ocean — stretches upwards of 1000 miles along the north-east coast — varies in breadth from 200 yards to a mile, and in distance from the shore from 20 to 70 miles. There are many openings through the reef, by which vessels enter the interior ocean, which is everywhere safely navigable.

4. Fringing-reefs are mere ribbons of coral, enclosing no lagoons, but immediately lining the shore.

VIII. The growth of coral reefs and islands is chiefly confined to the Torrid Zone. In a few cases, as in the warm waters of the Gulf Stream, among the Bermudas, as far north as 32° 15′, and in the Red Sea at 30° north, it has been observed beyond the Tropics. Atolls, Encircling-reefs, and Barrier-reefs, are confined exclusively to the Indian and Pacific Oceans. Fringing-reefs occur exclusively among the West India Islands, and in the Mediterranean and Red Seas, and are also found in various parts of the Indian and Pacific waters. The tropical waters of the Eastern Atlantic and Eastern Pacific appear to be entirely destitute of coral formations.

IX. *Recapitulation.*—It thus appears that all the land on the surface of the earth is arranged in the form of Continents or Islands; that the continents have many points of contrast and resemblance; that the islands are either portions of a continent separated from it by some convulsion of nature, or by the action of water — or that they are masses of sand washed up by the waves — or that they are of volcanic or coral formation.

Give some examples of new islands which have arisen. — Describe the formation of Coral islands. — Name the four classes of Coralline Formations. — Which are Lagoon islands?

Describe Encircling-reefs — Barrier-reefs — Fringing-reefs. — To what Zone is the growth of Coral chiefly confined? — Recapitulate the subjects of this and the preceding chapter.

Mount Ararat.

CHAPTER IV.

MOUNTAINS AND VALLEYS.

I. The surface of the earth is greatly diversified by mountains and valleys, hills, table-lands, and plains.

II. Mountains are the highest elevations of the earth's surface; and with reference to their height, may be considered as forming three classes. The first class includes those rising to the elevation of 20,000 feet, and upwards; the second, those ranging between 10,000 and 20,000 feet; the third, those between 2000 and 10,000 feet, all inferior elevations being styled hills and slopes.

The Himalaya range and Andes are of the first class; the Rocky Mountains, Alps, Pyrenees, and Atlas belong to the second class; and the Alleghanies, White Mountains, and Appenines are examples of the third class.

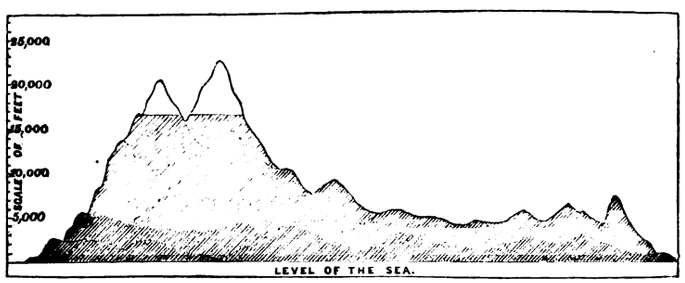
The impression is a natural one, that the mountains on the earth cause it to be an irregular body, and not a sphere, but the highest mountain known, rising above 29,000 feet, is only one five-thousandth part of the earth's greatest circumference, and only one sixteen-hundredth part of its diameter. A single hair, on an ordinary globe, would fully represent the elevation.

Mountains are seldom found in plains remote from each other, and when they do thus occur are usually of volcanic origin — as Mount Etna, the Peak of Teneriffe, and Mount Egmont in New Zealand.

III. A continued line or succession of mountains constitutes what is termed a mountain chain or range. The culminating point of a mountain chain is its highest elevation. A mountain system consists of a number of chains or ranges extending in the same general direction, and having an apparent connection with each other.

Mountain chains are rarely simple, but usually consist of distinct, and often short ridges, extending in the same general direction, and nearly parallel with each other — the whole constituting a grand chain. The extremities are usually rather low, the culminating point being near the centre. Though making many curves and angles, the mountain chains usually correspond in their prevailing direction to the line of greatest extent in the tracts of country in which they are situated. The mountain ranges of the islands of Cuba, Jamaica, and Porto Rico, and those of the peninsulas of California, Italy, and Kamtschatka are good illustrations of the truth of this general law. Secondary lines or spurs branch off at various angles from the main chain stretching far away on to the plains.

IV. The popular idea of a mountain chain as consisting of a single elevated ridge resembling the roof of a house, is far from being correct. A mountain chain is frequently hundreds of miles in width, consisting of alternate ridges and depressions, the entire mass of land being greatly elevated above the surrounding surface. In mountain ranges of no great height, as the Alleghanies, the depressions between the ridges are often fertile and beautiful valleys; in higher chains, as the Himalaya and Andes, they are frequently dreary, inhospitable regions, unfitted for the abode of man. It is through these depressions that rivers, fed from the melting snow of the mountain, or from brooks trickling down the mountain side, find their way towards the reservoirs into which they flow.



The above diagram is a representation of a section of the Chilian Andes, from which may be derived a very correct idea of the general formation of common mountain chains.

V. Mountain chains have usually steep declivities on the sides towards the ocean, and long, gentle slopes towards the interior. The Andes are an example. They rise abruptly from the Pacific; their descent towards the interior is much more gradual. The ascent of the Alleghanies from the Atlantic is quite precipitous; their descent in the direction of the valley of the Mississippi is gentle and gradual.

By what is the surface of the earth diversified? — What are mountains? — How many classes may they be considered as forming? — State the elevation, and give examples of the first class — Second — Third.

What effect have mountains upon the spherical form of the earth? — Of what origin usually are solitary mountains? — What constitutes a mountain chain? — What is the culminating point of a mountain chain? — What is a mountain system?

Describe the general formation of a mountain chain. — Which side has usually steep declivities? — Give some examples to illustrate your statement.

VI. It is a fact worthy of observation that most of the gold and silver hitherto discovered has been found in mountain ranges, extending in a northerly and southerly direction. Humboldt first called attention to this fact as verified by the gold and silver mines of the Andes, Ural mountains, and Alleghanies. The recent discoveries of gold in California and Australia strikingly confirm the truth of this general law.

Tacora Pass — A View in the Andes.

VII. The mountain chains of America are fewer in number, more simple, and more readily traced than those of the old world. They may be considered as constituting six distinct systems, as follows: 1. The Rocky Mountain system. 2. The California system. 3. The Alleghany, or Apalachian system. 4. The Andean system. 5. The system of the Parime. 6. The Brazilian system. The first three are in North America, the last three in South America.

The Rocky Mountain and Andean systems constitute a connected chain, extending along the Pacific coast from the Arctic Ocean to the southern extremity of South America, a distance of more than 10,000 miles. For convenience of description, this chain, the longest upon the globe, is considered as forming two systems.

1. *The Rocky Mountain System.* — The Rocky Mountains extend from near the Arctic Ocean, under about the 70th parallel of latitude, in a south-easterly direction to the 38th parallel; here, assuming the name of the Sierra Madre, the chain is continued in the same general direction to the Isthmus of Panama, which is reached at the low elevation of about 300 feet. The Sierra Madre, through Mexico and Central America, is an irregular intermixture of high table-lands and lofty mountains, many of the higher peaks being active volcanoes. The entire length of this range may be stated at 5,500 miles, at varying distances from the Pacific of from 25 to 900 miles.

2. *The California System.* — This system comprises all the mountains of North America, west of the Rocky Mountain system. It consists in some parts of its extent of a single chain, and in others of several parallel ranges; and stretches along the Pacific coast, from the southern extremity of the Peninsula of California nearly to the Peninsula of Alaska. A spur from the Sierra Nevada, the most eastern range of the California system, connects that chain with the Rocky Mountain system. Some of the peaks of the California system are of loftier elevation than any of the summits of the Rocky Mountain system, though its average elevation is not so great.

3. *The Alleghany, or Apalachian System.* — This system consists of a series of elevations, rarely more than 3000 or 4000 feet in height, which extend north-easterly along the Atlantic coast, from about the 34th parallel of latitude to the Gulf of St. Lawrence. The average width of the mountain chains constituting this system may be stated at from 60 to 150 miles, at various distances from the ocean of from 30 to 300 miles.

4. *The Andean System.* — The Andean system comprises the grand mountain chain which extends in an unbroken line along the Pacific coast, from the Isthmus of Panama to the southern extremity of South America, a distance of more than 4500 miles. South of latitude 20° south, the system consists of but a single chain; north of this latitude, it frequently comprises two or three different parallel ranges. North of the Equator, a spur from the main chain extends in a north-easterly direction along the coast of the Caribbean Sea, constituting the coast-chain of Venezuela and Cumana. Next to the Himalaya range in Asia, the Andean system contains the loftiest elevations upon the globe.

5. *The System of the Parime.* — This system includes several parallel ranges extending from east to west between the Orinoco and Amazon Rivers. The ranges are spread over a tract of country 350 miles in width, by from 1000 to 1200 miles in length, and have an average elevation of perhaps 3000 or 4000 feet.

6. *The Brazilian System.* — The Brazilian mountains extend along the south-east coast of Brazil in several parallel ranges, at various distances from the ocean of from 20 to 80 miles, from the river Uruguay, north-east to Cape St. Roque, a distance of more than 2000 miles. Their average elevation may be stated at 3500 feet.

VIII. The mountain systems of the Old World are much more complicated than those of the New; but on examination it will be found that, as in the New World, the principal ranges extend in the direction of the line of the greatest length of the continent.

IX. The principal mountain systems of Europe and Asia consist of numerous nearly parallel ranges, extending from the eastern shores of the Atlantic to the western shores of the Pacific. The various ranges may be considered as constituting one grand system, extending a distance of little less than 8000 miles, varying in width from 500 to 2000 miles. It reaches its culminating point with Mount Everest, 29,100 feet high, a peak of the Himalaya range, and the highest point of land upon the globe. Although this chain is not continuous, yet it is sufficiently so to be regarded as the grand central chain from which secondary ranges of greater or less importance diverge at various angles.

The situation of this vast mountain band, about midway between the Equator and the North Pole, considerably influences the climate of the extensive regions through which it passes, and forms a separation between the warm, fertile regions of Southern Asia, and the less genial northern countries. In ancient times, in Europe, it constituted the boundary line between the civilized nations of the South and the barbarous countries of the North. And, at the present time, it separates the more civilized nations of Persia and India, from the uncivilized hordes which occupy the northern and central regions of Asia.

The Grimsel Pass — A Scene among the Alps.

X. The Cantabrian mountains, the Pyrenees, the low range of the Cevennes, the Alps, and the Balkan mountains, constitute the central European chain.

In what direction do the principal mountain chains extend, in which gold and silver are found? — Name the six mountain systems of America. — Give a general description of each of them. — Which two of them constitute a connected chain?

In what general direction do the principal mountain chains of the Old World extend? — Describe the grand central system of Europe and Asia. — Name the mountain ranges constituting the central European chain.

South of this central chain, and more or less distinctly connected with it, are the mountain ranges of the Spanish, Italian, and Grecian Peninsulas. The Sierra Morena and Sierra Nevada in the Spanish Peninsula, the Appenines in Italy, and the chain of Mount Pindus, which extends southwardly from the Balkan mountains, are the principal ranges of these regions.

North-westwardly from the Cevennes, the Auvergne mountains extend into the centre of France, and from the great Alpine system numerous branches extend northward into central Europe. The chain of Mount Jura, which separates France and Switzerland, and the Carpathian mountains, which border nearly the whole of the northern and eastern frontiers of Hungary, protecting its vast plains from the chilly winds which sweep across the low lands of the north, are the most important.

The Caucasian system, between Europe and Asia, extends in a south-east and north-west direction, between the Black and Caspian Seas, through a length of about 700 miles. Mount Elbruz, the culminating point of this system, is the highest mountain in Europe.

Mountain Chains of Central Europe, Western Asia, and Northern Africa.

XI. Crossing the slight interruption of the Dardanelles and Sea of Marmora, this central chain is continued in Asia, in a south-easterly direction, by the Taurus, Elborz, and Hindoo Koosh mountains, to about 75° east longitude. The lofty elevations of the Hindoo Koosh form a mountain knot or group, from whence the central chain is continued to the Pacific in four distinct mountain systems, among the grandest and most stupendous upon the globe.

XII. The most southern of these systems, forming the northern boundary of the fertile plains of India, is the Himalaya range, continued through China to the Pacific by the Nanling mountains. Further north, forming the northern boundary of the table-land of Thibet, is the system of the Kuen Lün, continued to the Pacific by the Peling mountains. The rugged and lofty Belor range first takes a northerly direction, but is continued in an easterly course by the Thian Shan, enclosing the great desert of Cobi. From the same mountain knot branches off to the north-east the vast system of the Altai mountains, which separates Tartary and Siberia, and taking a north-easterly direction, reaches the Pacific near Behring's Strait.

Many secondary chains of importance diverge at various angles from the main chain already described. The Solimaun mountains are an important range, branching off to the south from the mountain knot of the Hindoo Koosh. The Ghaut mountains of Hindoostan, and the other ranges of the Indian Peninsulas, are spurs of the system of the Himalayas. A branch from the Altai system extends through Kamtschatka, and is probably continued through the Kurile Islands and Japan. The various branches of the Altai, Thian Shan, Kuen Lün, and Himalayan mountains, which contribute to make China one of the most mountainous countries on the globe, are little known. There are probably many secondary chains extending north and south, connecting these various systems.

The Ural mountains, which separate Europe and Asia, and whose course as a ridge may be traced from the northern extremity of Nova Zembla, in a southerly direction, a distance of 1700 miles; and the Scandinavian mountains, which extend from Cape North to the southern extremity of Norway, a distance of 1000 miles, are the only mountain ranges of note in Europe and Asia unconnected with the great central chain already described.

XIII. The principal mountain systems of Africa are the Atlas range, the Abyssinian mountains, the Snow mountains of South Africa, and the Kong mountains. There are probably other mountain systems in this grand division of the earth, but our knowledge of them is very limited.

The entire north-western part of Africa, between the Great Desert and the Mediterranean Sea, is occupied by the Atlas range, a series of disconnected elevations, extending north-easterly from the Atlantic a distance of 1500 miles.

Between the Nile and the Red Sea commence the mountains of Abyssinia, which are supposed to be continued at a considerable distance from the African coast, nearly to the southern extremity of the Peninsula. South of the Equator this chain has been long recognized by geographers under the name of the Lupata mountains, though the existence of such a range is by no means satisfactorily determined. The recently-discovered Peaks of Kenia and Kilimandjaro, near the Equator, which are believed to be at least 20,000 feet in height, are supposed to be among the loftiest elevations of this extensive chain. The system of the Sneeuw-bergen or Snow mountains comprises a number of ranges extending across South Africa from ocean to ocean.

Describe the secondary ranges which diverge from the central European chain.—Where are the Caucasus mountains?—Name the mountains constituting the central chain in Asia.—Describe the four grand Systems extending to the Pacific from the mountain knot of Hindoo Koosh.

Which are the principal secondary chains of the central system in Asia?—Name the two mountain systems of Europe and Asia not connected with the central chain.—Describe each of them.—Which are the principal mountain systems of Africa.—Describe the one north of the Great Desert—The one between the River Nile and Red Sea.

This system is doubtless a continuation of the chain bordering the eastern coast.

The Kong mountains constitute another African system. They are of inconsiderable elevation, and extend in an easterly direction from the Atlantic Ocean, parallel with the northern coast of the Gulf of Guinea. On most maps of Africa, the Mountains of the Moon are represented as an easterly continuation of the Kong mountains. They are so drawn on the authority of Ptolemy, the ancient Egyptian geographer; but recent discoveries render it doubtful if the position assigned to them be correct, and, indeed, makes the existence of such a chain a matter of great uncertainty. The Cameroons mountains are a group of volcanic formation, on the western coast of Africa, south of the Kong mountains.

XIV. Australia appears to have no central mountain range, but is encircled on every side by elevations rising rarely more than 2000 or 3000 feet. These elevations have a precipitous ascent from the water, but decline by a gradual slope towards the low lands of the centre of the island.

XV. Chains of mountains are variously intersected by valleys, which form two leading classes, termed *longitudinal* and *transverse*. Longitudinal valleys separate parallel ridges of mountain chains, and extend in the same general direction with them. Transverse valleys cut the ridges at right angles, and extend in an opposite direction from the longitudinal.

Longitudinal valleys are frequently of great extent. The Valley of Virginia, 700 miles in length, so noted for its fertility and beauty, and the Valley of the Sacramento and San Joaquin in California, 500 miles long, so celebrated for gold, are of this class.

Transverse valleys are sometimes gradual and gentle depressions in the mountain ranges, of considerable width, as the famous South Pass in Oregon, thirty miles broad, but more frequently they are narrow and frightful gorges, through which only can high mountain chains be crossed. Such are the Passes of the Himalaya and Andes, which are sometimes scenes of great magnificence — often of appalling gloom and peril.

View of the Bolan Pass — A Transverse Valley of the Solimaun Mountains.

XV. *Recapitulation.* — It thus appears that the mountain chains upon the earth may be considered as constituting distinct systems, — that these systems usually consist of several parallel ranges, extending in the direction of the line of the greatest length of the district in which they are situated, — that the chains have usually steep declivities on the sides towards the ocean, and long, gentle slopes towards the interior. It appears, also, that solitary mountains are usually of volcanic formation.

CHAPTER V.

PLATEAUS, OR TABLE-LANDS.

I. A PLATEAU, or Table-Land, is an extensive tract of elevated land, having a comparatively level surface. It may contain hills and valleys, be traversed by mountain ridges, and serve as a platform for lofty mountain peaks; but its prevailing character is that of an elevated region, with a considerable area of plain surface.

Land having an elevation of less than 2000 feet, is not usually regarded as table-land.

PLATEAUS OF THE WESTERN CONTINENT.

II. *North America.* — The Plateau of North America extends from about the 50th parallel of north latitude, between the Rocky Mountains and the coast-range of the Pacific, south-easterly through the central part of Mexico and Central America, to the Isthmus of Panama. This region may be divided into the following sections: —

1. *The Great Basin of Utah.* — This Basin, also called Fremont Basin, on account of having been first explored by Lieut. Fremont, extends from the 44th to the 37th parallel of latitude, and is bounded on all sides by mountain chains. It is for the most part a desolate region, a more particular description of which will be found on page 81.

2. *The Great Mexican Plateau.* — South of the Great Basin of Utah, and extending south-easterly to the Isthmus of Tehuantepec, is the Great Mexican Plateau. The principal table-lands of this region are the Plateaus of Chihuahua and Anahuac. The table-land of Chihuahua, north of the 24th parallel, is a barren region, with an elevation of from 4000 to 6000 feet. The table-land of Anahuac is from 6000 to 9000 feet in height, and is a healthful and generally fertile region. The surface of this Plateau supports several high mountains, many of which are volcanoes, and is also traversed by several well-defined ridges, which divide it into separate and distinct plains. The descent from it is very steep on all sides; on the east especially it is so precipitous, that, seen from a distance, it is like a range of high mountains. From the Mexican Gulf it is only accessible by two carriage-roads: one by Jalapa, the other by Saltillo; both of which were made

Where are the Kong mountains? — On what authority have the Mountains of the Moon been represented on Maps? — Where are the Cameroon mountains? — Describe the mountains of Australia.

What is a Longitudinal valley? — What is a Transverse valley? — Give an example of each. — Recapitulate the subjects of this chapter

What is a Plateau? — Above what elevation is the term Table-Land applied? — Describe the Plateau of North America. — Where is the Great Basin of Utah? — By what other name is this Basin known?

Describe the Great Mexican Plateau. — Which are the principal Table-lands of this Plateau. — Describe each of them.

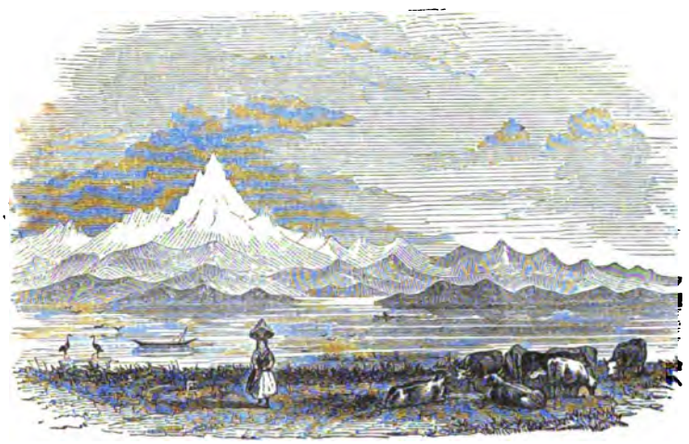
points of attack by the Army of the United States during the recent war between the two nations. On one of the plains of this Plateau, surrounded by lofty mountains, stands the city of Mexico, at an elevation above the ocean of 7430 feet.

3. *The Table-lands of Central America* extend from the Isthmus of Tehuantepec to the Isthmus of Panama, and include the three Plateaus of Guatemala, Nicaragua, and Costa Rica. The country rises westward from the low hills of the Isthmus of Panama to the height of 5000, and even 8000 feet.

III. *South America.* — The Plateaus of South America consist of the great Plateau of the Andes, the elevated plains of Quito, Bogota, and Popayan, and the table-land of Brazil.

1. The great Plateau of the Andes is an enormous mass of lofty table-land, stretching along the tops of the Andes, between the parallels of 15° and 30° of south latitude, a distance of about 1000 miles. It contains the Plateau and basin of Lake Titicaca, in the north, and the desert tract of Despoblado in the south.

The table-land of Lake Titicaca, with an average elevation of 13,000 feet, is the highest Plateau in America. Yet the mountain ridges and elevated peaks which form its boundaries rise to double its height, the loftiest summit being the Nevado de Sorate, 21,286 feet above the level of the sea. The territory, of which such mountains are the enormous ramparts, exhibits a varied surface, and comprises an area nearly four times as great as that of the State of New York. Potosi, the highest city in the world, stands on the southern end of this plateau, at an absolute elevation of 13,330 feet.



View of Nevado de Sorata, from the west shore of Lake Titicaca. — Taken from Gibbon's Exploration of the Valley of the Amazon.

Lake Titicaca is rather more than half the size of Lake Erie, comprising an area of about 4000 square miles. Lieut. Gibbon reports that it is gradually filling up; that "the water is getting shallower every year." "Finally," says he, "there will be a single stream flowing through what in future ages may be called Titicaca Valley." This region includes the plain of Cuzco, which is in itself three times the extent of Switzerland.

South of the table-land of Titicaca, and immediately adjoining it, is an extensive tract of land called Despoblado, "*uninhabited.*" Cold winds blow over this desolate region from the mountains on the west and south-west, so keenly as to chafe the skin when exposed to them; yet there are sometimes currents of hot air of so high a temperature as to produce a similar effect. A singular valley, or narrow cleft in the earth, crosses this tract from north to south, a length of about 140 miles, but having in some places a breadth of only about an eighth of a mile.

2. Less elevated and less extensive than the great Plateau just described, though not less grandly environed by magnificent heights, is the table-land of Quito, 220 miles long, by 30 broad. "From the terrace of the government palace," says Humboldt, speaking of the city of Quito, "there is one of the most enchanting prospects the human eye ever witnessed, or nature ever exhibited. Looking to the south, and glancing towards the north, eleven mountains covered with perpetual snow present themselves, their bases apparently resting on the verdant hills that surround the city."

3. The Plateau of Bogota, in New Granada, has a level surface, enclosed by a barrier of rocks. It is of limited extent, but has an average elevation of nearly 9000 feet.

4. The elevated land occupied by the city of Popayan is a Plateau formed by the main trunk of the Andes.

5. The table-land of Brazil extends westward from the coast-range of the Brazilian mountains, with an average altitude of 2600 feet, — sinking gradually towards the west, into the low marshy plains of the Madeira and Paraguay Rivers.

What Plateaus are included in the table-lands of Central America? — Name the Plateaus of South America. — What are the divisions of the great Plateau of the Andes? — Describe each of these divisions. — Describe the Plateau of Quito — Bogota — Popayan — Brazil.

Plateaus of the Eastern Continent.

IV. *Asia* contains a greater area of table-land than any other grand division of the globe. Its Plateaus may be divided into the table-lands of Central, and of Southern and South-western Asia.

1. *Central Asia.* — The Great Desert of Cobi, the name signifying in the Mongolian language, "*a naked desert,*" also called by the Chinese "Shamo," *the sea of sand*, and "Han-hai," *the dry sea*, lies between the Thian Shan and the Kuen Lün mountains; and stretches in a north-east direction, from about longitude 81° East, to the eastern extremity of Chinese Mongolia, comprising an area estimated at more than half a million of square miles — a territory more than ten times the extent of the State of New York. Its mean elevation is 4000 feet. In the central region it sinks to 2400 feet, while towards the wall of China it rises to the height of 5800 feet. Its surface is for the most part of shingly gravel, though there is an extensive tract of shifting sands near the centre.

The table-land of Thibet occupies the space between the Kuen Lün and the Himalaya mountains, and is divided from east to west into Upper, Middle, and Little Thibet. The surface is much broken by numerous mountain chains, and has an average elevation of about 11,000 feet, — the capital, Lassa, in Upper Thibet, being 9590 feet above the level of the sea.

The common opinion that the whole of Central Asia east of the Belor mountains, between the Altai and Himalaya chains, is a great mass of table-land from 3000 to 12,000 feet high, is doubted by Humboldt, in his volume, "Aspects of Nature." He states that the country north-west of the Thian Chan mountains is lowland, being only from 200 to 1200 feet high. He also states, (page 81): "That outside of the Thibetian Highlands and of the Cobi, the boundaries of which have been defined above, there are in Asia, between the parallels of 37° and 48°, considerable depressions and even true lowlands, where one boundless uninterrupted Plateau was formerly imagined to exist, is shown by the cultivation of plants which cannot thrive without a certain degree of heat."

2. *Southern and South-western Asia* contain the table-lands of Hindoostan, of Iran, of Asia Minor, and of Arabia.

The table-land of Deccan, "*the south,*" in Hindoostan, lies within the triangle formed by the Eastern and Western Ghauts and the Vindhya mountains. This Plateau is divided into three sections: the most southerly of which, the table-land of Mysore, is the smallest, but most elevated — having an average height of about 3000 feet, and rising in some places to more than 7000 feet. The British soldiers, when debilitated by service under the tropical suns of Hindoostan, instead of being sent home to recruit their strength, are now removed to the high lands of this Plateau, the elevated position of which gives them a temperate climate in a torrid zone.

The Plateau of Iran, or Persia, extends from Asia Minor, and from the plains of the Euphrates and Tigris, nearly to the Indus River, leaving only a narrow border of lowland along the Persian Gulf, the Indian Ocean, and the Caspian Sea. This table-land comprises on the west the cold, treeless plains of Armenia, and in the centre consists of extensive salt wastes and immense seas of sand, than which few parts of the globe can be more uninviting.

What divisions may the Plateaus of Asia be considered as forming? — Describe at length the different Plateaus of Central Asia. — What table-lands are found in Southern and South-western Asia? — Which of them are in Hindoostan? — Describe the Plateau of Iran.

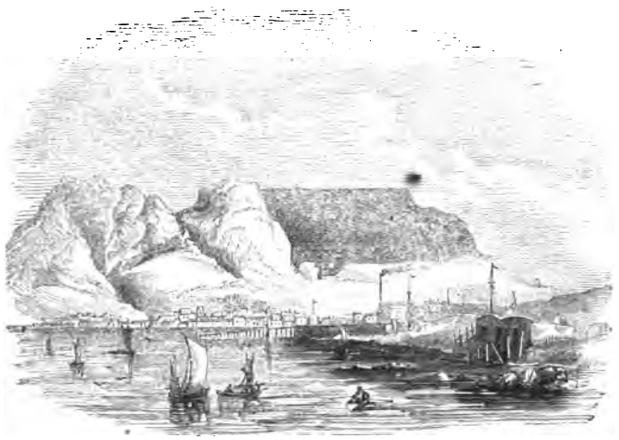
The Plateau of Asia Minor, or Anatolia, is enclosed within the mountain chains which skirt the sea-coast of that peninsula. It has an average height of 3000 or 4000 feet, though some of the summits of its mountain ramparts far exceed this elevation. This table-land is drained by the rivers which flow into the Black Sea; but there is an extensive tract north of the Taurus mountains, covered with numerous salt lakes, marshes, and rivers, having no visible outlet.

Arabia. — The interior of Arabia is very little known, but it is supposed to consist mainly of barren table-lands, supported by the mountain chains which approach the coast.

V. *Africa.* — This grand division of the earth has not yet been sufficiently explored to permit geographers to speak with confidence of the character of its surface. The only table-lands of which there is any thing like certain information, are those of Abyssinia and South Africa.

1. *Abyssinia.* — The entire country of Abyssinia may be considered as one great table-land, guarded by lofty mountain ranges, and supporting many elevated peaks. It rises precipitately from the Red Sea, and on the northwest sinks away gradually towards the low lands, bordering the Nile. On the south, the limits of this table-land are undefined; it may extend beyond the Equator.

2. *South Africa.* — This table-land may be considered as constituting three distinct Plateaus, which rise towards the north from the ocean in three successive terraces. The first of these Plateaus is a well-watered and fertile country, the second contains extensive tracts of barren soil, and the third is a clay desert, which in the hot season is impassable to man and deserted by beasts. Table Mountain, a stupendous mass of rock 3500 feet in height, is situated at the southern extremity of this Plateau.



View of Table Mountain.

VI. *Europe.* — The only European Plateau worthy of mention is that of the Spanish Peninsula, the whole central part of which consists of a series of lofty plains, divided from each other and from the maritime lowlands by parallel mountain ranges. The Plateau comprises 93,000 square miles, nearly equal to half the Peninsula. Madrid, the capital, is 2220 feet above the level of the Mediterranean.

VII. Table-land is not unfrequently characteristic of islands as well as continents. The Faroe Islands, west of Norway, which rise at once to the height of 2000 feet, presenting nearly the same elevation over the whole group, are an example.

Describe the Plateau of Asia Minor — Arabia. — Of what Table-lands in Africa do we possess any reliable information? — Describe the Plateau of Abyssinia — South Africa. — Name and describe the principal European Plateaus. — Are Plateaus exclusively confined to Continents? — Give an example to prove your statement.

CHAPTER VI.

PLAINS.

I. A PLAIN is a tract of land comparatively level, and but little elevated above the surface of the ocean. The term is not usually applied to land rising to the height of more than 2000 feet, the distinction between Plains and Plateaus being the difference in their elevation.

II. The Eastern and Western Continent each contains throughout its entire length a vast though not uninterrupted Plain. The Plain of the Western Continent stretches nearly from Pole to Pole, and that of the Eastern in an opposite direction, almost half the distance around the globe.

PLAINS OF THE WESTERN CONTINENT.

III. *North America.* — The great central Plain of North America extends from the shores of the Arctic Ocean to the Gulf of Mexico, and from the Rocky Mountains to the Alleghanies. It is divided about midway into a Northern and Southern Slope. The surface is so level that a man may traverse its entire length without seeing an elevation of more than a few hundred feet.

1. The section of the northern slope south and south-west of Hudson's Bay is a fertile region, possessing a genial climate, and capable of supporting a dense population. The remainder of the slope is a dreary region, which is thus described by Mr. R. H. Martin: "The whole territory consists of inland seas, bays, lakes, rivers, swamps, treeless prairies, barren hills and hollows, tossed together in a wave-like form, as if the ocean had been suddenly petrified while heaving its huge billows in a tumultuous swell There are, doubtless, several spots adapted in some respects for European settlements, but they are like oases in the desert, few and far between, and totally inapplicable for extended colonization." The climate is extremely severe. For eight months in the year the entire country is covered with snow, and the rivers and ponds, fifteen feet in depth, are frozen to the bottom.

2. The Southern slope comprises the great Valley of the Mississippi and the fertile lowlands bordering on the Gulf of Mexico, for a full description of which, as also of the Atlantic slope, see pages 80 and 81.

IV. *South America.* — The great Plain of South America comprises the entire Peninsula east of the Andes, with the exception of the systems of the Brazilian and Parime mountains, and the Brazilian table-land. The principal divisions of this great Plain are the Llanos of the Orinoco, the Selvas of the Amazon, the Pampas of the La Plata, and the barren wastes of Patagonia.

1. *Llanos.* — The Plains (*Llanos,*) of the Orinoco, constitute the northern division of the great South American Plain. They are so level and so vast, that the traveller is continually reminded of the smooth surface of the ocean. During the dry season these Plains are parched by the scorching heat, and the country is a gloomy scene of sterility and desolation; but with the return of the rains, life, which seemed almost extinguished, springs up again, beautiful and vigorous. To the powdered sand swept along by the winds, and the baked and hardened clay, succeed rich pastures, where range a multitude of animals.

2. *Selvas.* — The Forest Plains of the Amazon, called *Selvas*, occupy the lower part of its Basin, extending as far as the region of periodical inundation. The moisture, and excessive heat of the climate of this region, produce an extraordinary luxuriance of animal and vegetable life. "Behold," says Guyot, "under the same parallel, where Africa presents only parched table-lands, those boundless virgin forests of the Basin of the Amazon, those

What is a Plain? — Give the extent of each of the great Plains of the Eastern and Western Continent. — Name the two slopes of the great North American Plain. — Repeat R. H. Martin's description of the Northward slope. — Name the principal divisions of the great S. American Plain. — Describe the Llanos. — Repeat Guyot's account of the Selvas.

Selvas, almost unbroken, over a length of more than 1500 miles, forming the most gigantic wilderness of this kind that exists in any Continent. And what vigor — what luxuriance of vegetation! The Palm-trees, with their slender forms, boldly uplift their heads 150 or 200 feet above the ground, and domineer over all the other trees of these wilds, by their height, by their number, and by the majesty of their foliage. Climbing-plants, woody-stemmed, twining lianos, infinitely varied, surround them with their flexible branches, display their own flowers upon the foliage, and combine them in a solid mass of vegetation, impenetrable to man, which the axe alone can break through with success." Above the region of periodical overflow, we find vast plains of rich grass.

3. *Pampas.* — Between the 32d parallel and the Rio Negro, and extending from the foot of the Andes to the Atlantic Ocean, are the Pampas or Plains of Buenos Ayres. These Plains, covered with a heavy growth of grass, afford rich pasturage for numerous herds of cattle and droves of horses. Northwest of the Pampas is an extensive tract of country, abounding in lakes and salt marshes; still higher, and at the head-waters of the Madeira and Paraguay Rivers, again appear rich grassy meadows.

4. *Wastes of Patagonia.* — South of the Rio Negro, and extending from the foot of the Andes to the Atlantic Ocean, stretch the desert Plains of Patagonia. These Plains are sterile tracts, covered with sand and gravel, interspersed with numerous large boulders, or masses of rock lying on the surface.

The Pacific Slope. — The Patagonian Andes rise abruptly from the sea; but to the north, a narrow strip of land, from 10 to 100 miles wide, lies between the ocean and the foot of the mountains. Except in Chili, and the country north of the Gulf of Guayaquil, this region is a sandy waste, relieved only by the fertile banks of the mountain-torrents which rush to the sea. The sea-coast of Bolivia is occupied by the desert of Atacama, which is never wet by rains, nor moistened by dew.

Plains of the Eastern Continent.

V. The most extensive tract of low land upon the Eastern Continent is the great Northern Plain of Europe and Asia, which lies north of the central mountain band, (see page 13), and extends from the Bay of Biscay and the North Sea to Behring's Strait. The Ural Mountains form the line of separation between the Asiatic and European divisions of this Plain.

VI. *Europe.* — The Plains of Europe consist of the European division of the great Northern Plain, and of the Plains of Southern Europe.

1. *The Northern Plain.* — This great Plain, nine times the area of France, extends from the foot of the Ural Mountains westward, through North Germany, Denmark, Holland, and Belgium, to the western shores of France. Its eastern section lies between the Arctic Ocean at the north, and the Black Sea and Caucasus Mountains at the south; further westward, it is limited on the south by the Carpathian Mountains and the mountains of Germany. The greater part of this Plain is exceedingly level. From the Carpathian to the Ural Mountains, a distance of 1500 miles, there is scarcely a rise in the ground. The rocky hills of Valdai, near the source of the Volga — the highest elevation of which is only 1100 feet, are the most important interruption to the uniformity of this great Plain, while parts of its surface are below the level of the ocean. Thus the sea is kept out of Holland by artificial ramparts, and the country around the Caspian Sea and the Sea of Aral is considerably below the level of the Mediterranean.

This Plain comprises a large extent of land composed of the richest vegetable mould, and there are wide tracts clothed with natural forests of pine and fir; but there are also considerable quantities of waste lands, either covered with heath or sand, or forming swamps and morasses. From the Gulf of Finland and the Baltic Sea, southward to the Black Sea, wheat grows in great luxuriance. Poland has long been called the granary of Europe, and Southern Russia is equally productive — Dantsic, on the Baltic, and Odessa, on the Black Sea, being among the greatest grain sea-ports in the world. The country around the eastern and southern shores of the Baltic abounds with lakes, and contains extensive tracts of marshy land.

VII. Certain districts in the European Plains receive local names, referring to the character of the surface, or to the nature of the soil, viz.:

1. *Steppes.* — This term is generally applied to treeless plains, without reference to the character of the soil. The Steppes of Russia comprise a great extent of country bordering on the Black Sea, and extending to the Caspian Sea and the River Ural. West of the River Don, these Plains are called the Higher Steppes, being about 200 feet above the sea, and form part of the rich wheat district of Southern Russia. The eastern section, called the Lower Steppes, is a desolate region of sand, mixed with salt pools.

2. *Heaths.* — Much of the surface of Denmark and Northern Germany consists of sandy tracts, sometimes entirely naked, but more generally covered with pine woods, or with a species of *heath*, or low shrub.

3. *Landes.* — France, which has an uncommonly large proportion of fertile soil, contains also in the south vast sandy downs, called *Landes*, which are either wholly barren, or clothed with heath and pines.

View of the City of Turin, on the Plains of Lombardy.

VIII. The principal Plains of Southern Europe are those of Lombardy, Bohemia, Hungary, and the Turkish Provinces of the Danube, which are for the most part extremely fertile; those of Hungary and the Lower Danube sending vast supplies of grain to the ports of the Black Sea.

1. The *Pustzas* of Hungary are districts of deep sand, which indicate by their appearance that they were once the bed of a great sea or inland lake.

IX. *Asia.* — The Plains of Asia consist of the Asiatic division of the great Northern Plain of the Eastern Continent, and of the Plains of Eastern and Southern Asia. The Northern Plain comprises Siberia and Independent Tartary.

1. The *Plain of Siberia* stretches from the foot of the Ural Mountains to the eastern extremity of the Continent, and from the Altai Mountains to the Arctic Ocean. The land is so low that at Irkoutsk, near the southern limits of the Plain, the elevation is but 1246 feet. On the banks of the River Irtysh there is a district twice the area of the British Isles, almost uninhabited, though the richness of its soil, and the abundance of pasture and timber-land, renders it capable of supporting a numerous population. Farther north, near the shores of the Arctic, all is a wide-spreading desolation of salt steppes, boundless swamps, and lakes of salt and fresh water. The cold is so intense, that the spongy soil is perpetually frozen to the depth of several hundred feet.

Describe the Pampas — The Wastes of Patagonia — The Pacific Slope. — Give the boundaries of the great Northern Plain of the Eastern Continent. — Of what do the Plains of Europe consist? — Give a particular description of the European division of the great Northern Plain. — State the character of the soil of this Plain.

What local names are given to certain districts of the European Plains? — Where are the Steppes? — Heaths? — Landes? — Which are the principal Plains of Southern Europe? — Describe the Pustzas. — Name the principal Plains of Asia. — What divisions does the Northern Plain comprise? — Describe the great Plain of Siberia.

2. The *Plain of Turkestan*, or Independent Tartary, extends from the south-western part of Siberia to the northern limits of the Plateau of Iran, or Persia. This vast region contains extensive tracts of desert land, but has also much that is well adapted for pasturage and tillage. In the north, the Kirghis Steppes support wandering tribes of herdsmen, whose wealth consists in their immense number of horses, sheep, goats, and camels. At the south, in Bokhara, the inhabitants are chiefly devoted to agriculture.

View on the Plain of Turkestan.

X. The principal Plains of Eastern and Southern Asia are—

1. The *Plain of Mantchooria.*—This region, separated by mountain chains from Siberia, Mongolia, and China, is drained by the waters of the River Amoor, and contains an area of more than 800,000 square miles. The Russians have lately taken possession of a large portion of this plain, and have established fortifications along the banks, and a naval arsenal near the mouth, of the Amoor river.

2. The *Plain of China* embraces the north-eastern part of the country of that name, extending from the shores of the East and Yellow Seas to a distance of 500 miles inland. It is well watered, and is one of the best-cultivated and most populous tracts on the globe.

3. The *Plains of Farther India* skirt the coast of that Peninsula. They are well watered and highly fertile tracts.

4. The *Plain of Hindoostan* separates the table-lands of Southern India from the region of the Himalaya Mountains, and is a fertile lowland, watered by the River Ganges and its tributaries. To the west of the Plain of the Ganges is a sandy tract, called the Great Indian Desert, which extends nearly to the banks of the River Indus. This river, in the lower part of its course, waters a very fertile tract.

5. The *Plains of the Tigris and Euphrates.*—Near the upper courses of these rivers the country is mostly barren; but towards their mouths, and extending around the head of the Persian Gulf, it possesses great natural fertility, though it is now very thinly inhabited, and is only productive to an extremely limited extent. Immediately to the west of the Euphrates begins the Syrian Desert, extending to the mountain region of the Syrian coast.

A narrow belt of low land, called *the Tehama*, extends around three sides of the Arabian Peninsula, between the mountains and the sea. This is a hot, dry, and sterile tract.

XI. *Africa.*—The principal Plains of Africa, known with sufficient accuracy to attempt their description, are the Sahara or Great Desert, the Plains of Egypt, Central Africa, and the Region of the Zambeze.

Where is the Plain of Independent Tartary?—Name the principal Plains of Eastern and Southern Asia.—Where is the Plain of Mantchooria?—Describe the Plain of China.—The Plains of Farther India.—Where is the Plain of Hindoostan?—Describe the Plains of the Tigris and Euphrates.—Where is the district of low land called the *Tehama?*—Name the principal Plains of Africa

1. *The Sahara*, or *Sea of Sand.*—This immense Desert extends from the Atlas Mountains southward to about the 15th parallel of north latitude, from 750 to 1200 miles in width; and stretches from the Atlantic Ocean to the Valley of the Nile, a distance of 3000 miles. Its area is equal to four-fifths that of the United States, and its average elevation is about 1500 feet above the sea. This vast region is in general almost destitute of water, and is the most parched, barren, and terrific waste upon the globe.

The Oases of the Desert are fertile spots, which occur here and there amidst the general desolation. They are usually at a lower level than the face of the country around them, and some of them are of considerable extent, containing a dense population.

2. *Plain of Egypt.*—The Valley of the Nile, in Egypt, is a Plain of limited extent, but of inexhaustible fertility. Its area is about half that of the State of Maine; yet in former times it supported a population one-third as great as that of the entire United States in 1850.

3. *Central Africa.*—South of the Sahara, and including the inland basin of Lake Tchad and a part of the country drained by the Niger, is the extensive Plain of Central Africa. It is a region of great fertility, and contains a dense population. In the western part of its extent, the southern boundary of this Plain is the Kong Mountains; further east, its southern limits are undefined.

4. *The Region of the Zambeze.*—This is the section which has been recently explored by that intrepid traveller and zealous missionary, Dr. Livingstone. It is a low plain, of great fertility, embracing the entire basin of the Zambeze river. During the rainy season the rivers overflow the country to such an extent that communication between the natives is carried on by means of canoes.

XII. *Australia.*—Geographers possess little knowledge of the interior of the great island of Australia. It is supposed to consist of a vast barren plain. That it is low land, is inferred from the sluggish movements of the rivers; that it is a barren tract of country, from the small number of those rivers. The limited explorations of the interior confirm these suppositions.

XIII. The Eastern Continent is remarkable for the extent of its waste land. A great belt of desert stretches across Northern Africa into Central Asia. It is a dreary zone of sand, gravel, or salt-marsh, and extends over nearly one-third of the circumference of the globe. Tracts of desert land occur in other parts of the Eastern Continent, and in the Western also. Many other smaller sections, though not wholly barren, have only a scanty growth of grass or heath; or like the Llanos of South America, are stripped of their vegetation during a part of the year.

XIV. *Recapitulation.*—From this and the preceding chapters, it appears that the land-surface of the earth consists of high lands and low lands. The high lands comprise Mountains and Plateaus, and include all elevations of more than 2000 feet: they are always found in immediate connection. The low lands are elevations less than 2000 feet above the level of the sea, and comprise by far the larger portion of the earth's surface: they are the scenes of man's highest civilization, containing the greatest cities and densest population. The attentive student has not failed to perceive that large tracts of the land have not yet been explored, as the interior of Africa and Australia; and that other large tracts, as portions of Asia and South America, are yet only imperfectly known.

Describe the Sahara.—What are Oases?—Describe the Plain of Egypt—The Plain of Central Africa.—State the result of recent explorations in South Africa.—What is supposed to be the character of the surface of the interior of Australia?—For what is the Eastern Continent remarkable?—Recapitulate the subjects of this and the preceding chapters.

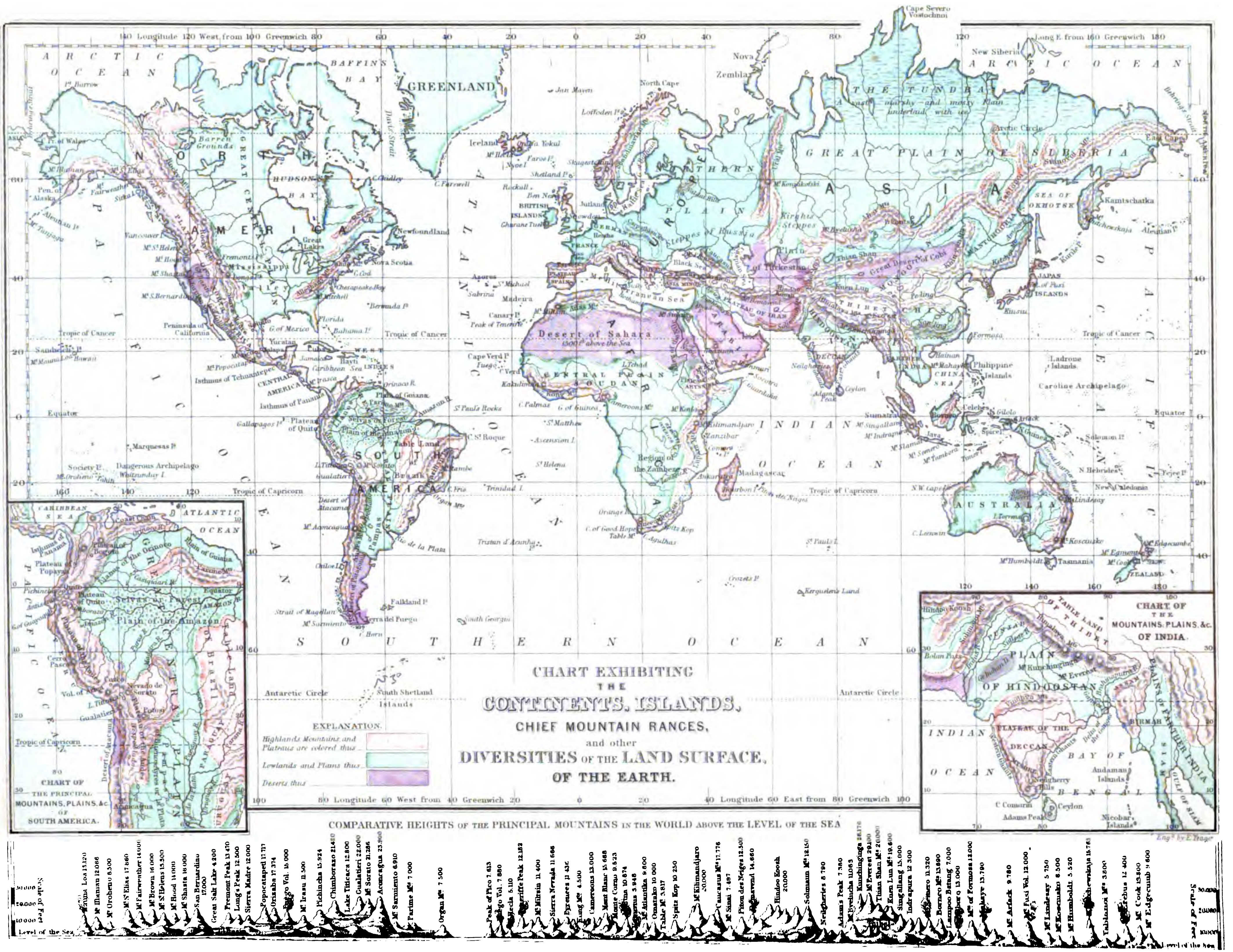


CHART EXHIBITING
THE
CONTINENTS, ISLANDS,
CHIEF MOUNTAIN RANGES,
and other
DIVERSITIES OF THE LAND SURFACE,
OF THE EARTH.
EXPLANATION.
Highlands Mountains and Plateaus are colored thus
Lowlands and Plains thus
Deserts thus
CHART OF THE MOUNTAINS, PLAINS, &c. OF INDIA.
CHART OF THE PRINCIPAL MOUNTAINS, PLAINS, &c. OF SOUTH AMERICA.
COMPARATIVE HEIGHTS OF THE PRINCIPAL MOUNTAINS IN THE WORLD ABOVE THE LEVEL OF THE SEA
Scale of Feet
Level of the Sea
ARCTIC OCEAN
PACIFIC OCEAN
ATLANTIC OCEAN
INDIAN OCEAN
SOUTHERN OCEAN
NORTH AMERICA
SOUTH AMERICA
GREENLAND
EUROPE
ASIA
AFRICA
AUSTRALIA
Desert of Sahara
Great Desert of Gobi
Tropic of Cancer
Tropic of Capricorn
Equator
Antarctic Circle
Engd by E. Weller

QUESTIONS ON THE NATURAL DIVISIONS OF THE LAND.

Continents.

To which Pole do the Continents most nearly approach? — Which Hemisphere, the Northern or Southern, contains the greatest extent of land?—Which is the larger of the two Continents?—In what direction is the greatest length of the Western Continent?—Of the Eastern?—Name the Grand Divisions of the Western Continent.—Of the Eastern.—What three Grand Divisions lie wholly north of the Equator?—What two lie partly south of the Equator? — Which is the largest of the five Grand Divisions? — The smallest?

Which Continent is the most deeply indented by arms of the sea?—Which Grand Divisions are the most deeply indented, the two southern or the three northern? — What Grand Division has the most indented coast?—Which affords the most ready access into its interior?—What two Grand Divisions have the most compact form? — How are the southern members of the Continents connected with the northern? — What two Grand Divisions have a somewhat similar shape? — What three Grand Divisions are widest at the north, and grow narrower towards the southern extremity? — What is the general direction of peninsulas? — Name the exceptions to this law.

Islands.

What is the difference between a continent and an island?—Which ocean contains the greatest number of islands?—What Grand Division has the greatest chain of islands on its coast? — What is the most important group of islands on the Atlantic coast of Europe? — What is the most important group of the Western Continent?—Which coast of America has the most important islands?

What connection is there between continental islands and the adjacent main-land?—Which are commonly the largest, the continental or the pelagic islands?—Which class most nearly resemble the continents in regard to climate and vegetation? — Are the West India Islands continental or pelagic? — The British Isles?—The Society Islands?—Rockall?—Borneo?—St. Helena?—Iceland?—The Sandwich Islands?—Juan Fernandez Islands? — Name some of the most remarkable examples of solitary islands.—Is Australia a solitary island?

What continental islands cluster around the southern part of South America?—What continental islands are in the Mediterranean Sea?—What continental islands are in the Gulf of St. Lawrence?—Trace the great chain of the Pacific, from Vancouver's Island, down the coast of Asia to Tasmania, mentioning all the principal islands and groups.

What is the origin of some of the Azores?—What ocean contains the greatest number of volcanic islands? — What instances of temporary islands can you mention?—Has any volcanic island been formed during the present century?

Which ocean contains the greatest number of coral islands? — Are they found in warm or in cold regions? — How have they become fit for the habitation of man? — Do they occur singly, or in groups? — What is a lagoon island?—Why are some of these lagoon islands dangerous to navigation? — What is the most remarkable example of a barrier reef?—What remarkable island is surrounded by an encircling reef? — Are coralline islands continental or pelagic?

What kind of islands would be likely to be formed on a low and sandy coast? — How would such islands generally be created?—What kind of islands are commonly found on a bold and rocky coast? — What kind of islands would you expect to find on the western coast of Patagonia?—What along the coast of Florida?—Are coral islands likely to have sand-bars and shallow water on their coasts?—Why?—Do sandy islands have a permanent form?

Mountains.

Which continent has the longest system of mountains?—Which has the greatest number of mountain-chains?—Which Grand Division has the greatest and most numerous mountain-chains? — Name all the peninsulas of North America which contain mountain-chains.—Name those of South America.—Of Europe.—Of Asia.—Do the great peninsulas generally contain mountain-chains?

What three great mountain-chains are nearly parallel with the Himalayas? — Mention three of the largest islands which contain mountain-chains? — What ranges of European mountains are independent of any great system? — The highest chains of mountains are said by geologists to be of the most recent creation: which then are the oldest, the Alleghanies or the Rocky Mountains?—The Scandinavian Mountains or the Alps? — The Alps or the Himalayas? — The Brazilian Mountains or the Andes?

Do mountains commonly occur singly, or in chains?—Are there any instances of single, detached mountains? — Does a mountain ever rise abruptly from the surface of a flat plain? — What is generally the nature of the surface around the base of a mountain? — What is a mountain-chain? — In ascending a mountain, would you ever find it necessary to go down hill?

Plateaus.

What is the difference between a plateau and a plain? — Between a plateau and a mountain-chain?—Has a plateau a level surface?—Can you mention an instance of a plateau which is unconnected with mountains? — In descending from a plateau, would you have to cross mountains? — Can you ascend to the surface of a plateau by a gentle and gradual path?

Which Grand Division has the greatest mass of table-land?—Name the highest plateau in South America.—In Europe.—In Asia.—Name all the plateaus in Asia. — What peninsulas contain table-lands? — What Grand Division contains a plateau at its southern extremity? — Are the great plateaus near the northern and southern limits of the continents, or are they near the middle? — Where is the Plateau of Iran? — Of Chihuahua? — Of Anatolia? — Of Deccan? — Of Mysore?

Plains.

Is the surface of a plain always level? — Are our western prairies classed among plains? — Are the basins of great rivers considered as plains? — What examples are there of very extensive level plains? — What plains are below the level of the sea? — What great plains slope towards the north?

In what direction do the great plains of the Western Continent have their greatest length?—Of the Eastern?—Mention the secondary plains of Europe. — Of Asia. — What great island is supposed to contain an extensive plain? — What two plains on the Danube? — On which side of the Black Sea is there a low-land plain?

What great plain contains the smallest proportion of waste or barren land?—What part of the great North American plain is waste land?—Mention all the plains which are nearly or quite uninhabitable on account of extreme cold. — Mention those which are sandy wastes.—Those which are parched up during a part of the year.

Miscellaneous.

What advantage does Europe derive from the numerous indentations of her coast? — What physical features in South America afford some compensation for the want of large gulfs and arms of the sea?—Would Africa be better known to Europeans if the interior were penetrated by large inlets? — Why?

What great island is sometimes classed among the continents? — Which Grand Divisions are most within the Tropics: those of the north, or of the south?—On which side of the Andes is the slope most abrupt?—What part of the Pacific slope in South America is barren?

Which is the highest land: Central Africa or the Desert of Sahara?—What is the highest mountain on the globe?—What mountains bound the Plateau of Deccan? — The Desert of Cobi? — Travel across the Eastern Continent on the parallel of 60 degress, and name the different mountain chains you would cross? — Where is the plain called the Tundra?

In crossing North America from the Arctic Sea to the Gulf of Mexico, what is the highest elevation you would encounter? — Which is the larger, the Desert of Sahara, or the United States?

Is there any good land in Siberia? — How can there be any settled towns in such a cold country as Siberia? — Is the Desert of Cobi as high as the Plateau of Bogota?—What peninsulas in Asia and Europe lie south of the central mountain system of these two divisions?—On which side of that system is there the most land in Asia and Europe?

Mount Etna.

CHAPTER VII.

VOLCANOES AND EARTHQUAKES

I. VOLCANOES are mountains which send forth from their summits or sides columns of flame and smoke, and vast quantities of ashes and melted lava. They are aptly styled in various languages, "*burning mountains.*"

The term is derived from Vulcanus, the name which the ancients gave their imaginary god of fire.

II. The crater of a volcano is the funnel-shaped mouth through which the melted matter issues.

III. The lava emitted from volcanoes generally forces for itself a passage through the sides of the mountains, but sometimes it overflows the top of the crater. Upon its first emergence, the lava has in general about the consistency of honey, hence it proceeds slowly. The surface soon cools and acquires a hard crust, but the interior retains its heat, and remains fluid for a long time.

A mass of lava, 500 feet thick, thrown up from the volcano Jorullo, in Mexico, in 1759, was found smoking, by Humboldt, in 1804, forty-five years afterwards, and still in so heated a state that a cigar might be lighted in any of the crevices, a few inches below the surface; and smoke was observed to issue from it in 1827, sixty-eight years after its ejection.

The amount of lava thrown out by a single eruption is often enormous. Perhaps the most prodigious fiery flood on record was that which proceeded from one of the volcanoes in Iceland, in 1783. The lava flowed in two opposite directions; 50 miles in length, by 12 or 15 miles in width in one, and 40 miles in length, by 7 in breadth in the other, with an average depth of 100 feet, and in some places amounting to 600 feet. The mass has been calculated at nearly twenty thousand millions of cubic yards, or forty thousand millions of tons; which, if accumulated, would cover the city of New York with a mountain rivalling in height the Peak of Teneriffe.

IV. The ashes, stones, and dust ejected during an eruption frequently darken the air for hours, and even for days. Boiling water has flowed copiously from Vesuvius during its eruptions. Discharges of water, mud, and even small fishes have been observed in the case of the Andean volcanoes; but these are not to be ranked with proper volcanic phenomena.

A putrid fever which prevailed in 1691, at Ibarra, a mountain town, north of Quito, was ascribed to the quantity of dead fish ejected from the volcano of Imbamburu. The fish, locally known by the name of "prenadillas," abound in the under-ground reservoirs of the district, and are carried out by internal disturbance through crevices, with the water and mud of pools.

The area over which ashes have been strown from volcanic eruptions, and the thickness to which they have fallen, indicate the enormous quantities ejected. Ashes from Vesuvius, A. D. 472, 473, fell in Constantinople, Syria, and Egypt. In 1815, the sun was obscured, and the streets and houses in Java were strewed with ashes from Tomboro, in Sumbawa, a distance of 300 miles. They were found floating in the ocean to the west of Sumatra, at a distance of more than a thousand miles, forming a stratum two feet thick, through which vessels with difficulty forced their way. It was not a stream of lava from Vesuvius, but simply its ashes, that buried the cities of Pompeii and Herculaneum.

The height and distance to which stones and other projectiles are thrown from volcanoes, furnishes an additional illustration of the immense subterranean power which causes the eruption. A block of stone, weighing more than 200 tons, was thrown from Cotopaxi a distance of nine miles.

Stones have been observed to ascend from Vesuvius so high, that they were eleven seconds in falling, which gives an elevation of 2000 feet. During an eruption in Teneriffe, in 1798, the mountain Chahorra threw out stones which occupied from twelve to fifteen seconds in falling, which indicates a height of from 2500 to 3600 feet. Sir W. Hamilton says that in the eruption of Vesuvius, in 1779, jets of lava having the appearance of columns of fire were thrown up to the height of at least 10,000 feet.

V. So far as relates to the eruptive force, steam-power appears to be a perfectly adequate agent, and sudden evolutions of it will explain the fits and starts of volcanic action.

VI. The energy of volcanic action is most strikingly displayed in the elevation of great masses of land constituting islands (see page 12,) and the formation of new mountains.

What are Volcanoes? — What is the crater of a Volcano? — Through what part of the mountain does the lava generally force for itself a passage? — Give an example of the length of time required for the lava to cool. — Give an example also of the amount of ava thrown out at a single eruption. — Name some other substances ejected from Volcanoes beside lava.

To what was the putrid fever at Ibarra ascribed? — Give examples to show the area over which ashes have been strown. — Give examples to illustrate the weight, distance, and height to which stones have been thrown.

What appears to be an adequate agent to produce these eruptions?

How else is the energy of volcanic action displayed?

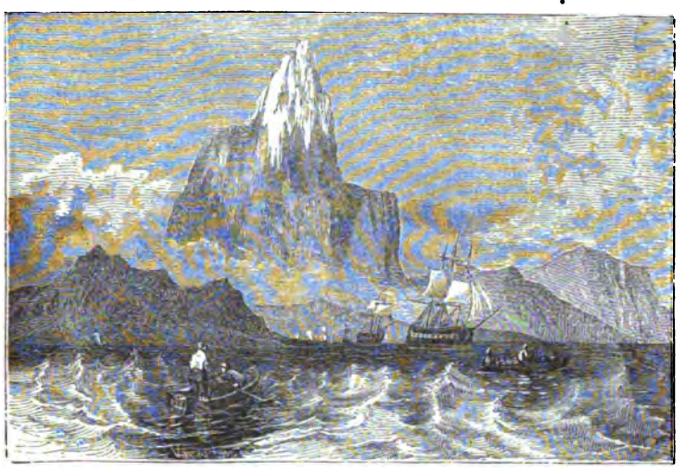
In the Neapolitan district, in Italy, in 1538, the Monte Nuevo, 440 feet high, and 8000 feet in circumference, was thrown up in 48 hours.

In 1669, the Monte Rossi, 450 feet high, and two miles in circumference, was thrown up on the slope of Etna, in Sicily.

In 1759, the mountain of Jorullo, 1695 feet in height, arose out of a plain to the west of the city of Mexico.

The volcano of Isalco, in San Salvador, Central America, now from 1500 to 2000 feet high, has arisen within the last eighty years, and covers a tract of land which formerly constituted a fine estate. This volcano is in a constant state of eruption, discharging ashes and scoriæ at regular intervals of about a quarter of an hour each.

VII. The volcanic mountains are either active, intermittent, or extinct. The frequency and character of their eruptions appears to be related to their height. The eruptions of low mountains being generally more frequent and less violent.



Peak of Teneriffe.

Lofty mountains, such as the Peak of Teneriffe, Mount Etna, and Cotopaxi, have periods of rest, sometimes amounting to centuries. Stromboli, on the contrary, a low mound, little more than 2000 feet in height, has been uninterruptedly active from the earliest dawn of authentic history, and has been appropriately named "the Light-house of the Mediterranean."

Extinct volcanoes are those which have plainly once been the outlets of fire, but whose activity has been suspended for ages. Some of these may really belong to the intermittent class, now experiencing a long state of inaction.

The volcano of Tolima, in New Grenada, in South America, had been at rest for two centuries, when a violent outburst in 1827 showed that the internal forces were still at work. Imbamburu, a volcano of Equador, had been long considered extinct, when in the year 1691 it overwhelmed a large tract of country with mud and water.

From the period of the earliest historical records to A. D. 79, when Herculaneum and Pompeii were destroyed, Mount Vesuvius seems to have been inactive. Since then it has been at least eighty times in action. There are fifty-five recorded eruptions of Mount Etna between the years 480 B. C. and A. D. 1832. Between the commencement of the eleventh century and 1845, there have been twenty-five outbursts of Mount Hecla, in Iceland.

VIII. Nearly all the active volcanoes upon the globe are limited to the immediate vicinity of the ocean. Many are found on islands, others in chains of mountains extending along the line of the coast, others at the base of such chains between them and the coast. Humboldt suggests that coast lands are simply favorable to eruptions, because they form the sides or edges of the deep sea-basin, which, covered with water, and lying many thousand feet lower than interior sites, offer less resistance to subterranean forces.

The principal exceptions are the Volcanoes of Pechan (white mountain,) and Hochow (burning mountain,) in Western Asia, both of which are about 1500 miles from the ocean.

IX. Of all the reasons which have been assigned for a general theory of the cause of volcanoes, the simplest and best founded is that the centre of our earth is a vast sea of liquid fire, to which the volcanoes serve as vents. This sea may remain at rest for ages beneath enormous areas, but is liable to be locally excited and uplifted by the force of compressed vapor. This theory is supported by the fact that the temperature of the earth increases regularly at the average rate of one degree for every fifty-four feet of descent below the level of the sea.

X. Volcanoes may be distributed into the two great classes of Central and Linear systems. A Central system consists of a number of vents grouped together, one of which usually serves as a common point of eruption, as the Peak of Teneriffe for the seven volcanoes of the Canary Islands. A Linear system consists of several vents extending in one direction at no great distance from each other, forming as it were chimneys along an extended fissure, as the volcanic chain of South America.

The following table gives the number of volcanoes of each system. It includes active and extinct volcanoes, and some perhaps of doubtful existence:—

CENTRAL CLASS.

System.	No. of Volcanoes.
1. Etna (Sicily)	1
2. Vesuvius (Naples)	1
3. Lipari Islands	2
4. Jan Mayen	2
5. Iceland	8
6. Azores	2
7. Canary Islands	7
8. Cape Verde Islands	1
9. Ascension Island	1
10. Tristan d'Acunha Island	1
11. Traverse Islands	1
12. Trinidad Island	1
13. Mauritius and Bourbon Islands	3
14. Sandwich Islands	4
15. Galapagos Islands	1
16. Marquesas Islands	1
17. Society Islands	1
18. Easter Island	1
19. Western Asia	3
Total	42

LINEAR CLASS.

System.	No. of Volcanoes.
1. Santorini (Greek Islands)	1
2. Thian Shan Mts. (Central Asia)	2
3. Red Sea	2
4. Friendly Islands	2
5. Australasian Islands	13
6. Sunda Islands	80
7. Spice Islands, Phillipine Islands, and Formosa	37
8. Japan Islands	23
9. Kurile Islands	18
10. Kamtschatka	21
11. Ladrone Islands	7
12. Bonin Sima Islands	2
13. Aleutian Islands	35
14. North-west America	10
15. Mexico	7
16. Central America	38
17. West Indies	10
18. Equador	17
19. Peru and Bolivia	12
20. Chili	22
21. Terra del Fuego and South Shetland Islands	4
22. Antarctic Land	2
Total	365

The number in both classes amounts to 407; of which 270 are active, and of these, 190 belong to the islands and shores of the Pacific Ocean. Indeed, this vast ocean seems to be almost surrounded by a great volcanic chain.

XI. Volcanoes are most numerous in the Torrid Zone; yet they occur in all latitudes. The most northern volcanoes known are those of Jan Mayen, latitude 72° north. In the opposite

Give examples of mountains which have been formed by volcanic agency.—To what does the frequency and character of volcanic eruptions appear to relate?—What is the difference in the character of the eruptions of high and low mountains?—Illustrate your statement by examples.—What are extinct volcanoes?—Give examples of intermittent volcanoes.

To what vicinity are nearly all of the volcanoes upon the globe limited?—What reason is assigned by Humboldt for this fact?—What reason is assigned for a general theory of the cause of volcanoes?—By what fact is this theory supported?—Into what two classes may volcanoes be distributed?—What is a Central system?—What a Linear system?—What is the number of volcanoes of both classes?—How many are active?

hemisphere, Mount Erebus, an active volcano in Victoria Land, is situated amidst the region of eternal ice, within twelve degrees of the South Pole.

Mount Erebus.

XII. In no part of the globe, of the same extent, are there so many volcanoes as in the island of Java. Out of eighty assigned to the Linear system of the Sunda Islands, forty-three belong to Java; and in no part of the earth are the eruptions more terrific.

Leopold von Buch, the celebrated geographer, gives the following account of one of them: — "On the 8th of October, 1822, about one o'clock in the afternoon, a frightful noise was heard in the neighborhood of Galung Gung, in Java. The mountain was immediately shrouded in a thick cloud of smoke, and streams of hot, muddy, sulphurous water poured down its slopes on every side, and carried before them every thing they met with. There was then an awful sight in Badang; the river Tschiwulan sweeping down vast multitudes of corpses of men, cattle, rhinoceroses, tigers, antelopes, and even entire houses carried with them into the sea. This flood of hot, muddy water lasted but two hours, yet these were enough to lay in waste a whole province. At three o'clock it had ceased, and there now followed a thick rain of ashes and pumice, which utterly destroyed all that had been spared of the face of the country, and burnt up all the trees. At five o'clock all was at rest again, and the mountain was seen once more. And during this short time, every dwelling, every village for many miles round, had been covered with mud; in places, which just before had been level plains, hills had arisen, and a vast number of human beings had ceased to live."

XIII. Several of the mountain peaks of the north-western section of the United States are supposed to be volcanic, and smoke and ashes are said to have arisen from them at different times. Mt. St. Helen's, in Washington Territory, north of the Columbia River, has been recently in a state of eruption. In 1842, ashes and cinders from this mountain fell at Fort Vancouver, about fifty miles distant, slightly covering the country in its vicinity. There are indications of volcanic action, in former times, in many parts of this region of country.

XIV. Salses, or mud volcanoes; the Fires of Bakou; the Fire-Hills and Fire-Springs of China; and the Geysers of Iceland, are volcanic phenomena, undoubtedly owing their origin to the same cause as that of volcanoes.

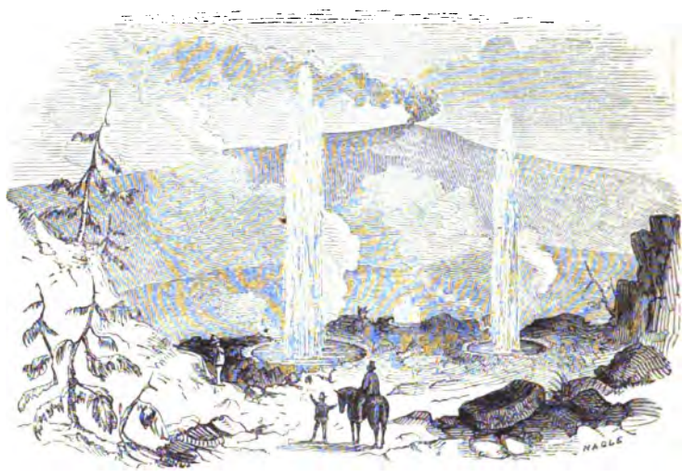
1. *Mud Volcanoes* occur in Sicily, in Java, and south-west of the Caspian Sea in Asia. They are small hillocks, from which are discharged occasionally various gases, hot water, mud, and sometimes columns of fire.

2. *Fires of Bakou.* — The town of Bakou is on the south-west coast of the Caspian Sea, and about ten miles from it is situated the remarkable tract called the "Field of Fire." It is a hollow expanse, full of fissures, from which an inflammable gas continually issues, producing a blue flame. This spot was formerly one of the most celebrated "shrines of grace" among the Ghebers, or fire-worshippers of Persia; and a few still find their way to it, even from India.

3. *Fire-Hills and Fire-Springs.* — The agency of volcanic action is evinced in China by numerous *Hochans*, or fire-hills, and *Hotsing*, fire-springs, or wells of fire. The latter yield an inflammable gas, which, when lighted, burns with a blue flame, and is made of much practical service in evaporating salt water. A similar spring occurs in Fredonia, in New York, south of Lake Erie, the gas from which is used for lighting the town.

4. *The Geysers* are an extraordinary collection of about fifty hot springs, which occupy an area not exceeding twelve acres, in Iceland, at about the distance of thirty-five miles from Mount Hecla. The term is derived from the Icelandic word *geysa*, "to rage," or *gys*, "to rush out with impetuosity." The Great Geyser, the largest of these springs, is a circular mound, on the summit of which is a basin, resembling in shape a saucer, about sixty feet in diameter, and six or seven feet deep. In the centre of this basin is a well, ten feet in diameter, and 70 feet deep, through which the boiling water rises clear as crystal, gradually filling the basin.

Between grand eruptions there is an interval of a day or more. Their approach is announced by hollow, rumbling sounds, which warn the spectator to retire to a safe distance. The water in the basin boils furiously, the earth is slightly shaken, and the agitation increases, till at length a column of water is suddenly thrown up with vast force and loud explosions to the height of 100 or 150 feet. After playing for a time like an artificial fountain, and giving off great clouds of vapor, the basin is emptied, and a column of steam rushing up with great violence, terminates the explosion.



The Geysers of Iceland.

Prof. Shepherd describes the "Pluton Geysers" of California, as situated in a deep defile north of San Francisco, in the valley of the Pluton River, where he found, in a space of half a mile square, from one to two hundred openings, through which the steam issued with violence, sending up dense columns of vapor to the height of 200 feet. The roar of the large tubes could be heard for a mile or more.

Earthquakes.

XV. Earthquakes are those terrible convulsions of nature by which towns and villages have been swallowed up, great cities destroyed, and even entire continents shaken. They are chiefly confined to the volcanic regions of the earth, and undoubtedly owe their origin to the same cause as that of volcanoes.

The shocks are usually most severe in places some distance removed from active volcanoes, the vents of the latter appearing to act as a kind of safety-valve to the elastic force which, when pent up, so terribly shakes the crust of the earth.

Repeat Leopold von Buch's account of the volcanic eruption in Java.—In what part of the United States are there Volcanoes?—Where do Mud Volcanoes occur?—Describe the Fires of Bakou

In what country are there Fire-Hills and Fire-Springs? — Describe the Geysers of Iceland. — What is said of the Pluton Geysers of California. — What are Earthquakes.

XVI. Observation gives us little room to doubt the intimate connection of volcanoes and earthquakes. Most of the great eruptions of modern times have been preceded by earthquakes, and most of the great earthquakes of recent date have been followed by eruptions.

Stromboli, for the first time upon the record of history, had an interval of repose immediately preceding the great earthquake of Calabria, in 1783, during which 40,000 persons perished. The great convulsions of the years 1811 and 1812, which were felt in the Azores, in the West India Islands, in the Valley of the Mississippi, and which destroyed the city of Caraccas in South America, in March, 1812, were followed, on the 30th of April, by the terrible eruption of the volcano Morne Garou, on the Island of St. Vincent's, which had been quiet for nearly a century.

XVII. The movements of the ground during an earthquake are described as being either horizontal, vertical, or rotary.

The horizontal movement is the most common and the most harmless. It consists of an alternate rising and sinking of the earth in the direction of the movement, and may be likened to the undulations of the waves of the ocean.

The mine-like explosion, the *vertical* action from below upwards, was most strikingly manifested in the earthquake of Riobamba, in Equador, Feb. 4, 1797; when the bodies of many of the inhabitants were thrown upon a hill, several hundred feet high, on the opposite side of the river from that on which the town is situated.

Rotary movements are rarely felt, except in the most disastrous and appalling catastrophes. They cause a whirling movement of the earth, by which, in some cases, buildings are turned round without being thrown down, and rows of trees are turned from their parallel direction. Such were the movements of the great earthquake of Calabria, in Italy, Feb. 5, 1783, which destroyed over two hundred towns and villages, and during which nearly one hundred thousand persons perished. The face of the country was so completely changed by the movements of this earthquake, that many disputes afterwards arose as to whom the property should belong which had so far shifted its position.

XVIII. The undulations of earthquakes are propagated in two very distinct ways: sometimes extending in a linear direction, and sometimes from a centre almost equally in every direction.

The earthquake of Guadeloupe, Feb. 8, 1842, was a linear one. It was felt along a right line from 60 to 70 miles in width, from the mouth of the Amazon to South Carolina, a distance of 3000 miles.

In circular earthquakes, the progress of the shock may be compared to the ring-like waves produced on the surface of still water when a stone is thrown in, the waves growing wider and fainter as the distance increases. The great earthquakes of Lisbon and Calabria were of this character. The vibrations of the Lisbon earthquake extended over an area four times the size of Europe.

XIX. Earthquakes furnish the most striking examples with which we are acquainted, of the production of stupendous effects in very brief intervals. The most severe are generally the shortest in their duration.

The following brief account of the great earthquake at Lisbon, during which 60,000 persons lost their lives, is extracted from a volume published in 1757, two years after the catastrophe:—

"At thirty-five minutes after nine o'clock, on the morning of the first of November, 1755, without the least warning, except a rumbling noise, not unlike the artificial thunder at our theatres, immediately preceding, a most dreadful earthquake shook by short but quick vibrations the foundations of all Lisbon, so that many of the tallest edifices fell that instant. Then, with scarcely a perceptible pause, the nature of the motion changed, and every building was tossed like a wagon driven violently over rough stones, which laid in ruins almost every house, church, convent, and public building, with an incredible slaughter of the people. It continued in all about six minutes."

Name the three movements of Earthquakes.—Describe and give examples of each.—In what two directions are earthquake movements propagated?—Describe each.—Repeat the account of the Lisbon earthquake.

The desolation of Caraccas, March 26, 1812, occupied less time. In the space of fifty seconds, three great shocks shattered the city, killed 10,000 of its inhabitants, and covered the province with ruins.

XX. Beyond the limits of the volcanic regions, where earthquakes are most numerous and destructive, all countries are subject to slight tremors at distant intervals of time. Slight shocks have been felt frequently in various parts of the United States, and one destructive earthquake has been experienced—that of New Madrid, in the winter of the years 1811 and 1812.

The principal shock which devastated the town, and extended through the Mississippi Valley, from Cincinnati on the east, and North-western Missouri on the west, across the Gulf of Mexico and the Caribbean Sea, and at Caracas, in New Grenada, is thus described by a gentleman who had secured for the night the flat-boat in which he was floating down the Mississippi, at New Madrid:—

"It was about twelve o'clock, on the clear moonlight night of the 6th of February, 1812, when there came a frightful crash, like a sudden explosion of artillery, and instantly followed by countless flashes of lightning. The Mississippi foamed up like the water in a boiling cauldron, and the stream flowed rushing back, while the forest trees near which we lay came cracking and thundering down. This fearful spectacle lasted for several minutes, and the fierce flashes of lightning, the rush of the receding waters, and the crash of the falling trees, seemed as if they would never end. At sunrise, the whole terrible scene was disclosed to our gaze; and the little town of New Madrid, sunken, destroyed, and overflowed to three-fourths of its extent, lay more than 500 paces from us, with some of its scattered inhabitants here and there visible among its ruins. Of twenty flat-boats and their crews which surrounded us on this terrible night, nothing was ever afterwards heard!"

XXI. Earthquake shocks are often preceded or accompanied by various sounds. Sometimes, however, the sound is heard after the shock, and in some instances no sound whatever is perceived; thus the great earthquake of Riobamba occurred without any noise.

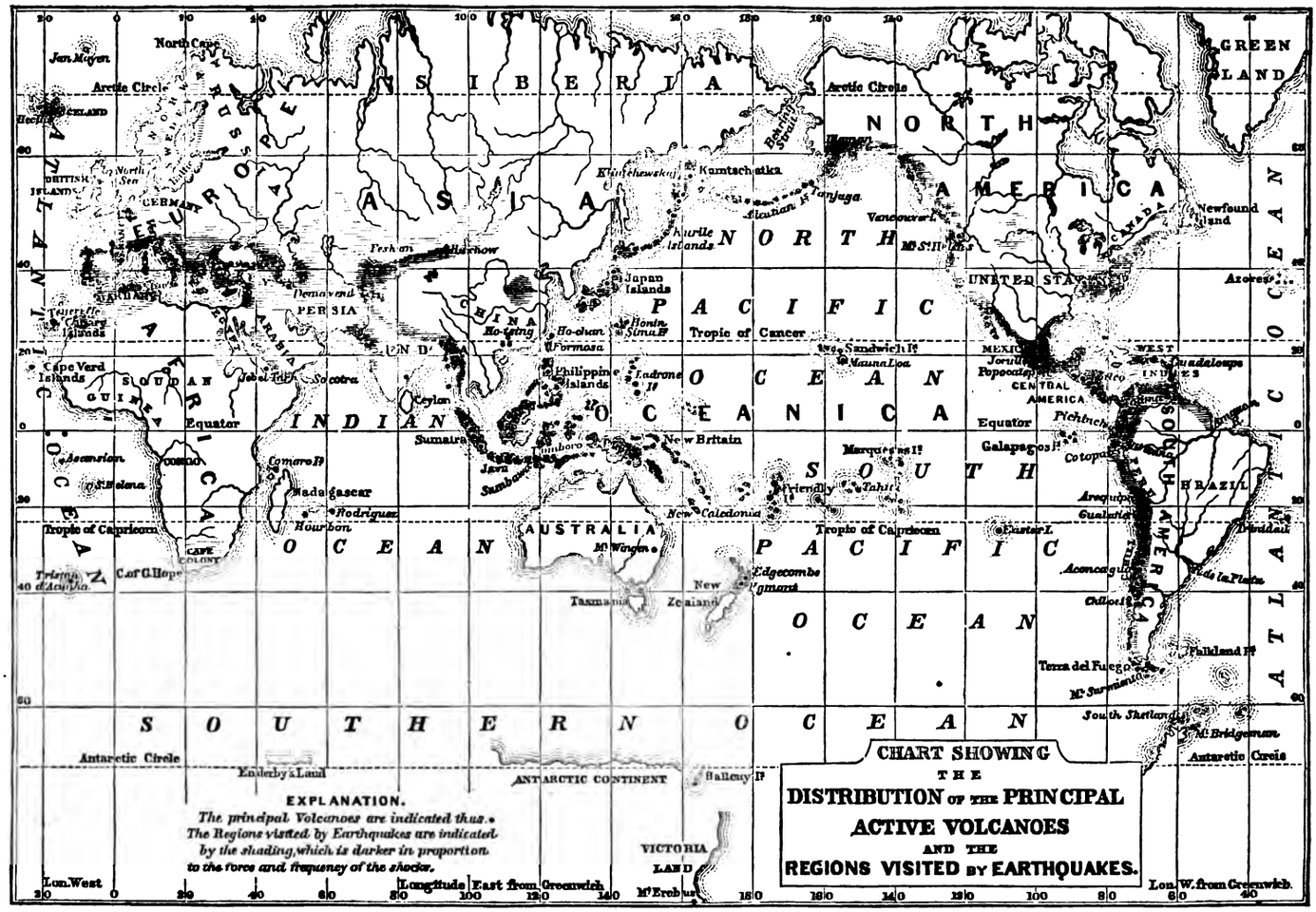
These sounds are described as greatly differing: dull, rumbling noises, sounds like the discharges of cannon, like the clanking of chains, like thunder close at hand, or as if vast quantities of glass were broken in caverns underneath the ground, are noticed.

A striking and unparalleled instance of subterranean noise, unaccompanied by any trace of an earthquake, is the phenomenon known in the elevated Mexican Plateau by the name of the "Roaring and the Subterranean thunder" of Guanaxuato. The noise began about midnight, on the 9th of January, 1784, and continued for a month. From the 13th to the 16th of January, it seemed to the inhabitants as if heavy clouds lay beneath their feet, from which issued alternate slow, rolling sounds, and short, quick claps of thunder. The noise, which was limited to a small space, abated as gradually as it had begun. During its continuance, the inhabitants in great dismay fled from the city, and only returned when compelled by the city authorities, who sent out the military to force them back.

XXII. The permanent elevation and subsidence of great tracts of land are occasional attendants upon earthquake action. Thus the coast of Chili was permanently elevated several feet by the great earthquake of 1835.

During the earthquake of 1692, the city of Port Royal, in Jamaica, with a large tract of adjacent land, sunk into the sea. In 1755, the new quay at Lisbon, to which an immense concourse of people had fled for safety from the falling ruins, suddenly sunk, and its place is now occupied by water a hundred fathoms deep. In 1819, a town and large tracts of country were submerged at the mouth of the river Indus, but at the same time a tract of land, fifty miles in length, and in some parts sixteen in width, was elevated above the plain; to this tract, the inhabitants, to distinguish it from artificial mounds, gave the name of Ullah Bund (the Mound of God).

Repeat the account of the New Madrid earthquake.—What are some of the sounds accompanying earthquakes?—State some of the permanent effects attendant upon earthquake action.



XXIII. Tremblores, so called in South America, where such tremors of the surface are common, occur almost every day in certain seasons. Though walls are sometimes split, and objects are thrown down, they are little dreaded by the inhabitants.

Lima has, on an average, forty-five earthquake shocks a year; but long habit, and the very prevalent opinion that dangerous shocks are only to be apprehended two or three times in the course of a century, cause faint movements of the earth to be regarded there with scarcely more attention than a hail-storm in the Temperate Zone.

XXIV. *Recapitulation.* — According to the preceding account of Volcanoes and Earthquakes, it will be seen that both of these wonderful natural phenomena are attributable to the same cause — the action of the internal fires of the earth; that Volcanoes may be divided into two classes, the Central and the Linear sytems; that they may also be divided into *active*, *intermittent*, and *extinct;* that nearly all the active Volcanoes on the globe are near the ocean; that eruptions of mud, hot water, and steam, owe their origin to the same cause as Volcanoes: that the movements of the ground which accompany Earthquakes are either vertical, horizontal, or rotatory; and that both these agencies perform important functions in the economy of nature — Volcanoes affording the natural opening through which the imprisoned gases make their escape, and Earthquakes materially modifying the configuration of the land.

QUESTIONS ON THE CHART.

Where are volcanoes most numerous: near the coast, or in the interior? — Name any volcanoes in the interior of a country. — Are they most numerous along the Atlantic or Pacific coast? — Along the coasts of the Indian or the Arctic Ocean? — Name the most northern volcano known. — The most southern. — Are they more numerous in the tropical regions than in the Temperate Zones?

Name any islands on which there are more than five volcanoes. — In what part of America are volcanoes most numerous? — Are there any in the United States? — In Greenland? — In the West Indies? — In Europe? — Can you name any volcanoes of recent formation?

Do the eruptions of lofty or low volcanoes occur most frequently? — Which are the most terrific: the bursting forth of lofty volcanoes, or of low ones? — What kind of a volcano is Stromboli? — Cotopaxi? — Mt. Hecla? — Vesuvius? — Mt. Etna? — Which would probably be most destructive: the eruption of Mt. Cotopaxi, or that of Stromboli?

Where are there mud volcanoes? — Where are the fires of Bakou? — What are they? — Where are the Geysers? — The Pluton Geysers? — Are there any springs in the United States which yield an inflammable gas? — Are there similar springs in any other part of the world?

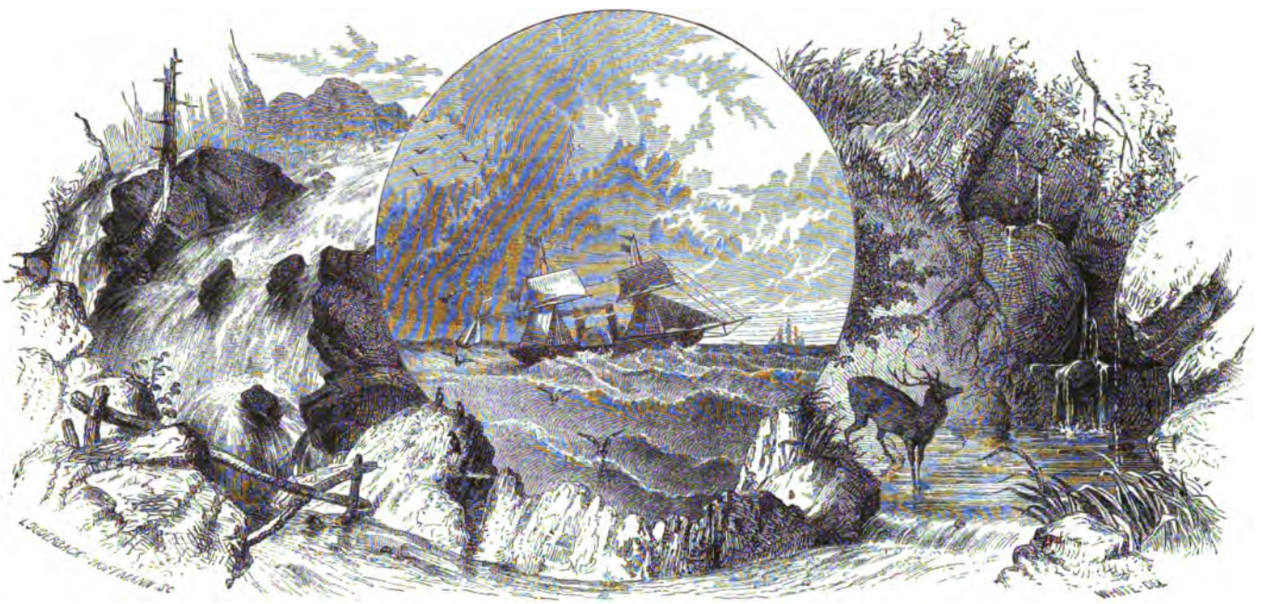
Do earthquakes occur in the regions where there are volcanoes, or in districts remote from them? — Where are they usually most severe: near the volcano, or some distance from it? — Are the shocks of an earthquake usually accompanied by any noises?

Has any part of the United States ever suffered from the shock of an earthquake? — Give a description of the most destructive earthquake of which you have read? — Have severe shocks of earthquakes ever been experienced in Europe? — In South America?

What are the so-called Tremblores? — Where are they common? — How are slight earthquake shocks regarded in Lima? — What is supposed to be the cause of volcanoes and earthquakes? — Recapitulate the subjects of this chapter.

PART II.

HYDROGRAPHY.



HYDROGRAPHY, (from two Greek words, signifying "water," and "to describe,") is that department of Physical Geography which treats of the water upon the earth. The subject will be considered under the general divisions of Springs, Rivers, Lakes, the Ocean, and Oceanic movements.

Water, one of the most abundant substances in nature, chemically considered, is a compound of two gases — oxygen and hydrogen: in the proportions of eight parts, by weight, of the former, to one of the latter. When pure, it is a transparent and colorless liquid, destitute of smell, and nearly without taste. It is rarely found, however, in a pure state, being variously affected by different matters with which it has come in contact.

Different bodies of water upon the globe vary in their composition, (some being fresh, others salt,) in their temperature, and in their color. The subject of temperature will be considered in the article TEMPERATURE, page 40. Other peculiarities will be described in connection with the general divisions already enumerated.

CHAPTER I.

SPRINGS.

I. SPRINGS are fountains of water, which gush forth from the ground, flowing from reservoirs underneath the surface. They may be classified as perennial or constant, intermittent, and periodical.

Springs derive their supplies from water raised into the atmosphere by evaporation, which is again deposited on the earth in the form of rain, hail, snow, or dew. A part of the water thus deposited is drained from the surface into streams or rivers, or again returned to the atmosphere by evaporation, or devoted to the purposes of animal and vegetable life. The remainder enters the ground through porous beds, or by means of fissures in rocks, and continues to sink until arrested by strata, which renders its further progress impossible; when the continued pressure from above forces it to gush forth as a spring, larger or smaller, according to the supplies it has received.

II. Perennial springs show no diminution in a long-continued drought. The reservoirs of such springs must be very extensive; so considerable as not to be materially affected from any cause.

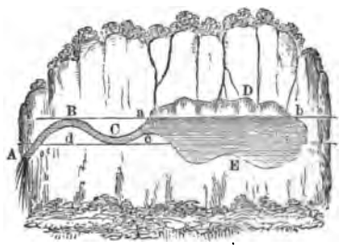
Of what does Hydrography treat? — Under what divisions will the subject be considered? — What is the chemical composition of water? — In what do bodies of water vary?

What are Springs? — How may they be classified? — State the manner in which Springs are formed. — What are Perennial Springs?

III. Intermittent springs depend entirely upon the prevailing character of the season. They gush abundantly after heavy rains; but flow feebly, and often completely fail, in dry weather. Such springs are common in a gently rolling, or moderately elevated district.

IV. Periodical springs flow only at regular intervals, and for a limited time. Such springs are rare. The far-famed Pool of Siloam is an example.

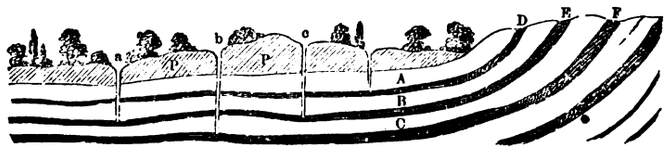
The flow of springs of this class may be explained on the well-known principle, that water, in whatever situation it is placed, always tends to seek its lowest level.



In the figure at the side, let A B C be a syphon-shaped fissure leading from the reservoir in the ground, D E, which is supplied through crevices extending from the surface. When this reservoir is filled as high as the line a b, even with the highest point in the fissure, the water will commence to flow, and continue until the reservoir is exhausted down to the point c. It will then cease, until again filled to the line a b.

V. Artesian wells, from the ancient Artesium, (modern Artois, a province of France, where they have long been in use,) are artificial springs constructed on the principle of natural springs.

The annexed diagram of a supposed section of country will represent the theory on which Artesian wells are sunk. They are formed by boring into the ground, and sinking a tube until a subterranean reservoir of water is reached. If the sources whence this reservoir is supplied are at a higher level than the surface of the well, the pressure from above will force the water up the tube, sometimes in jets many feet in height.



Let P P represent a bed of clay impervious to water, A B C strata through which water cannot pass, and D E F strata into which the water that falls on the surface penetrates. If, then, pipes be sunk at a b c into the strata D E F respectively, the pressure from above will force the water up the tubes to the surface.

These wells are sometimes of great depth, and enormous quantities of water flow from them. The famous well of Grenelle, at Paris, is 1686 feet deep; and throws up, in 24 hours, 744,490 gallons of water.

The importance of Artesian wells can scarcely be over-estimated. It has been proved that in some desert regions, Arabia for example, water can be obtained in abundance from underground reservoirs by sinking these wells. Possibly a series of Artesian wells might diminish the perils of the passage of the Sahara.

VI. The water of most springs is fresh, but in many it is salt. The most important in the United States are those at Syracuse, in New York, and near the Kanawha River, in Virginia, which are very rich, and extensively evaporated for table-salt.

VII. There are numerous springs, especially in the United States and Europe, variously impregnated with mineral matter, which are much resorted to for medicinal purposes. Among the most noted in the United States are: Saratoga Springs, in New York; the Sulphur Springs, of Virginia; and the Blue Licks, of Kentucky.

What are Intermittent Springs? — Periodical Springs? — Explain the principle on which Periodical Springs flow.—What are Artesian Wells? — Explain the principles on which they are sunk. — Give examples of Salt Springs and Mineral Springs.

CHAPTER II.

RIVERS.

I. Rivers are streams of water flowing in a channel on land, toward the ocean, a lake, or another river. They have their origin in springs, or flow from lakes, or have their source in the melting of snow and the ice of glaciers. They are important aids to civilization, being natural channels of communication between inland regions, and affording great facilities for commercial intercourse, especially since the discovery of steam navigation.

II. The basin of a river is the whole extent of country drained by it; that is, all the region which contributes its waters to the formation of the river. The basin of the Hudson River, for example, is the entire tract of country included within a line which should pass through the source of each river, creek, brook, rill, or stream, which flows into it. The greatest river-basins are in America; the smallest, in Europe.

III. The margin of country which separates one basin from another is called its water-parting, or water-shed; the waters flowing from this line in different directions. The ridge of the roof of a house is a familiar illustration. A water-shed is sometimes a lofty range of mountains, as the Andes, the waters on the west of which flow into the Pacific, while those on the east reach the Atlantic; but more frequently a slight elevation which turns the water in different directions.

The water-shed between the basins of the Mississippi and St. Lawrence is a slightly-elevated ridge, not far from the chain of great lakes from which the St. Lawrence flows. There are numerous examples, in the Western States, of buildings so situated that the rain which falls on one side flows into the Mississippi, thence into the Gulf of Mexico; while that which falls on the other, flows into the St. Lawrence, thence into the Gulf of St. Lawrence. So slight is the elevation of the water-parting between the lakes which form the sources of the Mississippi and the Red River of the north, which flows through Winnipeg Lake and Nelson's River into Hudson's Bay, that after a heavy rain the country is overflown, and boats may pass from one to the other.

Where the water-sheds are low, rivers are frequently united by canals, thus promoting navigation. The Erie Canal, the most important work of this character in the world, connects Lake Erie and the Hudson River. The Mississippi and St. Lawrence Rivers are connected by several canals.

There are examples of river-basins so running into each other, that water communication subsists naturally between two primary streams. The most remarkable case of this kind, long deemed by geographers impossible, is the bifurcation of the Orinoco.

The River Cassiquiare, 180 miles long, connects the Orinoco with the River Negro, a tributary of the Amazon. It sometimes flows from the Orinoco into the River Negro, and sometimes in the opposite direction—as the water is high or low in the rivers which it connects.

IV. The course of rivers is in general very winding: a wise provision of nature, affording means of communication to a much larger area of country, and preventing that rapidity of current which would render navigation impracticable.

What are Rivers?—What is the basin of a River?—What do you understand by the water-shed of a River?—Give examples to illustrate the difference in the elevation of water-sheds.—What advantages result from the winding course of most Rivers?

V. The size of rivers depends upon various causes: the length of their course, the extent of their basins, the rain-producing character of the climate, and connection with mountains covered with eternal snow. The St. Lawrence, Indus, Lena, and Ganges, are estimated to discharge annually about an equal quantity of water; the Nile and Yang-tse-Kiang each about two and one-fourth times as much; the Mississippi about three times; and the Amazon, the mightiest of rivers, about twelve times as much. These estimates are to be considered as mere approximations, there being no data on which any very accurate calculations can be made.

VI. The velocity of a river depends upon the form of its channel, the slope of its bed, and the volume of water. Mountain streams, were it not for the friction of the sides and bottom of their beds, would become irresistible torrents. The most rapid and powerful rivers are those deep streams which have a very direct course.

A very slight declivity is sufficient to give the running motion to water. Three inches per mile in a smooth, straight channel, gives a velocity of about three miles an hour; a fall of three feet per mile makes a mountain torrent.

VII. The fall in the bed of a river is usually indicated by the difference between its level at its source and at its mouth. The Mississippi, from its source in Lake Itasca, has a fall of 1575 feet. The Ganges falls 13,762 feet; it has, however, numerous rapids and cataracts: while the Mississippi has but one precipitous descent of 17 feet, and but few rapids. The Danube has a fall of 2850 feet; the Rhine, 7650 feet. The Volga has the least fall of any extensive river; its entrance into the Caspian Sea, 83 feet below the surface of the ocean, being only 633 feet lower than its source, at an elevation of 550 feet above the level of the sea.

When water has once received an impulse, by following a descent, the simple pressure of the particles upon each other is sufficient to keep it in motion long after its bed has lost all inclination; the pressure and rate of motion being in proportion to its volume. The Amazon has a fall of only 12 feet in the last 700 miles of its course; and the La Plata, for 400 miles, has a descent of only one-third of an inch in a mile.

VIII. The slope of the bed of a river, if great, produces a rapid; a greater inclination still, approaching the perpendicular, causes a cataract. At high water, caused by inundations or the rise of the tides, some rapids disappear, and the river is navigable. The rapids of the Ohio River, at Louisville, are navigable at high water; when the water is low, navigation is carried on through the canal which is cut around the rapids. The rapid of Richelieu, in the St. Lawrence, between Quebec and Montreal, appears and disappears with the ebb and flow of the tide. Cataracts depend for their effect upon the height of the falls, but mainly upon the magnitude of the volume of water.

The Falls of Niagara, perhaps the grandest natural spectacle on the globe, occur in the River Niagara, which connects Lake Erie with Lake Ontario. The river, before making its final plunge, has a descent in rapids, in less than a mile, of about 50 feet; and a still further fall afterwards, before reaching Lake Ontario, of 106 feet. Goat Island separates the Falls into two parts: the wider, known from its shape as the Horse-Shoe Falls, by far the most magnificent, is 800 yards in width, and 150 feet high; the American Falls, 320 yards wide, are 165 feet in height. A cloud of mist points out the locality at a great distance, and its continuous roar is heard for many miles.

The Falls of St. Anthony, 17 feet in height; Trenton Falls, in New York, which descend by cascades 312 feet in two miles; Passaic Falls, near Paterson, New Jersey, 70 feet high; and the Falls of Montmorenci, a river in Canada East, near Quebec, which has a perpendicular descent in an unbroken sheet of 240 feet, are much visited and greatly admired by tourists.

View of Trenton Falls.

Of other Falls more inaccessible, the great Falls of the Missouri, in Nebraska Territory, may be mentioned. These are a succession of rapids and cataracts — 26, 47, and 87 feet in perpendicular height; the great river descending 360 feet in 17 miles, forming a scene only inferior to Niagara.

The cataract of Tequendama, near Bogota, is a fall of the river Bogota, a branch of the Magdalena, in two perpendicular bounds of 574 feet. This fall is described by Humboldt as "an assemblage of every thing that is sublimely picturesque in beautiful scenery."

The Cauvery, the principal river of Southern India, has two cataracts of extraordinary grandeur: one 350 feet, and the other 460 feet in height. The Tecazze River, an affluent of the Nile, receives its name, "the terrible," from its numerous cataracts, some of which are 100 feet, and others 150 feet high. The Victoria Falls of the River Zambeze, called by the natives Mosyo-atunyo (smoke sounding), as described by Dr. Livingstone, are scarcely less grand than the Falls of Niagara.

IX. The alluvial soil transported by great rivers is gradually deposited as the current slackens. When the coasts are flat, and the quantity of matter brought down considerable, deltas are formed at their mouth; so called from their resemblance to the Greek letter Δ (delta). The Mississippi, Ganges, and Nile, have large deltas.

Many rivers have no deltas, but empty themselves by a single broad, deep, and unobstructed channel, in which the navies of the world might ride. This circumstance gives importance to many rivers which would otherwise

On what does the size of Rivers depend?—Give examples to illustrate the comparative amounts of water discharged by different Rivers. — On what does the velocity of a River depend? — By what is the fall in the bed of a River indicated?

What effects are produced by different slopes in the beds of Rivers? — Name and describe some of the principal cataracts and water-falls in the world. — What is the delta of a River? — Name some Rivers which have large deltas.

be regarded as of an inferior order. The Hudson, in the United States, and Thames, in England, are examples.

X. Rivers are subject to changes of level, which are either irregular or periodical, according to the cause. Irregular changes are such as are produced by a casual heavy rain, or they are occasioned by peculiar winds.

A sudden and heavy rain sometimes magnifies a small stream into an irresistible torrent. A strong easterly wind causes a rise in the St. Lawrence, which is not affected in its level by rain or drought. A strong westerly wind blowing from the Gulf of Finland raises the waters of the Neva, and has repeatedly threatened the safety of the city of St. Petersburg, which is situated upon its banks.

XI. The periodical changes in the level of rivers are daily, semi-annual, and annual.

A daily variation is that caused by the tide. The more direct the course of a river, the higher the tidal influence extends. In the Amazon it is perceptible 550 miles, in the Hudson 150 miles, in the Thames 70 miles. In the Mississippi the tidal influence is not perceptible. Another daily variation is that in the upper course of streams which descend immediately from snow mountains. The heat of the sun, by melting the snow, produces high water every day — the increase being greatest in hot days.

Semi-annual and annual variations distinguish the rivers of tropical regions, and of countries bordering on the tropics. They are the effect of regular changes of the season, which occur at exactly opposite periods north and south of the Equator.

The Tigris rises semi-annually: first in April, from the melting of the snow in the mountain regions of its upper sources; and secondly, in November, from periodical rains. The Mississippi rises twice in the year: first in the winter, from periodical rains; and second, from March till about June, from rains and the melting of snow in its upper sources.

XII. The greatest river inundations are annual, and are the effect of periodical rains. The flood of the Orinoco is at its greatest height in August, extending over 600 miles in length, by from 60 to 90 miles in width, covering the Llanos through which it flows to the depth of 12 or 14 feet. The Ganges, Niger, and Gambia attain their full elevation about the same period. The Amazon begins to rise in December, attains its greatest elevation in March, and is least in July and August.

The inundation of the Nile, to which Egypt is indebted for its fertility, by the testimony of antiquity has been regular for 3000 years.

XIII. Rivers may be classified as either Oceanic or Continental. Oceanic rivers are those which flow into the sea. They may be considered as constituting four distinct systems, namely: 1. The Arctic system, which includes the rivers flowing into the Arctic Ocean. 2. The Atlantic system, or the rivers which flow into the Atlantic. 3. The Pacific system. 4. The system of the Indian Ocean.

XIV. *The Arctic System.* — The rivers of this system drain the principal part of the northern slope of the great North American Plain, and the larger portion of the great Northern Plain of Europe and Asia. They have in general a sluggish course, and frequently overflowing their banks, contribute to the formation of the extensive marshes in which these desolate regions abound.

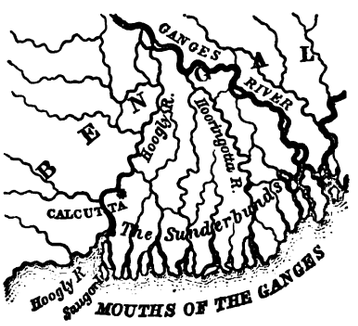
The principal rivers of the Arctic system, on the Eastern Continent, are the Obi, Lena, Yenesei, and Dwina; and on the Western, the Mackenzie, and Great Fish or Back Rivers. In the lower parts of their course, all these rivers are frozen for more than half of the year, and some of them for nine months in the year.

XV. *The Atlantic System.* — The Atlantic Ocean receives the waters of the largest rivers in the world, and drains more than one-third of the entire land surface of the globe. This system includes not only those rivers which flow directly into the ocean, but those also which empty into Hudson's Bay, the Gulf of Mexico, and the Caribbean, Baltic, Black, and Mediterranean Seas.

The Amazon, La Plata, Mississippi, Orinoco, and St. Lawrence, are the largest rivers of the Atlantic system upon the Western Continent; and the Nile, Niger, and Danube, are the largest upon the Eastern. The rivers which flow into the Atlantic are not less remarkable for their size, and for the extent of country drained by them, than for the immense facilities they afford for inland navigation; thus the navigable waters of the Amazon and its tributaries are estimated to exceed 50,000 miles, and those of the Mississippi and its branches are estimated at not less than 25,000 miles.

XVI. *The Pacific System.* — The Pacific, though much the largest ocean, drains only about one-third as great an extent of country as the Atlantic. From the Western Continent it only receives two rivers of any considerable size, the Columbia and Colorado; from the Eastern, it receives the waters of the rivers Amoor, Yang-tse-Kiang, and Hoang Ho, each of which drains extensive regions that are little known.

XVII. *The System of the Indian Ocean.* — The rivers which flow into the Indian Ocean drain the southern part of Asia, a considerable portion of Africa, and a large part of Australia. The principal rivers of this system, in Asia, are the Ganges, Brahmaputra, Irrawaddy, Indus, and Euphrates. These are all remarkable for the extent of their deltas. That of the Ganges is 60 miles in length, and occupies 120 miles of coast. The Zambeze is the principal African river of this system, and the Murray, the only river of any size in Australia, belongs to it also.



Delta of the Ganges.

XVIII. Continental rivers are those which never reach the ocean, but flow into lakes unconnected with it, or become absorbed and lost in sandy deserts. Most of the continental rivers are in Central and Western Asia. The rivers which flow into the Caspian Sea, Dead Sea, and Sea of Aral, are continental.

The Volga, which drains an area of 580,000 square miles, is the largest continental river upon the globe. In Fremont Basin, Utah, there are numerous examples of considerable rivers which lose themselves in the sands of that desolate region; Humboldt's River, 280 miles in length, is the largest of them. The river Desaguadero, which flows from Lake Titicaca, in Bolivia, is lost in lakes and swamps, after a southerly course of about 300 miles.

To what changes of level are Rivers subject? — By what are irregular changes produced? — Give examples of such changes. — Name the different periodical changes. — By what are daily variations caused? — Semi-annual and annual? — Give examples of each. — Into what two classes may Rivers be divided? — What are Oceanic Rivers? — Name the four systems of the Oceanic Rivers.

Describe the Rivers of the Arctic System. — Name the principal Rivers of this system. — How great an extent of country does the Atlantic drain? — For what are the Rivers flowing into the Atlantic remarkable? — Name the principal Rivers of the Pacific system. — What sections are drained by the Indian Ocean? — What are Continental Rivers? — Give examples of Rivers of this class.

XIX. Some peculiarities of river systems and particular rivers remain to be mentioned. 1. The channels of main rivers are not always increased in width by the additional waters of tributary streams: the Mississippi is no broader after receiving the great volumes of water from the Missouri and the Ohio: of course its channel is deeper. 2. The Nile is remarkable for not receiving a single brook from its junction with the Tecazze to the Mediterranean, a distance of 1500 miles; a fact without a parallel elsewhere upon the globe. 3. The meeting of great rivers with strong oceanic currents and tides frequently occasions a violent disturbance of the waters. The dreaded *prororocca* of the Amazon, from which fishermen and mariners flee in great dismay, and the terrific *bore* of the Hoogly, off the mouth of the Ganges, are occasioned by such collisions.

CHAPTER III.

LAKES.

I. A LAKE is a collection of water nearly or quite surrounded by land. The water of most lakes is fresh, yet that of a considerable number is salt. Some salt lakes are termed seas, as the Caspian Sea. Lakes may be divided into four classes.

II. The first class embraces those which receive no running water, and have no outlet. They commonly occupy hollows — extinct volcanic craters — and receive their supplies from springs which burst forth from the bottom of the lake.

III. The second class comprises those which have an outlet, but receive no running water; such lakes derive their supplies in the same manner as the first class. They are commonly of small extent, and often form the sources of rivers.

IV. The third class includes those lakes which receive streams of water, but have no outlet. Such lakes are not numerous, and their waters are usually salt.

Until very recently it was supposed that *all* lakes of this class were salt, and it may still be proved that such is the fact. The only exception, if exception there be, is Lake Tchad, in Central Africa, which is known to be a body of fresh water, and which is now supposed to have no outlet. Recent explorations have proved that it has no connection with the rivers flowing westward into the Atlantic, and it is believed to be at a lower level than the Nile, thus rendering it impossible that its waters should flow into that river.

The principal salt lakes of the Western Continent occur on elevated table-land, as Great Salt Lake, in the Great Basin of Utah; those of the Eastern Continent, on the contrary, occupy a great depression on the earth's surface: the Caspian Sea being 83 feet below the Black Sea, and the surface of the Dead Sea being more than 1300 feet below that of the Mediterranean.

Salt lakes generally appear to be decreasing in size, losing more water by evaporation than is supplied by their tributaries. The Sea of Aral is diminishing rapidly. The Caspian Sea, though it receives through its 70 mouths the majestic volume of the Volga, the largest river in Europe, as also the Ural and other large streams, decreases, instead of increasing, in size. Captain Stansbury reports with reference to the region of the Great Salt Lake, that "There must have been here at some former period a vast inland sea, extending for hundreds of miles."

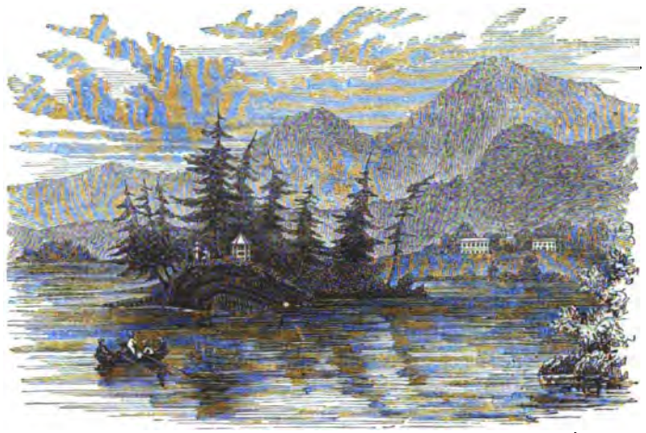
Name other peculiarities of some Rivers.—What is a Lake?—Into how many classes may Lakes be divided?—Describe the first class—the second—the third.—Is the water of Lakes of the third class generally fresh or salt?—Give examples of them.

The water of most of these lakes is much more salt than that of the ocean. The Oceanic waters contain about 3½ per cent. of salt; Great Salt Lake, 20 per cent.; the Dead Sea, 26 per cent.; and Lake Elton, 29 per cent. Lake Elton furnishes more than two-thirds of the salt consumed in Russia.

V. Dr. Rebmann, the zealous African missionary, reports the recent discovery of an immense inland sea or lake in Central Africa, south of the Equator. It is said to be without an outlet, and "twice as large as the Black Sea, including the Sea of Azov." The outlines of this great sea, as reported by the learned missionary, are traced on the Hydrographical map; but as yet we are possessed of little information with reference to it.

VI. The fourth class, by far the most numerous, comprises those lakes which both receive and discharge streams of water. Lake Superior is an example.

Collections of water of this character are most extensively distributed in northern latitudes. The great chain between the United States and Canada, of which the River St. Lawrence forms the outlet, is estimated to contain half the fresh water upon the surface of the globe.



View on Lake George.

The waters of many lakes of this class are very transparent, and of the purest azure hue: as the Lake of Geneva, in Switzerland, Great Bear Lake, in British America, and Lake George, in New York. Lakes Superior and Huron are much admired by tourists for the clearness and purity of their waters. Lake Sir-i-kol, in Asia, the most elevated lake known, is 15,600 feet above the level of the sea. It forms the source of the river Amoo.

Lake Titicaca, situated on the Great Plateau of the Andes, in South America, usually discharges its waters through the river Desaguadero; but sometimes the river reverses its course, and flows into the lake, instead of from it. This was the case for thirty days in the year 1846. The waters of this lake are brackish, and Lieut. Gibbon reports that it is "gradually filling up."

VII. *Recapitulation.* — From this, and the two preceding chapters, it appears that the fresh water upon the globe is distributed into Springs, Rivers, and Lakes. That the Springs are perennial, intermittent, or periodical. That the Rivers are oceanic (flowing into the sea), or continental (flowing into lakes on land). That the Lakes comprise four classes: the first class embracing those which receive no running water, and have no outlet; the second, those which have an outlet, and receive no running water; the third, those which receive running water, and have no outlet; the fourth, those which both receive and discharge streams of water. It appears, also, that the water of many Springs and Lakes is salt.

What is the difference of elevation in Lakes of the third class on the Eastern and Western Continents?—What recent discovery is reported in Central Africa?—Describe Lakes of the fourth class.—Recapitulate the subjects of this and the preceding chapters.

CHAPTER IV.

THE OCEAN.

I. THE OCEAN, or Sea, is that great extent of water which surrounds the continents and islands of the Earth, and covers about three-fourths of its entire surface.

II. The water of the ocean is salt, and by evaporation a large proportion of common salt is obtained from it. Different parts of the ocean vary in the amount of salt found in their waters, and consequently in density. The ocean is less salt near the Equator, and towards the Poles, than in other parts. This is probably owing to the abundant rains at the Equator, and to the melting of the ice in the Polar regions.

The saline ingredients render sea-water much heavier than fresh water, and consequently better adapted for navigation, while a larger area is thus prevented from being ice-bound. Fresh water freezes at the temperature of 32°; salt water at the temperature of 28½°. The healthfulness of the ocean is ascribed to its constant motion, which prevents its waters from becoming stagnant and corrupt.

III. The color of the ocean is generally of a deep bluish-green, which becomes clearer and brighter towards the coasts. Particular parts of the ocean show peculiar colors. The sea is white in the Gulf of Guinea, black amid the Maldive Islands, and has a reddish appearance near the peninsula of California. Green water, in connection with the deepest blue, appears in the Persian Gulf, off the Arabian coast, and in the Arctic Ocean. These appearances are permanent, and so distinct, that ships have been seen partly in blue and partly in green water at the same time.

These different tints are occasioned by myriads of minute insects which swarm in these waters. The phosphorescence of the ocean, which presents a magnificent and imposing spectacle, owes its origin to the same cause.

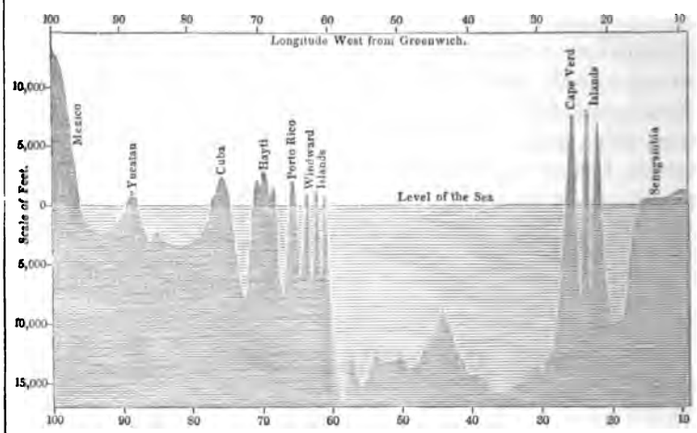
This beautiful phenomenon is thus described by Mr. Darwin: — "While sailing a little south of the La Plata, on one very dark night, the sea presented a wonderful and most beautiful spectacle. There was a fresh breeze, and every part of the surface, which during the day is seen as foam, now glowed with a pale light. The vessel drove before her bow two billows of liquid phosphorus, and in her wake she was followed by a milky train. As far as the eye reached, the crest of every wave was bright, and the sky above the horizon was illuminated from the reflected glare of these lurid flames."

IV. It is only quite recently that methods have been adopted, and apparatus invented, by which the depth of the deeper parts of the ocean, "the blue water," could be accurately determined. As the result of these recent and correct measurements, Lieut. Maury reports the Atlantic Ocean, north of 10° South Latitude, as varying in depth from 6000 to 25,000 feet.

The average depth of the Atlantic, for a distance of from 75 to 150 miles from the coasts of the Continents, is less than 6000 feet. For a further distance of from 200 to 250 miles, the depth varies from 6000 to 12,000 feet. "The deepest part of the North Atlantic Ocean," says Lieut. Maury, "is probably somewhere between the Bermudas and the Grand Banks, but how deep it may be, yet remains for the cannon-ball and sounding-twine to determine."

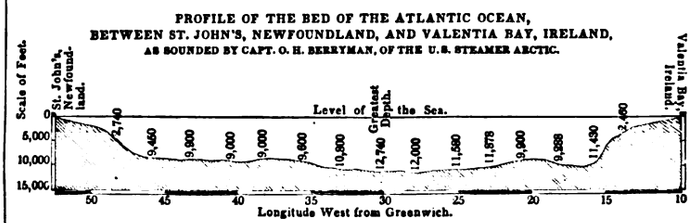
V. Another result of the recent correct measurements of the depth of the North Atlantic, is the certain knowledge that the bed of the ocean, like the land, is diversified by mountains and valleys, hills, table-lands, and plains.

The annexed diagram, copied from Lieut. Maury's Sailing Directions, is a representation of the bed of the Atlantic Ocean, in a line extending southeastwardly from Mexico to Africa. It is drawn to a scale, and represents the elevation of the land above the level of the sea, as well as the depth to which the ocean sinks below it.



VI. The bed of the ocean, between Newfoundland and Ireland, is so remarkably level, that it has received the name of "The Telegraphic Plateau."

Europe and America are connected by a sub-marine telegraph laid on this plateau. The distance between the two islands is 1950 miles, and the greatest depth of the ocean, as sounded by Captain Berryman, is 12,740 feet. The annexed diagram is a representation of the Telegraphic Plateau.



VII. Properly speaking, there is but one Ocean; but for convenience of description it is separated into five divisions — called the Arctic, Antarctic, Atlantic, Pacific, and Indian Oceans.

The Arctic Ocean is north of the Arctic Circle; the Antarctic Ocean south of the Antarctic Circle. The Atlantic Ocean stretches from the Arctic Circle on the north to the Antarctic Circle on the south, and from the western shores of the Eastern Continent on the east to the eastern shores of the Western Continent on the west. The Pacific Ocean extends from Behring's Strait on the north to the Antarctic Circle on the south, and from the western shores of the Western Continent on the east to the eastern shores of the Eastern Continent and Australia on the west. The Indian Ocean extends from Asia southwards to the Antarctic Circle; Australia forms its eastern, and Africa its western boundary.

The portions of the Atlantic and Pacific Oceans, north of the Equator, are known respectively as the North Atlantic and North Pacific; those south of the Equator, as the South Atlantic and South Pacific.

The boundaries here assigned to the different oceans are those agreed upon by the Royal Geographical Society of London, in 1845.

What is the Ocean? — What is the character of the water of the Ocean? — In what parts are its waters less salt? — What is the general color of the Ocean? — What is the cause of the peculiar colors of some parts of the Ocean? — Repeat Darwin's description of the phosphorescence of the Ocean. — What is the depth of the North Atlantic?

By what is the bed of the Ocean diversified? — State the location of the telegraphic plateau. — Is there any difference in the level of the Ocean? — Give examples to confirm your statement. — Name the five different Oceans. — Give the boundaries of each of them. — On what authority are these boundaries stated?

VIII. The Arctic and Antarctic Oceans are supposed to be of about the same size, though both have been only partially explored. They are chiefly remarkable for the vast fields of ice which they contain, and for the huge icebergs which proceed from them into the warmer waters towards the Equator.

Many navigators have attempted to press through the ice of these oceans to the Poles, but thus far without success. Captain Parry, in 1827, reached Latitude 82° 45′ North; and Sir James Ross, in 1841, reached Latitude 78° 10′ South: being the two nearest points to the Poles yet attained by man.

Dr. Kane, the intrepid American explorer, in his recent Arctic expedition, abandoned his vessels, which were frozen fast in the ice, and proceeded northwards, on sledges drawn by dogs, as far as 82° 30′ North, where he discovered a great open sea stretching in the distance as far as the eye could reach.

IX. The Atlantic Ocean, though only about one-third the extent of the Pacific, is of far more importance to man. It is the principal highway of the larger portion of the world's commerce, and its great branches, penetrating far into the land, afford immense facilities for navigation to the countries whose waters they drain.

The most important eastern branches of the Atlantic are the Mediterranean and Baltic Seas; the principal western branches are the Caribbean Sea, the Gulf of Mexico, and Hudson's Bay.

X. The Pacific Ocean is remarkable for its vast size, and for the great number of its islands. It was not known to Europeans until 1513, when it was discovered by *Vasco Nunez de Balboa*, from the summit of a mountain near the Isthmus of Panama. Magellan, who sailed on it from America to the Ladrone Islands, gave it the name of *Pacific*, in consequence of the calm and delightful weather which he experienced while navigating its surface.

On the American side, the Pacific corresponds to the South Atlantic, rarely extending its branches into the land. On the Asiatic side, it corresponds to the North Atlantic, in deeply indenting the coasts. The China, Yellow, and Japan Seas, enclosed by islands, are strikingly similar to the Caribbean Sea and Gulf of Mexico, shut in by the West Indies.

XI. The Indian Ocean has for its principal branches the Bay of Bengal, the Persian Gulf, and the Arabian and Red Seas. This ocean is chiefly remarkable for its hurricanes and monsoons, for an account of which, see Meteorology, page 43.

CHAPTER V.

OCEANIC MOVEMENTS, WAVES, TIDES, AND CURRENTS.

I. The Ocean is subject to the three great general movements of Waves, Tides, and Currents: the causes of which are independent of each other. The wave movement is of an inconstant and transitory character, occasioned principally by winds. The movement of the tides is regular and periodical, and caused by the attractive influence of the moon, modified by that of the sun. The currents are the effects of various circumstances, and, in their constant flow, are like great rivers in the midst of the sea.

For what are the Arctic and Antarctic Oceans remarkable? — What are the nearest distances to the Poles yet attained by man? — What discovery was made in this Ocean by Dr. Kane? — State some points of resemblance between the Atlantic and Pacific.

Waves.

II. Waves appear to be an onward flow of the water of the surface of the ocean; but they are not really so, except in shoal water, and in the case of a strong continuous wind, which sometimes creates a current. If the formation of a single wave be carefully observed, it will be seen that while the forward part of it is rising, the hinder part is falling.

The common saying of "*the waves running mountain high*," is a popular exaggeration. The highest wave observed in the Atlantic by Dr. Scoresby, during two voyages made across it in 1847 and 1848, was 43 feet, and this observation immediately followed a very severe gale. The highest wave noticed in the Mediterranean Sea was 16 feet; off Australia, 20 feet; and in the Bay of Biscay, as measured by Sir James Ross, 36 feet. At a comparatively small depth the ocean is tranquil, while furious tempests are agitating its surface. The effect of the strongest gales does not probably extend beyond the depth of 200 feet.

III. The force of the waves in gales of wind is tremendous. The great storm of the 17th of April, 1851, carried away Minot's Ledge Light-house, on the coast of Massachusetts, twenty miles from Boston.

Minot's Ledge Light-House.

This famous structure was composed of nine iron piles, from 60 to 63 feet in height, each of which was ten inches in diameter, and firmly imbedded five feet deep in the solid part of the rock on which it was situated. These piles were strongly braced together, but in the fury of the gale were twisted off as if they had been made of wood. After the gale had subsided, a huge block of granite, estimated to weigh seven tons, to which the keeper had attached a hawser extending from the structure, was found to have been washed 400 or 500 feet towards the shore.

IV. The rate at which waves travel, is strikingly exhibited by the following circumstances narrated by Prof. Bache:

"On the 23d of December, 1854, an earthquake occurred at Simoda, on the island of Niphon, Japan. The harbor was first emptied of water, then

For what is the Indian Ocean remarkable?—To what three general movements is the Ocean subject? — Describe each of them.—What are Waves? — How high are they?—Give an example to illustrate their force.

an enormous wave rushed in, which again receded, leaving the harbor dry. This was repeated several times, and thus several great waves were formed. At San Francisco, there are self-acting tide-gauges, which indicate any disturbance in the level of the sea; and these gauges, four thousand eight hundred miles from the scene of the earthquake, marked the time at which the waves arrived. The first one travelled across the Pacific in twelve hours and sixteen minutes, or at the rate of nearly four hundred miles an hour. The others followed at intervals of about an hour each."

Tides.

V. Tides are alternate risings and fallings of the water of the surface of the ocean, which occur regularly twice in every day.

On all coasts of the ocean where tides are felt, the water is in restless motion at all times, even when there is not a breath of wind. It is only on the coasts of inland seas, gulfs, and bays, which penetrate far into the land, as the Baltic and Black Seas, that tides are not experienced.

If a convenient place be chosen for observation, as a gradually sloping sea-beach, we shall notice for about six hours a continued rise of the water up the beach, each wave advancing higher and higher: this rise is called the *flood tide*. For about ten or fifteen minutes the water will be at rest: this is termed *high water*. The water then recedes for about six hours as gradually as it rose: this is called *ebb tide*. Here it remains at rest for about ten or fifteen minutes, which is called *low water;* and then commences to rise again, and so on alternately.

The perpendicular height to which the tide rises may be very plainly seen upon the surface of a rock on the beach, or upon a stake fixed in the sand.

VI. Tides do not rise to the same height on all coasts. In the open ocean the rise is small. Thus, at the Sandwich Islands, it is only about two and a half feet; and at St. Helena, about three feet. On coasts, however, where the tides are interrupted, or forced around a headland, or up a narrow bay, they sometimes reach an amazing height.

At St. Malo, on the northern coast of France, the highest tides rise forty or fifty feet; and, in the Bay of Fundy, they are often sixty or seventy feet in height, advancing with such rapidity that swine, feeding on the shell-fish upon the beach, are sometimes overtaken by the flood, and drowned. The highest tides of the principal ports of the Atlantic coast of the United States, vary from three to twelve or fifteen feet.

VII. The height to which the tide rises at any given place is not always the same. It changes every day, and these changes are connected with the phases of the moon. At the times of the new moon, and of the full moon, the *flood* rises higher, and the fall of the *ebb* is greater than at other times: these are called *Spring tides*. During the first and last quarters of the moon, the ebb and flow are least: called *Neap tides*. The difference between Neap and Spring tides, at Boston, is about five feet; at New York, two feet; and at Brest, on the coast of France, about eleven feet.

VIII. The connection between the tides and the place of the moon and sun was known to the ancients, but Newton first demonstrated the influence of these bodies in producing them. To understand this influence, some knowledge of the laws of attraction is necessary. Attraction is that power which draws bodies towards each other. The moon and sun attract the earth; the moon, by reason of its lesser distance, is estimated to exercise about three times the influence of the sun in producing tides. Neither the attractive influence of the moon, however, nor of the sun and moon combined, is strong enough to disturb the solid matter of the land of the earth; but either is sufficiently powerful to raise the more easily lifted particles of the sea.

To explain clearly the influence of the moon and sun in producing tides, let us suppose the earth to be a globe entirely covered with water, and let it be represented in the annexed diagram by E, then M will represent the moon, S the sun, and a b c d the water covering the earth.

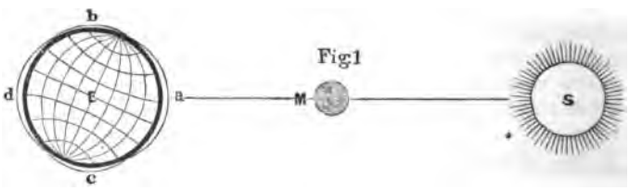


Fig. 1

This figure represents the moon and sun as attracting the earth in the same direction. Their influence is, of course, the strongest on that portion of the earth which is nearest to them, and the water is accordingly elevated at a, drawn thither from b and c. The water is also raised at d, and this is caused by the entire solid matter of the earth being drawn from the water at d, thus producing the same effects as if it had been raised by the direct action of the moon and sun. Figure 1 represents Spring tides and high water at a and d, and low water at b and c.

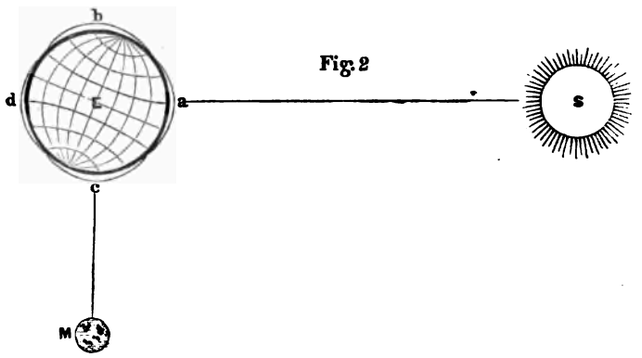


Fig. 2

Figure 2 represents the moon and sun as attracting the earth in different directions; the moon's influence being greatest, it is high water and Neap tides at b and c, and low water at a and d.

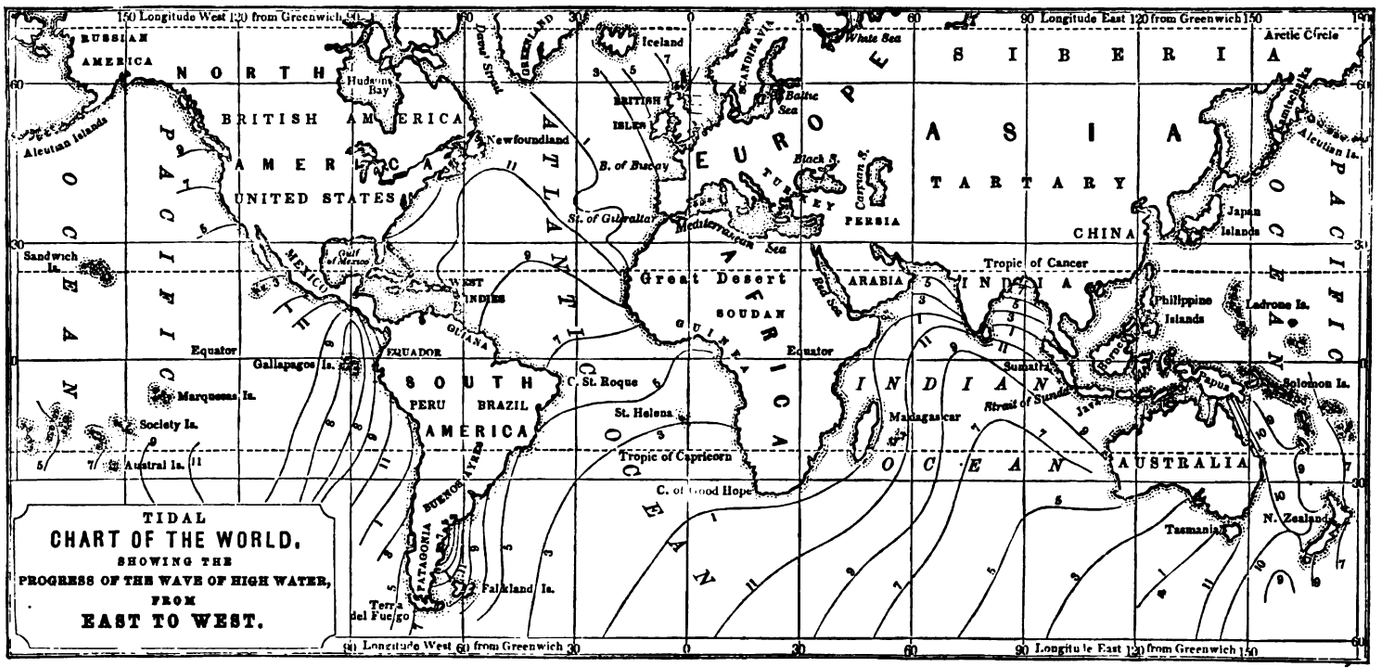
The greatest rise of the water does not happen at the moment when the moon is directly over it, but occurs a little later; some time being required for the water to run up and form a wave.

IX. The earth, however, is not a sphere entirely covered with water, and the peculiar conformation of the land causes a very different tidal movement from that in the case supposed. It has been ascertained that the only part of the sea, of sufficient extent and depth to admit of the formation of a tidal wave, is the great ocean south of Australia. When, therefore, by the revolution of the earth upon its axis, this part of the ocean is brought nearest to the moon, a great tidal wave is created.

The numerous islands and coral reefs of the Pacific, and the peculiar canal-shape of the Atlantic, prevent the origination of tides in either of these great oceans. So, also, the small extent of inland lakes and seas prevents all tidal movements in such bodies of water.

Give an example to illustrate the speed with which Waves travel.—What are Tides? — Describe the tidal movement as it would be observed on a sea-beach. — State the height to which the Tide rises on different coasts. — Explain the terms *Spring tides* and *Neap tides*.—What causes Tides?

Which has the greatest influence in producing Tides, the sun or moon? — Explain figure 1. — Explain figure 2. — In what part of the ocean do Tides originate? — What prevents their formation in the Pacific and Atlantic Oceans? — In inland lakes and seas?



X. The tidal wave which first receives its impulse south of Australia, follows the apparent westward course of the moon, entering from the south the Atlantic and Indian Oceans, bearing high water to all the coasts it visits. Like other waves, it is not an onward flow of the water, except over shoals, and near the land. In the deep and open ocean its velocity is a thousand miles an hour, but near the land its movement is much less rapid.

The progress of a tidal wave is represented on the map at the top of the page by lines, called co-tidal, because they connect places which have high water at the same time. If we suppose it to be high water on the east coast of Tasmania at 11 o'clock, A. M. — at 11, at night, the wave will have reached the southern point of the peninsula of Hindoostan; at 1 o'clock, next morning, it will have passed the Cape of Good Hope; and advancing rapidly in the deep waters of the Atlantic, it will reach Newfoundland at 11 o'clock, A. M., or in 24 hours from the time it started from Tasmania.

The spaces between the co-tidal lines, proceeding from east to west, indicate the progress the tidal wave makes in two hours.

Currents.

XI. The currents of the ocean are among the most important of its movements. They are like vast rivers in the midst of the sea — transferring its waters from the Poles to the Equator, and from one ocean to another.

XII. Currents are caused by the heat of the sun, the rotation of the earth, the saltness of the sea, by winds, tides, the melting of ice, and by various minor circumstances. They are constant, periodical, or temporary.

XIII. Constant currents are those great ocean streams which have their origin in permanent causes, and flow in one direction throughout the year.

In what direction does the tidal wave flow? — What do you understand by co-tidal lines? — How long does it take the tidal wave to flow from St. Helena to the West India Islands? — Is it high water first at St. Helena or Newfoundland?

XIV. The theory most generally adopted as to the causes of constant currents may be stated as follows:

The heat of the Torrid Zone produces a greater evaporation in the part of the ocean included within that zone than anywhere else, and an immense quantity of water is constantly rising in the form of vapor, to be borne away by the winds. To supply the vacancy which has thus been caused, the waters of the Polar regions move towards the Equator.

The rotation of the earth promotes this movement in the following manner: The waters of the ocean are impelled towards that part of the earth's surface which revolves with the greatest rapidity; and as the rotary motion of the earth is more rapid at the Equator than anywhere else, the waters of the Polar regions thus receive an impulse towards the Equator, in addition to that caused by the heat of the Torrid Zone. When the water leaves the region of the Poles, where the rotary motion of the earth is slight; it flows directly north and south; but as it advances towards the Equator, where the surface of the earth revolves with great rapidity, it cannot at once acquire the same velocity — consequently it is left behind; and instead of running north and south, as it would do if the earth's surface did not turn round, it flows in an oblique direction towards the west, until finally it forms a great equatorial current setting towards the west: while the trade-winds, which blow in a general westerly direction, combine to increase its velocity.

Were it not for the land, such would be the uniform and constant flow of the waters of the ocean. The presence of the land interrupts the regularity of this great westward movement of the waters, sending them to the north or south, and also occasioning temporary and periodical currents.

Thus it appears that the three principal causes of constant currents are the heat of the sun, the rotation of the earth, and the trade-winds. Writers on this subject are not agreed as to which of the three exerts the greatest influence in producing currents.

XV. Periodical currents are occasioned by tides, and by periodical winds, called *monsoons*. (See article Monsoons, page 48.) These currents are frequent in the eastern seas: one flows into the Red Sea from October until May, and out of it from May till October. In the Persian Gulf, this order is reversed.

What are the Currents of the ocean like? — By what are they caused? — What are Constant Currents? — Explain the generally-adopted theory of the cause of Currents. — By what are the Periodical Currents occasioned?

In the Indian Ocean and China Sea, the waters are driven alternately backwards and forwards by the monsoons.

XVI. Temporary currents are caused by tides, melting ice, and by gales of considerable duration.

There are strong local currents produced by tides, flowing through narrow channels and projecting coasts: as "Hurlgate," in East River, seven miles from New York, where the water has a velocity of six miles an hour; and the "Roost" of Sumburgh, at the south promontory of the Shetland Isles, which runs at the rate of fifteen miles an hour. These local currents sometimes meet from opposite quarters, and cause a whirlpool, like the long-celebrated Maelstrom on the coast of Norway, occasioned by the meeting of tidal currents round the adjacent island.

XVII. Let us trace the course of the great system of constant currents, through the various deviations occasioned by the outlines of the land. This system has different names in the various parts of its course: —

1. *Antarctic Current.* — In consequence of the natural tendency of the Polar water towards the Equator, a great oceanic stream flows northward from the Antarctic Sea. Driven by the westerly winds which prevail in that quarter, it bends towards the western coast of South America. Here it is divided: a small part rounding Cape Horn, while the greater body flows north along the coast of South America, until turning suddenly to the west, it is lost in the Equatorial current of the Pacific.

2. *Equatorial Current of the Pacific.* — This great stream flows westward, with a breadth of 3500 miles, until its progress is interrupted by the shores of China, Farther India, and the islands of the Indian Archipelago; but a part forces its way between the islands, and joins the equatorial current of the Indian Ocean. Passing round the northern end of Madagascar, it flows through Mozambique Channel, and around the Cape of Good Hope. It then moves northward along the western shores of Africa, until it is turned aside by the coast of Guinea, and forms the Equatorial current of the Atlantic.

3. *Equatorial Current of the Atlantic.* — Moving westward, this stream reaches Cape St. Roque, in Brazil. Here it divides into two branches. One branch, setting southward along the coast of South America, is turned towards the east before reaching the mouth of the La Plata, and assumes the name of the Southern Connecting Current.

4. *Southern Connecting Current.* — This stream stretches directly across the Atlantic to the Cape of Good Hope, and passing 200 miles south of the westward Cape Current, pursues its course into the Indian Ocean.

5. *Guiana and Caribbean Current.* — The principal branch of the Equatorial current of the Atlantic takes a north-westerly direction, from off Cape St. Roque; and rushes along the coast of Brazil, with such rapidity and depth, that its course is but little affected by the powerful streams of the Amazon and Orinoco. After passing through the Caribbean Sea, and sweeping around the Gulf of Mexico, it flows between Florida and Cuba, assuming the name of the Gulf Stream.

6. *Gulf Stream.* — This powerful stream passes north-easterly along the coast of North America to Newfoundland, where it turns to the east, and reaches the Azores; there it takes a southerly direction, and is gradually lost in the Atlantic Ocean. An important branch leaves the Gulf Stream, near Newfoundland, setting towards Great Britain. It is divided by the British Isles — part of it flowing towards the western shores of France, and another branch to the coasts of Norway, where its waters can be readily distinguished by their warmth. The waters of the Gulf Stream are warmer, more salt, and of a deeper blue than those through which it passes. Between Florida and Cuba it flows with great velocity, and has a high temperature. As it proceeds north, its breadth becomes greater, while its depth and speed diminish; and although losing much of its heat as it proceeds north, it still retains throughout its entire course a higher temperature than that of the surrounding ocean.

By what are Temporary Currents caused? — Give examples of such Currents. — Describe the Antarctic Current.—The Equatorial Current of the Pacific.—Of the Atlantic. — In what direction does the Southern Connecting Current flow? — Along what coasts does the Guiana and Caribbean Current flow? — Where is the Gulf Stream?

7. *North African and Guinea Current.* — Commencing off the coasts of Ireland and Spain, this current, after sending a stream through the Straits of Gibraltar, moves down the coast of Africa, alongside of the Equatorial current, with which perhaps its waters finally mingle. This current, in connection with the Gulf Stream, completes the entire circuit of the Northern Atlantic Ocean.

8. *Grassy Sea.* — "Midway the Atlantic, in the triangular space between the Azores, Canaries, and Cape de Verd Islands, is the Sargasso Sea Covering an area equal in extent to the Mississippi Valley, it is so thickly matted over with Gulf weed that the speed of vessels passing through it is often much retarded. When the companions of Columbus saw it, they thought it marked the limits of navigation, and became alarmed. To the eye, at a little distance, it seems substantial enough to walk upon. Patches of the weed are always to be seen floating along the Gulf Stream. Now, if bits of cork or chaff, or any floating substance, be put into a basin, and a circular motion be given to the water, all the light substances will be found crowding together near the centre of the pool, where there is the least motion. Just such a basin is the Atlantic Ocean to the Gulf Stream, and the Sargasso Sea is the centre of the whirl. Columbus first found this weedy sea in his voyage of discovery; there it has remained to this day; and certain observations as to its limits, extending back for fifty years, assure us that its position has not been altered since that time."—*Maury's Physical Geography of the Sea.*

9. *Arctic Current.* — This stream originates in the masses of ice which surround the North Pole. Passing down the coasts of Greenland and Labrador, it reaches the Gulf Stream on the coast of Newfoundland. Here it divides: one portion flowing south to the Caribbean Sea, which it enters as an under-current; while the other flows down the coast of the United States, inside of the Gulf Stream.

10. *Japan Current.*—This is a current which has been lately investigated, entering the Pacific from the Indian Ocean, bearing many striking points of resemblance to the Gulf Stream of the Atlantic. Lieut. Bent, who was attached to Commodore Perry's late Japanese expedition, reports this current as being well known to the Japanese, who called it the *Kuro siwo*, or black stream; the name being undoubtedly given to it on account of its dark blue color, as compared with the adjacent ocean. This current pours a stream of warm water through the China Sea, between Borneo and Anam, which corresponds to that between Florida and Cuba; it flows north-easterly along the coast of Asia, as the Gulf Stream follows the line of the American coast; and it imparts a warmth and moisture to the Aleutian Islands and the north-western coasts of America, similar to the effect produced by the Gulf Stream upon the western and northern shores of Europe. Moreover, there is a cold current flowing southward down the coast of Asia, inside of this northward current, corresponding to the southward current of our eastern coast. To complete the resemblance, there is a southward current along the coast of California and Mexico, corresponding to the continuation of the Gulf Stream by the North African and Guinea current; and masses of floating sea-weed occur in the Pacific, not unlike the Sargasso Sea of the Atlantic.

XVIII. *Counter Currents.* — A counter-current is a stream which runs by the side of, or beneath, another current, and in an opposite direction to it.

There is scarcely a strait joining two seas that does not furnish an example — a current running in along one shore, and a counter-current running out along the other; or a surface-current running in one direction, and an under-current in another.

Lieut. Maury remarks: "We may lay it down as a law in the system of oceanic circulation, that every current in the sea has its counter-current; * * * for wherever one current is found carrying off water from this or that part of the sea, to the same part must some other current convey an equal volume of water, or else the first would, in the course of time, cease for the want of water to supply it."

Thus the North African and Guinea current runs for a thousand miles along the northern margin of the Equatorial current of the Atlantic, and in

Along what coasts flows the North African and Guinea Current? — Describe the Sargasso Sea.—The Arctic Current.—State some points of resemblance between the Japan Current and the Gulf Stream. — What are Counter Currents? — Give examples of them.

an opposite direction to it. The southern connecting current forms a counter-current to the stream which flows westward around the Cape of Good Hope. The United States current, which flows southward inside the Gulf Stream, is another example.

XIX. *Under Currents.* — Many of the counter-currents flow beneath the surface with immense force and velocity.

Navigators report that there is a powerful under-current flowing from the Atlantic into the Arctic Ocean. "They describe," says Maury, "huge icebergs, with tops high up in the air, and, of course, the bases of which extend far down into the depths of the ocean, ripping and tearing their way, with terrific force and awful violence, through the surface-ice or against a surface-current, on their way into the Polar basin."

View in the Arctic Ocean.

The existence of an open sea at the Poles, north of the dreary wastes of ice in the Arctic Ocean, had for some time been supposed by hydrographers. Its existence was also inferred from the well-known fact, that the birds and animals of the Arctic regions are found at certain seasons migrating to the north, evidently in search of a milder climate. This inference has recently been confirmed by the explorations of Dr. Kane, who actually reached the margin of it in Latitude 82° 30′, north of Greenland.

Lieutenant Maury attributes the cause of this open sea, which is supposed to be free from ice, chiefly to the under-current of water flowing to the north, which he has so graphically described. He supposes this current to come from the warmer regions of the Equator, and to rise to the surface near the Poles, communicating its warmth to the waters of those regions.

XX. The extent, temperature, and velocity of currents have an important influence upon climate and navigation.

Their velocity varies at different points of their course. The average velocity of some of the great currents is 60 miles a day — while at some points it is 120 miles. Near Cape Corrientes, on the African coast, west of Madagascar, a velocity of 139 miles a day has been observed. It is, therefore, obvious that a knowledge of the ocean currents is of the utmost importance in navigation.

Lieutenant Maury states that very recently a fine frigate took a hundred days to sail from the United States to Rio Janeiro, while another vessel, which left at the same time, performed the same voyage, by the aid of the chart of the currents, in thirty days. In the waters near the Equator, where long calms prevail, a vessel may be carried hundreds of miles by the force of the current alone.

Where a powerful current flows through a labyrinth of islands, navigation is often rendered very difficult and dangerous: this is the case in the China Seas and Indian Archipelago. In the West Indies, a vessel going from Jamaica to the Lesser Antilles is prevented, by baffling winds and currents, from sailing directly across the Caribbean Sea, and must go round through the ocean, outside of the Caribbee Isles — a voyage requiring several weeks; while the return passage, directly across the Caribbean Sea, is made in as many days.

Vegetable matter and the seeds of plants are transported by currents from one region to another. Coral islands thus become clothed with vegetation, and are fitted for the habitation of man. Vast quantities of timber are thrown upon the islands in the Polar Sea. The bodies of men, animals, and plants of unknown appearance, brought to the Azores by the Gulf Stream, suggested to Columbus the idea of land beyond the Western Ocean, and thus led to the discovery of America.

XXI. Ocean currents carry on a constant exchange between the waters of the Poles and those of the Equator, and thus diminish the extremes of heat and cold in every Zone. The temperature of the currents is either higher or lower than that of the surrounding ocean, according to the heat of the climate in which they have their origin. This difference amounts to from 10° to 30° Fahrenheit.

The Antarctic current pours a cold stream along the western coast of South America, producing an important effect upon the climate of Chili. It renders the temperature of the Equatorial current three degrees colder than that of the adjacent waters. The waters of the Equatorial current again become heated in the Gulf of Mexico, and under the name of the Gulf Stream, flow forth into the Atlantic, ten degrees warmer than the surrounding ocean.

The Gulf Stream, pouring out a vast flood of warm water over the surface of the Atlantic, makes the climate of northern Europe mild and moist; while the shores of Labrador, in the same latitude, washed by the cold waters of the Arctic, are encased in ice.

The waters of the Gulf Stream preserve, even in winter, the heat of summer. The difference between their temperature and that of the surrounding waters is greatest in winter, being twenty and even thirty degrees at the Banks of Newfoundland, and off Cape Hatteras.

"The presence of the warm waters of the Gulf Stream, with their summer heat in mid-winter, off the shores of New England, is a great boon to navigation. No part of the world affords a more difficult and dangerous navigation than the approaches of our northern coast in winter. In making this part of the coast, vessels are frequently met by gales which mock the seaman's strength, and set at nought his skill. In a little while his bark becomes a mass of ice, with her crew frosted and helpless; she remains obedient only to her helm, and is put away for the Gulf Stream. After a few hours' run she reaches its edge, and almost at the next bound passes from the midst of winter into a sea at summer heat. Now the ice disappears from her apparel; the sailor bathes his stiffened limbs in tepid waters; feeling himself invigorated and refreshed by the genial warmth about him, he is ready for a fresh endeavor." — *Lieut. Maury's Physical Geography of the Sea.*

So the ice-bound ships in the Northern Pacific seek refuge in the warmer waters of the Japan Current, when beaten back from the inhospitable ports of Kamtschatka.

On the other hand, the Arctic currents bear their cold waters to the coasts of the United States and to the shores of the Caribbean Sea, modifying the intense heat, and counteracting the numerous causes of pestilence. Thus, the great currents of the ocean play their part in renewing and invigorating the life of the globe.

XXII. *Recapitulation.* — It has thus been shown that the ocean is that great body of salt water, which covers about three-fourths of the earth's surface; and that it is subject to the three great movements of Waves, Tides, and Currents. It appears that the wave movement, and that of some currents, are inconstant, dependent upon local circumstances; while the flow of the tides, and of most currents, is constant, depending upon permanent causes. It appears, also, that the movements of the oceanic waters are of vast importance to man — promoting navigation, moderating the severity of extreme climates, transporting seeds, and in various other ways contributing to his happiness and enjoyment.

Repeat Maury's description of the effects of the under-current which flows into the Arctic Ocean. — To what does he attribute the cause of the open Polar Sea? — Give examples to illustrate the velocity of Currents. — Give examples to illustrate their influence upon navigation. — State some other important offices performed by Currents.

What effects have Currents upon the temperature of different countries? — Illustrate your statement by examples. — Repeat Maury's description of the approach to the coast of New England in winter. — What Current in the Pacific resembles the Gulf Stream in the warmth of its waters? — Recapitulate the subjects of this and the preceding chapter.

QUESTIONS ON HYDROGRAPHY.

Springs.

How are springs formed? — Is the reservoir of a spring higher or lower than its outlet at the surface?—What do you understand by a perennial spring? — What is the difference between intermittent and periodical springs?—What is the cause of salt and mineral springs?—Of what use are such springs? — What advantages may hereafter be derived from Artesian wells?

Rivers.

How are river-basins separated from each other? — Is there always a decided elevation between them? — Where do rivers generally rise? —Mention some great rivers whose head-waters are in comparatively low land. — What circumstances retard the velocity of a river? — Why are not the Amazon and La Plata sluggish in the latter part of their course?

What is the difference between a rapid and a cataract? — Are there likely to be rapids in a flat country?—Mention some of the most famous cataracts in our own country. — To what purpose are rapids and falls sometimes devoted by man?—How are they sometimes a disadvantage?

How are deltas formed?—What circumstances cause periodical inundations of rivers? — Of what advantage are such overflowings? — Mention some rivers which are remarkable for their inundations.—What kind of surface is most favorable for extensive inundations?

Upon what circumstance does the direction of a river depend? — If you know the direction of a river, can you determine the slope of the land? — In what direction does the basin of the St. Lawrence slope? — Of the Mackenzie? — Of the Nile?

What is the difference between continental and oceanic rivers? — Is the Volga a continental river? — The Don? — The Ohio? — The Amoor? — The Missouri? — Which class is the most important? — Into what four systems are the oceanic rivers divided? — Which of these systems comprises the most important rivers? — Name the greatest rivers of the Arctic system.—What is the general direction of the Arctic rivers? —What is their condition during part of the year?

Mention the largest rivers of the Atlantic system in the Western Continent.—Which of these eight rivers are at present of the most importance for commercial purposes? — Why are not all great rivers as much navigated as the Mississippi? — In which division of America are the great Atlantic rivers of the most immediate use to man?

Name the principal rivers of the Pacific system. — Of the system of the Indian Ocean. — What country forms the basin of the Amoor? — What nation has recently taken possession of the country near its mouth? —What great rivers of the Pacific system are in America?

Is the basin of the Amoor occupied by a dense population? — The Hoang Ho?—The Yang-tse-Kiang?—The Ganges?—The Columbia?—Which system of rivers, the Pacific or the Arctic, flows through the most populous country?

How many of the four river-systems are partly in North America? — In South America? — In Europe?—In Asia? — In Africa? — Name the most famous river of Africa. — How is it famous? — Name three of the largest rivers of Southern Asia.— Let each scholar name three of the most celebrated rivers in the world.

Which is the longest river on the globe? (See Table, p. 91).—Which is the largest river-basin in the world? — Name the longest continental river.—Into what does this river flow? — In what Grand Division are most of the continental rivers? — Are there any important continental rivers in the United States?

Lakes.

Where are lakes most numerous: in northern latitudes, or in the tropical regions? — In the Northern or Southern Hemisphere? — Do salt lakes ever have an outlet? — Can a vessel sail from the Caspian Sea to the ocean?—Suppose the Black and Caspian Seas to be connected by a canal: would the water flow from the Caspian into the Black Sea, or in the opposite direction?

The Ocean.

What resemblance is there between the bed of the ocean and the surface of the land?—What is the greatest depth of the Atlantic Ocean, mentioned in the text?—Where is the telegraphic plateau?

Into what divisions is the ocean commonly separated? — Which of these oceans are least known? — Why? — How near to the Poles have the Arctic and Antarctic Oceans been navigated?—Which is the largest ocean? — Which one is most frequently navigated? — In what ocean is the Sargasso Sea?

Tides.

What is the difference between waves and tides? —Why do tides rise higher in a narrow bay than in the open ocean? —What remarkable examples of high tides are recorded? — Explain the cause of tides.— Where does the great tidal wave originate? — Where is the progress of the tidal wave the most rapid: in the open sea, or near the coast?

What do you understand by flood tide? — By ebb tide? — By high water?—By low water?—Which tides rise the highest: Spring or Neap tides? — What is the difference between Spring and Neap tides at Boston? —At New York?

Currents.

How are currents classified?—What are the three principal causes of constant currents? — What interrupts the regular westward flow of the constant currents? —Where is the equatorial current of the Pacific first interrupted? —What branch does it send to the north-east? —Where do the rest of its waters go?

Where is the Atlantic equatorial current first divided? — Into what sea does the northern division flow?—In what ocean is the Gulf Stream? — From what gulf does it issue? — How does the water of this stream differ from that of the surrounding ocean? — Would this stream aid or retard the passage of a vessel from the United States to Europe? — What corresponding stream is there in the Pacific Ocean? —What is the Sargasso Sea? — How do you account for it?

What is a counter-current? — Give examples of counter-currents.— Are they always surface currents? — What are periodical currents? — Give an example of a periodical current.

Suppose a boat to be set adrift at the mouth of the Red Sea in June: would it float into the sea, or out of it?—Suppose a boat were set adrift, in the same month, at the mouth of the Persian Gulf: which way would it float?

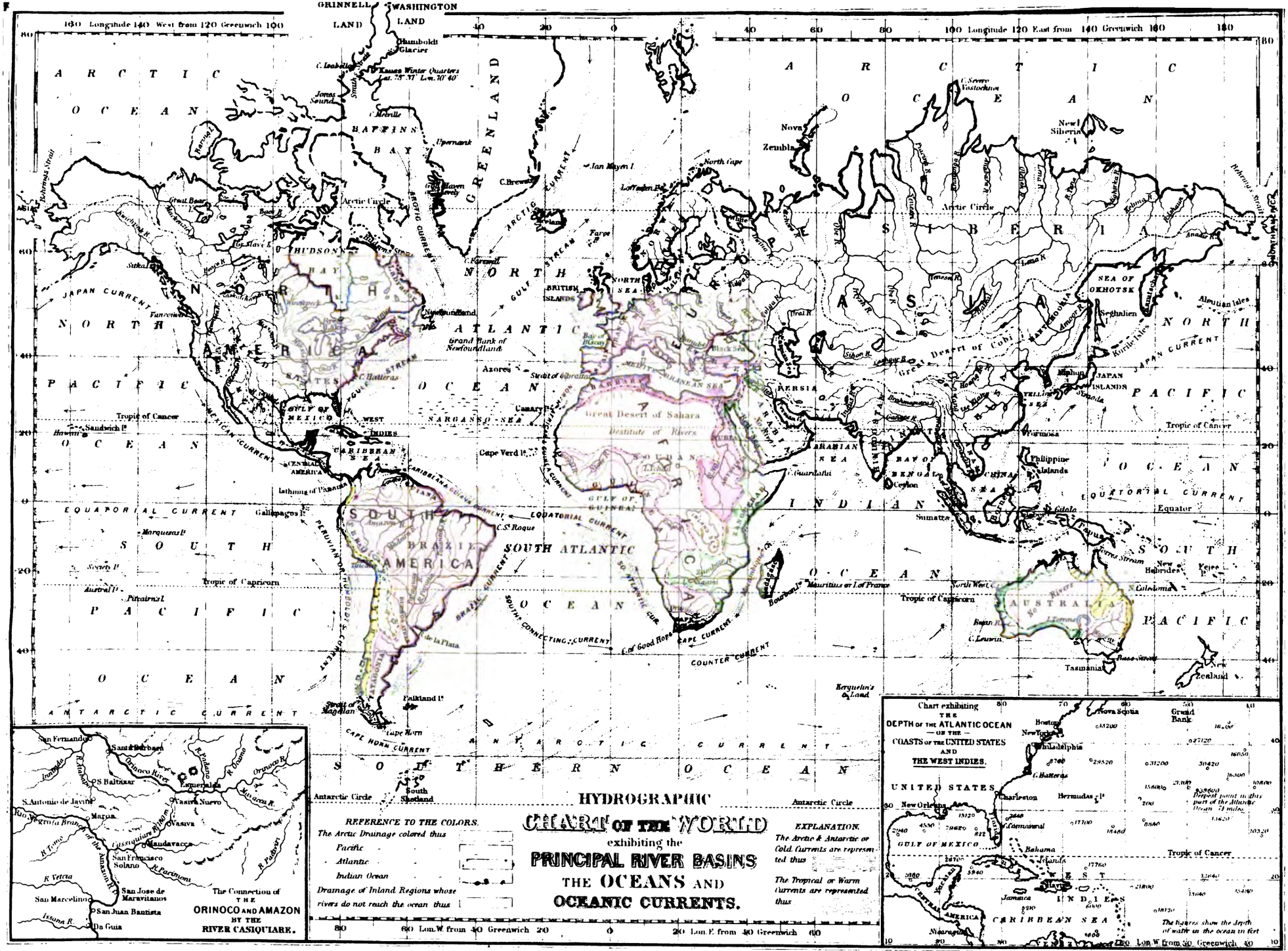
If you were to throw a bottle overboard in Baffin's Bay, which way would it float? — If a tree should fall into the Mississippi River, and meet with no accidental obstruction, where might it finally be found?—A live boa constrictor, coiled around a cedar tree, was found on the shores of one of the West India Islands: — This monster was probably washed out to sea by the flood of some South American river: by what current was it borne to the West Indies?

If a boat should be set adrift off the Cape of Good Hope, which way would it go? — If it should be set afloat two or three hundred miles to the south of the Cape, what direction would it take? — If a vessel is wrecked in the Atlantic equatorial current, where may she finally drift?

In sailing eastward around the Cape of Good Hope, would you keep near the shore? — Which is the easiest passage through Mozambique Channel, northward or southward? — If a vessel were set adrift in the Strait of Gibraltar, would it float into the Mediterranean Sea or the Atlantic Ocean?

Mention some examples of the influence of currents upon climate.— What effect upon the climate of North-western Europe has the Gulf Stream?—How does the Japan Current affect the climate of the north-western coast of America? —Would it be warmer or colder on the coast of Chili and Peru, if all of the Antarctic Current flowed to the south of Cape Horn?—Where would you find the warmest water: in the equatorial current, or in the surrounding ocean?

Suppose a mast to be lost overboard in Behring's Strait, would it float into the Arctic or Pacific Ocean? — It is stated that icebergs force their way through the surface-ice of Baffin's Bay to the north: can you account for this fact? — At the same time the surface-ice drifts to the south: can you account for that? — Where is the open sea of the Arctic Ocean? — State the theory of Lieut. Maury as to the cause of the open Polar Sea?


HYDROGRAPHIC
CHART OF THE WORLD
exhibiting the
PRINCIPAL RIVER BASINS
THE OCEANS AND
OCEANIC CURRENTS.
REFERENCE TO THE COLORS.
The Arctic Drainage colored thus
Pacific
Atlantic
Indian Ocean
Drainage of Inland Regions whose rivers do not reach the ocean thus
EXPLANATION.
The Arctic & Antarctic or Cold Currents are represented thus
The Tropical or Warm Currents are represented thus
The Connection of THE ORINOCO AND AMAZON BY THE RIVER CASIQUIARE.
Chart exhibiting THE DEPTH OF THE ATLANTIC OCEAN — OR THE — COASTS OF THE UNITED STATES AND THE WEST INDIES.
The figures show the Depth of water in the ocean in fort
Engd by F Yeager

PART III.

METEOROLOGY.

METEOROLOGY (from the Greek, "*a discourse on things above,*") is that department of Physical Geography which treats of the phenomena of the Atmosphere, especially in its relations to heat and moisture.

The subject will be considered under the general divisions of, 1. The Atmosphere. 2. Temperature. 3. The Winds 4. Moisture of the Atmosphere — Dew, Fogs, Rain, Snow, and Hail. 5. Climate. 6. Electrical and Optical Phenomena.

CHAPTER I.

THE ATMOSPHERE.

I. THE ATMOSPHERE is that fluid which we breathe, and which entirely surrounds the earth.

The atmosphere was formerly supposed to be a simple element, but the investigations of modern chemists have shown it to be composed almost entirely of dry air and the vapor of water. Dry air is formed of two simple substances or gases — oxygen and nitrogen — in the proportion of 20 or 21 parts of the former, to 79 or 80 parts of the latter. The amount of the vapor of water in the atmosphere fluctuates: in the dryest weather it is supposed to be at least one per cent.

II. The atmosphere has weight, is very elastic, and naturally colorless.

Of what does Meteorology treat? — Under what general divisions may the subject be considered? — What is the Atmosphere? — Of what is it composed?

The fact that the atmosphere has weight, was not verified until the commencement of the seventeenth century, though it had been surmised much earlier. It is now known that it exerts a pressure, or has a weight, of about fifteen pounds on every square inch of the earth's surface; which is equal to the weight of a column of mercury, one inch square, and 30 inches high — or a column of water, one inch square, and 34 feet in height.

The pressure of the atmosphere was noticed by Galileo, but demonstrated by his pupil Torrecelli, who invented the barometer, a simple instrument, consisting of a column of mercury, balanced or pressed upwards into vacuum by the weight of the atmosphere. The mercury in this instrument regularly falls as we ascend above the level of the sea, thus showing a decrease in the atmospheric pressure or weight. The amount of its fall indicates the elevation to which we have ascended, thus rendering it easy to determine the height of mountains. The mercury in the barometer is usually high in calm and fair weather — it falls when it is wet and stormy; hence the value of this instrument as a weather-glass.

What properties has the Atmosphere? — What is the amount of its pressure? — Who invented the Barometer? — Of what practical use is this instrument?

III. The atmosphere is in a high degree elastic, possessing the property of occupying less space under the influence of great pressure, and returning to its original volume when the pressure is withdrawn. Its density is not uniform, but diminishes from below upwards, because the lower portions receive the pressure of the air above.

IV. The height of the atmosphere is not known, but it is supposed to extend upwards, about 50 miles. Yet by far the greater portion is within 15 or 20 miles of the earth's surface; and at a much less distance it becomes so rarefied as to be incapable of supporting life.

In ascending high mountains, the rarity of the air sensibly diminishes the intensity of sound, renders respiration difficult, and causes a great loss of physical strength. Humboldt, who ascended Mt. Chimborazo to the height of more than 19,000 feet, describes the blood as bursting from his nose and ears; and Captain Gerard, who ascended the Himalaya to a height even greater than that reached by Humboldt, speaks of the great physical debility and mental dejection there experienced on the least motion.

CHAPTER II.

TEMPERATURE.

I. TEMPERATURE is the quantity of sensible heat which a body possesses, as indicated by a thermometer.

The thermometer is a very simple instrument, constructed on the principle that bodies expand with heat, and contract with cold. It consists of a small glass tube, with a bulb at the bottom, attached to a graduated scale. The bulb is filled with mercury, which, on being exposed to the action of heat, expands and rises in the tube, forcing out the air which filled it; the top of the tube is then sealed up, and the instrument is ready for use. Let the bulb be immersed in melting ice, and the height of the mercury marked on the graduated scale will denote the freezing point of water; and if the bulb be inserted in boiling water, the height to which the mercury rises will indicate the boiling point of water. Above, below, and between these points, the graduated scale is marked off in degrees indicating the different temperature to which the mercury is exposed.

There are three kinds of thermometers in common use in various parts of the world: Fahrenheit's, Reaumur's, and the Centigrade. Fahrenheit's, that most generally used in the United States and England, and the standard adopted in this work, fixes the freezing point of water at 32°, and the boiling point at 212°. Reaumur's, in most common use in Germany, fixes the two points respectively at 0° and 80°; and the Centigrade, the standard in France, and in many scientific works, fixes them at 0° and 100°.

One degree of Centigrade is equal to 1·8° Fahrenheit; and one degree of Reaumur is equal to 2¼° Fahrenheit. Thus, if you wish to change the temperature from Centigrade to Fahrenheit, multiply the degrees given by 1·8, taking care to add 32°, the difference in the freezing points. In the same manner, if you wish to change from Reaumur, multiply by 2¼, and add 32°.

Thus, 20° Reaumur is equal to 77° Fahrenheit, as follows:—

$$20 \times 2\tfrac{1}{4} = 45 + 32 = 77.$$

And 20° Centigrade is equal to 68° Fahrenheit, thus:—

$$20 \times 1{\cdot}8 = 36 + 32 = 68.$$

What is understood by the elasticity of the atmosphere?—To what height is it supposed the atmosphere extends?—State some of the effects produced by its rarity at a high elevation.—What is Temperature?—Explain the construction of the thermometer.—State the difference between the three in most common use.

II. The temperature of the solid body of the earth varies according to its depth. Neither the heat of the sun nor the effects of cold are experienced beyond a moderate depth; and at a distance rarely exceeding 50 or 60 feet, a limit is reached at which the temperature is invariable from year to year.

In the Torrid Zone, under the Equator, this limit is not more than one foot from the surface; and in temperate climates, it is reached at the distance of about 60 or 65 feet. In the Polar regions the ground is perpetually frozen, in some cases to the depth of 300 or 400 feet.

III. Below the line of invariable temperature, the mercury rises one degree for every 54 feet of descent. At this rate of increase, water would boil at the depth of two miles, and iron would melt at the depth of twenty-four miles.

The temperature of the globe, as a whole, has undergone no sensible change for thousands of years. The earth throws off into the air all the heat that it receives from the sun; while M. Arago has demonstrated that the effects of the internal heat have not affected its mean temperature one-tenth of a degree for 2000 years.

IV. The temperature of the ocean varies, according to the depth and the latitude. This variation is not uniform, being greatly modified by various local circumstances, such as the prevailing currents and the melting of the Polar ice.

At a certain depth, varying with the latitude, a limit of water in the deep sea is reached which has an invariable temperature of about 39°·5. At the Equator this temperature is found at the depth of 7200 feet. From the Equator towards the Poles it rises, until at about Latitude 56°, it reaches the surface, where the temperature of the water is 39°·5; from this parallel it sinks again, and at Latitude 70° it is found at a depth of 4500 feet.

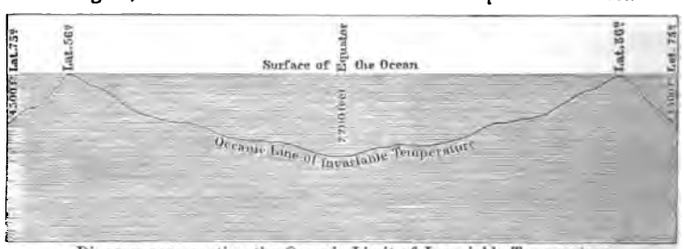


Diagram representing the Oceanic Limit of Invariable Temperature.

The greater parts of the Arctic and Antarctic Oceans, during eight months in the year, are covered with ice. In summer, their waters, though open, are by no means clear, but exhibit immense icy masses, floating to and fro, and often drifted by winds and currents far into the heart of the Atlantic, where they are dissolved in its warmer waters.

These floating masses are of two kinds: sheet ice and icebergs. The latter, which are of fresh water formation, will be considered in connection with glaciers.

Sheet ice resembles that of lakes and rivers, presenting a generally level surface. Sheets of ice, when of great extent, are called *ice-fields*, and sometimes have an area of 100 square miles, rising from two to eight feet out of the water. Smaller sheets are called *floes*. Fields and floes, when broken up, and the fragments crowded together, form what is called a *pack*.

The temperature of the surface of the ocean is more uniform than that of the land. The rays of the sun penetrate to a greater depth in water than in the ground. A much greater mass, therefore, is warmed, yet it is very slowly warmed and cooled; so that it does not undergo any very rapid or violent changes. While the surface of the ground, on the contrary, being affected to only a moderate depth, receives and throws off the heat of the sun's rays with great rapidity. The greatest variation in the temperature of the open sea throughout the year, at any given place, is only 10 or 12 degrees, while that of the land is sometimes 160 degrees. Accordingly, the sea is

At what depth from the surface of the solid body of the earth is found the line of invariable temperature?—Does it become warmer or colder below this line?—State the depths from the surface of the ocean at which it is found.—Explain the terms *ice-fields*, *floes*, and *packs*.—How does the temperature of the ocean compare with that of the land?

cooler than the land in summer, and warmer in winter; it is also cooler than the land during the day, and warmer at night. Its temperature, like that of the land, is not affected by the internal heat of the earth.

The Oceanic warmth Equator, or line of greatest heat of the surface of the ocean, is for the most part to the north of the geographical Equator. In the Gulf of Mexico it extends as far north as Latitude 28°, the Gulf Stream bearing thither the warm waters of the great Equatorial current.

V. Fresh water becomes heaviest at the temperature of 39°·2. If it be heated above or cooled below this point it will rise, and the heavier water will sink. Since, then, water cools very slowly, deep lakes, in the most rigorous climates and severest seasons, will be frozen to but comparatively a slight depth.

Shallow lakes in the Polar regions are often frozen to the bottom, consequently no fish can live in them; while the deep lakes, which, owing to this kind provision of Nature, are never frozen to the bottom, are abundantly stocked with the finest fish, affording almost the entire means of subsistence to the wandering tribes of these sterile regions.

VI. Springs appear at the surface of the earth at all temperatures, from that of freezing, nearly or quite to the boiling point. Their temperature depends upon that of the reservoirs from which their supplies of water are received, and the character of the soil through which it passes to the surface. Warm and hot springs derive their supplies from waters which have ascended from a great depth, variously affected by contact with the heated rocks of the interior.

Commodore Wilkes, of the United States' Exploring Expedition, describes water, with a temperature from 200° to 210°, oozing up through the gravel and sand of the beach on one of the Feejee Islands.

Humboldt describes a spring near Porto Bello, in South America, with a temperature of 207°. The Hot Springs of Arkansas, about eighty in number, have a temperature averaging from 135° to 160°.

VII. The temperature of the atmosphere chiefly depends upon the amount of heat received from the land and water.

But little of the sun's heat is absorbed by the air before it reaches the earth. The sun's rays first strike the surface of the earth, and are either directly reflected, or are first absorbed, and then radiated, or thrown off into the atmosphere.

VIII. The temperature of a place depends upon the direction and amount of the sun's rays, on its vicinity to the sea, on the prevailing winds to which it is exposed, and on its elevation above the level of the sea.

1. The temperature of a place depends upon the direction and continuous time in which the sun's rays fall upon it.

When the sun is most nearly vertical to any place, that is, when it is nearest to being directly over head, the greatest number of his rays reach the surface of the earth at that place, imparting a greater amount of heat than at other times. This is the reason why it is warmer in our latitude at mid-day than at sunrise or sunset. In the equatorial regions, accordingly, over which the sun is nearly vertical during the whole of the year, the mean temperature is the highest. Moreover, since the days and nights between the Tropics are of nearly equal length, the temperature during the year is quite uniform. The mean equatorial temperature of the air is about 83°. Tropical Africa is the hottest region on the globe, the mean temperature reaching 85°·10; that of tropical Asia is 82°·94; and that of America, 80°·96.

The temperature of the air decreases as the distance from the Tropics towards the Poles increases. Thus, the mean temperature of the year, at the subjoined places, ranges as follows:—

	N. Latitude.	Temperature.
Cairo	30°	72°.
Philadelphia	40°	52°.
Quebec	46°	42°.
Melville Island	70° 47′	1°·7.

The temperature is not, however, as in the equatorial regions, uniform, but ranges between points far removed from each other. Thus, in the celebrated northern expedition of Captain Parry, 1819–20, the maximum daily temperature at Melville Island, Lat. 70° 47′ N., on the 17th of July, was 60° *above* 0; while the minimum, on the 15th of February, was 50° *below* 0: the maximum and minimum points being 110° apart.

There are greater differences. During the Russian expedition to Khiva, in 1840, the mercury fell to 45°·4 below zero; and for more than three months the mean temperature was about 0°. In June, the temperature rose to 114°·8. Thus, in the course of a few months, the troops were exposed to a variation of 160°.

At Franconia, N. H., the mercury rose to 102° on July 13th, 1849, which was 140° higher than on the 6th of February following.

DIFFERENCE BETWEEN SOME MINIMUM AND MAXIMUM TEMPERATURES.

Places.	Difference.	Places.	Difference.
Rome	73°	Prague	109°
Copenhagen	90°	Petersburg	117°
Paris	108°	Moscow	126°

The high maximum temperature observed in the extreme northern latitudes is the result of the *continuous time* that the sun's rays fall upon those regions. During the brief summer of the Arctic regions, the power of the sun's beams, though feeble from the obliquity of their direction, accumulates in the long days, and sometimes produces in sheltered spots, effects which might be more naturally expected in the Torrid Zone. Pitch has been melted on the sides of ships—at Quebec, grapes sometimes ripen in the open air—and the summer temperature is often quite oppressive.

It is owing, also, to the accumulated power of the sun's rays that the month of July is warmer than the month of June in our latitudes, notwithstanding the greater length of the days and the smaller inclination of the sun's rays in June; the days are longer than the nights, and the quantity of heat imparted to the earth during the day is greater than the amount lost by radiation during the night: the maximum effect of this accumulation, or the hottest day, is generally observed in the latter part of the month of July.

The variation in the mean annual temperature at any one place, from year to year, is very slight. Thus, the highest mean annual temperature in Geneva, Switzerland, for 20 years, from 1796 to 1815 inclusive, was 51°·6; the lowest, during the same time, 46°·9—the difference being only 4°.7.

At Paris, in the years between 1803 and 1813, the variations from the standard mean never exceeded it more than 3°·4, or fell short of it more than 2°·9. The variable produce of our harvests is owing more to a change in the distribution of heat through the different months, than to any difference in the annual supply.

2. The temperature of a place is dependent upon its vicinity to the sea. The ocean is warmer in winter and cooler in summer than the land. The atmosphere over it, partaking of its temperature, and borne by the winds to places situated on or near the coast, gives to them a more uniform temperature than to those at a distance from the sea.

These facts are illustrated in the following table:—

	Mean Summer Temp.	Mean Winter Temp.	Mean Temp. of the Year.
North Cape	43°	23°	32°
Irkoutsk	60°	0°	33°
Reikiavik (Iceland)	53°	30°	39°
Moscow	67°	10°	40°
Falkland Islands	53°	39°	47°
Quebec	68°	14°	42°

Give the reason why deep lakes in the Polar regions are not frozen to the bottom.—On what does the temperature of springs depend?—On what does the temperature of the atmosphere depend?—On what does the temperature of a place depend?—Why does the direction of the sun's rays affect the temperature of a place?—Illustrate your statement.

What effect upon the temperature of a place has the continuous time which the sun's rays fall upon it?—Illustrate your statement.—How do the mean annual temperatures of places compare from year to year?—What effect has the vicinity of the ocean upon the temperature of a place?

The currents of the sea materially affect the temperature of places contiguous to them. The Gulf Stream moderates the severe cold of Newfoundland, Iceland, and the coast of Norway. Humboldt ascribes the coolness on the shores of Peru to the cold sea current which flows along that coast. In the Pacific Ocean, near Lima, the temperature is 60°·2; while in the same latitude, *out of* the current, it is 79°·2.

3. The temperature of a place depends also upon the prevailing winds to which it is exposed. The effect of a change in the direction of the wind, in producing a change of temperature, is a subject of common observation. In the higher latitudes these changes are often strikingly marked. Captain Scoresby, while in the neighborhood of the polar ice, observed that the mercury fell 34° in sixteen hours, by reason of the sudden veering of the wind to the north.

It is undoubtedly owing in a great measure to the warm south-west trade-winds that the western coasts of North America and of Europe have a higher temperature than their eastern coasts. The mean annual temperature of Nain, in Labrador, (Lat. 57° 10′,) is 6°·8 *below* the freezing point, while on the western coast, at New Archangel, (Lat. 57° 3′,) it is 12° *above* this point.

4. The temperature of a place depends upon its elevation above the level of the sea. The repeated observations of aeronauts and of travellers who have ascended high mountains, have established the fact that the temperature of the atmosphere decreases according to the perpendicular height above the surface of the earth. The rate of decrease is about 1° for each 352 feet of ascent.

A traveller, who should ascend one of the high peaks of the Andes, in tropical America, would find on the plain at its base the luxuriant productions of the tropics, and an oppressively hot atmosphere; at an elevation of 6000 feet, he would experience the warmth of summer in the Temperate Zones; at the height of 10,000 feet, he would find the climate of spring in the same Zones; at 12,000 feet, only a few stunted shrubs would be found growing; and at an elevation of 15,000 or 16,000 feet, he would arrive at a region of perpetual snow.

State the influence of the currents in producing a change of temperature.—Give examples to illustrate the effect of the winds upon the temperature of a place.—What effect has the elevation of a place upon its temperature?—Recapitulate the subjects of this chapter.

IX. *Recapitulation.* — It thus appears that the temperature of the land of the earth varies with the depth; that the temperature of the ocean varies with the depth and the latitude; that the temperature of the atmosphere chiefly depends upon the amount of heat received from the land and the water. It follows that the heat of the land and the water, imparted to the atmosphere, determines the temperature of different places upon the earth: and that they vary with reference to the direction and continuance of the sun's rays, to proximity to the ocean, to the direction of the prevailing winds, and to the elevation above the level of the sea.

CHAPTER III.

THE WINDS.

I. Wind is air in motion. The motion of the air is produced by a disturbance of its equilibrium, and the principal cause of this interruption is heat.

The air expands and becomes lighter with heat; contracts, and becomes heavier with cold. When, therefore, any portion of the earth's surface is heated more than the surrounding districts, the air above it becomes heated also, and rises, causing an upper outward current. At the same time, the colder, heavier air rushes in to fill the space occupied by the ascending air, producing a lower inward current.

A very simple experiment will illustrate the effect of a change of temperature in causing currents of the atmosphere. Let a lighted candle be held near the top of a door-opening from out of a heated room into the external air, the current of warm air passing out will give to the flame an outward direction; hold the candle near the floor, and the current of cold air pressing in will give the flame an inward direction.

II. Currents of air receive their names from the direction *from* which they blow; currents of water from the direction *towards* which they flow.

III. Winds, at different elevations, frequently blow in opposite directions. This is manifest from the fact that clouds, at a high elevation, are often seen moving towards a point of the compass opposite to that indicated by the weather-vane.

The occurrence of upper counter-currents is very decisively proved by the following circumstances:—

The inhabitants of the island of Barbadoes, in the West Indies, observed, one day, to their astonishment, a shower of ashes fall from the sky. This came from the volcano of St. Vincent, which is situated directly west of their island. The ashes had been launched high into the air, and transported from west to east, in the opposite direction to the trade-wind blowing below.

On the 25th of February, 1835, the ashes emitted from the volcano of Cosiguina, in Guatemala, fell in the streets of Kingston, in the island of Jamaica. Kingston is 700 miles in a north-east direction from the volcano, and the trade-wind at the surface was blowing to the west.

Aeronauts, who have ascended in balloons during a complete calm at the surface of the earth, have frequently encountered, when at an elevation of a few thousand feet, powerful currents carrying them at the rate of a mile a minute.

What is Wind?—What is the principal cause of winds?—Give an illustration of currents of air created by heat.—In what respects are currents of air and water differently named?—What proof is there that winds at different elevations blow in opposite directions?

IV. Winds may be distinguished as constant, periodical, and variable. Constant winds, prevailing within the tropics, are called "trade-winds," and maintain nearly the same direction and rate throughout the entire year. Periodical winds are those which regularly prevail in various parts of the earth at a certain time of the day or year, as the monsoons. Variable winds prevail in the regions beyond the tropics, the same wind seldom lasting many successive days.

V. *Trade Winds.* — The origin of these winds may be easily explained. The equatorial regions are the hottest on earth. The air over those regions, therefore, becomes heated, and rising, flows over the colder masses on either side towards the north and south, from which directions the colder air rushes in to supply the place of the warmer currents constantly ascending. Thus, a northward and a southward current are created in each hemisphere: the one flows near the surface of the earth, and the other some distance above it. If the earth were at rest, the surface-winds of the tropical regions in the Northern Hemisphere would be north, and those of the Southern Hemisphere south.

The earth, however, revolves from west to east, and the atmosphere which surrounds it partakes of its motion. The masses of air from the Poles, unable, by reason of friction and other causes, to acquire the full measure of the earth's increased rotary velocity, fall behind, and are gradually turned from a direct northerly and southerly into a north-eastern and south-eastern direction; and, on approaching the Equator, they form the great easterly trade-wind which sweeps round the equatorial regions unceasingly, at a speed of from 10 to 20 miles an hour.

The wind from the Poles, on its way to the Equator, takes the name of the North-east trade-wind in the Northern Hemisphere, and the South-east trade-wind in the Southern. "The North-east and South-east trades," says Lieut Maury, "blow perpetually, and are as steady and constant as the current of the Mississippi River, always moving in the same direction."

The Trade-winds extend generally about 30° on each side of the Equator, but their limits vary considerably in different parts of the ocean; and being influenced by temperature, vary also with the seasons. The limits of the North-east trade-wind advance with the sun to the north, from winter to summer, and retreat with it towards the Equator, from summer to winter.

The average varying limits of the Trade-winds in the Atlantic Ocean, at different seasons, are stated in the annexed table, taken from Johnston's Physical Atlas: —

	North-east Trade-wind.		South-east Trade-wind.	
	Northern Limit.	Southern Limit	Northern Limit.	Southern Limit.
Spring	28° N.	5° 45′ N.	1° 30′ N.	Unknown.
Summer	30° 45′ "	11° 20′ "	3° 15′ "	"
Autumn	28° 20′ "	10° "	3° 15′ "	"
Winter	24° 45′ "	5° 45′ "	2° 30′ "	"

The North-east Trades commence in the Atlantic Ocean, a short distance from the African coast, and after being interrupted by the high lands of the American Continent and the islands of the Caribbean Sea, blow across the Pacific Ocean to the region of the Monsoons, about Longitude 145° East.

The South-east Trades commence with the African coast, and extend across the Atlantic, and over the great plains of the Amazon to the foot of the Andes. Interrupted by this lofty chain, they commence again a short distance from the South American coast, and extend across the Pacific to Australia. West of Australia, and south of 10° S. Lat., they are continued nearly to the coast of Africa.

The numerous islands of the Pacific, between the meridian of the Marquesas Islands, 139° W., and the east coast of Australia, give to the South-east Trade-wind much the character of a Monsoon, the variation in the temperature causing a change in the direction of the wind. In the open sea, however, the direction of the trade-wind is maintained. So, also, in the region of the North-east Trades, in the Caribbean Sea, westerly currents called *vendavales* (rainy winds,) prevail from July to December, alternating with the trade-winds.

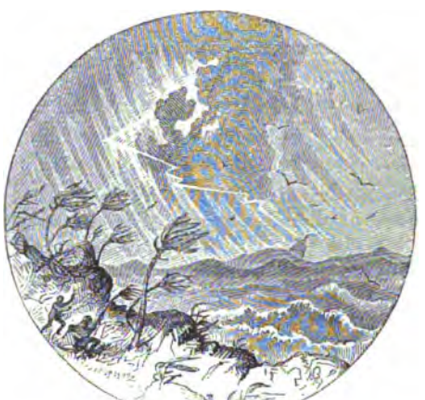
Where the North-east and South-east Trades approach each other, they tend to produce a purely eastern breeze, but this is not perceptible, on account of the continued ascent of the air caused by the excessive heat. This is the region of calms so much dreaded by sailors, which would be almost perfectly so, were it not for the frequent violent rains which disturb the equilibrium of the atmosphere, occasioning sudden squalls and storms. The limits of this region of calms at different seasons is given in the table — the southern limit of the North-east Trade being its northern, and the northern limit of the South-east Trade being its southern boundary.

The extension of the Trade-winds further to the north than to the south of the Equator, may be accounted for by the greater quantity of land in the Northern than in the Southern Hemisphere, which retains a greater amount of heat, and by the additional warmth furnished by the northerly course of the warm Equatorial current. (See page 35.)

VI. *Periodical Winds.* — The Land and Sea Breezes, Monsoons, Etesian Winds, and Northers of Mexico and Texas, are of this class.

VII. *Land and Sea Breezes.* — On the sea-shore, especially on the coasts of tropical islands, a breeze from the sea is experienced a few hours after sunrise. At first it is light and scarcely perceptible, but increases till mid-day; it is strongest between two and three o'clock in the afternoon, dying away to a perfect calm at sunset. Soon after sunset, a breeze from the land commences, and continues till morning. These breezes are caused by the different temperature of the land and water; the land being hottest through the day, and coolest at night. Around spacious lakes, those in the northern part of the United States for example, for the same reasons, there is a breeze from the lake by day, and towards it at night.

VIII. *Monsoons.* — The Monsoons are winds which prevail in the Indian Ocean, blowing part of the year in one direction, and part in the opposite one. The term is derived from the Malay word *Moussin*, signifying *a season*.



Commencement of the Monsoons.

The North-east Monsoon, which prevails north of the Equator from about the middle of October to the middle of March, is a continuation of the North-east Trade-wind. The South-west Monsoon prevails north of the Equator, extending from the coast of Africa to about Longitude 145° East, from about the middle of April to the middle of September. This wind is caused by the greater warmth of the land, during the summer, than the sea. The air over the southern part of Asia, being heated more than that over the ocean, rises, and that of the sea rushes in to supply its place, causing the South-west Monsoon.

South of the Equator, in the region of the Indian Ocean, north and north-west of Australia, a south-east wind prevails from about the middle of March to the middle of October, and a north-west wind from about the middle of

What are Constant Winds?—What Periodical?—What Variable?—Explain the cause of the Trade-winds. — What name is given to the one north of the Equator? — What name is given to the one south of the Equator? — Give the extent of the North-east Trades. — Of the South-east Trades. — Where is the region of Calms?

Why do the Trade-winds extend further north of the Equator than south of it?—How do you account for the Land and Sea Breezes?—What are the Monsoons?—When and where does the North-east Monsoon prevail? — The South-west?—The North-west?—The South-east?

September to the middle of April. The south-east wind is a continuation of the South-east Trade-wind, which, south of 10° South Latitude, blows regularly throughout the year.

It is summer in Australia, south of the Equator, when it is winter in countries north of the Equator. The North-west Monsoon, which is caused by the heat of this large island, rarely blows with force and regularity except in the months of December and January.

During the intervals between the establishment of the two monsoons, or from about the middle of March to the middle of April, and from the middle of September to the middle of October, calms and light breezes alternate with furious gales, hurricanes, and violent thunder-storms.

Monsoons prevail also, though not so decidedly, on the coast of Brazil, and Pacific coast of Central America; the cause of them being the unequal temperature of the sea and land, which has been already explained.

The Monsoons are much stronger than the Trade-winds, frequently amounting to gales. They are also more serviceable to navigation from the change in their direction: for a ship sailing with one monsoon to a distant port, may be aided on the return voyage by its successor.

IX. *Etesian Winds.*—The ancients gave this name (signifying annual or seasonal,) to periodical winds which blow strongly from the north in the Mediterranean Sea in summer. The cause assigned for these winds is the intense heat of the Desert of Sahara, lying to the south of the Mediterranean. With the aid of these winds, a passage across the sea from Europe to Africa in summer is much quicker than the return.

X. *Northers.*—The Northers are violent winds from the north, which sweep the prairies of Texas and the low plains of Mexico. They prevail from October to March, seldom continuing to blow with severity, however, more than four or five days in succession. They are cold winds, most severe in the months of December and January.

XI. *Variable Winds.*—The winds of the temperate and polar regions, since the same current rarely continues many successive days, are properly classed as variable. The prevailing direction of these winds, however, is clearly defined, and may be easily explained. Those of the Northern Hemisphere are south-west; of the Southern, north-west.

The hot air which rises from the equatorial regions, and blows off towards the north and south, descends as it cools, and approaches the surface of the earth at about Lat. 30°, here encountering the currents proceeding from the Poles towards the Equator. For precisely the same reason as that which causes the winds from the Poles to bend towards the west, these "Return Trade-winds," as they are called, bend towards the east; and in the Northern Hemisphere are south-west winds: in the Southern, north-west. They are more powerful than the winds from the Poles, and thus become the prevailing winds; yet by no means have the constancy of the Trade-winds.

The point at which the winds from the Equator and Poles encounter each other is a region of calms, similar to that existing between the trade-winds. On the ocean, these regions are well defined, advancing to the north and south with the change of seasons. They are called by Lieut. Maury the Calms of Cancer and of Capricorn. The Calms of Cancer have been long known to mariners as the "Horse Latitudes." This name was derived from the fact that vessels, engaged in carrying horses from New England to the West Indies, were often delayed by the baffling winds of this calm region, until their stock of water was nearly exhausted, and they were compelled to throw some of the horses overboard to save the others.

The direction, extent, and elevation of mountain ranges, the occurrence and character of low lands, the vicinity of bodies of water, and all important changes in temperature, are among the reasons which will account for material changes in the prevailing direction of the winds, especially those of the Northern Hemisphere.

XII. Some interesting deductions from the elaborate work of Prof. Coffin, on the Winds of the Northern Hemisphere, published by the Smithsonian Institute, are here subjoined:—

1. In the Arctic regions of North America, lying within the Polar Circle, the mean direction of the wind is about N. N. W.

2. Between the parallels of Latitude 60° and 66° N., there appears to be a belt of easterly or north-easterly winds.

3. South of this region we find a Zone of westerly winds, about 23½° in breadth, entirely encircling the globe. It embraces the southern portion of British America, all of the United States, except the extreme southern part, nearly the whole of Europe, and most of the northern half of Asia. Out of 251 stations in North America, east of the Mississippi, and situated within this belt, all but *six* have the mean direction of the wind westerly. Out of 142 stations situated in this belt, 117 have the mean direction of the wind from some point between north-west and south-west. The eight stations of Asia, lying in this belt, all have the mean direction of the wind westerly.

4. South of this belt the mean direction of the winds is easterly.

5. Valleys strikingly modify the direction of winds.

XIII. Winds may be divided also with reference to their physical characters, into hot and cold, moist and dry. Those blowing from the ocean, or large bodies of water, are moist; those from deserts, or the interior of continents, are dry. Those from the Polar regions, or descending from snow-capped mountains, are cold; and those from the Torrid Zone are hot.

A Sand-Storm in the Desert.

XIV. The Simoom or Samiel, Khamsin, Harmattan, Sirocco, and Solano, are noted hot winds. The Pamperos and Bora are cold winds.

1. The *Simoom*, known in the deserts of Arabia, Nubia, Persia, and Syria, derives its name from its temperature and supposed pestilential character:

What kind of weather prevails during the intervals between the establishment of the Monsoons?—Which are most serviceable to navigation, the Monsoons or Trade-winds?—Describe the Etesian Winds.—The Northers.—Why are the winds of the Temperate and Polar regions called Variable?—What is the prevailing direction of the winds of the Northern Hemisphere?—What of the Southern Hemisphere?

State the cause of these winds.—Where are the Calms of Cancer?—Of Capricorn?—By what name have the Calms of Cancer long been known to mariners?—Why this name?—What conclusions with reference to the winds of the Northern Hemisphere are drawn from the elaborate work of Prof. Coffin?—State some of the physical characters of winds.—Describe the Simoom.

the Arabic *Samma* signifying at once hot and poisonous. The Turks call it *Samiel*, which likewise means poison. But though dangerous, and sometimes fatal in its effects, its pestilential and deadly attributes may be regarded as an Oriental fiction. The Simoom blows only occasionally during intense heats, and seldom lasts longer than fifteen or twenty minutes, though sometimes it continues for days.

2. The *Khamsin* (fifty,) is the name given to a hot south wind, not so oppressive as the Simoom, which blows in Egypt, continuing at intervals for a period of somewhat more or less than fifty days, from the end of April until June.

3. The *Harmattan* is a very dry, hot wind, which blows from the Sahara over the coast of Guinea, during the months of December, January, and February. It generally occurs three or four times during the season, and continues usually from one to six days, though it has been known to last fifteen days. A fog or haze always accompanies it, so dense that the sun is only visible for a few hours at noon.

4. The *Sirocco*, a well-known hot wind of Greece and Italy, and the *Solano*, a hot wind of Spain, are usually ascribed to the vicinity of the Sahara.

5. The *Pamperos* are cold south-west winds, which originate among the snow of the Andes, and sweep with great violence over the level Pampas of Buenos Ayres. So sudden and violent are these winds, that persons bathing in the La Plata River have been drowned, finding it impossible to regain the shore while they raged.

6. The *Bora*, a north-east wind, common in Dalmatia, on the eastern shores of the Gulf of Venice, is sometimes so furious as to overturn horses at the plough.

XV. *Whirlwinds.*—We often see in the streets of our cities and towns, especially on a warm summer afternoon, just before a shower, many small whirlwinds, by which dust, leaves, and other light objects are raised up into the air. They are generally caused by the conflict of two winds meeting at an angle, in the same manner that eddies and whirlpools are formed in water by two currents being obliquely impelled against each other. When the winds thus meeting are powerful, great damage ensues, trees being torn up, and buildings destroyed.

XVI. *Tropical Storms*, variously named Hurricanes, Typhoons, Cyclones, and Tornadoes, are revolving winds, which occur in certain localities at particular seasons of the year, often occasioning immense destruction of life and property.

Meteorologists are not agreed as to all the causes of these terrific storms, though the condensation of the vapor of the atmosphere, caused by sudden changes in its temperature, is undoubtedly the principal one. When these storms occur upon a grand scale, they are accompanied by much thunder and lightning, and immense quantities of rain. They seldom approach nearer to the Equator than 8° or 10°, and rarely extend beyond the tropics, raging most furiously in the vicinity of continents and islands.

From recent investigations by Mr. Redfield, Col. Reid, and others, it appears that these storms may be regarded as great whirlwinds, from 50 to 500 miles in diameter, revolving around a calm centre. The place of this centre, meanwhile, advances along a definite line upon the globe with a velocity varying from two to thirty or forty miles an hour. In the Northern Hemisphere, the direction of the whirlwind is from right to left, or opposite to the movement of the hands of a watch. In the Southern Hemisphere, the direction of the wind is from left to right, or with the movement of the hands of a watch.

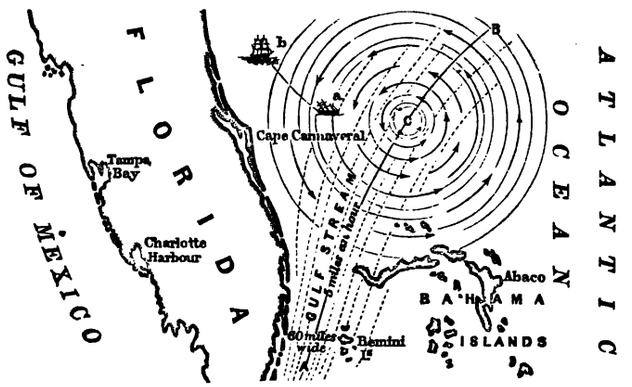
The storm is most furious, and, of course, most dangerous, nearest this calm centre; the navigator, therefore, who finds himself within the limits of the hurricane, will, if possible, sail in the opposite direction from this centre.

Describe the Khamsin.—Harmattan.—Sirocco.—The Pamperos.—Bora.—By what are whirlwinds generally caused?—What is the principal cause of tropical storms?—State the result of recent investigations into the character of tropical storms.

To enable him to do so, the following rule is given in the London Admiralty Manual:—

"When sure that you are within the limits of a Cyclone, stand erect, and look full in the wind's eye; then, if in the Northern Hemisphere, turn yourself 90°, or one quarter of the circle, round *to your right*, (if in the Southern, as much to your left,) and you will have the centre of the hurricane facing you."

This will be made more clear from an examination of the annexed drawing, which is designed to represent a West India Hurricane.



Let C represent the calm centre of the storm, then the arrows will show the direction in which the wind revolves, and A B will represent the line along which the storm advances. Now, let us suppose a vessel at a, the commander, who "stands erect, and looks full in the wind's eye," will find the wind there to be due north; turning one quarter round to the right, he has the direction of the calm centre, or place of greatest danger, due east from his vessel: and, knowing its direction, the experienced navigator knows what course to take to avoid it.

XVII. There are three well-known hurricane regions: the West Indies, the Indian Ocean, and the Chinese Seas.

Of 127 hurricanes in the West Indies, recorded in 354 years, from 1493 to 1847, 15 occurred in July, 36 in August, 25 in September, and 27 in October. The only months in which no hurricanes have been known in this region, are January, April, and May.

Some idea of the immense force of these storms may be derived from the description of the hurricane at Barbadoes, August 10th, 1831. "By this awful visitation, the whole face of the country was laid waste, 2500 persons perished, and 5000 were wounded. The force of the wind may be estimated by the fact that a piece of lead, 400 pounds in weight, was lifted and carried to a distance of 1800 feet."

In the Indian Ocean, the chief period of the occurrence of hurricanes is from November to June. They are most frequent in January and March. In the Bay of Bengal, they often prevail in May, but are most numerous in October and November. In the Chinese Seas, the typhoons occur at about the same season of the year as the West India hurricanes.

The vicinity of Cape Horn, and the region of the Gulf Stream, beyond the Tropics, are noted ocean-storm regions. It was in one of the terrible gales of the Gulf Stream region that the ill-fated steamer San Francisco was lost, in December, 1853. It first encountered the gale at Lat. 39° N., and Lon. 70° W., but before the vessel was abandoned, it had drifted with the stream several hundred miles to the north-east.

XVIII. Water-spouts are occasioned by whirlwinds near the surface of the water. They are much dreaded by sailors, though it is doubtful if large vessels have ever been destroyed by them. Sometimes twelve or fourteen may be seen at once in the Mediterranean Sea.

State the rule by which a navigator may know in what direction to find the place of greatest danger.—Explain the diagram.—Name the three principal hurricane regions.—By what are water-spouts occasioned?

Navigation.

XIX. The knowledge of the locality and direction of the winds and currents is of the utmost importance in navigation. Formerly, the average time of a sailing vessel from England to the United States was sixty days; now the same voyage is often made in less than half that time.

"I knew an officer," says Captain Basil Hall, "who was ordered to cruize in the Mozambique Channel, between Africa and Madagascar, until a certain day, and then to proceed to the Isle of France. At the time appointed, he sailed to the northward, but though he proceeded nearly to the Line in search of a north-west wind, he could not make a bit of easting; and after six weeks of ineffectual struggle between the north end of Madagascar and the Equator, he was obliged for want of water to run for a port in Africa, where he lost half of his crew by sickness, and was compelled to bear up at last for the Cape of Good Hope, and the whole object of his mission was defeated." If this officer, at the season of the year he was ordered to sail for the Isle of France, had taken a southerly course from Madagascar, he would have found a south-west wind which would have taken him, in fifteen or twenty days, directly into the port which he wished to reach.

XX. A series of careful observations have recently been conducted under the direction of Lieutenant Maury, by which a pretty accurate knowledge of the currents of the air and sea have been obtained, and the result has been furnished to navigators in the form of sailing-charts.

By following the directions of these charts, the time required for voyages has been greatly shortened. "The average passage out from the Atlantic ports to San Francisco," says Lieut. Maury, "is upwards of 180 days, but vessels with these charts on board have made it in 107, in 97, in 96, in 91, and even in 90 days; and their masters, after making allowance for the improved models of their ships, ascribe this great success to the information which they derived from these charts as to the winds and currents by the way."

The properly-trained seaman of the present day knows not only where to expect the existence of the prevailing winds at the different seasons, but how to turn them to the best advantage in prosecuting his voyage. "It is one of the chief points of a seaman's duty," says Captain Basil Hall, "to know where to find a fair wind, and where to fall in with a favorable current. If we take a globe, and trace on it the shortest route by sea to India, and then fancy that such must be the best course to follow, we shall be very much mistaken. And yet this is very much what our ancestors actually did, until time, and repeated trials, and multitudinous failures, gradually taught them where to seek for winds, and how to profit by them when found. According to this 'rule of thumb' sailing, a ship had only to steer from England to Madeira, pass the Canaries and Cape de Verdes, and then make a direct course to the Cape, and thence to India. On trial, however, this experiment always failed; for, on getting near the Equator, a series of calms and squalls put a stop to this rectilinear scheme, and the mariners of old were then forced to toil along the coast of Africa, or were driven towards that of the Brazils, and very often came back in utter helplessness."

XXI. *General Principles in Navigation.*—*(Selected from Johnston's Physical Atlas, and Maury's Sailing Directions.)*—In the navigation of the great oceans by wind-propelled vessels, it is a general rule that, in sailing from east to west, it is necessary as soon as possible to enter the zone of the trade-winds, and to endeavor to keep outside of that zone in sailing from west to east.

1. *From Europe to America.*—In sailing from England to the United States, vessels are much retarded by westerly winds, which prevail in the proportion of two to one. They must also keep to the north of the Gulf Stream, whose eastward current would still farther oppose their passage. The Gulf Stream advances and recedes north and south with the sun, being farthest north in September, and farthest south in March; the route must, of course, be adapted to this circumstance. After passing the Banks of Newfoundland, the voyage is favored by the Arctic Current running south-west. The above is the route pursued by the steam and sailing packets from England to our northern ports.

The southern route from Europe to America, although much longer in the distance to be traversed, is by some authorities reckoned preferable to the foregoing. On quitting Europe by this route, the object is to steer south or south-west, according to the prevailing winds, in order as soon as possible to reach the zone of the trade-winds. Once in the region of the trade-winds, the course westward must be shaped in accordance with the position of the port to be attained.

2. *From the United States to Europe.*—The return to Europe is favored by the Gulf Stream and by the prevailing winds. The average passage for sailing vessels from New York being only 23 days, while that of the opposite voyage is 40. The passage from west to east has been accomplished in 13 days.

3. *From New York to San Francisco.*—On leaving New York, the ship must sail eastward to about the 60th meridian, before attempting to go south. The reason of this is, that if she were to steer *directly* from New York to Cape St. Roque, the North-east trades would carry her too far west, on to the northern shores of Brazil, and she would thus be retarded in passing around Cape St. Roque.

After reaching the meridian of 60°, she takes the North-east trades as soon as possible, and passes Cape St. Roque at about the meridian of 32°. Thence her course along the coast inside of the Falkland Islands to Cape Horn is quite direct. The passage around Cape Horn is the most difficult part of the voyage, owing to the westerly winds of that quarter, which blow around the Cape in violent puffs and gales.

After doubling Cape Horn, the vessel must sail far to the west, in order to enter the region of the South-east trades at a great distance from the coast, as these winds blow with much greater force and regularity far out at sea, than when within the disturbing influences of the land. After crossing the Equator, and getting into the North-east trades, the course is north-west, till these winds are passed. The vessel is then within the region of prevailing westerly winds, by which she may sail directly into port.

4. *From the United States or Europe to China, India, and Australia.*—Vessels usually make for Cape St. Roque, as if they were bound to Cape Horn. Having passed inside of the Island of Trinidad (opposite Rio Janeiro), they can then take the westerly winds and Southern Connecting Current, and make for the Cape of Good Hope. If the ship is bound for Australia, the best course is to pass about 1000 miles south of the Cape. The route thence to port is entirely in the region of prevailing westerly winds.

From the Cape of Good Hope to India and China, the voyager has the choice of several routes, in the selection of which he must be guided by the season of the year, and the consequent direction of the monsoons. The explanation of these routes is, however, too complicated for the purpose of this work.

South of the Calms of Capricorn, according to Lieut. Maury, the westerly winds prevail with great regularity entirely around the globe; in the Pacific, especially, they blow almost with the steadiness of trade-winds. Vessels, therefore, that are bound from Europe and America to Australia, had better go by way of the Cape of Good Hope, and *return via* Cape Horn.

For the locality of many routes between various ports, which require no particular description, see Wind Map of the World.

XXII. *Recapitulation.*—It has thus been shown that a change in the temperature of the atmosphere is the principal cause of Winds, and that they may be classified as Constant, Periodical, and Variable; the Constant and Periodical Winds prevailing principally within the Tropics, and the Variable in the regions beyond the Tropics. It has been shown, also, that a knowledge of the locality and direction of the Winds is of vast importance in navigation.

Give examples to illustrate the importance to navigators of a knowledge of the locality and direction of the winds.—State some of the results of the observations conducted under the direction of Lieut. Maury.

What is the general rule to be observed in sailing from east to west, and from west to east?—Describe the course to be taken in the various routes enumerated in this chapter.—Recapitulate the subjects of this chapter.

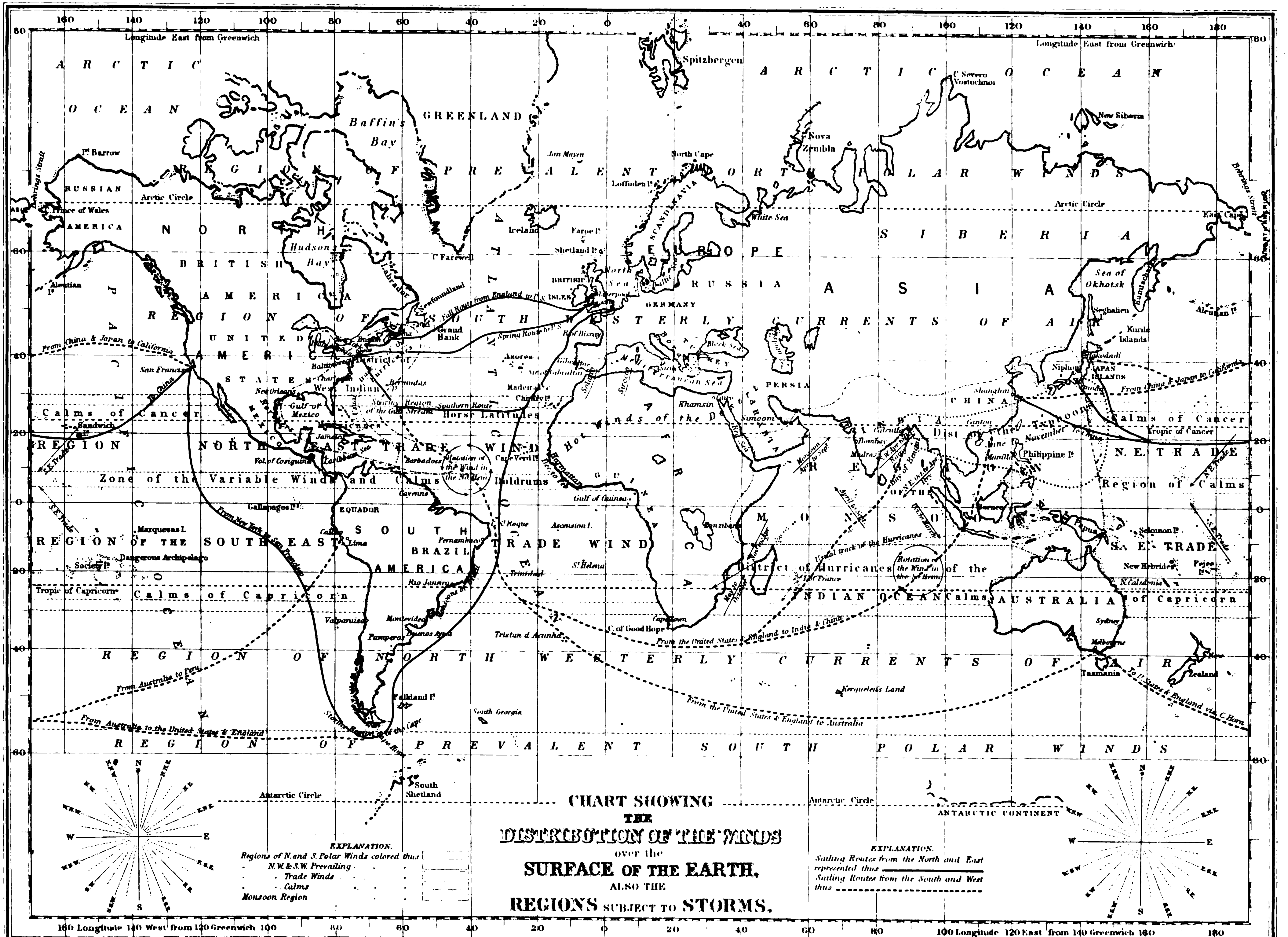


CHART SHOWING
THE
DISTRIBUTION OF THE WINDS
over the
SURFACE OF THE EARTH,
ALSO THE
REGIONS SUBJECT TO STORMS.
EXPLANATION.
Regions of N. and S. Polar Winds colored thus
N.W. & S.W. Prevailing
Trade Winds
Calms
Monsoon Region
EXPLANATION.
Sailing Routes from the North and East represented thus
Sailing Routes from the South and West thus
Engraved by E. Yeager

QUESTIONS ON THE WINDS.

Winds.

What is the principal cause of wind?—Explain the manner in which wind is produced. — In the case of a great conflagration, how would the air in its vicinity be affected? — State the proofs that winds at different elevations often blow in opposite directions.

Trade Winds.

Explain the origin of the trade-winds. — Why do they receive this name? — What is the resemblance between the origin of these winds and of the great ocean-currents? — What circumstance disturbs the regularity of the trade-winds?—Where are they the most regular and powerful: on land, or at sea?

What is generally the width of the trade-winds?—Are they constant in their locality? —Why? — Does the southern limit of the North-east Trades ever extend to the Equator? — At what season is its limit the farthest south? — Where do the North-east Trades commence in the Atlantic Ocean?

What is the farthest northern limit of the South-east Trade-winds? —At what season is it farthest north? — Where do they originate in the Atlantic Ocean?—What great mountain-chain interrupts their progress to the Pacific? — Why do the trade-winds extend farther north than south of the Equator?

Does any part of Europe lie within the limits of the trade-winds?— Does any part of South America?—Of the United States?—Are they felt in the Gulf of Mexico? — In the Caribbean Sea? — Do the Bermudas lie within their limits? — The Sandwich Islands? — The Society Islands? — St. Helena?

Land and Sea Breezes.

What is the cause of land and sea breezes? — In what regions are they most regular? — Are they felt in the interior of continents, or on the coast? — When does the sea-breeze blow: during the day, or at night?—Why?—What example is there of land and sea breezes in the United States?

Monsoons.

Where do the monsoons prevail? — What is the origin of the term? — During what season does the North-east Monsoon blow? — What is the cause of the South-west Monsoon? — In what months does the North-west Monsoon of Australia blow with regularity? — Are the monsoons as powerful as the trade-winds? — Of what service are they to navigation?

Are there any periodical winds on the coast of Brazil?—On the coast of Central America?—Why are the Northors of Texas and the Gulf of Mexico cold winds? — At what season do they blow? — Are they constant during that season? — Are they violent or gentle winds?

Variable Winds.

What are variable winds? — In what regions do variable winds prevail? — What is the prevailing direction of the variable winds in the North Temperate Zone? — Of the South Temperate? — State the cause of these winds. — Where and what are the Horse Latitudes? — The Calms of Capricorn?—What is the cause of these calms?

What is the mean direction of the winds in the Arctic regions of North America? — Describe the position and width of the zone of westerly winds in the Northern Hemisphere. — Is Europe included in this belt? — Are the United States?

Temperature and Moisture of Winds.

What is the character of winds which blow from the Desert of Sahara? — Which winds in winter would be the warmest for New Orleans: those from the north or from the south? — What is the origin of the Sirocco, Solano, and Harmattan?

Storm Winds.

What are the various names of tropical storms?—Describe the course of a hurricane or typhoon? — Are they most prevalent within or beyond the Tropics?—How can a mariner avoid a hurricane? — Suppose he is within the limits of one in the Indian Ocean, and finds the wind blowing from the north, which way from him is the centre of the storm?

In the Gulf Stream, off the coast of Florida, where must he look for the centre of the hurricane, when he finds the wind is south-west? — What three well-known hurricane regions are there? — What other noted regions of ocean storms? —Are hurricanes commonly as violent in the interior of continents as at sea?

Navigation.

To what circumstance are the quick passages of modern navigators in a great measure due?—Do the improved models of ships contribute to this advantage? — Describe the old route from England to India.— In the present route, what region of favorable winds does the navigator first endeavor to enter? — In what direction will they take him?

Why does he not sail directly across from Cape St. Roque to the Cape of Good Hope? — Why does he first pass inside of Trinidad? — In doubling the Cape of Good Hope, what current must he avoid?— What favorable wind will he find thence for India, from the middle of April to the middle of September? — What winds favor his passage from the Cape to Australia? — How will he return from Australia to England?

Which passage is generally the shortest: that from Liverpool to New York, or from New York to Liverpool?—Why?—What is the proportion of westerly winds on this route? — What is the average time for the passage from east to west? — From west to east? — In what time has the passage from west to east been accomplished?

In sailing from England to the northern ports of the United States, why do not the vessels make a direct course? — Does the westward passage deviate as far north in September as in March? — Why? — What favorable current is entered on the westward passage, near the Banks of Newfoundland? — What other route to the United States is there besides that usually pursued?

In the passage from our northern ports to San Francisco, what course does the vessel first take? — If she fails in going far enough to the east, what difficulty is she likely to encounter?—At what meridian may she double Cape St. Roque?—After passing Cape St. Roque, what is the next difficulty to be met? — After doubling Cape Horn, what course does the vessel pursue? — What would be the disadvantage in keeping close to the shores of South America all the way to San Francisco? — What winds does the ship take soon after crossing the Equator? — With these winds, what direction does the vessel take? — What other region of winds does she enter before reaching port?

What winds favor the passage from San Francisco to China? — Do the same winds favor the return? — Describe the return voyage.— Is the route from Australia to San Francisco direct? — Why is the passage from Australia to Liverpool or New York made *via* Cape Horn, rather than by the Cape of Good Hope? — Would the direct passage from Cayenne to the Cape Verd Islands have a favorable wind? — Would the return?

Select two ports between which a direct route can be easily made.— Describe four more such voyages.—Are the winds generally favorable for a direct passage from Philadelphia to Gibraltar?—From St. Helena to Pernambuco? — From Buenos Ayres to the Cape of Good Hope?— From Callao to the Society Islands? — Which is the shorter passage: from Pernambuco to the coast of Guinea, or the return?

What different regions of winds are crossed in the direct voyage from Cape Town to New York? — What belts of calms in the passage from New York to Rio Janeiro?—How do these calms affect the voyage?— In sailing from New York to Rio Janeiro, is it necessary first to sail eastward, as in the voyage to San Francisco?—Why?

In what months is the voyage from Zanzibar to Bombay most easily made? — When will a vessel most easily pass southward through the Mozambique Channel? — Can a vessel make a direct passage from Madras to Calcutta in June? — Is the passage in summer from Sicily to Cairo as short as the return? — Why?

In what time is the voyage sometimes made from the Atlantic ports to San Francisco?—In what region of winds is the passage made from the Canary Islands to Baltimore, Charleston, or New Orleans? — In what months would there be danger from typhoons in sailing from Manilla to Canton?—In what months would there be most danger from hurricanes in the West Indies?—In the Bay of Bengal?—The Indian Ocean?

CHAPTER IV.

MOISTURE OF THE ATMOSPHERE.

Dew, Fogs, Clouds, Rain, Snow, and Hail.

I. If a vessel be filled with water, and exposed to the open air, the quantity of the fluid will soon diminish, and after a time will entirely disappear. The stones wet by a summer shower, the plants covered by the morning dew, generally become dry soon after the sun has begun to shine upon them. In all these cases the water is evaporated — being converted by the heat into invisible vapor, and diffused through the air. So evaporation goes on from the oceans, lakes, rivers, and moist ground of the entire globe.

Since evaporation depends upon heat, it is apparent that it will be greatest in amount during the hottest season of the year and the warmest part of the day. It is apparent, also, for the same reason, that the quantity of vapor will decrease in proceeding from the Equator towards the Poles; and as water is less abundant in the interior of continents than in maritime regions, the amount of evaporation will diminish from the coast towards the interior, provided the temperature is the same.

The average annual evaporation in the Temperate Zones is estimated at from 36 to 37 inches. That of the Torrid Zone probably amounts to from 90 to 100 inches. The difference in the quantity of evaporation between hot and cold seasons is shown by the fact, that, in the vicinity of London, the amount in June was 3¾ inches, while that of January was less than half an inch.

II. The air is only capable of receiving a certain quantity of vapor. This capacity depends upon its temperature: increasing with heat, and decreasing with cold. When as much has been taken up as its temperature will permit it to receive, the air is said to be at the dew-point, or the point of saturation; and any farther supply floats in a state of cloud or mist, or is resolved into a fluid condition, and falls to the surface of the earth again. When, too, the atmosphere is saturated, the least decrease in its temperature is followed by the precipitation of moisture.

III. *Dew* is the moisture collected during the night, in the form of small drops of water, on the surface of plants and other bodies. Its deposit takes place on clear, still nights, when the surface of the bodies on which it collects is cooler than the dew-point of the surrounding atmosphere.

The explanation is simple. It has been already stated that the dew-point is that temperature of the atmosphere which will admit of no decrease without parting with some of its moisture. Most, perhaps all, bodies exposed to the open air after sunset, cool more rapidly than the atmosphere; when their temperature falls below the dew-point of the adjacent air, they condense its vapor into small drops of water, which are deposited on their surface.

If, on a warm summer day, a pitcher be filled with cold water, and permitted to stand for a short time, the outside of it will be covered with moisture, in the form of numerous small drops of water. This moisture is the vapor of the atmosphere which has been condensed by the cold surface of the pitcher, in precisely the same manner that dew-drops are condensed by plants and other bodies.

IV. Clear nights are most favorable to the collection of dew, because bodies cool much more rapidly on such nights than on cloudy ones. Gentle breezes facilitate its deposit, by bringing a greater portion of the atmosphere into contact with the cold bodies by which its vapor is condensed; while strong breezes utterly prevent this deposit, by not permitting the air to remain long enough in contact to be cooled below the dew-point.

Dew is most abundant in maritime countries, and in regions where the air contains a great amount of moisture. The average annual quantity throughout Great Britain is estimated at a depth of five inches. Within the Tropics, where the sky is clear, and the evaporation very great, the dew is so abundant that its effects are almost like that of a gentle shower of rain.

V. *Hoar-frost*, or White-frost, is frozen dew. When the objects by which the vapor is condensed are cooled below 32°, (the freezing point,) the vapor no longer appears in the form of drops of water, but in minute icicles, called Hoar-frost.

VI. *Mists*, or fogs, are masses of vapor resting upon or near the surface of the earth. They consist of an immense number of exceedingly small, hollow globules of water, and are formed when the air is saturated, and generally when the moist soil and bodies of water are warmer than the atmosphere; the vapors of the warmer air near the surface being condensed by the colder air above, and made visible.

In countries where the soil is moist and warm, and the air moist and cold, thick and frequent fogs may be expected. This is the case in England.

The dense fogs which prevail in the vicinity of the island of Newfoundland, are caused by the great difference between the temperature of the atmosphere and that of the warm waters of the Gulf Stream.

In some parts of the equinoctial regions, fogs sometimes continue during a considerable portion of the year. On the coast of Peru, in South America, they supply the place of rain, which is of very rare occurrence. Humboldt relates that Lima is often covered with a fog half the year, especially in the morning and evening.

VII. In Autumn, soon after sunset, on a fine, clear day, we frequently observe fogs hanging over the rivers and lakes, while the adjacent land is free from them. They are caused by the soil cooling more rapidly than the water. The atmosphere over the land becomes cooler than that over the water, and as the latter, being warmer, gently rises, the cooler air which presses in to take its place condenses the vapor of the warmer, and a fog ensues, confined to the expanse of water.

Fogs of an ordinary density are easily dispersed by a brisk wind, and quickly disappear before the rays of the morning sun. In the one case the air being kept in constant motion, and in the other its temperature being increased — both preventing the condensation of vapor.

VIII. *Clouds* are masses of visible vapor, differing in no respect from fogs, except in position. They are suspended at a considerable elevation in the atmosphere, instead of being confined to the surface of the earth.

Travellers, on the summit of high mountains, frequently speak of their view being intercepted by fogs below; while to the inhabitants in the valleys these fogs are clouds.

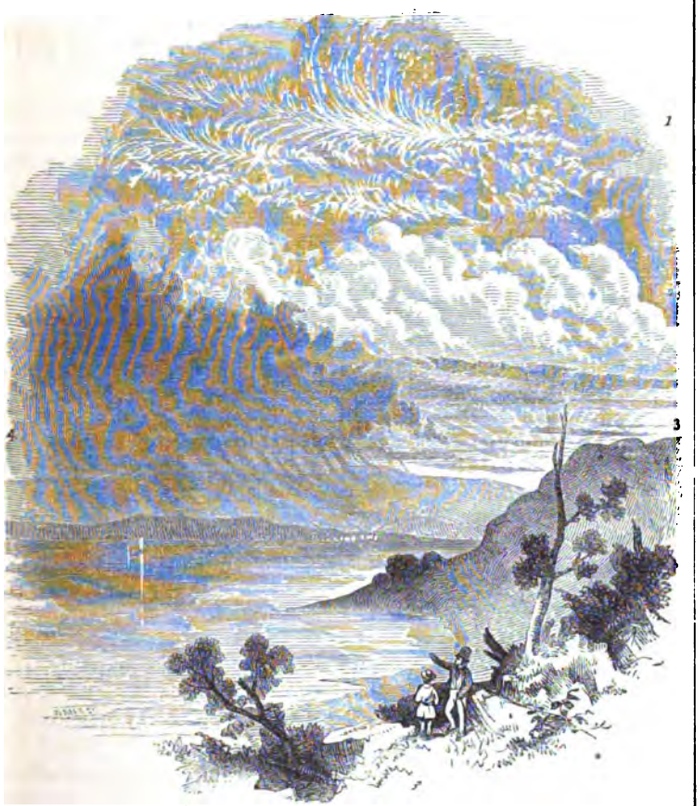
Clouds range from 150 feet to five miles in height: their average elevation being about two and a half miles. Though heavier than the atmosphere, they are supported by the ascending currents of heated air, and by the different winds — as soap-bubbles and dust are borne to great heights and distances.

What causes water to disappear if exposed to the open air? — On what does evaporation depend? — When and where will evaporation be greatest in amount? — On what does the capacity of the air to receive vapor depend? — What is Dew? — Explain the cause of dew.

State the circumstances most favourable to the deposit of dew. — What is Hoar-Frost? — What are Mists? — What is the cause of mists or fogs? — Where do fogs occur most frequently? — What are Clouds? — How do they differ from fogs? — How are they supported in the atmosphere?

IX. Clouds have been divided, according to their form, into three distinct classes:—

1. The *Cirrus* (also called the *Curl-cloud*, and by sailors the *Cat's tail*,) occupies the highest position in the atmosphere, and resembles a lock of hair, or a white feather. It is composed of thin, white threads, that frequently arrange themselves in parallel bands. Owing to their great elevation, they must consist of minute particles of ice, or flakes of snow. It is among these clouds that circles, called *halos*, are formed around the sun and moon. These clouds are supposed to indicate a change of weather, and last but a few hours, often but a few minutes. They are subject to the upper currents of wind.



1. Cirrus. 2. Cumulus. 3. Stratus. 4. Nimbus.

2. The *Cumulus* (heap or pile,) is usually seen in the form of a vast hemispherical heap of vapors, resting on a horizontal base. It may be called a *summer* cloud, most frequently occurring during that season, and resembling a mountain of snow, lighted up by the sun. It begins to form early in the morning, reaches its greatest magnitude in the hottest part of the day, and breaks up towards sunset.

3. The *Stratus* cloud consists of horizontal bands near the surface of the earth, and belongs to the night,—forming at sunset, and breaking up at sunrise.

4. The *Nimbus*, or rain-cloud, is much more dense and heavy than the others. It is fringed at the edges, and has a dull grey or leaden hue. Any of the other varieties of clouds may change to the Nimbus.

X. *Rain.*—As the quantity of vapor in the atmosphere increases, or a change in temperature causes its more rapid condensation, the clouds, growing more heavy, sink to a lower level; and the small globules of water, of which they are composed, becoming larger, form drops of rain, which, increasing in size, fall to the earth.

Into what three distinct classes are clouds divided?—Describe each of them.—What name is given to the rain-cloud?—What changes occur in the atmosphere to cause the fall of rain?—Why does less rain fall upon the top of a building than upon the ground?

The rain which falls to the ground is not all derived from the higher clouds which float in the atmosphere; but also from the lower regions, between them and the surface of the earth. Prof. Dove states that the yearly amount of rain which falls on the roof of the Royal Palace at Berlin, is 18 inches in depth; while that on the pavement below, amounts to 20 inches. The average annual fall of rain on the top of the Observatory at Paris, for ten years, from 1817 to 1827, was 19·88 inches; in the court, a hundred feet below, it was 22·21 inches.

XI. The distribution of rain is very unequal—the amount varying greatly between different places, and at different seasons of the year.

The quantity of rain falling in a single day in tropical regions is often immense. Thus, in Sierra Leone, on two successive days (the 22d and 23d of August, 1828), the fall was 26 inches; and at Cayenne, in French Guiana, Admiral Roussin collected 10 inches in 10 hours. On comparing several years, however, the annual amount of rain, like the annual amount of heat, is found to be remarkably uniform; long-continued droughts and excessive moisture being more the result of unequal distribution, than of any variation in the annual mean.

The absolute greatest annual fall of rain is reported as follows:—

Place.	Authority.	Inches.
Cherrapongi, British India, Tropical Asia.	Johnston's Physical Atlas (Folio Edition.)	610·3
Mahabaleshwar, British India, Tropical Asia.	Petermann.	303
San Luis de Maranham, Brazil, Tropical America.	Johnston's Physical Atlas, (Folio Edition.)	280
Matouba, Guadeloupe, West Indies.	Johnston's Physical Atlas, (Folio Edition.)	292
Sierra Leone, Tropical Africa.	Petermann.	313

XII. The following are general laws relative to the distribution of rain:—

1. It decreases in quantity from the Equator to the Poles, because heat, which is the origin of vapor and the cause of rain, decreases in the same direction.

The average annual fall of rain in the tropical regions of the Western Continent is stated in Johnston's Physical Atlas (Folio Edition), at 113 inches; that of the Eastern Continent, at 79·7 inches. The average annual quantity in the Temperate Zone of the Western Continent (United States), is stated on the same authority at 39 inches; that of the Eastern (Europe), at 34 inches.

Rainy days are more numerous in the Temperate Zones than in the Equatorial regions. Between the Tropics, during the dry season, weeks and frequently months pass without a drop of rain falling, or a cloud being seen; while in some places in the Temperate Zones, as the island of Sitka, on the north-west coast of North America, there have been years in which there were only forty days during which rain or snow did not fall.

2. The quantity of rain decreases as we recede from the coasts to the interior of a continent, because the land supplies less vapor than the sea.

The truth of this general law, though there are many exceptions to it, especially in the case of mountain chains, has been abundantly proved by many observations in Europe and the United States.

The western coasts of Great Britain, France, and Portugal, have an annual average of from 30 to 50 inches; Coimbra, in Portugal, has 111 inches of rain. In Poland and Russia, the fall is 15 inches; at Ekaterinburg, east of the Ural Mountains, it is 13 inches; and in the interior of Siberia, the amount is still less.

The annual number of rainy days also decreases with the increased distance from the sea. On the eastern coast of Ireland it rains 208 days in the year; at Irkoutsk, in Siberia, only 57 days.

Give examples to illustrate the amount of rain which falls in some tropical places.—State and illustrate the first general law with reference to the distribution of rain.—The second.

3. In the Temperate Zones of both hemispheres, more rain falls upon the western coasts than upon the eastern, because they are exposed to the prevailing westerly winds, which, passing over the ocean, are highly charged with moisture. Within the Tropics, on the contrary, the eastern coasts, especially those of the New World, are more moist than the western, because of their exposure to the trade-winds.

The average annual fall of rain on the west side of England is 45·5 inches; on the east side, 27·4 inches: on the west side of Ireland, 47·4 inches; on the east side, 29·7 inches.

4. More rain falls in mountainous than in level districts, because the mountains arrest the clouds, and their cold summits condense the vapors which these clouds contain. Much less rain, on the contrary, falls on elevated table-lands than on the low plains, because the mountain chains which usually form the boundaries of table-lands draw from the clouds the greater part of their moisture.

The average annual fall of rain among the mountain ranges of the British Islands is 40·59 inches; on the plains, 24·51 inches. The annual rain fall at Berne, at the foot of the Alps, is 43 inches; and on the Great St. Bernard, at an elevation of about 8000 feet, and the highest meteorological station in Europe, 63 inches.

High mountain ranges sometimes occasion an excess of moisture on one side of them. At Bergen, in Norway, west of the Scandinavian Mountains, the average annual rain fall is 82 inches; while at Stockholm, on the eastern side, it is only 21 inches. The clouds brought from the Atlantic by the prevailing south-west winds are arrested by the mountains, and nearly all the moisture is withdrawn from them. In like manner, the Sierra Nevada of the United States arrests the moist south-west winds of the Pacific, depriving them of nearly every particle of moisture; so that while California is abundantly watered, the Great Basin of Utah on the east, receiving but little rain, is mainly a barren desert.

The difference in the quantity of rain which falls on table-lands and low plains, is strikingly illustrated in the Spanish Peninsula. On the coasts of Spain and Portugal, the annual rain fall is from 25 to 35 inches; on the table-land of Spain, it is only 10 inches.

5. More rain falls in the Northern than in the Southern Hemisphere. Lieut. Maury assigns the following reason for this fact. The Southern Hemisphere contains three times as much water as the Northern; the amount of evaporation, therefore, in the former is much greater than in the latter. The South-east trade-wind bears away a much greater amount of moisture than the North-east. Where the two trade-winds meet, near the Equator, they rise into the higher regions of the atmosphere and cross each other, the South-east current proceeding to the north, and the North-east flowing to the south. When they afterwards descend to the surface, in the Temperate Zones, the South-east trade, being more moist, contributes a much greater amount of rain to the Northern Hemisphere, than the North-east to the Southern.

The average annual fall of rain in the Temperate Zone of the Northern Hemisphere, as stated by Johnston (Physical Atlas, Folio edition), is 37 inches; that of the Southern Hemisphere, 33 inches. It is evident, also, that more rain falls in the Northern than in the Southern Hemisphere, from the greater number and larger size of the rivers in the former than in the latter; if we except the La Plata, in South America, and the Orange and Zambeze, in South Africa, there is scarcely a river of any magnitude in the South Temperate Zone.

How does the quantity of rain which falls upon the western coasts of different countries compare with that which falls on the eastern?—How does the quantity which falls on mountains and table-lands compare with that which falls on the plains?—Give examples.—Why does more rain fall in the Northern than in the Southern Hemisphere?

XIII. The surface of the earth may be classified as comprising—1. Rainless Regions. 2. Regions of Periodical Rains. and 3. Regions of Frequent Rains.

1. *Rainless Regions.*—The rainless districts of the New World comprise a tract of country along the coast of Peru, and a part of Central America, Lower California, and the Table-land of Mexico. On the Eastern Continent, they consist of an enormous tract of country, 1200 miles wide, commencing in Africa near the Atlantic coast, and extending in a north-easterly direction, across the Red Sea nearly to the River Indus; and another tract nearly as large, lying north of the Himalaya Mountains, including the Table-land of Thibet, the Desert of Cobi, and a part of Mongolia.

The entire area of the rainless districts is estimated at six and a half millions of square miles. In some parts of them, not a drop of rain falls; and in others, it is only known at long intervals, and in very small quantities.

The rainless district of Northern Africa is a desert region, the intense heat arising from which disperses the clouds that the moist winds from the Atlantic and Mediterranean cause to blow over it—a decrease in temperature being always requisite to the fall of rain.

The rainless districts of Central Asia lie to the north of the Himalaya Mountains. This lofty range arrests the moist south-west winds which blow from the Indian Ocean, and draws from them nearly every particle of their moisture; so that, though the countries south of this range are among the most abundantly watered upon the globe, those north of it are barren deserts, on which scarcely a drop of rain falls.

The rainless district of Peru is situated in the region of the South-east trade-winds. These winds bear abundant moisture across the plains of South America to the foot of the Andes; climbing this high chain, their moisture is all precipitated on the eastern declivity, and on the coast of Peru they are cool and dry.

The fogs and copious dews, which prevail along the Peruvian coast, in a great degree compensate for the absence of rain. Occasional showers are, however, experienced; and thunder is sometimes heard, but so rarely, that such occurrences are noted as shocks of earthquakes are in the United States.

The quantity of rain in the centre of Australia, in the central part of Southern Africa, on the low plains of Patagonia, and in the western part of the United States between the Sierra Nevada and Rocky Mountains, is very limited; during some years, indeed, no rain falls.

2. *Periodical Rains* occur in the tropical regions, where seasons of excessive moisture are followed by months of entire absence of rain. The length of the rainy season varies in different districts, but generally lasts from three to five months. In some parts of these regions there are two rainy and two dry seasons annually.

Periodical rains follow the apparent course of the sun. From April to October, when the sun is in the Northern Hemisphere, they prevail north of the Equator; from October to April they prevail south of it. The trade-wind belts and region of calms advance with the sun to the north in summer, and recede with it towards the south in winter. The region of equatorial calms is one of almost constant precipitation; to all places, therefore, which it passes on its way from the north to the south, and from the south to the north, it brings abundant rains: and to all places which it passes twice during the year, it brings two rainy seasons.

More rain falls in a single month in the tropical regions than during the entire year in most parts of the Temperate Zone. There is a striking similarity in the character of these rainy days. The sun usually rises in a clear sky—a little before noon, clouds appear; and at noon the rain commences, frequently pouring in torrents for four or five hours: at sunset, the clouds disappear, the rain ceases, and not a drop falls during the night.

How may the surface of the earth be classified with reference to the quantity of rain that falls?—Which are the principal rainless districts?—Why does it not rain in Northern Africa?—In Central Asia?—On the coast of Peru?—Where do Periodical Rains occur?—Describe these rains.—What sections have two rainy seasons during the year?

In the countries bordering on the Indian Ocean, the fall of rain is dependent upon the monsoons, and not upon the change of seasons. The influence of the monsoons extends to the Himalaya Mountains, and far into the interior of China.

During the prevalence of the South-west Monsoon, from the middle of March to the middle of September, the western coasts of the peninsulas of Southern Asia are washed by abundant rains, and the eastern enjoy fine clear weather. When the North-east Monsoon blows, the eastern coasts of Southern Asia, Africa, and Madagascar are visited by rains, while the western coasts of the Asiatic Peninsulas are dry.

The western coasts of Patagonia and Chili are watered by heavy winter rains — the opposite coasts by light summer rains. Around Cape Horn the rain is almost perpetual: according to Johnston, 153·75 inches were collected here in forty-one days. In California, the rainy season is during the winter and spring. In Oregon, rain is most abundant in winter.

3. *Region of Frequent Rains.* — In countries beyond the Tropics, rain is not confined to any particular time of the day or season of the year.

In the region of Frequent Rains it does or may rain during every day of the year, and the rains are probably as common during the night as the day; whereas, within the Tropics, during many months, not a drop of rain falls, and even in the rainy season the nights are generally dry. The rain in this region is not always equally distributed throughout the entire year. Thus, in Southern Europe, more rain falls in winter than in summer.

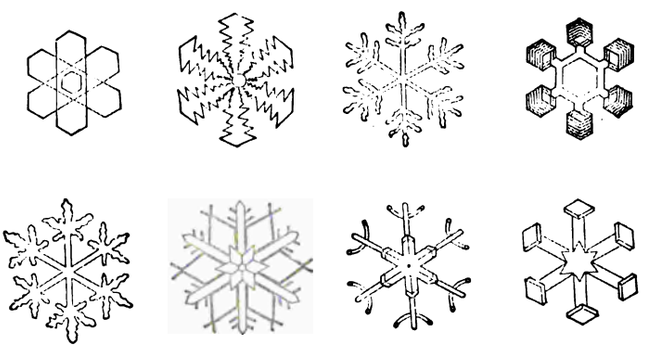
XIV. The annual rain fall of the entire globe is estimated by Johnston as follows: "Within the Tropics, the mean annual fall of rain is about 8·50 feet; in the Temperate Zones, 3·05 feet; and in the Frigid Zones, 1·25 feet."

A Snow Storm.

XV. Snow, which is the frozen vapor of the atmosphere, falls when the temperature of the air is at or below the freezing point. If the air near the surface is sufficiently cold, the snow reaches the earth; but if it is too warm, the snow melts near the surface, and descends in the form of rain, while at the same time it may be snowing at a greater elevation.

The colder the atmosphere, the less moisture it contains Snow, therefore, rarely falls on very cold days; neither is the quantity which falls on the summits of very high mountains, as the Himalaya and Andes, large, compared with that which descends to a lower level. The common expression, that it is "too cold to snow," is quite correct.

Flakes of snow, when collected on objects of a dark color, and examined are observed to be of a beautiful and regular form, similar to the annexed representations.



XVI. Snow never falls to the level of the sea between the Tropics; but from the Equator to the Poles, at different elevations, forms a permanent covering of the earth's surface.

The northern and southern limits of the fall of snow to the level of the sea, are indicated by lines on the rain-map of the world. It may be stated as a general law, that from the northern limit thus indicated towards the North Pole, and from the southern limit towards the South Pole, the quantity of snow, and the number of days on which it falls, increase.

The number of days in which snow falls in Europe increases in the following order from south to north: — Rome has one and one-half snowy days in each winter; Venice, five and one-half; Paris, twelve; Copenhagen, thirty; and St. Petersburgh, one hundred and seventy-one.

XVII. It has been already stated that the temperature decreases in ascending above the level of the sea. It is evident, therefore, that in all latitudes, and at all seasons of the year, a limit may be reached, above which the moisture precipitated will all fall in the form of snow, and constitute a permanent covering to the earth's surface: this limit is called the snow-line.

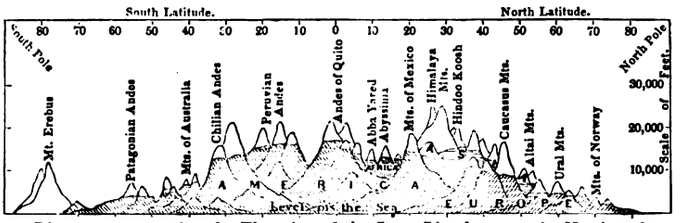


Diagram representing the Elevation of the Snow Line between the North and South Poles.

If we suppose a line representing the limit of perpetual snow to be drawn from the South to the North Pole, in the direction of the Andes and Rocky Mountains, we shall find that in the Polar regions it corresponds with the level of the sea; in the latitude of the Straits of Magellan, 53° South, it is 3700 feet above the level of the sea; in lat. 43° South, 6000 feet; lat. 33°, 14,700 feet; in lat. 15°, about 15,000 feet; and in the Andes, near Quito, 1° South, where it attains its greatest elevation, 18,300 feet: from this point it descends gradually towards the North Pole.

On what depends the fall of rain in countries bordering on the Indian Ocean? — Repeat Johnston's description of the difference in the fall of rain in the tropical regions, and regions beyond the Tropics. — What is Johnston's estimate of the annual rain fall of the entire globe?

Under what circumstances does snow fall? — Is it ever too cold to snow? — What portion of the earth's surface is permanently covered with snow? — State the number of days on which snow falls in some of the principal cities of Europe. — What is understood by the "snow line"?

The actual height of the snow-line is variously affected by local causes: such as the vicinity of the sea, the prevailing direction of the wind, and the amount of heat radiated from the adjacent table-lands. Thus, on the southern slope of the Himalaya Mountains, the snow-line is reached at the elevation of 12,982 feet; while farther north, on the northern slope of the same range, it rises to 16,630 feet. This is owing to the radiation of heat from the adjacent plains and plateaus of Thibet, and to the remarkable serenity of their atmosphere.

XVIII. *Glaciers.* — Intimately connected with the fields of perpetual snow, and dependent upon them for their origin, are Glaciers or Ice Rivers. They are found in all latitudes. In the Polar regions they form a permanent covering of the earth at the sea level; receding through the Temperate and warm Zones, their hold on the earth is found to depend on the elevation; until in the Equatorial regions, they are permanent only on the summits and in the valleys of high mountains, at an elevation of 15,000 or 16,000 feet.

View of a Glacier on the Northern Coast of Greenland. (Drawn by George G. White, from a Sketch by Dr. Kane.)

The principal localities of glaciers, besides the Polar regions, are, in America, the Andes of Chili and Patagonia; in Europe, Iceland, the Scandinavian Mountains, the Alps, the Pyrenees, and the Caucasus Mountains; in Asia, the Himalaya, Kuen Lün, and Altai Mountains; in Africa, the Atlas range. The extent of surface covered by glaciers has not been definitely ascertained. In the Alps alone there are 1500 square miles of ice, from 80 to 600 feet thick; ninety-five square miles of snow and ice clothe Mont Blanc. Some of the glaciers of the Alps are from 15 to 20 miles in length, and three miles in breadth. Dr. Kane, in his recent Arctic Expedition, discovered, on the northern coast of Greenland, an immense glacier 500 feet high, which he followed along the base for 80 miles.

XIX. Glaciers may be compared to the icicles which hang from the eaves of a snow-covered roof. As these icicles owe their origin to the melting of the snow upon the roof, so also the glaciers are caused by the melting of the snow which perpetually covers the mountain peaks above.

In elevated mountain valleys, glaciers are formed by the fall of snow, which is increased in amount by immense quantities precipitated from the adjacent mountain peaks. This mass is subjected to alternate freezing and thawing, until, in the progress of centuries, the valley becomes filled with a body of ice constituting the glacial formation.

XX. The ice of glaciers differs from pond or river ice, being less transparent and more porous. It is not formed in layers, but is a mixture of ice, snow, and water. The lower part of glaciers contains the most pure and solid ice. As seen through the numerous fissures, it has a green hue; at the bottom, a blue tinge; but the entire mass frequently exhibits every variety of blue.

The observations and experiments of many scientific men have demonstrated that glaciers have a regular descending motion, by which they are often pushed below the limit of perpetual snow. That of the Aar descends 1500 feet, and that of the Lower Grindelwald 5000 feet, below the snow-line. Thus reaching the warm cultivated grounds below, they are wasted by the increased temperature, and are of essential service in supplying water to the surrounding lands; they form also the sources of rivers.

Were the snow precipitated at once into the valleys, its sudden melting would overflow and devastate the surrounding countries; congealed in the form of glaciers, it is held suspended, and forms an unfailing supply of water during the protracted droughts of summer. The Rhone issues from the glacier of Mount Furca; and the Ganges flows at once a rapid stream, 40 yards broad, from a huge cave in the perpendicular front of a glacier.

Glaciers, by their enormous onward pressure, break off masses of rock from the sides and bottoms of their valley-courses, and carry along everything that is movable; forming large accumulations of earth and stones in front, and along their sides. These accumulations are called *moraines.*

XXI. Icebergs are huge masses of fresh-water ice, broken off by the waves from the glaciers in the Polar seas. They are of various dimensions, from a few yards to miles in circumference, rising hundreds of feet out of the water. They have the appearance of glittering chalk-cliffs, towering aloft in fantastic shapes, and presenting a most sublime spectacle.

Great numbers of icebergs are annually drifted by marine currents far into the Atlantic Ocean. As they slowly melt in its waves, they cool the water sensibly for 40 or 50 miles around, and lower the temperature of the air to such a degree that their approach is plainly perceived long before they come in sight. They are often encountered in such numbers that the sea is covered with them as far as the eye can reach. In the spring, the Arctic icebergs come within the routes of navigation, and occasion the loss of many vessels every year.

XXII. Avalanches are large masses of snow and ice which roll down the mountains, and sometimes cause fearful destruction. They destroy houses and villages, break down whole forests, and sometimes even interrupt the course of rivers.

In 1478, sixty soldiers, in the district of St. Gothard, in Switzerland, were destroyed by an avalanche. In 1595, the course of the River Rhine was so much interrupted by the fall of a great avalanche across it, that the water rose, and drowned many men and cattle.

XXIII. Hail is frozen rain. It is usually formed at a great height in the atmosphere, and appears to owe its origin to the sudden condensation of vapor, caused by the meeting of winds of different temperatures. Its fall is generally accompanied with thunder and lightning, and frequently occasions much damage. Hail-stones sometimes fall as large as hen's eggs.

XXIV. *Recapitulation.* — It thus appears that heat is the chief cause of all those conditions of the atmosphere which have been described in this chapter, viz.: Dew, Hoar-frost, Fogs, Clouds, Rain, Snow, Glaciers, Avalanches, Icebergs, and Hail. It is an important fact, that since the amount of heat which the globe annually receives from the sun is the same from year to year, the annual moisture caused by that heat is unvarying, notwithstanding local changes.

What are Glaciers? — State the principal localities in which they occur? — To what may they be compared? — How are they formed? — How does the ice of glaciers differ from other ice?

What are Icebergs? — In what ocean are they often found? — What is an avalanche? — What is Hail? — How is it formed? — Recapitulate the subjects of this chapter.


CHART OF THE DISTRIBUTION OF RAIN AND SNOW OVER THE SURFACE OF THE EARTH
EXPLANATION.
Regions of Frequent rains colored thus
Periodical
Constant
Rainless Regions
EXPLANATION.
The figures attached to the different places indicate the Mean Annual fall of rain in inches.
Longitude West from Greenwich
Longitude East from Greenwich
ARCTIC OCEAN
PACIFIC OCEAN
ATLANTIC OCEAN
INDIAN OCEAN
NORTHERN ZONE OF FREQUENT RAINS
Summer Rains
RAINLESS DISTRICT
Desert of Sahara
Persia and Cobi or Shamo
Zone of almost constant Rains accompanied by Thunder Storms
ZONE OF THE PERIODICAL RAINS
Within the Tropics one half of the Year is Wet and the other half Dry
Here rain seldom falls during the night
S.W. Monsoon April to Oct. Rainy
N.E. Oct. to April Dry
SOUTHERN ZONE OF FREQUENT RAINS
Beyond the Tropics N. and S. it does or may rain every day in the Year and rain falls as often during night as day
Southern limit of Snow at the level of the Sea in the Northern Hemisphere
Southern limit of the fall of Snow at the surface of the Sea in the Northern Hemisphere
Northern limit of the fall of snow at the surface of the Sea in the Southern Hemisphere
Arctic Circle
Tropic of Cancer
Tropic of Capricorn
Antarctic Circle
Sketch of a PART OF THE GLACIER OF CHAMOUNI
Glacier of Taculd
Mer du Glace
RAIN CHART OF INDIA
RAINLESS DISTRICT
BAY OF BENGAL
Engd by F. Yeager

QUESTIONS ON THE RAIN CHART.

Evaporation.

When is evaporation most rapid: in summer, or in winter?—Why?—Where is the greatest amount of evaporation: at sea, or on land?—On the coast of Iceland, or of Cuba?—In the Desert of Sahara, or in the Valley of the Amazon?—In the Polar Seas, or in the equatorial regions of the ocean?—Is there any evaporation from a surface of sand or stone?

Fogs.

What is the difference between fogs and clouds?—Why is England so foggy?—What is the cause of the continual fogs on the Banks of Newfoundland?—What region of South America is remarkable for its fogs?—Of what use are they in that country?

Rain.

How is rain produced?—Is the amount of rain dependent upon the amount of evaporation?—What similarity exists between the laws for the distribution of rain and of evaporation?—Why does the quantity of rain decrease from the Equator to the Poles?—What is the average annual fall of rain in the tropical parts of the Western Continent?—In the Temperate Zone of that continent?

Which has the most rain: the Valley of the Amazon, or of the Mississippi?—Why?—The Valleys of the Obi and Lena, or of the Ganges?—Why?—Southern Europe, or the Desert of Sahara?—Which Zone has the greatest number of rainy days: the Tropical, or the Temperate?

Which place has the most rain: Coimbra, or Warsaw?—Ekaterinburg, or Bergen?—London, or Irkoutsk?—Cape Town, or Fezzan?—Which place has the greatest number of rainy days: Irkoutsk, or Dublin?—State the reason for these differences.

Within the Tropics, which coast has the most rain: the eastern, or the western?—Why?—Which coast in the Temperate Zone has the most rain?—Why?—Which place then has the greatest annual fall of rain: Lima, or Pernambuco?—Liverpool, or London?

Where is the amount of rain the greatest: on the table-lands of Mexico, or on the eastern coast?—Why?—What is the average annual amount of rain in the mountains of Great Britain?—On the plains?—What is the difference between the amount of rain at Bergen and Stockholm?—Why?—How much rain falls on the coast of Spain and Portugal?—On the table-lands?—What is the cause of this difference?—Where is the greatest rain-fall: on the Great St. Bernard, or on the plains of England?—Why?

What is the average annual fall of rain in the Temperate Zone of the Northern Hemisphere?—In the Southern?—Explain the cause of this difference.—Do the number and size of rivers indicate the amount of rain in a country?—In which hemisphere are large rivers most numerous?

Which continent contains the most extensive tracts of rainless country?—Describe the locality and extent of all the rainless regions on the globe.—Is there ever any rain in those regions?—What is the cause of the absence of rain in Peru?—On the Desert of Sahara?—In Central Asia?—If the soil in the Valley of the Amazon were to be transformed into sand, what would be the result in regard to rain?

In tropical countries, does it rain all the time during the rainy season?—Does it rain at all during the dry season?—Would an excursion party from Pernambuco be likely to get caught in a shower in the month of June?—In December?—Suppose they should start out on some morning in January, and come home before eleven o'clock, A. M., would they escape the rain?—Suppose they should seek shelter until night, might they then return without being caught in the rain?

Are umbrellas often necessary at night in Havana?—In what months does it rain in Bombay?—What is the weather during these months in Madras and Calcutta?—What are the rainy months in Madagascar?—In Calcutta?—Does it rain in July in San Francisco?—What is the greatest recorded amount of rain for one year?—Where was this?

When is the rainy season in Havana?—In Panama?—Canton?—Is there any decided rainy season in Cincinnati?—In London?—In Washington?—Are the inhabitants of St. Louis liable to a shower at any season of the year?—Of Quebec?—Of Cayenne?—Of Madras?

Does it ever rain at Irkoutsk in January?—At Rio Janeiro?—At Vera Cruz?—At Canton?—At Cape Town?—At Moscow?—At New York?—In Greenland?—In the southern part of Patagonia?

What remarkable circumstance with regard to rain in the zone of equatorial calms?—What is there remarkable about the southern part of Patagonia in this respect?—At the rate recorded in the text, how many feet of rain would fall in Patagonia in the course of the year?—What is the mean annual fall in the Tropics?—In the Temperate Zones?—In the Frigid?—Which has the most rain: Europe, or the United States?—The Tropics of the Western or of the Eastern Continent?

If British America had a soil like that of the Desert of Sahara, would it ever receive any fall of rain?—Why?—Is any part of the United States within the region of Periodical Rains?—Of Europe?—By what circumstance are the rainy seasons of Southern Asia determined?

In sailing from St. Helena to Pernambuco, in the latter part of August, would the vessel encounter rain?—In sailing from St. Helena to Havana, at the same season?—In what months are the rainy seasons in Madras?—In Calcutta?—Are there as many rainy days in Boston as in Pernambuco?—Is there as much rain in the former as in the latter?—If a traveller should cross from Madras to Bombay in July, what difference in the weather would he find?—What kind of weather would he find if he should return in December?

Snow.

How does snow differ from rain?—What conditions of the atmosphere are necessary to the formation of snow?—Does snow often fall on very cold days?—Why is snow not as abundant upon the summits of lofty mountains as upon a lower level?—What is the snow-line?—Does it ever snow within the Tropics?—Does the snow ever reach the level of the sea within the Tropics?—Why?—Is the snow-line the same in all seasons of the year?

Does the snow-line rise, or fall, from the Equator to the Poles?—How high must the traveller ascend the Andes, in the latitude of the Straits of Magellan, in order to find snow?—In about the latitude of Valparaiso?—In that of Quito?—Why is the snow-line higher within the Tropics than elsewhere?—On which side of the Himalayas does the snow-line reach the lowest point?—Why?

Does it ever snow in Key West?—In Vera Cruz?—In Havana?—Would it be likely to snow upon Mount Kilimandjaro, at the height of 6000 feet?—Upon the Himalayas, at the same height?

Where does the snow-line descend nearest to the sea level: on the mountains of Abyssinia, or of Switzerland?—In the winter passage from New York to San Francisco, in what latitudes may the vessel encounter storms either of rain or snow?—Where does the ship escape from the possibility of a snow-storm?—In what part of the voyage is it likely to meet with almost constant rain?—Where, in winter, will they be exposed to almost constant snow-storms?—Are there ever any snow-storms in the Indian Ocean?

Icebergs and Sheet-ice.

Is there as much snow and ice, in the polar regions, in summer as in winter?—Are the snow and ice ever entirely gone in those regions?—Why?—In what season do the great fields of ice break up?—Whither do many of the icebergs drift?—Is the water which melts from an iceberg drinkable?—At what season do icebergs endanger navigation between the northern ports of the United States and Europe?

Miscellaneous.

Follow a traveller through the following journey: starting from Yakoutsk in January, and travelling overland to St. Petersburg—would he ride on wheels, or in a sleigh?—Would he cross the rivers in a boat, or in his sleigh?—Would the weather grow milder, or colder, as he approached St. Petersburg?

Crossing over to Bergen, what change in climate would he experience?—In what season would the voyage to New York be attended with the greatest danger from icebergs?—Escaping these perils, he arrives in New York in the middle of May: does he find the air drier, or more moist, than at Bergen?—He takes ship for Canton in June: describe the route, and the winds?—Sailing thence to the Sea of Okhotsk, he arrives in Yakoutsk in the middle of July: what change in the face of nature since his departure from home?

CHAPTER V.

CLIMATE.

I. THE word *Climate* signifies the condition of the atmosphere with regard to heat and cold, moisture or dryness, healthiness or unhealthiness.

Climate is chiefly dependent upon temperature, by which winds, and the amount of rain or snow are in a great measure determined. The purity of the atmosphere, or its mixture with noxious gases, the amount of electricity, and the clearness of the sky, are also important circumstances.

According to the laws of temperature, (see page 41,) it is evident that if the earth had everywhere a level surface, of similar character, either of land or water, so as to absorb and radiate heat equally, the decrease of the mean annual temperature from the Equator to the Poles would be uniform.

II. Numerous circumstances, however, disturb this uniformity, viz.: the irregular surface of the land, the vicinity of the sea, and the nature of the soil.

III. The most important diversities in the surface of the land, affecting climate, are the elevation of a country above the general surface, the slope of the land, and the position of the mountains and plains.

1. *Elevation above the General Surface.*—We have seen (page 42,) that the temperature of the atmosphere decreases according to the height above the level of the sea. This is owing to the fact that the air derives its heat chiefly from the warmed surface of the earth; the heat which is so radiated diminishes with the distance from the general surface, so that places situated far above the level of the sea, receive but a small part of the warmth thus imparted.

When, however, the elevated region is of great extent, as in the case of table-lands, the country has a radiation of its own, which raises the temperature much higher than that of an isolated mountain chain. We have seen the effect of this circumstance in the snow-line of the Himalaya Mountains, where the heat imparted to the northern slope by the table-lands of Thibet, raises the limits of perpetual snow higher upon the northern than upon the southern side.

For the same reason, the cities of Mexico, Quito, Popayan, and Bogota, situated on elevated plains, have a warmer climate than they would have at the same height, if on isolated mountains.

It is obvious that countries which are at different elevations, though in the same latitude, must have different climates; and that in the same country there may be great diversity of climate, according to the elevation of the surface. Hence, while the tropical valley or plain is oppressively hot, and may be loaded with luxuriant vegetation, the tropical mountain, rising a few thousand feet above it, is as cold in its higher regions, and as bare of vegetation, as any Polar island.

Thus, in Mexico, where there are low coasts, high table-lands, and mountains covered with perpetual snow, there are distinct and well-defined climatic districts:—

1. *Tierras Calientes.*—The hot regions, including the country of the east and west shores below the height of 2000 feet, where bananas, sugar, indigo, and cotton flourish luxuriantly. Mean temperature, about 77°.

2. *Tierras Templadas.*—The temperate regions, between the heights of 2000 and 5000 feet, where oaks, cypresses, tree ferns, and the grains of Europe and the United States are encountered. Mean temperature, from 68° to 70°.

3. *Tierras Frias.*—The cold regions, from 5000 to 8000 feet high, beyond which limit the climate soon becomes rigorous, fruit will not ripen, wheat and oaks disappear, and pines occur.

In Switzerland, the beautiful vegetation in the valleys and on the plains at the foot of the Alps,—the vineyards, orchards, forest-trees, and grains,—have for the most part disappeared at the height of 6500 feet.

2. *The Slope of the Land.*—Where the land is so inclined that the rays of the sun fall directly upon it, the heat is greatly increased. A familiar example of this fact is afforded by the superior fertility of a field which lies upon the south side of a hill. The opposite sides of valleys or mountains often present striking contrasts in the character of the vegetation.

3. *The Position of its Mountains and Plains.*—The articles on Winds and Rain exhibit the influence of wind in transferring the temperature and moisture of one region to another. Thus, the great plains of South America allow the moist winds from the Atlantic to sweep over the face of the country, softening the tropical heat, and imparting that character of humidity by which South America is distinguished. The Andes, however, by opposing the further progress of these winds, occasion the dryness and sterility which characterize a large part of the Pacific coast.

The low plains in the northern regions of both continents allow full sweep for the cold winds from the Poles; the southern shores of Europe are exposed to the winds which blow from the burning sands of Sahara; the southern peninsulas of Asia receive the warm winds from the Indian Ocean, while they are prevented from reaching Central Asia by the immense mountains and plateaus of that region. So, too, the Sierra Nevada cuts off the Great Basin of Utah from the south-west winds which bring warmth and moisture to the shores of California.

A change in the position of these mountains and plains would produce a complete alteration in the climate of the various countries. Were the mountains of Asia removed to the shores of the Arctic Ocean, we should no longer see those striking contrasts which now exist, between the bleak and barren plateaus of the interior, and the tropical peninsulas on the southern margin. The abundant moisture and luxuriant vegetation of South America would be in a great degree lost by the transfer of the Andes to the Atlantic coast.

IV. The vicinity of the sea is one of the most powerful influences in determining the climate of a country.

In the article on Temperature we have seen that those regions which are open to the influence of the ocean, partake of its moist and equable climate; while those which are removed from this influence are commonly dry, and subject to great excesses of heat and cold. Thus, places which have the same mean annual amount of heat may differ greatly in the nature of their climate.

Those regions which are near the sea may be said to have an oceanic climate; and those in the interior, a continental climate. Cool summers and mild winters are the conditions of the oceanic climates; while cold winters and hot summers characterize the continental.

In countries lying far to the north, the continental climate has a great advantage over the oceanic. Nova Zembla has the same mean annual temperature as Yakoutsk; nevertheless, this island is quite uninhabitable, and devoid of vegetation, on account of its cool summers: while at Yakoutsk, the hot, though short, summers ripen an abundant harvest of wheat and rye.

Many other instances might be stated, to show that the most inhospitable places on earth are not those in which the mean temperature is the lowest, but those in which the summer does not supply warmth sufficient for the growth of plants.

V. The nature of the soil must not be disregarded in considering the climate of a country. Barren sand is dry and hot, while marshy land, and ground covered with forests and rich vegetation, are cool and moist.

What does the word *Climate* signify?—Upon what is climate chiefly dependent?—State some of the circumstances which disturb the uniformity of climate.—Name the most important diversities in the surface of the land affecting climate.—Give illustrations of the effect of elevation above the general surface.

Give an illustration of the effect of the slope of the land upon the climate of a country.—What influence have the mountains and plains?—What do you understand by an Oceanic climate?—By a Continental climate?—Give examples of each of them.

"Any great abundance of water in a country, numerous lakes, swamps, marsh-lands, and extensive forests, in which the moisture of the air is retained, and gradually dissipated into the atmosphere by evaporation, exert, to some extent, the same influence as the sea, in mitigating the cold of winter, and in lowering in turn the heat of summer. By the draining of swamps, and the cutting down of forests, the escape of the water is hastened, and at the same time a greater extent of the ground is exposed to the immediate influence of the sun. This explains the gradual change in the climate of countries which have been inhabited for thousands of years. Thus, there can be no doubt that Egypt, if it were covered with forests, would have much more rain than it has at present, and a much milder climate."—*"Physics of the Earth," by Henry Buff.*

Mr. Buff confirms this opinion by stating that in Cairo and Alexandria, at the beginning of the present century, very little rain fell; but that "since that time the Pasha has had many millions of trees planted there, and now, it is stated that, in consequence of this, they have from thirty to forty rainy days in the year, and that in winter it often rains for five or six days together."

"It seems too," says this writer, "that the climate of Germany was formerly different, and more severe than at present. In the time of the Romans, Germany was covered with an almost unbroken forest. It abounded in swamps: its atmosphere was moist. Many plants, which require a high summer temperature, could not grow two thousand years ago in places where they are now thriving; since the clearing of the forests has favored the draining off of the water, and by the removal of the excess of moisture has improved the climate, and enhanced the fertility of the soil." In the time of the Romans, the reindeer and elk were numerous in Germany, though now confined to the more northern parts of Europe — an additional evidence of the former severity of the climate of Germany.

Yet the complete removal of its forests, by diminishing the moisture of a country, impairs its fertility. Some countries which formerly enjoyed a mild and genial climate, now suffer from drought, in consequence of the extirpation of the forests. It is, therefore, the duty of every State to make careful provision against their reckless destruction.

VII. The healthiness of a country is closely connected with the nature of the soil.

The sea-coast and low-lands of tropical countries are often extremely unhealthy for Europeans. The excessive heat and moisture produce a luxuriant vegetation, which decays and lies in a decomposed state upon the ground. The noxious gases thence arising, produce fevers which are so fatal to whites as to prove a barrier to the settlement of many extensive districts.

The eastern and western coasts of Africa have such pestilential airs that any extensive settlement by whites seems impossible; and this is one of the obstacles to European exploration in that country. The low lands on the Gulf of Mexico and the Caribbean Sea have a character almost as fatal. In building the Panama Railroad, the foreign laborers employed upon the work perished by hundreds. Yet the Pacific coast of Central America has a very agreeable and healthy climate.

VII. Comparative views of the climate of the two continents:

1. The Southern Hemisphere, from its greater proportion of water, has a more oceanic climate than the Northern.

2. Africa and South America are much warmer than North America, Asia, and Europe.

3. The Eastern Continent, as a whole, is drier than the Western.

4. South America has perhaps the most moist, and Africa the hottest, climate of all the Grand Divisions.

5. Of the three Northern Divisions, Asia has the most continental climate.

6. South America, owing to the influence of the sea, is much warmer than North America, in corresponding latitudes.

What effect upon the climate of a country has the nature of its soil? — What effect upon climate has the cutting down of the forests? — Give examples to illustrate the effects of the character of the soil upon the healthfulness of a country.

7. The neighborhood of the Arctic regions is much colder in North America than in Europe and Asia. The immense extent of ice which covers the numerous bays and inlets in the high latitudes of North America, and which often remains through the entire summer, accounts for this rigorous climate.

8. In the Northern Hemisphere, the eastern shores of both continents are colder and drier than the western. The superior warmth and moisture of Western Europe and the Pacific coast of North America are owing to the prevalence of south-westerly winds, which blow warm and moist upon the western shores. The Gulf Stream and Japan Current contribute very much to the mild and genial character of the climate.

VIII. *Isothermal Lines.*—To render the various irregularities of climate apparent to the eye, lines are drawn through all places which have nearly the same mean annual temperature. They are called *isothermal* lines (lines of equal heat).

An examination of the map will show that, in the Northern Hemisphere, the deviations of these lines from the parallels are sometimes 20° of latitude.

IX. The surface of the earth may be divided by the Isothermal lines into six Zones of climate, viz.: the Torrid, Hot, Warm, Temperate, Cold, and Frigid.

1. *The Torrid Zone.*—This Zone is bounded on both sides of the Isothermal Equator by the Isotherms of 80°. It comprises the hottest regions of the earth. Here are found the most luxuriant vegetation, the largest and most savage animals, and the most dangerous reptiles. The climate is generally moist and unhealthy.

2. *The Hot Zone.* — This region has many of the characteristics of the Torrid Zone, though it is marked by a greater variety; containing tracts of luxuriant vegetation and numerous extensive deserts. The climate is less humid and unhealthy, and man here attains a much higher civilization than in the Torrid Zone.

3. *The Warm Zone* includes the countries between the Isotherms of 70° and 60°. The climate of this favored region is such as to permit the growth of both tropical and temperate plants.

4. *The Temperate Zone.* — This Zone comprises but a small portion of the Southern Hemisphere; in the northern, however, it includes an extensive region. Though it does not exhibit the extraordinary size and vigor of animals and plants which are found within the Tropics, the Temperate Zone is the region in which are produced the most valuable articles of food. The climate is cool and bracing, though subject to great extremes. In this and in the Warm Zone, man, in all ages, has attained his highest civilization.

5. *The Cold Zone* is bounded on the north by the southern limit of perpetually frozen ground. This line corresponds generally to the northern limit of the cultivation of the bread plants. The winters here are very severe, though the summer days are often oppressively hot.

6. *The Frigid Zone* of the Northern Hemisphere includes all the land north of the southern limit of perpetually frozen ground. In the south, the continuous heat of the short summers thaws the upper surface, ripens a few of the most hardy grains, and permits the growth of trees. In the dreary tracts to the north, the ground is perpetually covered with ice and snow, and the only vegetation to be seen is a few mosses and lichens which are sometimes found in sheltered places.

X. *Recapitulation.* — It thus appears that climate is not dependent entirely upon latitude, and, therefore that the ordinary method of representing the extent of the different Zones, by the Tropics and Polar Circles, does not convey a correct idea of the climate of the regions thus bounded; and that Zones of climate are more correctly shown by Isothermal lines.

Give comparative views of the climate of the two continents.—What are Isothermal lines? — Into how many Zones of climate may the surface of the earth be divided? — Describe each of these Zones. — Recapitulate the subjects of this chapter.

QUESTIONS ON TEMPERATURE, CLIMATE, AND THE CLIMATIC CHART.

Temperature.

From what two sources does the globe derive its heat?—Upon which of these is the temperature of the *surface* dependent?—How far beneath the land surface does the sun affect its temperature?—How near to the surface is the effect of the internal fire perceived?—To what depth is the ground frozen in the polar regions?

At what distance beneath the surface at the Equator do we find the temperature invariable?—Where do you find the limit of invariable temperature in the Temperate Zones?

Is the ground in your own vicinity, two feet below the surface, warmer in summer than in winter?—Is the earth warmer at the depth of 500 feet than at the surface?—At Yakoutsk, is the surface warmer in summer than at the depth of 20 feet?—At the same place, is the soil at the surface colder in winter than at the depth of a mile?

In descending below the limit of invariable temperature, does the heat increase or diminish?—Why?—What is probably the condition of substances at the depth of 40 or 50 miles?—Is the temperature of the surface affected by the internal fire?—What becomes of the heat which the surface receives from the sun?—If it were all accumulated and retained beneath the surface, what would be the effect upon the atmosphere?

Does the temperature of the ocean vary with its depth?—Does it also vary with the latitude?—Is the change of temperature in the ocean uniform from the surface to the bottom?—Is the surface of the ocean warmer at the Equator than at Lat. 56°?—At Lat. 56° than at 70°?

Why has the sea a more equable temperature than the land?—What is the greatest difference of temperature at any one place in mid-ocean?—What is the greatest difference recorded on land?

Why are deep fresh-water lakes in the Arctic regions never frozen to the bottom?—How would their freezing injure the inhabitants of these countries?—Are any lakes ever frozen to the bottom?—Can fish live in such lakes?

How is the heat of the atmosphere produced?—Why is the air colder at the top of a mountain than at its base?—Why is the air warmer on an extensive table-land than on a single mountain at the same elevation?

Why is the temperature more uniform near the Equator than elsewhere?—What is the cause of the extremes of heat and cold in inland countries of the Temperate and Polar Zones?—Is the temperature of all places beyond the Tropics subject to extremes?—What circumstance produces uniformity in such places?

Are there any places in the tropical regions which have a temperate climate?—Can you find a cold climate near the Equator?—Is the temperature of a place affected by that of a neighboring region?

Climate.

What is understood by the word *Climate?*—Suppose the globe were everywhere covered with water, would the climate be more uniform than at present?—What are the chief causes in producing a diversity of climate?

Can there be any difference of climate between places in the same latitude?—Can you mention any instances of this kind?—What influence have winds upon the climate of a country?—Mention some examples.

What effect upon climate has the position of mountains and plains?—Name some instances of this influence.—How would the climate of Western Europe be affected by the presence of a great mountain chain upon its Atlantic coast?—Would the climate of the interior of the United States be more moist if the Gulf of Mexico were skirted by a chain of lofty mountains?—Suppose Central Asia to be low land, and the Himalayas to be removed, would the climate be warmer than at present?—Would there be less rain?—Would Canada be colder if a mountain chain skirted the shores of the Arctic?

What effect has the Desert of Sahara upon surrounding countries?—By what ocean current is the climate of the Aleutian Islands affected?—By what current is the climate of Chili modified?

What is the difference between the continental and the oceanic climate?—Is the harvest in Iceland likely to be as abundant as in Yakoutsk?—Why?—Is the winter of New England as cold on the coast as in the interior?—In summer, on our Atlantic coast, which wind is generally cooler, the east or the west?

What is the chief cause of an unhealthy climate in tropical countries?—What contrast do the opposite coasts of Panama present in this respect?—By what means has the climate of Germany been improved since the time of the Romans?—What effect is produced by the total destruction of forests?—What Grand Division has the most unhealthy coast?

Are the coasts of California, Bolivia, and Peru visited by warm and moist winds from the sea?—Why is Central Asia so dry?—What change in the outline or surface of the land would alter its climate?

Climatic Chart.

In which Hemisphere, the Northern or the Southern, are the Isothermal lines most irregular?—Why?—On which side of the Continents do the Isotherms run farthest north?—Why?—On which side of the Equator does the Isothermal equator chiefly lie?—Do places on the same Isothermal line have the same kind of climate?—Why?

What is the difference of temperature between Quito and Pernambuco?—Bogota and Caracas?—Guatemala and Kouka (Central Africa)?—What is the cause of these differences?—Mention four of the hottest places on the globe.

In following the Northern Isotherm of 70°, what islands, peninsulas, countries, and seas would you cross?—In following the Isothermal equator, how many degrees north of the true Equator would you go?—Where does the Isothermal equator cross the true Equator?—Near what cities would a traveller pass in following the Northern Isotherm of 40°?—What towns near the Southern Isotherm of 60°?

What cities on or near the Northern Isotherm of 60°?—What difference in temperature between Boston and St. Augustine?—Between Astoria and Panama?—Between Edinburgh and Madrid?—Between Archangel and Cape Town?—Between Cairo and Massuah (on the Red Sea)?—Between Caraccas and Valparaiso?

Name three of the coldest places on the map.—Name the warmest place on the map of South America.—Of North America.—Of Europe.—Of Asia.—Of Africa.—On the western coast of America.—On the eastern coast.

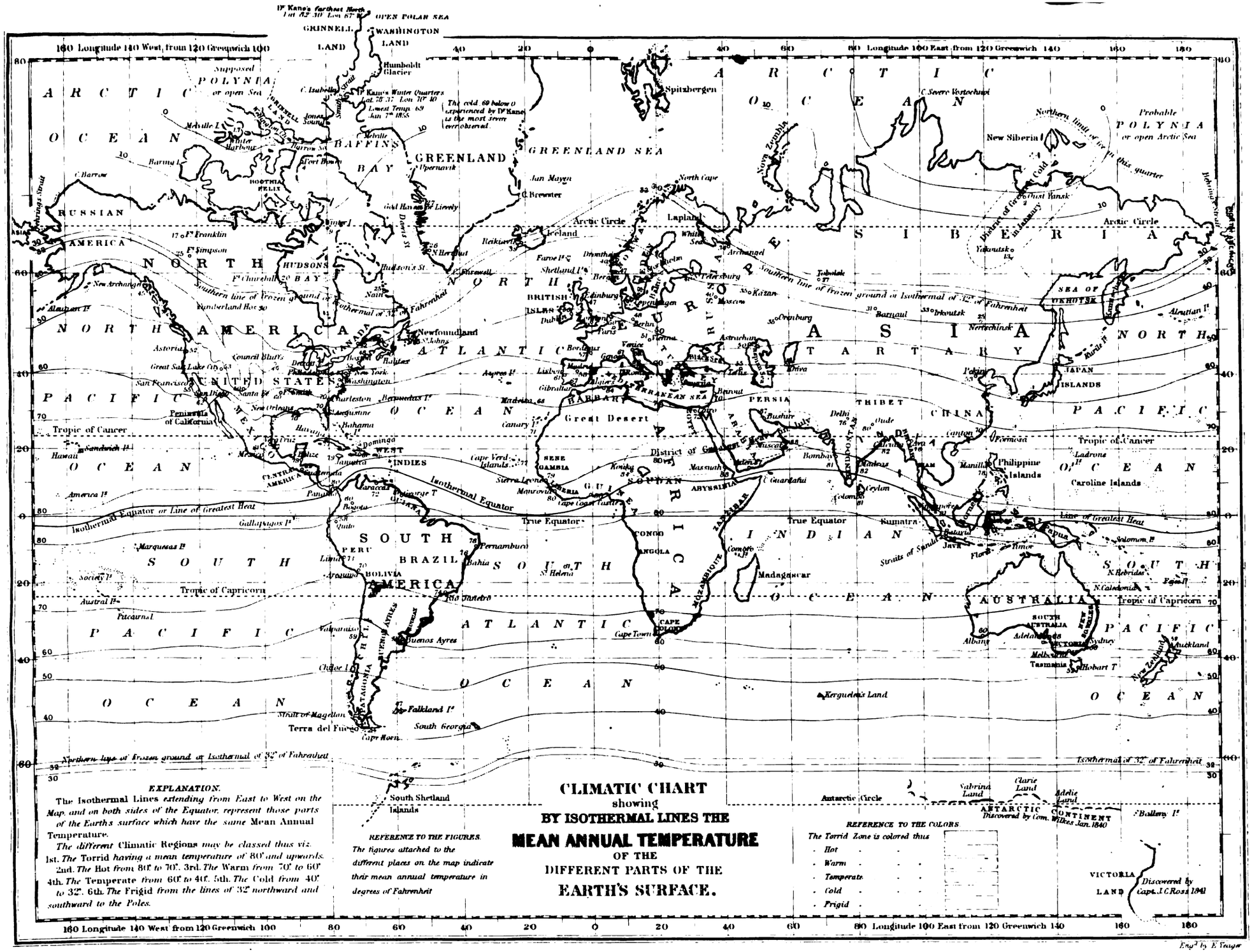
Which has the highest mean temperature, Boston or San Francisco?—Washington or San Francisco?—New York or Dublin?—Philadelphia or Cape Town?—Washington or Buenos Ayres?

Why is St. Petersburg colder than Bergen?—Astrachan than Drontheim?—Why is Cape Farewell, in Greenland, on the same Isotherm as North Cape?—Hobart Town and New York have the same mean temperature: which has probably the coldest winter?—Astrachan and Dublin are on nearly the same Isothermal lines: which is most subject to extremes of heat and cold?—Which has the hottest summer, Detroit or London?—Which has the hottest climate, Delhi or the Canary Islands?—Which is most liable to climatic extremes, Washington or San Francisco?—Which of our coasts has the most oceanic climate, the Atlantic or Pacific?

How many Zones of climate are there in South America?—In North America?—In Australia?—In Asia?—In Africa?—What Zones are best adapted for vegetable and animal growth?—What three Zones are best adapted for man's highest civilization?

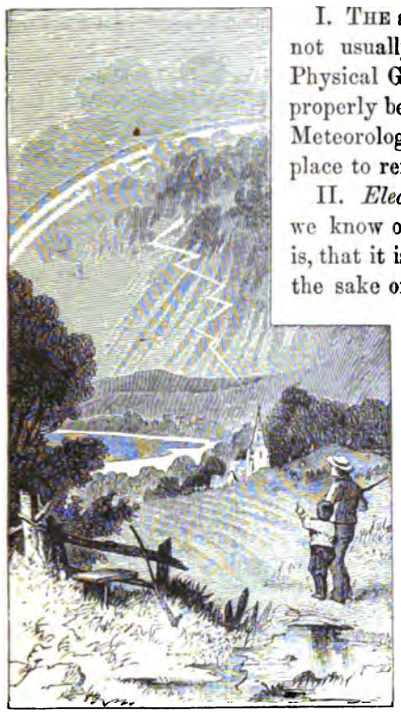
In what Zones do the United States lie?—The West Indies?—Europe?—In what Zone is Cincinnati?—Pernambuco?—Tefflis?—Ceylon?—Boston?—Moscow?—The Faroe Isles?—Cape Town?—Yakoutsk?—Do all places in the Torrid and Hot Zones have a tropical climate?—Why?

Is Havana in the same Zone of climate as Batavia?—Is Guiana in the same as Guinea?—Name six important places which are in the same Zone as the city of Mexico.—As Washington.—What part of South America is in the Temperate Zone?—What cities in South America are in the Torrid Zone?—In the Hot Zone?—Which Hemisphere, the Northern or Southern, contains all the Zones?—What is the coldest Zone in South America?—In Africa?—In Australia?—In Asia?—In the Antarctic Continent?—Is any part of Europe in the Frigid Zone?—What is the hottest Zone in Europe?—Is any part of North America in the Torrid Zone?—In the Hot Zone?


CLIMATIC CHART
showing
BY ISOTHERMAL LINES THE
MEAN ANNUAL TEMPERATURE
OF THE
DIFFERENT PARTS OF THE
EARTH'S SURFACE.
EXPLANATION.
The Isothermal Lines extending from East to West on the Map, and on both sides of the Equator, represent those parts of the Earth's surface which have the same Mean Annual Temperature.
The different Climatic Regions may be classed thus viz.
1st. The Torrid having a mean temperature of 80° and upwards.
2nd. The Hot from 80° to 70°. 3rd. The Warm from 70° to 60°
4th. The Temperate from 60° to 40°. 5th. The Cold from 40° to 32°. 6th. The Frigid from the lines of 32° northward and southward to the Poles.
REFERENCE TO THE FIGURES.
The figures attached to the different places on the map indicate their mean annual temperature in degrees of Fahrenheit
REFERENCE TO THE COLORS.
The Torrid Zone is colored thus
Hot
Warm
Temperate
Cold
Frigid
Northern line of Frozen ground or Isothermal of 32° of Fahrenheit
Isothermal of 32° of Fahrenheit
Isothermal Equator or Line of Greatest Heat
True Equator
Tropic of Cancer
Tropic of Capricorn
Arctic Circle
Antarctic Circle
ARCTIC OCEAN
NORTH AMERICA
EUROPE
ASIA
AFRICA
SOUTH AMERICA
AUSTRALIA
ATLANTIC OCEAN
PACIFIC OCEAN
INDIAN OCEAN
SOUTHERN OCEAN
GREENLAND
BAFFINS BAY
GREENLAND SEA
HUDSONS BAY
BRITISH ISLES
MEDITERRANEAN SEA
GREAT DESERT
SIBERIA
TARTARY
CHINA
INDIA
JAPAN ISLANDS
PHILIPPINE ISLANDS
CAROLINE ISLANDS
SEA OF OKHOTSK
VICTORIA LAND
ANTARCTIC CONTINENT
Discovered by Com. Wilkes Jan. 1840
Discovered by Capts. J.C. Ross 1841
Engd by E. Yeager

CHAPTER VI.

ELECTRICAL AND OPTICAL PHENOMENA.



I. The subjects of this chapter are not usually treated in works upon Physical Geography; yet, since they properly belong to the department of Meteorology, it will not be out of place to refer to them in this manual.

II. *Electrical Phenomena.* — All we know of the nature of electricity is, that it is a mighty force, called, for the sake of convenience, a fluid. It appears to exist in every substance in nature, in both solid and fluid bodies, and may be roused from its repose by a variety of causes, such as friction, heat, and chemical action; but we are totally ignorant of the reason why these causes excite it. When thus roused, it becomes visible, often displays tremendous power, and sometimes produces the most destructive effects. There are two kinds of electricity: the *positive* and the *negative*.

Two bodies, charged with different kinds of electricity — one with positive, the other with negative — have an attraction for each other. When two bodies thus differently electrified are brought into each other's vicinity, if they are highly charged, the one imparts a portion of its electricity to the other, and receives from it in return an equal quantity of the opposite kind. This interchange is effected with immense rapidity, causing a flash and explosion.

There is a certain class of substances through which electricity passes with great facility: such as metals, water, trees, plants, and the human body. These are therefore styled *conductors*. Through other substances, as glass, silk, and the atmosphere, its passage is more difficult. The latter are called *non-conductors*. The atmosphere, especially when it is dry, is one of the most complete non-conductors known.

III. *Thunder and Lightning.*—If two clouds, differently electrified, approach within a certain distance of each other, their electricity begins to accumulate on the sides nearest each other. When this accumulation has become sufficiently intense to overcome the resistance of the non-conducting atmosphere between, an interchange takes place; in the flash and explosion which follows, we have the phenomena of thunder and lightning. The same interchange frequently takes place between a cloud and the earth, in which case the lightning passes upwards and downwards.

Thunder is caused by the violent displacement of the air produced by the passage of the lightning, and its rush back again into the partial vacuum created. The lightning is perceived first, because sound travels slower than light. The loudest thunder can scarcely be heard at the distance of ten miles; and is less intense, therefore, than the report from a piece of heavy artillery.

What do we know of Electricity? — How many and what kinds of Electricity are there? — What do you understand by conductors? — By non-conductors? — What is the cause of thunder and lightning?

IV. There are three kinds of lightning: the zig-zag or chain, sheet, and globular.

The rapidity of the movement of a flash of lightning condenses the air immediately in advance of its path, so that great resistance is offered to its further progress in that direction; hence the lightning darts from side to side. This is called *zig-zag lightning*.

Sheet lightning, the most common form, is an expanded flash, illuminating whole clouds, so as distinctly to show their entire outline.

Globular lightning, or balls of fire, have been often seen. Mr. Chalmers states that on Nov. 4th, 1749, on board the ship Montague, he observed a ball of blue fire, as large as a mill-stone, rolling along on the surface of the water, at about three miles distance. When it had come within forty yards of the ship, the ball rose perpendicularly, with a fearful explosion, and shattered the main top-mast to pieces.

Heat lightning (lightning without thunder,) is to be attributed to the moist state of the air which favors its conductibility, occasioning very frequent but weak discharges. This lightning is sometimes attributed to the reflection of storms below the horizon. The color of lightning is orange, white, or blue.

Lightning, in its course, follows the best conductors, attaching itself principally to metals, and after metals to damp substances; but inferior conductors may be chosen which present to the fluid the most direct route to the earth. Hence, objects raised above the surface, whether good or bad conductors, are peculiarly exposed to the stroke of lightning: as church-steeples, houses, trees, (especially solitary ones,) the masts of ships, animals in the midst of a plain, and men on high points of land. Other circumstances being equal, there is of course greater safety on a non-conducting than on a good conducting surface.

Some particular objects seem to be especially liable to strokes of lightning. St. Mark's tower, at Venice, is an example. It has been struck nine times, and once entirely consumed; but in 1766 a lightning-conductor was put up, which has since protected it.

Dr. Franklin's Experiments with Electricity.

V. *Lightning Rods.* — Dr. Franklin, who first discovered that lightning and electricity were the same, also invented the means of averting its destructive power.

How many kinds of lightning are there? — What are their names? — What causes zig-zag lightning? — Sheet lightning? — Globular lightning? — What is heat lightning? — Who invented lightning-rods?

Metallic rods are attached to the building, slightly projecting above it, and in direct communication with the ground. As they offer an easier passage to the fluid than is presented by the materials of the building, the lightning passes harmlessly to the earth. A good lightning-rod will protect a circle having a diameter of sixty feet.

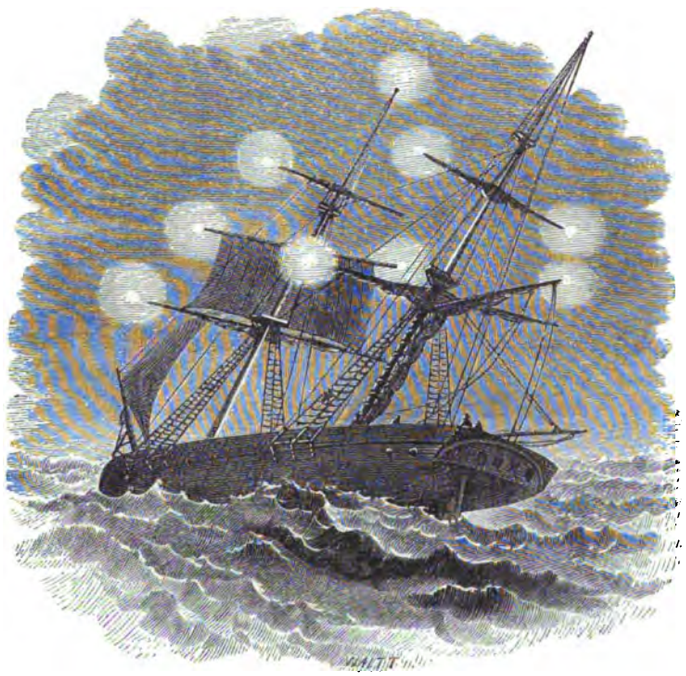
VI. The quantity of electricity in the atmosphere diminishes, like heat and light, from the Equator to the Poles. It increases with the distance from the surface of the earth.

Hence, it is within the Tropics that thunder-storms are the most frequent and violent. The coast-line of Peru, however, where thunder and lightning never occur, is a remarkable exception.

The thunder-storms become fewer and less violent as we recede from the Tropics, and, in some places in the Polar latitudes, are entirely unknown. At the Faroe Islands, thunder is seldom heard, and lightning is never known to do any injury.

VII. There is a class of quite harmless phenomena caused by a strong degree of electricity. When the air is highly charged with electricity, as in storms of snow and rain, it sometimes becomes visible in the form of pale-colored flames, quivering on the points of non-conductors or of insulated conductors.

A phenomenon of this kind was witnessed by Mr. Henry Ware, of Cambridge, Massachusetts. Returning home at 11 o'clock at night, across Cambridge bridge, his attention was attracted by a loud hissing noise from the lamp-posts. On raising his hand to the rim of his hat, he felt sharp pricks on his forehead, accompanied by discharges of electric sparks. On examining the lamp-posts, he saw electric sparks streaming from every point, to the distance of three or four inches. The sound was distinctly heard across the bridge, which is forty feet wide. It was snowing fast at the time.



St. Elmo's Fire.

Mariner's Light, or St. Elmo's Fire, often remarked by the ancients, is a phenomenon of this description, usually reckoned by sailors a fortunate omen. It was noticed during the voyages of Columbus and Magellan. M. Forbin thus describes its appearance, as observed by him in 1696:—

"The sky was suddenly covered with thick clouds. Fearing a gale, I had all the sails reefed. There were more than thirty St. Elmo's Fires on the ship; one of them occupied the vane of the mainmast, and was about nineteen inches long. I sent a sailor to fetch it. When he was aloft, he heard a noise like that which is made when moist gunpowder is burned. I ordered him to take off the vane; he had scarcely executed this order, when the fire quitted it, and placed itself at the top of the mainmast, whence it could not possibly be removed."

Admiral Smyth describes one observed by him in 1807, while on board the frigate Cornwallis, in the Bay of Panama, of such brilliancy "that they could see each other's faces on deck."

VIII. The Aurora Borealis, or Northern Light, is a flickering light of varying intensity, seen at night streaming up from the north towards the zenith, often illuminating the whole northern heavens with brilliant, variously-colored shooting flames.

This phenomenon is doubtless owing to atmospheric electricity, which, at great heights, becomes luminous. During the occurrence of an Aurora electrical action upon the wires of the telegraph has been observed.

The Northern Lights, to us merely an object of curiosity and fascination, are of great practical utility to the natives of high latitudes, relieving their dreary winter night, and compensating for the long absence of the sun.

IX. *Optical Phenomena* are those singular appearances which are sometimes produced by Light in its passage through the atmosphere. Optics is the science of light and vision.

Sir Isaac Newton discovered that light is a compound of several different colors. He admitted a sunbeam into a dark chamber, through a hole in the shutter, in which he inserted a *prism* (a three-sided solid piece of glass); the light which shone through this glass consisted of seven different colors. Sir David Brewster has since proved the seven colors to result from three primary rays: the red, the yellow, and the blue.

That endless variety and combination of tints displayed by the sky, the flowers of the fields, the rich hues of the autumnal woods, and the gorgeous plumage of tropical birds — in short, the colors of all objects, arise from their varying capacity of absorbing or reflecting certain rays. The reflection of all the rays causes white, and the absorption of all produces black.

X. Optical phenomena are due to the reflection of light, to its separation into the primary colors, and to its refraction.

The refraction of the rays of light is the bending or distortion from a straight line, which they undergo in passing through a dense medium — as in water, or when the sun is near the horizon.

XI. *The Rainbow.* — When vapor has been condensed into fluid drops of water, and the spectator has his face to the showery cloud, with the sun shining at his back, he sees the glorious vision of the Rainbow. A ray of light, on entering a rain-drop, is separated into its primitive colors, as if by a prism, and is then reflected from the rear side of the drop.

When the rain is copious, and the sun is shining brightly, a second bow appears outside of the first, but fainter, and with the order of the colors inverted. This secondary bow is produced by reflection from the first. The spray of a cataract, and the shower of an artificial fountain, often exhibit the phenomenon of the rainbow.

When the sun is near the horizon, the bow forms a perfect semi-circle to an observer on the plain; but the greater the height of the sun above the horizon, the smaller is the proportion of a circle presented by the rainbow. In our latitude, no rainbow is visible during the middle of the day in summer.

Lunar rainbows are sometimes seen, though they are of rare occurrence, on account of the feebleness of the moon's light. They are commonly white, or of a yellowish hue.

Does the quantity of Electricity increase or decrease from the Equator to the Poles? —Where do the most thunder-storms occur, at the Equator or in the Polar Latitudes? — Describe the Mariner's Light. — What is the cause of it? — Describe the Aurora Borealis. — What is the cause of this phenomenon?

Where are the Northern Lights most brilliant? — What are Optical Phenomena? — What was Sir Isaac Newton's discovery with reference to Light?—What did Sir David Brewster prove?—To what are Optical Phenomena due?—What do you understand by the refraction of light? — How is the Rainbow formed? — What is a Lunar Rainbow?

XII. *Halos*, *Coronæ*, or *Glories*, are colored circles sometimes seen around the sun and moon. They are owing to the inflection or bending of the rays of light by the globules of vapor with which the atmosphere is charged. When these circles are small and clearly marked, it is because the atmosphere is overcharged with moisture; hence, there is truth in the common remark, that "a dense halo portends rain."

XIII. Mock-suns (*Parhelia*,) and Mock-moons (*Paraselenæ*,) are quite common in the Arctic regions, where minute crystals of ice and snow float in the air, and reflect the image of the sun and moon. Captain Parry, during his winter sojourn at Melville Island, saw one that continued from noon till six o'clock in the evening.

XIV. In certain conditions of the atmosphere, strange illusions occur with regard to objects upon the surface of the earth.

The *mirage* (delusive appearance of water,) common in the plains of Asia and Africa, on the edge of the horizon, is a well-known instance. When the weather is calm, and the ground is highly heated, the landscape at a distance assumes the appearance of a pure transparent lake. So perfect is the illusion, that the traveller, oppressed with heat and thirst, is deceived into the hope of speedy refreshment.

"On one occasion," says Admiral Smyth, in his work upon the Mediterranean Sea, "the illusion which I witnessed was so perfect, that it was with difficulty I could persuade my companion, whose extreme thirst made him long to reach the water, that the supposed lake was receding from us as we advanced; until our amused Arab guides pointed to another Saráb formed in the space over which we had ridden."

Saráb (vapor of the desert,) is the Arabic term for what we call *mirage*. With the Arabians it is a common emblem of deceit. Mahomet says: "The actions of the unbelievers are like the *Saráb* of the plain; he who is thirsty takes it for water, and finds it to be nothing."

This phenomenon is caused by the difference in density of the layers of air near the ground, by which the rays of the sun are unequally refracted. When the sun has heated the sandy plains, and, by radiation, the air above them, the clear blue sky is reflected, and appears like an extensive sheet of water, in which the eminences and objects around seem inverted.

XV. The most remarkable effect of irregular refraction recorded, is the celebrated *Fata Morgana* of the Straits of Messina.

It is said to occur in calm, sultry weather, when the tides are at their highest. At such times, multiplied images of all the objects existing on the two lines of coast — as castles, arches, towers, houses, trees, animals, and mountains — are presented in the air with wonderful precision and magnificence.

XVI. Strange figures in the air, which were once regarded as real supernatural beings, are produced by natural objects, enlarged and distorted by peculiar reflection. The vision of troops of horses and armies, marching and counter-marching in cloud-land, has been caused by some animals pasturing on an opposite height, or travellers quietly pursuing their journey.

As two travellers were standing on the summit of Ben Lomond, in Scotland, watching the sun set in the west, the attention of one of the party was arrested by the appearance of two gigantic figures pictured on a cloud in the east, apparently standing on an enormous pedestal. He pointed out the phenomenon to his companion, and immediately one of the figures was observed to strike the other on the shoulder, and point towards them. They waved their hats, and the shadowy figures made a similar movement, faithfully imitating every gesture. The spectacle continued about a quarter of an hour.

What are Halos? — By what other names are they known? — Where are Mock-suns and Mock-moons most common? — What is understood by Mirage? — Repeat Admiral Smyth's description of the delusion. — What is the Arabic term for Mirage?

XVII. When the state of the air is favorable to extraordinary refraction, the distance to which the spectator may see is greatly enlarged, and objects are magnified as if seen through a telescope.

Mountains, unseen before, are brought within the range of visibility; and low coasts assume a bold and precipitous outline. The chain of the Himalaya has been transiently beheld from a point in the plains of Bengal, from which it had never been seen before.

XVIII. In the Polar regions, it is very common for extraordinary and unequal refraction to play fantastic tricks with terrestrial objects.

Captain Scoresby gives the following details: — "June 19, 1822, the sun was very hot, and the coast suddenly appeared to come fourteen or eighteen miles nearer. Above distant ships their own image was seen inverted and magnified; in some cases, it was very high above the ship, and then it was always smaller than the original. The image of a ship that was itself below the horizon, was seen for several minutes. A ship was even surmounted by two ships, one in the right position, the other inverted. Some days later, the most curious phenomenon was to see the inverted and perfectly distinct image of a ship that was below our horizon. We had before observed similar appearances; but the peculiarity of this was the distinctness of the image, and the great distance of the ship it represented. Its outline was so well marked, that on looking at this image through a telescope, I distinguished the details of the rigging, and recognised it as my father's ship. When we afterwards compared our log-books, we saw that we were then thirty miles apart, far beyond the limits of distinct vision."

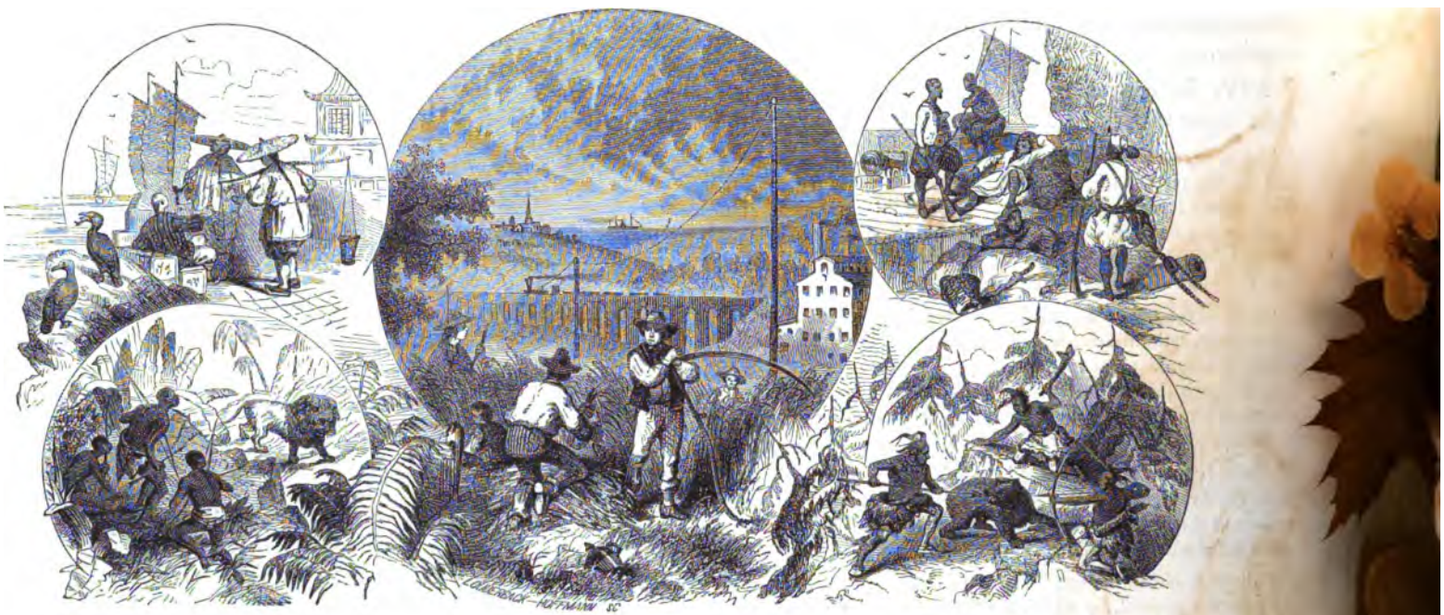
Ignis Fatuus.

XIX. The Ignis Fatuus, or Will-o'-the-wisp, is a wandering meteor, peculiar to places where putrefaction and decomposition are going on. It appears in battle-fields and marsh lands, with a flickering, unsteady motion, a few feet above the ground, and speedily vanishing. It is thought to be caused by gases arising from decayed animal or vegetable matter.

Describe the Fata Morgana. — Give illustrations of the effect of Mirage in various parts of the world. — Repeat Captain Scoresby's description of the spectacle seen by him in the Polar regions. — What is the Ignis Fatuus? — By what is it caused?

PART IV.

ORGANIC LIFE.



Organic Life is that department of Physical Geography which treats of vegetable and animal life. The subject may be considered under the three general divisions of Botanical Geography, Zoological Geography, and Ethnography.

Plants and animals exist in the bosom of the ocean as well as on land. They live in the extremes of heat and cold, in the Polar and Equatorial regions. They occupy the summits of the loftiest mountains, and the dark vaults of caverns, far below the surface of the earth. No part of the globe is known to be entirely destitute of animal and vegetable life.

CHAPTER I.

BOTANICAL GEOGRAPHY.

I. Botanical Geography treats of the different divisions of the vegetable kingdom, and their geographical distribution.

The entire number of different species of plants known to botanists exceeds one hundred thousand; and as large regions of the earth have not yet been explored, the whole number upon the globe is undoubtedly much greater.

The number of species decreases from the Equator towards the Poles. Thus, in Spitzbergen, the botanists compute that there are not above thirty species; while in Jamaica there are about four thousand. The number also decreases from the level of the sea upwards.

II. Vegetable forms are divided into two great classes: the *Cryptogamous* (flowerless) plants, and the *Phœnogamous* (flowering) plants.

The plants which have no flowers, properly so called, comprise the mosses, lichens, fungi, ferns, and sea-weeds.

The Phœnogamous plants comprise two divisions: the Endogenous (increasing from within), and Exogenous (increasing from without). Endogenous plants have stems increasing from within, as the numerous grasses, lilies, and the palm family. Indian corn and the sugar-cane are Endogenous plants. Exogenous plants increase by coatings from without, as trees, where the growth of each year forms a circle of wood around the pith or

Under what three divisions may the subject of Organic Life be considered?—Of what does Botanical Geography treat?—What is the entire known number of plants?

Into what two great classes are vegetable forms divided?—What are Cryptogamous plants?—Phœnogamous plants?—How are the latter divided?—Describe each of them.

centre of the stem. This class is the most perfect in its organization, and by far the most numerous — including the trees of the forest, and most flowering shrubs and herbs.

III. The Exogens furnish examples of gigantic size and great age. The Adansonia, or Baobab, of Senegal, Africa, though attaining no great height, rarely more than fifty feet, has a trunk sometimes thirty-four feet in diameter. The mammoth trees of California, eighty or ninety in number, occupy a solitary district containing an area of about 200 acres. Some of them are more than 300 feet high, and 100 feet in circumference. Twenty-one feet in height of the bark from the lower part of the trunk of one of these huge trees, was arranged in its natural form in San Francisco for exhibition. It formed a spacious room in which was placed a piano, and seats for forty persons.

The Banian Tree.

The Banian Tree of India sends out shoots from its horizontal branches, which, reaching the ground, take root and form new stems, till a single tree multiplies almost to a forest. A Banian tree, near the River Nerbuddah in India, is described as covering an area 2000 feet in circumference. It has 350 large and more than 3000 small stems, and an army of 7000 men has rested beneath its shade.

M. Adanson estimated the age of the Baobab which he saw in Senegal, to be 5150 years. One of the mammoth trees of California, above described, is supposed to be over 2000 years old. A Yew tree at Fountain's Abbey, Yorkshire, England, is known to be more than 700 years old; its existence in 1133 being an historical fact.

IV. Vegetation is most luxuriant in tropical countries. There an abundance of moisture combines with light and heat to produce trees of an enormous size, flowers of the most brilliant colors, and climbing plants in great number and variety; all of which combined present so dense a mass of vegetation as to be almost impenetrable, even to the explorer who advances with axe in hand.

Give illustrations of the size and age of some Exogenous plants. — Describe the vegetation of tropical countries. — Give examples of the vegetation of tropical countries.

The Fan Palm, an East India species, has leaves in the form of an umbrella, eighteen feet across. Humboldt describes a plant growing on the banks of the River Magdalena, the helmet-shaped flowers of which are of such dimensions as to serve the children for hats. The magnificent lily, *Victoria Regia*, a native of Guiana, and successfully cultivated in hot-houses in the United States, has leaves from five to six feet, and a flower fifteen inches in diameter. These are specimens of the vegetation of the Torrid Zone

V. Proceeding from the Equator, tropical plants disappear and new forms of vegetation mark the change from a hot to a temperate climate. Bright green meadows, abounding with tender herbs, succeed to the tall rigid grasses which form the impenetrable jungle. Instead of the towering ever-green forests, trees which cast their leaves in winter, as the oak, maple, and beech, appear. Here the cereal grains and the vine come to their highest perfection.

The vine is less affected by a cold winter than by a cool summer. In Europe, the northern limit of its successful cultivation on the west coast of France is Latitude 47° 30′; but in Germany, where the summers are warm, and the winters colder than on the coast of France, it is cultivated as far north as Lat. 52° 30′. In the United States, the southern limit of its successful cultivation is Lat. 32°; the northern, on the Atlantic coast, Lat. 42°; on the Pacific, Lat. 46°.

VI. Receding further from the Equator, magnificent forests of the fir and pine tribe prevail: as in Canada, the northern part of the United States, Central Russia, and the countries bordering on the southern shores of the Baltic. Some of the grains cannot be cultivated there, and several trees common to the Temperate Zone are no longer found. Gradually, as higher latitudes are approached, the trees dwindle to mere dwarfs, and finally all wooded vegetation disappears.

A Pine Forest.

The northern limit of the forests is a line running along the extreme north of the Eastern Continent, and extending in the Western, from Hudson's Bay,

What change occurs in vegetation proceeding from the Equator? — State the limits of the cultivation of the vine. — What change is noticed in the vegetation receding further from the Equator?

Lat. 60°, to Behring's Strait, crossing the Mackenzie River at Lat 68°. The dwarf birch, a mere bush, is the last tree found on drawing near the eternal snow of the North Pole. Near Hammerfest, Lat. 70° 40′, the most northern town in Europe, it grows in sheltered hollows between the mountains, to about the height of a man; and its branches, trailing on the ground, form a shelter for the ptarmigan, a bird of the grouse family, which inhabits the most northern districts.

VII. In the Polar Zones, some low flowering annuals, as saxifrages, gentians, and chick-weeds, flourish during the brief but hot summer; a few perennials, never rising higher than four or five inches from the ground, also accommodate themselves to this rigorous climate. At last, no development of vegetable life is seen, except lichens and the microscopic forms that cover the snow.

The extreme northern regions of America produce a species of lichen, to which the name of *tripe de roche* has been given. This lichen is much esteemed by the Canadian hunters and voyageurs as an article of food. Various species of fungi, which are highly injurious, if not absolutely poisonous, in temperate regions, appear to lose their pernicious qualities in cold climates, where they are even eagerly sought as articles of food.

VIII. Thus distinct vegetable regions are observed from the Equator to the Poles, defined by the Isothermal lines, and not by the parallels of Latitude. Similar changes mark the ascent above the level of the sea, the height of the elevation corresponding to distance from the Equator, in its effects upon vegetation.

This change of vegetation is most strikingly exhibited by isolated mountains. The Peak of Teneriffe, Lat. 28°, is an example. This mountain is divided by Von Buch into five botanical districts:—

1. *The region from the level of the sea to a height of* 1248 *feet.*—Here Palm trees, the sugar-cane, the banana, and other plants similar to those of the fertile level districts of the same latitude in Africa, are found.

2. *The region from the height of* 1248 *to* 2748 *feet.*—Here grow the vine, wheat, olive, and the fruit trees of Europe.

3. *From* 2748 *to* 4350 *feet.*—This is known as the region of laurels. Many evergreens and a species of oak characterize its vegetation.

4. *From* 4350 *to* 6270 *feet.*—This is the region of pines. The vegetation is similar to that of the regions near the northern limit of trees.

5. *From* 6270 *to* 11,061 *feet.*—Here are found a species of broom, and some low flowering plants, which furnish food to the goats that run wild on the mountain. Above this elevation there are only a few lichens and mosses, and the summit is entirely destitute of vegetation.

IX. All plants appear to have been created in certain specific localities; from which they have been diffused by the action of nature, or transported by man to regions remote from their original station.

Some plants appear to be confined to their original locality, which is often a very limited area. Thus, the Cedar of Lebanon, of sacred fame, appears to be restricted in its growth to the mountains of Syria. The beautiful flower, *Disa Grandiflora*, is limited to a spot on the Table Mountain, in South Africa. A species of Marjorum was discovered in 1700, on a rock in the little island of Amorgo, one of the Grecian Archipelago. It was observed eighty years afterwards on the same rock, but has never been found elsewhere.

Some plants are confined entirely to one continent. Thus, there are upwards of 300 species of heath spread over the Eastern Continent, from the Cape of Good Hope to a high northern latitude; while the Western does not produce a single native specimen. The New World contains many families, the Cactus, for example, which are not found in nature in the Old.

The principal natural agents in the diffusion of plants are the winds, the currents of the ocean, rivers, and many animals. Seeds are borne by these agents from their natural locality to other sections of the globe, where the plant takes root, and becomes established in regions sometimes thousands of miles from its native home.

What is the northern limit of forests?—State the character of the vegetation of the Polar Zones.—What changes mark the ascent above the level of the sea?—What are the principal natural agents in the diffusion of plants?

X. Providence has so endowed those plants which are of most value to man as articles of food or of luxury, that their cultivation in various climates and on different soils may be widely extended. Such plants have been transported by man to regions very distant from those in which they were originally found.

Wheat, rye, oats, and rice were brought from the Old World to the New. Most of the finer fruit trees, as the apple, pear, peach, fig, cherry, and orange, were introduced into Europe from Western Asia by the Romans, whence they have been brought to the United States. A variety of the plum (the damson or damascene,) was obtained from the vicinity of Damascus. The name of the damask rose indicates the importation of that beautiful flower from the same quarter.

In return for these gifts, the New World has supplied the Old with tobacco, Indian corn, and the potato; the two latter of which now furnish sustenance to many millions of human beings.

XI. The principal food-plants of the Torrid and Hot Zones are Rice, Bananas, Bread-fruit, Dates, Cocoa-nuts, Yams, Cassava, and Sago.

1. Rice is the chief food of perhaps one-third of the human race; and requiring for its successful cultivation a considerable amount of heat and abundance of moisture, is principally produced within the Tropics. It is extensively cultivated, however, in countries beyond the Tropics. Its native country is unknown, but was probably Southern Asia. It was introduced into America by Columbus in 1493. In such estimation is this grain held in Asiatic countries, that on some of the natives of India being told none was produced in Great Britain, they spoke of the inhabitants as objects of pity, wondering how they could possibly exist without rice.

Banana Trees.

2. Bananas and Plantains are now cultivated in the tropical regions of both hemispheres. There are many varieties of these plants, requiring different degrees of temperature for ripening their fruit. Humboldt estimated that a given space of ground, planted with the banana, would yield one hundred and thirty-three times as much nutritive substance as a similar extent of wheat.

With what peculiar properties has Providence endowed most food-plants?—Give illustrations of the diffusion of some of these plants.—Which are the principal food-plants of the Torrid and Hot Zones?—Where is Rice grown?—Bananas?

3. The Bread-fruit tree grows to the height of forty feet. It has leaves resembling those of the fig, and bears large fruit, which, when cooked, is said to taste like wheaten bread. This tree yields fresh fruit for eight or nine months in the year, and during the rest of the time, the fruit is prepared like dough, and bread baked from it is eaten. It is estimated that three trees are sufficient to feed one human being. This tree does not appear to thrive beyond the Tropics, nor where there is a difference of more than 10° or 12° between the temperature of the summer and the winter.

The Date-Palm Tree.

4. *Dates.*—The fruit of the Date-palm is the most important article of food in most parts of Northern Africa. The tree is a native of this region, and grows in such abundance between the Atlas range and the Great Desert, that the Arabs name the country *Beled-el-jerid* (land of dates). Dates are cultivated to some extent in the Warm Zone of Southern Europe and Southwestern Asia, though they are principally produced in the Hot Zone.

5. *Cocoa Nuts.* — The Cocoa-nut palm, which produces this well-known fruit, is abundant in the West Indies and the tropical islands of the Indian and Pacific Oceans. The trunk of this tree furnishes wood; the fruit yields the kernel, oil, and milk; the shell is used for household utensils; cloth is manufactured from the fibres which surround the shell; and houses are thatched with the leaves. Both the date and cocoa-nut palm trees grow in Florida; neither of them, however, bearing fruit.

6. *Yams.*—These roots resemble the potato, and are cultivated in a similar manner. They are sometimes of immense size, growing to the length of two or three feet, and often weighing thirty pounds. They are much used for food in Africa, and in the East and West Indies.

7. *Cassava.*—The meal prepared by washing and bruising the root of the Mandioc, a shrub which grows in Brazil, Congo, and Guinea, is called Cassava, and is much used in those countries for food. In its natural state this plant is poisonous, but its deleterious qualities disappear with heat. Tapioca is prepared from Cassava.

8. *Sago* is the pith of several species of palm trees, which form entire forests in many of the Spice Islands. The ease with which the natives may supply themselves with food, where Sago grows wild in the woods, is thus stated in Schouw's "Earth, Plants, and Man": — "When the native has satisfied himself, by boring a hole in the trunk, that the pith is ripe, the trunk is cut down and divided into several pieces; the pith is scraped out, mixed with water, and strained — and there is Sago-meal perfectly ready for use. A tree commonly yields 300 pounds, and may afford 500 or 600 pounds. Thus, a man goes into the woods and cuts his bread, as we hew our firewood."

Where does the Bread-fruit tree grow? — Describe it. — What name is given to the country south of the Atlas Mountains?—Why?—State the uses to which the Cocoa-nut tree is applied?—What are Yams?—What is Cassava?—Repeat Schouw's statement.

XII. The principal food-plants of the Warm and Temperate Zones are Wheat, Rye, Oats, Barley, and Potatoes. Indian Corn is an important bread-plant of these Zones, but is also cultivated in tropical regions.

1. *Wheat* is cultivated throughout the greater part of the Warm and Temperate Zones. We have no certain knowledge of its native country, but it is generally supposed to have been Tartary or Persia. The first wheat sown in North America consisted of a few grains accidentally found by a slave of Cortez, among the rice taken for the support of the army.

2. *Rye, Barley,* and *Oats* have a further northern limit, and endure a more rigorous climate than wheat. Barley is found as far north in Lapland as Lat. 70°. Oats was formerly the principal grain of Northern Europe. At a later period, rye displaced it. Now, wheat is rapidly taking the place of rye; and wheaten bread, formerly regarded as a luxury, and seen only upon the tables of the rich, is a common article of food for other classes.

3. *Potatoes.* — The potato is supposed to be a native plant of Peru and Chili, where it still exists in a wild state. Its culture now extends, according to Humboldt, from the extremity of Africa to Lapland. In the Hot and Torrid Zones, however, like other plants peculiar to the temperate regions, it is only found at an elevation where the climate corresponds with that of the Temperate Zones. It has a more northern limit than barley, being cultivated in Iceland, where no grains are grown.

4. *Indian Corn* (also called *Maize,*) is principally cultivated in the Temperate and Warm Zones, but it is grown in the tropical regions. Like the potato, it is a native plant of America; and, like that also, it has been widely diffused throughout the different parts of the earth. In South America it was grown, though with great difficulty, around the Inca's Temple of the Sun, on an island in Lake Titicaca, 12,795 feet above the level of the sea, to furnish a sacrifice to the Sun-god, and that the corn grown there might be distributed throughout the nation; a single kernel raised near the temple being regarded as a noble and fortune-bringing object.

XIII. The climate of some large tracts of land upon the globe is such that no bread-plants can be cultivated. In these countries, bread must be obtained from more favored lands, or animal food substituted. Thus, dried fish forms the chief substitute for bread among the inhabitants of the northern parts of Siberia and America.

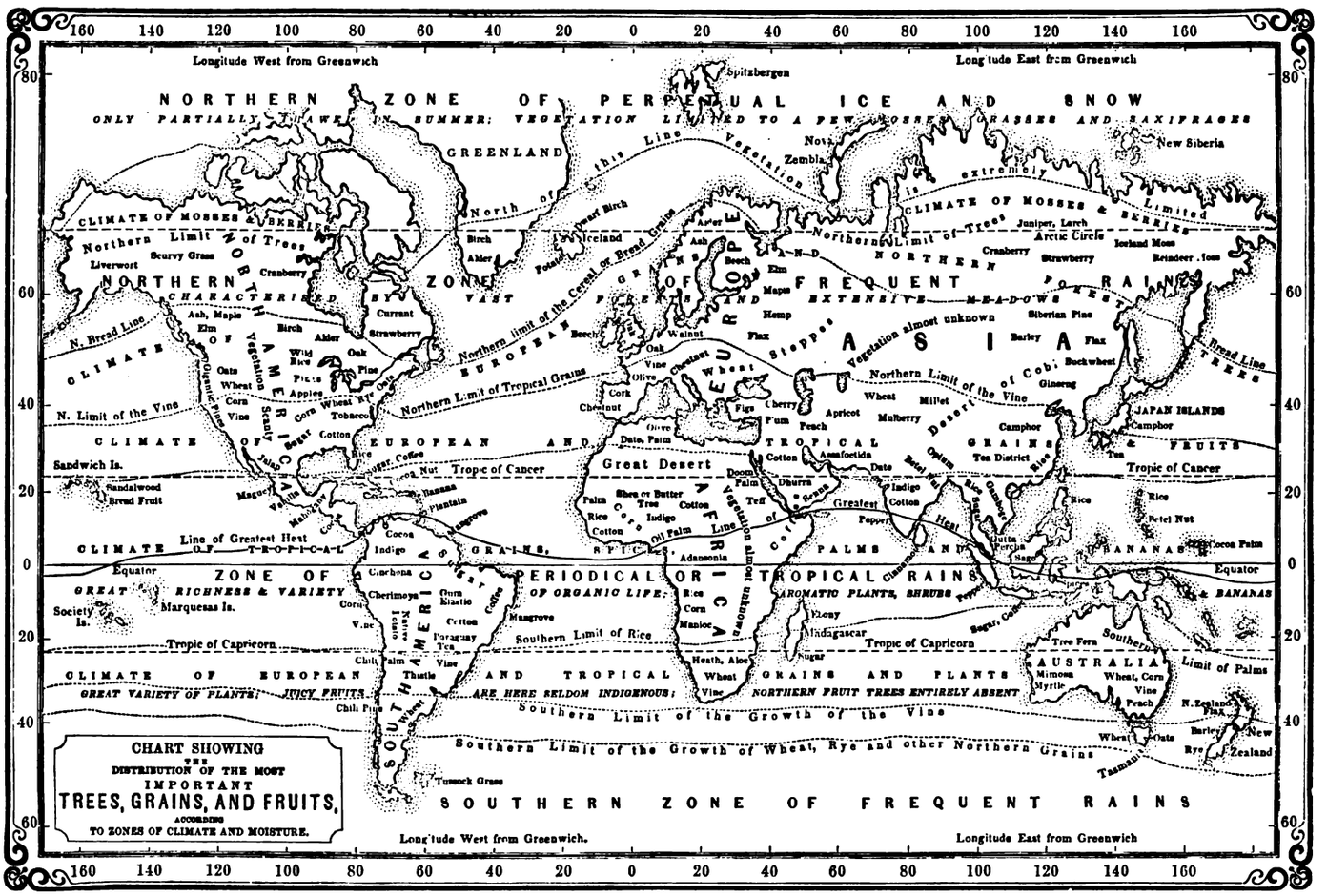
If we imagine a line drawn, separating these regions from the bread countries, it may be called the "*Bread line.*" It is represented on the map (page 64), and corresponds very nearly with the Isotherm of 32°.

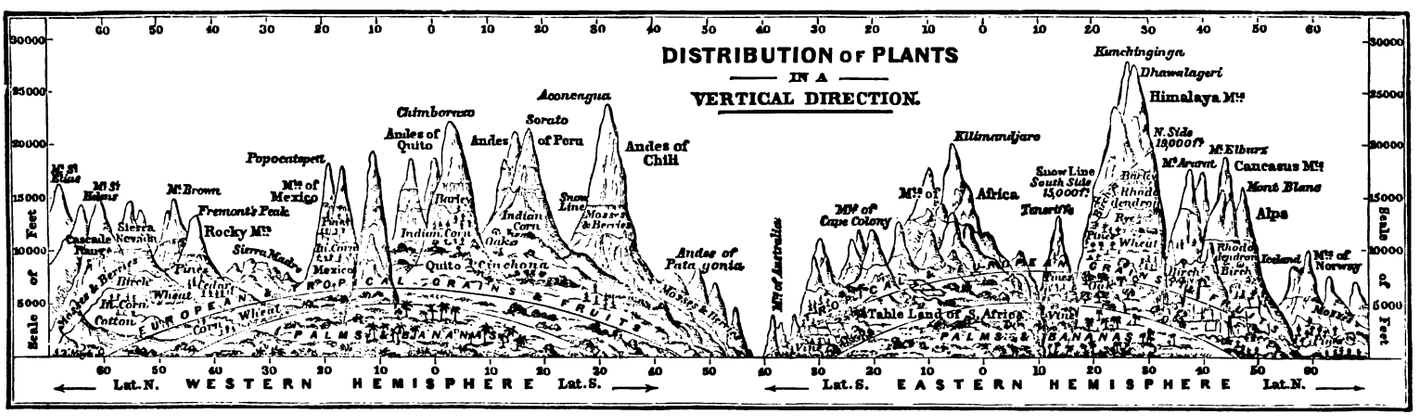
Labrador, Iceland, and Greenland, have no bread-plants; and in the Faroe Islands there is only an inconsiderable cultivation of barley.

XIV. In some of the bread countries, where the population is dense, the failure of the crop of a particular plant is the cause of famine. Thus, in India, a scanty rice crop is the occasion of great distress, and its failure causes universal famine. The failure of the potato crop in Ireland, in 1847, caused a frightful destruction of human life.

In many of the bread countries, where the soil is fertile, the climate favorable, and the population comparatively sparse, a large surplus of grain is collected, which is sent to regions less favored in this respect, and containing a more dense population. Thus, China receives rice from India; the United States exports wheat, corn, and rice to Europe and South America; and the countries upon the Baltic and Black Seas send wheat to Norway, Great Britain, and France.

Name the principal food-plants of the Warm and Temperate Zones?—Where is Wheat cultivated?—Rye, Barley, and Oats?—Of what country is the Potato a native?—Indian Corn?—What is substituted for bread in Siberia?—What countries export breadstuffs?





XV. The plants of most value to man, as furnishing materials for clothing, are Cotton, Hemp, and Flax.

1. *Cotton.* — India is probably the native country of the cotton plant, though it is now most extensively cultivated in the southern part of the United States. It has been grown to some extent in Southern Europe, and is an important article of culture in tropical South America, the West Indies, Mexico, Egypt, and Southern Asia. The value of the cotton exported from the United States for the year ending June 30, 1857, exceeded one hundred and thirty millions of dollars.

2. *Hemp* and *Flax* are productions of the Temperate Zone, and are extensively cultivated in the United States, Great Britain, the countries south of the Baltic, and on the great plains of Russia.

What plants are of most value to man for clothing?—Where is Cotton most cultivated?—What was the value of that exported in 1851?—Where are Hemp and Flax cultivated?

XVI. The Tea plant, Sugar-cane, Coffee, and Cocoa trees are principally cultivated in the Hot Zone.

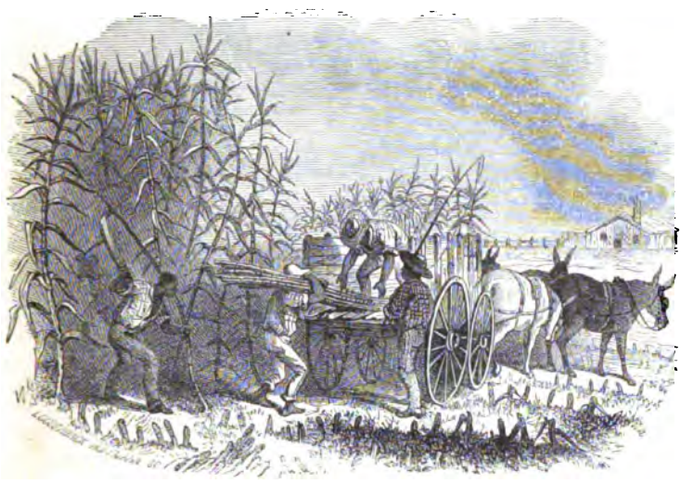
1. *Tea.*—The tea shrub is an evergreen plant, found in China and Upper Assam. It is cultivated to some extent in other parts of the world, but the tea used in this country is brought from China. If left to itself, the plant may attain a height of ten or twelve feet; but, in cultivation, it is not permitted to grow higher than five or six feet. Its leaves may be used after the third year of its growth, but in order to secure a good crop, the plant is usually replaced at the end of the seventh year. The limit of its profitable cultivation in China may be considered the parallel of 25° on the south, 33° on the north, and Thibet on the west. Tea was first introduced into England about the year 1660. In 1664, the East India Company presented the King

What Zone produces Tea, Sugar, Coffee, and Cocoa?—In what countries is Tea indigenous? — State the limits of its successful cultivation in China.

of England, Charles II., with two pounds of tea; and in 1667, a ship received orders to bring home 100 pounds. The value of the tea imported into the United States for the year ending June 30, 1854, was nearly seven millions of dollars.

In China and Japan, tea, in the truest sense of the word, is a national beverage, and has been so for at least a thousand years. It is used by all, from the Emperor to the common people, taken without sugar or milk, at all meals, and at all hours of the day.

Maté, or Paraguay tea, is the dried leaf of an evergreen tree which grows in great abundance in the dense forests of the northern and eastern provinces of Paraguay. It is extensively used in the southern and eastern countries of South America.



A Sugar Plantation.

2. *Sugar Cane* is grown beyond the limits of the Torrid Zone, though it is properly a tropical plant. It is cultivated most extensively in the Southern United States, the West Indies, Brazil, Mauritius, Bourbon, the Sunda and Philippine Islands, and British India. The plant was found wild in several parts of America, and also in many of the islands of the Pacific Ocean. Sugar has been known in India from very early times; but it was used by the Greeks and Romans only as a medicine, and esteemed a great rarity.

3. *Coffee.*—The coffee tree is a native of the highlands of Southern Abyssinia, whence it was taken to Southern Arabia in the fifteenth century. It has been introduced, and is now extensively cultivated in Brazil, Java, Ceylon, the West Indies, and other tropical regions. It may be raised as far north as latitude 36°, where the mean temperature is about 70°. In Arabia and Java, where the best coffee is produced, the plant is a tree fifteen or twenty feet in height; in the West Indies, it is cut down from the top that it may spread and bear more fruit. It is an evergreen tree, and when in blossom, its white and sweet-scented flowers resemble a plant covered with snow.

The use of coffee became general in Egypt about the time of the discovery of America by Columbus. In 1511, the Governor of Mecca prohibited it, on the ground that it was injurious to health; but his decision was overruled by the Sultan at Cairo, who was himself a coffee-drinker. Twenty years after, a zealot of Cairo preached against coffee-drinking, and so violently enraged his hearers, that they collected in a mob, and destroyed the coffee-houses. So serious, indeed, became the excitement, that the Chief Judge called together the wise men of the city, who deciding that it was both allowable and useful, it was again established in public favor. It was first introduced into England in 1652. The first coffee-house in Paris was established in 1672.

4. *Cocoa.*—The cocoa tree is a native of America, but has been transported to other parts of the world, and is now successfully cultivated in Tropical America, India, Japan, and the islands of the Indian Ocean. Chocolate is prepared from Cocoa.

What is Maté?—Where is it used?—Where is Sugar-cane principally cultivated?—Where is Coffee grown?—What is said of its history?—Where is Cocoa cultivated?

XVII. The spices in common use in the various countries of the globe, as Pepper, Cinnamon, Cloves, Nutmegs, and Vanilla, are principally produced in the Torrid Zone.

1. *Pepper.*—The pepper plant is a climbing shrub, producing reddish-brown berries, each of which contains one seed. These berries, dried, constitute the black pepper of commerce. They are usually gathered twice a year, commencing with the third year of the growth of the shrub, and continuing till about the twentieth year, when the plant becomes useless. The shrub was found wild on the Malabar coast of Hindoostan, and is cultivated there, in Sumatra, Siam, and Malacca.

Cayenne pepper is principally produced in Guiana, in South America, but it is also cultivated in the tropical regions of the Eastern Continent.

2. *Cinnamon.*—The cinnamon of commerce is the inner bark of a tree, growing chiefly in Ceylon, of which island it is probably a native.

3. *Cloves.*—Cloves are the dried buds of a small evergreen tree, thirty or forty feet high, which is cultivated almost exclusively on the little island of Amboyna, one of the Spice Islands.

4. *Nutmegs* are the seeds of a tree thirty feet high, now grown chiefly on the Banda Islands. The covering of the nutmeg is the mace of commerce.

5. *Vanilla.*—This well-known aromatic is produced in Mexico, Central America, and Brazil.

XVIII. The principal narcotics used in different parts of the earth are Tobacco, Opium, and the Betel.

1. *Tobacco* was found by the Spaniards in America when they landed. It was introduced into Europe in 1559, by being transported to Lisbon as a medicinal herb. Through Sir Walter Raleigh, (who brought it to England in 1586,) and other young men of fashion, the custom of smoking spread rapidly through England, Holland, Spain, France, and Italy, to Turkey, Persia, India, and even to China and Japan. In 1619, the British King, James I., wrote a book against its use; and in some countries, laws were passed, prohibiting its culture. These attacks, however, did not prevent its continued and increased use. Cuba, Mexico, Brazil, parts of the United States, and some sections of Europe and Asia, constitute the principal sources of its production.

2. *Opium* is prepared from a species of poppy, and is very extensively used in China and Turkey as a narcotic.

3. The *Betel plant* is a climbing shrub which grows in Hindoostan and the islands of the Indian Ocean. The leaves are chewed in combination with the Areca nut, and the custom of so using them is as prevalent as a similar use of tobacco in the United States.

XIX. *Recapitulation.*—It thus appears that vegetation is most luxuriant at the level of the sea, in the tropical regions; and that similar changes in its character are observed receding from the Equator, and ascending above the general surface. It appears, also, that while some plants are confined to narrow limits, others, including the greater part of those which are of most importance to man, are susceptible of being widely diffused.

QUESTIONS ON THE MAP.

Name the principal food-plants of the Torrid and Hot Zones.—Which one of them is regarded as most important?—From what plant is Cassava prepared?—Where is it most used?—What is Sago?—Do Yams grow on trees?—In what region are Dates cultivated?—Where does the Bread-fruit tree grow?—What tree produces Cocoa-nuts?

What are the principal food-plants of the Warm and Temperate Zones?—Name those in the immediate vicinity of your own residence.—What countries export food-plants?—Name some others which import them.—Name some of the plants thus exported and imported.—What plants are important as furnishing materials for clothing?—Where do they grow?

Where is Tea cultivated?—Coffee?—The Sugar-cane?—What kind of plant produces Pepper?—Where does it grow?—From what island is Cinnamon obtained?—Do Nutmegs grow on a tree or shrub?—What is Mace?—Where are Cloves produced?—Vanilla?

Name the spices in common use.—Where are they produced?—What are the principal narcotics?—What is said of Tobacco?—Recapitulate the subjects of this chapter.

CHAPTER II.

ZOOLOGICAL GEOGRAPHY.

I. Zoological Geography treats of the different divisions of the animal kingdom, and their geographical distribution.

II. Following the classification of the learned French naturalist, Baron Cuvier, the animals upon the globe may be considered as comprising four principal divisions — variously subdivided into classes, orders, families, species, and varieties.

Division 1.—*Vertebrated Animals.*—This division includes all animals which have an internal skeleton joined to a back-bone. It comprises four classes:—1. Mammalia (animals which produce their young alive, and for a time suckle them, as the cat, dog, lion, &c.). 2. Birds. 3. Reptiles, and 4. Fishes.

Division 2.—*Molluscous Animals.*—Animals of a soft texture, and having no skeleton; generally furnished with a stony covering or shell: as the oyster, snail, and mussel.

Division 3.—*Articulated Animals.*—Animals consisting of a number of joints or rings, soft or hard, supplying the place of a skeleton: as the lobster, worms, spiders, and insects.

Division 4.—*Radiated Animals.*—So called because in many cases their organs are arranged like rays proceeding from a centre; also called *Zoophytes*, or plant animals, from the resemblance of some species to plants. The coral insect and microscopic animals belong to this division.

III. Animals, as well as plants, appear to have been originally created in certain specific localities, from which they have been to some extent dispersed according to their power of locomotion, their ability to endure change of climate, and to procure proper food, and the absence of other obstacles to their migration.

Some animals appear to be limited strictly to their original locality. Thus, the Kangaroo is confined to the islands of Australasia; the Grizzly Bear to the mountains in the north-western part of the United States; and the far-famed Bird of Paradise to New Guinea and the adjacent islands.

The winds and currents have often been the means of widely dispersing some animals. Thus, insects and birds have been transported by the winds from the continents to adjoining islands. The White Bear has repeatedly made the passage from Greenland to Iceland on drifting ice. Wolves and foxes have often been seen on great cakes of ice far out at sea, and thus probably have frequently been transported from one land to another. A live Boa Constrictor, coiled round the trunk of a cedar tree, was found on the shores of the island of St. Vincent, one of the West Indies. The monster had probably been washed out by the flood of one of the great South American rivers, and borne thither by the force of the currents.

Man has largely contributed, voluntarily and involuntarily, to the dispersion of animals. They have spread domestic species throughout the civilized world, planting them on lonely islands as a source of supply to future visitors. With them, also, some of the most troublesome animals, as rats and mice, common in merchant-ships, have been transported to the remote islands of Oceanica.

Man has also greatly restricted the range of many animals, especially those of a dangerous or savage nature. Thus, buffaloes once inhabited North Carolina, but they have retreated westward before the settler, and are now found only on the plains east of the Rocky Mountains. Wolves and bears, not many years since, were numerous in New England and in New York: now they are very rarely found in those States. The Auroch, the wild ox of Europe, a very savage animal, of which a few still linger in the forests of Poland, formerly roamed in great numbers through Central Europe.

Of what does Zoological Geography treat? — Name the four divisions of the animal kingdom.—Name the different classes of Vertebrated animals.—Give examples of the contracted area occupied by some animals.—State some of the means of their diffusion.

IV. The *Mammalia* are the most perfect of the animal creation. They differ greatly in appearance and habits, but correspond in the one particular of suckling their young. They are divided into the following orders:—

1. *Quadrumana* (four-handed), monkey, ape.
2. *Carnivora* (flesh-eaters), bear, cat, dog.
3. *Marsupialia* (pouched), opossum, kangaroo.
4. *Rodentia* (gnawers), beaver, squirrel, rat.
5. *Edentata* (toothless), sloth, armadillo.
6. *Pachydermata* (thick-skinned), elephant, horse, hog.
7. *Ruminantia* (chewing the cud), camel, ox, sheep.
8. *Marine Mammalia* — whale, dolphin, seal.

1. *Quadrumana.*—No animals of this order are found on the Western Continent, north of Central America; and none in Europe, except upon the rock of Gibraltar — whose inaccessible heights have been long occupied by a race of monkeys, identical with the Barbary ape. In the New World, their range extends from Central America to the Pampas of Buenos Ayres; in the Old World, they inhabit all of Africa, the southern part of Asia, and the islands of the Indian Archipelago.

There are 170 different species of the monkey tribe, 91 of which belong to America. The American species are very different from those of the Old World; they bear much less resemblance to man, and are more gentle and lively. They are most numerous in the forests of Brazil and Guiana.

The ape and baboon are confined to the Old World. The ourang-outang, the name signifying in the Malay language, "wild man of the woods," inhabits Malacca, Cochin-China, and Borneo. The chimpanzee, which inhabits Western Africa, has the nearest resemblance to man of any animal. They live in troops, construct huts of branches of trees, and arm themselves with stones and clubs for defence against man and elephants. In a domestic state they are very docile, and readily learn to walk, sit, and eat like men.

2. *Carnivora.*—Carnivorous animals include all the land mammalia which feed on other animals. The order numbers 514 species, and is subdivided into four principal families, namely: I. *Cheiroptera* (animals with winged arms). II. *Insectivora* (animals that feed on insects). III. *Digitigrada* (animals which walk on their toes). IV. *Plantigrada* (animals which walk on the entire soles of their feet). Carnivorous animals are spread over the entire globe, their food existing in all sections. Many species are, however, confined to a very contracted area.

What are the *Mammalia*? — Name the orders into which they are divided.—Describe the order *Quadrumana*.—State their geographical range.—Describe the order *Carnivora*.—Name the four principal families.—What are some of the animals of the *Cheiroptera*?

Some species of bats, which belong to the family *Cheiroptera*, are widely distributed; ranging in the Old World from the Arctic Circle to the southern extremity of Australia, and extending over almost the entire Western Continent. They are nocturnal animals, and in temperate climates pass the winter in a torpid state. The most remarkable species of this family, in the New World, is the vampire bat of South America, which, feeding entirely on the blood of other animals, attacks all kinds of quadrupeds, and even human beings.

A species, popularly known as "flying cats," belongs to this family, and abounds in the Molucca and adjoining islands. These singular creatures are about the size of a full-grown cat. During the day, they are found suspended from the branches of trees; and in the night, they fly about, uttering a loud cry like that of a goose. To preserve fruit from their attacks, it is necessary to cover it with a net.

The animals of the family *Insectivora*, as the name implies, are appointed to keep in check the overwhelming increase of the insect world. The largest one of them is the hedge-hog, which lives in Europe and Asia.

Of the numerous varieties of the family *Digitigrada*, two merit especial notice, viz., the cat and the dog.

The cat tribe, in some one of its species, is a native of all parts of the world, except Australia, the Philippine Islands, Japan, and the islands of the Pacific Ocean. The only representatives in Europe, in a wild state, are the cat and lynx. The puma, or cougar, known as the American lion, and the jaguar, are peculiar to America. The tropical regions of the Old World contain the most numerous animals of this tribe. The lion, the most powerful of the beasts of prey, is confined to Africa and the southern parts of Asia; the tiger, the scourge of the East Indies, and the most cruel of quadrupeds, inhabits Southern Asia, and the adjoining islands; and the leopard and panther, two closely-related animals, are widely spread over Africa, the hottest regions of Asia, and are also found in the islands of the Indian Archipelago.

The domestic dog, of which there are many species, has attended man in all regions and in all climates, and has everywhere been his faithful companion and friend. There are two instances of the existence of wild dogs: the dhole of India, and the dingo of Australia.

The principal wild animals of the dog tribe are jackals, wolves, and foxes. The jackal, the characteristic dog of Africa, ranges from India and the Caspian Sea, as far south as Guinea. They are very numerous in Northern Africa.

The wolf has a wider range. In America, wolves are found from the Arctic Circle to near the Isthmus of Panama. In the Old World, from the same northern limit to Arabia and India; and from Spain, on the west, to the eastern shores of the continent: not occurring, however, in India beyond the Ganges.

But of all animals of the canine tribe, excepting the domestic dog, the fox is the most extensively diffused. It is found throughout the greater part of America, Europe, Asia, and Africa. The red fox inhabits the wood-lands of North America; the black fox, the Siberian forests; and the white fox, the polar regions, coming down for food, in mid-winter, on the American Continent, to near the parallel of 50°.

Hyenas, martens, and otters represent other tribes of the family *Digitigrada*. The spotted hyena is limited to Africa; the striped hyena is found throughout Africa, and in the southern countries of Asia. These snarling, disgusting creatures are chiefly nocturnal animals, inhabiting caverns, and subsisting on dead bodies.

The more important species of the marten tribe, the ermine and sable, valuable on account of their furs, have their province in the polar regions of the two continents. Two species of sea otter, the most valuable of fur-bearing animals, are peculiar to North-eastern Asia, North-western America, and the Aleutian Islands.

On what do the family *Insectivora* feed? — Name the different animals of the cat tribe found wild in America.—Europe.—Asia.—Africa.—Name the principal wild animals of the dog tribe.—State the countries they inhabit.—Give the names of the countries in which animals of the family *Plantigrada* are found.

Of animals belonging to the family *Plantigrada*, the most important is the bear tribe. The grizzly bear, the most formidable species, is found only in the region of the Rocky Mountains of North America. The American black bear inhabits all the wooded districts from the Gulf of Mexico to the Arctic Ocean, and from the Atlantic to the Pacific. The polar bear, so noted for its

voracity, occupies the polar regions of both continents. Abyssinia, Thibet, Syria, and Sumatra have each different species. The raccoon, badger, and wolverine, are numerous in the western parts of the United States, and are also members of the family *Plantigrada*. They are not found in Oceanica.

3. The *Marsupialia*, of which there are 123 known species, are animals furnished with a pouch, in which the females carry their young while very small and imperfectly formed. They are not found on the Eastern Continent, and on the Western are represented by only one family, the opossums, spread from the Northern United States to the La Plata River. The order specially characterizes Australia, the Spice Islands, and New Guinea.

The kangaroo, the principal animal of this order, and the largest native animal of Australia, was first discovered by Captain Cook in 1779. It is found in all the explored parts of Australia, Tasmania, and New Guinea.

4. The *Rodentia*, or gnawers, so named from the manner in which they file or gnaw with their front teeth, number 604 different species. The beaver, mouse, rat, musquash, or musk-rat, squirrel, and porcupine, are the best known animals of this order. The *Rodent* families of the Old World generally differ from those of the New, but the common mouse appears to be distributed over all Europe and North America; and rats have been transported in ships to all quarters of the globe.

The beaver of North America, hunted for its fur, and now comparatively rare, has a geographical range from the Atlantic to the Pacific, and from about Lat. 37° to Lat. 68°. They live solitarily during the summer, but in winter herd together in huts, which they ingeniously construct, partly above and partly below the surface of running streams.

5. The *Edentata*, of which there are only 28 different species, are animals characterized by the absence of front teeth. They peculiarly belong to Central and South America, and only occasionally occur in the southern regions of the Old World. The sloths, armadillos, and ant-eaters are the principal animals of this order.

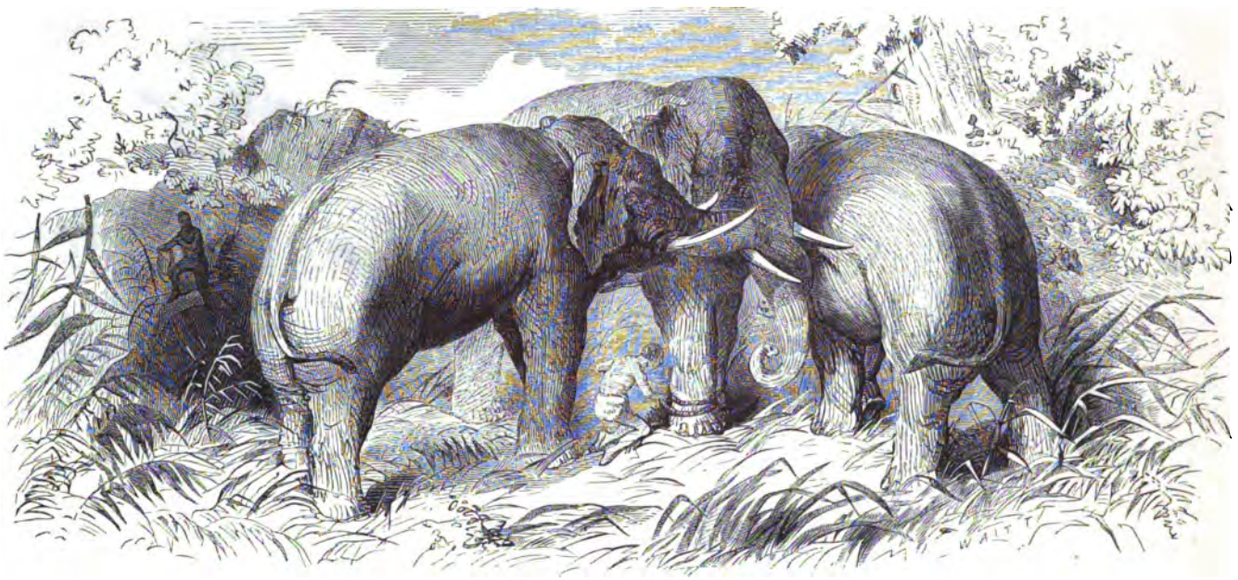
Describe the order *Marsupialia*.—How many species does it contain?—Which family is represented on the Western Continent?—Which is the largest animal of this order?—Describe the order *Rodentia*.—Name some of the principal animals.—What is the peculiarity of animals of the order *Edentata*?—Where are they most numerous?

Sloths inhabit the dense forests of Brazil, where they can traverse many miles without touching the ground. They suspend themselves by one limb from the boughs of the trees, using the others to draw towards them the adjacent branches, on the foliage of which they feed, never leaving a tree till it is entirely stripped of its leaves.

The armadillo is remarkable for a scaly and hard bony shell which covers its head and body, and often its tail. It is much hunted by the inhabitants on account of its flesh, which, when roasted in the shell, is said to be extremely delicate.

The ant-eater feeds almost entirely upon insects, especially, as its name implies, on ants.

6. The *Pachydermata*, or thick-skinned order, numbering 39 species, comprise the largest and most powerful of all land animals, and also some of the most useful domesticated by man. The important families of this order are: I. The Elephant II. The Rhinoceros. III. The Hippopotamus. IV. The Horse, and V. The Hog.



There are two species of the elephant, inhabiting two distinct regions. The Asiatic species ranges from the lower slopes of the Himalaya Mountains, through all India, on both sides of the Ganges; through the peninsula of Malacca, the south of China, and the islands of Sumatra and Ceylon. The African species, of smaller size, and supposed to be more ferocious and less sagacious, inhabits the countries from the northern borders of Cape Colony to Lat. 15° North.

The range of the rhinoceros is nearly the same as that of the elephant. It is found, however, in Java, where the elephant is wanting. The hippopotamus, or river horse, of which there is but one species, appears to be confined to the rivers and lakes of Middle and Southern Africa. Both these animals are remarkable for their stupidity and ferocity.

The native country of the horse is unknown. It is now found wild on the plains of Central Asia, the llanos and pampas of South America, and the prairies of North America; but in all these cases, its present condition is probably a return from the domesticated to a wild state. The horse was introduced into America by the Spaniards, soon after the discovery of the Continent by Columbus, and is now very generally diffused throughout the civilized world. This valuable and beautiful animal seems to arrive at perfection in warm and temperate regions, and to degenerate in cold climates.

The ass was probably domesticated at an earlier period than the horse. It is a native of Central Asia, and still ranges there in immense troops, free and unreclaimed, migrating north and south, according to the season.

The beautiful, gaily-striped, but vicious zebra, resembling in form the ass, and the more handsomely-formed, sober-colored quagga, are peculiar to Southern Africa.

The European wild boar, which is the parent stock of the domestic hog, has a wide geographical range. It occurs generally throughout the Old World, from France eastward to the Asiatic shores of the Pacific, and extending as far north in Asia as Lat. 60°. It is not found in Spain, Italy, and Persia. The domestic hog is now spread throughout the earth. It was unknown in America till introduced by the Spaniards towards the close of the fifteenth century, but has since run wild, and formed large herds in many parts of the Continent.

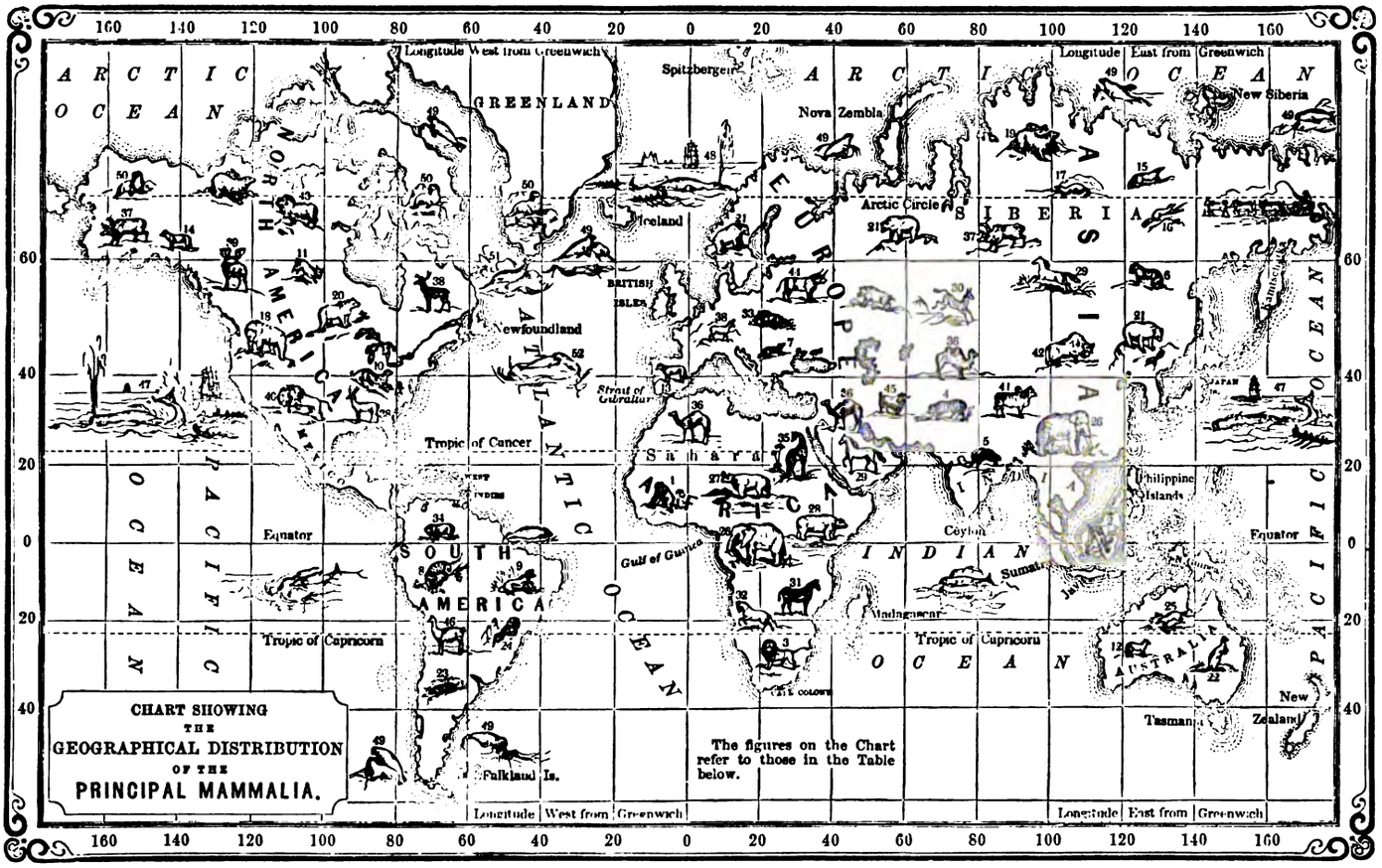
7. The order *Ruminantia* numbers 180 different species, and includes all animals which chew the cud. The animals of this order are remarkable for their elegance of form, and for their usefulness to man. They furnish him with food, milk, tallow, leather, horn, and other products, and also serve him as beasts of burden. The principal families of this order are as follows: I. Camels. II. Llamas. III. Camelopards (Giraffes). IV. Deer. V. Antelopes. VI. Goats. VII. Sheep, and VIII. The Ox.

The name *Ruminantia* intimates the singular faculty possessed by these animals of masticating their food a second time, after it has been returned to the mouth from the stomach. This faculty depends on the structure of their stomachs, which are always four in number—the first three being so disposed that food may enter into either of them. The first and largest stomach receives a quantity of vegetable matter, coarsely bruised by the first mastication. This matter passes thence into the second stomach, where it is moistened and compressed into little pellets or cuds, and returned to the mouth to be re-chewed. The food thus re-masticated, descends directly into the third stomach, whence it passes to the fourth, which is the true organ of digestion, analogous to the stomachs of animals in general.

Camels are confined to Southern and Central Asia and Northern Africa; and limited to two species, both of which are completely domesticated. The dromedary is a fleet variety of the Arabian camel. The camels of the East are represented in the Western Hemisphere by the llamas of South

What country does the Sloth inhabit?—For what is the Armadillo remarkable?—Name the important families of the order *Pachydermata*.—How many species of the Elephant are there?—State the regions inhabited by the Rhinoceros and Hippopotamus.

Where is the Horse found wild?—What is the country of the Quagga and Zebra?—When was the Hog first introduced into America?—Name the principal families of the order *Ruminantia*.—What does the term *Ruminantia* imply?—Where are Camels found?



QUADRUMANA.	9. Puma.	19. White Bear.	PACHYDERMATA.	RUMINANTIA.	44. Auroch.
1. Chimpanzee.	10. American Panther.	20. Black Bear.	26. Elephant.	35. Camelopard.	45. Cashmere Goat.
2. Ourang Outang.	11. Canada Lynx.	21. Brown Bear.	27. Rhinoceros.	36. Camel.	46. Llama.
CARNIVORA.	12. Dingo.	MARSUPIALIA.	28. Hippopotamus.	37. Reindeer.	MARINE MAMMALIA.
3. Lion.	13. Wolf.	22. Kangaroo.	29. Horse.	38. Deer.	47. Spermaceti Whale.
4. Tiger.	14. Fox.	EDENTATA.	30. Ass.	39. Elk.	48. Greenland Whale.
5. Striped Hyena.	15. Marten.	23. Armadillo.	31. Zebra.	40. American Buffalo.	49. Seal.
6. Ounce.	16. Sable.	24. Ant-Eater.	32. Quagga.	41. Zebu.	50. Walrus.
7. Lynx.	17. Ermine.	25. Platypus.	33. Wild Boar.	42. Yak.	51. Narwhal.
8. Jaguar.	18. Grizzly Bear.		34. Peccary.	43. Musk Ox.	52. Grampus.

America, principally found on the west side of the Andes, from New Grenada to the Straits of Magellan. The alpacca is a species of llama, with long, woolly hair. The camelopard (giraffe), the tallest of all animals, is confined to the desert regions of Africa.

The deer family include all those ruminating animals which are furnished with solid horns, or antlers. The elk, or moose-deer, is as large as a horse. It has broad, solid, and very heavy antlers; and belongs to the northern regions of both Continents. The reindeer is more capable of enduring cold than the elk, and hence occupies the highest latitudes. It is peculiar to the glacial regions of both Continents, and is the animal so celebrated for the services which it renders to the Laplanders. The true musk-deer, noted for its secretion of musk, is an inhabitant of Central Asia.

Africa is peculiarly the land of the antelope, the most numerous in species of any of the families of the *Ruminantia*, differing widely in size, color, habits, and station. A few court the shade of the forests; some inhabit the lofty table-lands; but the greater number roam the plains in troops. The gazelle, long noted for its large, mild, black eyes, is found in Egypt, Barbary, and through all the country bordering on the Great Desert. Of two European species, one is the chamois, so remarkable for its agility, dwelling on the highest regions of the Alps, and other lofty mountains.

The parent stock of the common domesticated goat is unknown. The Cashmere goats, occupying the declivities of the Himalaya Mountains, and upper plains of Thibet, are celebrated for the fine wool which grows among their hair, of which cashmere shawls are made.

The largest and most powerful of all ruminating animals belong to the ox tribe. The common domestic ox is a native of the Old World; and though now living in Lapland, as far north as 70°, probably came from the warmer parts of the Temperate Zone. The Brahminy bull, a sacred animal in India, is distinguished by a hunch on its back. The musk-ox, named from the odor of its flesh, inhabits the coldest regions of North America.

QUESTIONS ON THE CHART.

What animals of the order Quadrumana are found on the Eastern Continent? — On the Western?—On which Continent are the most ferocious Carnivorous animals?—Are they most numerous in Polar regions, or near the Equator? — Name five Carnivorous animals of North America.—Name an animal of the order Marsupialia, and state where it may be found.— In what Grand Division are the Edentata most numerous? — Name three different animals of the order Pachydermata found in Africa.—How do these animals compare in size with the Carnivora? — Which do you think the most valuable animal of this order? — What valuable animal of the order Ruminantia is found in Africa? — In Lapland? — In the United States? — In South America? — In Thibet?— What countries does the Yak inhabit? — The Giraffe? — What savage animal of the order Ruminantia inhabits the western part of the United States?

The Auroch, or European bison, a very savage animal, which was abundant in Germany in the time of Charlemagne, is now found in the forests south-east of the Baltic Sea. It is the largest European quadruped. The American buffalo roams in great numbers on the prairies east of the Rocky Mountains. The Cape buffalo, which inhabits the forests of Southern Africa, is a very large and ferocious animal. All these species are remarkable for their daring energy, boldness, and untamable disposition.

The Yak, or mountain ox of Central Asia, is the highest ranger of the tribe. Its chosen abode is where the average annual temperature is below the freezing-point. Hence it lives amid eternal snow on the table-land of Thibet, the roof of the world, at an elevation of 15,000 feet. The fine-haired, bushy tail of this animal furnishes the well-known oriental insignia of rank. The phrase, "Pacha of three tails," signifies the number of tails of the Yak which that officer is allowed to have carried on State occasions.

8. *Marine Mammalia.* — This order includes all the marine animals which suckle their young. Several of the species are popularly considered as fishes, resembling them in external appearance. The order forms two distinct families: the *Amphibia* (animals which live both on land and in water), and the *Cetacea* (animals of the whale kind).

Seals and walruses are the principal animals of the family *Amphibia*. Their favorite habitation is the Frigid, and the colder parts of the Temperate Zones, in both the Northern and Southern Hemispheres. The walrus, a grim-looking animal, exceeding in size the largest bull, is much hunted for its oil, and for its tusks, the ivory of which is employed in the arts. It is exclusively confined to the Arctic regions.

Whales were formerly much more numerous, and more generally distributed through all the oceanic waters than at present. They have been driven almost entirely from the Atlantic Ocean, and much reduced in numbers in the waters of the Arctic and Pacific, by the untiring pursuit of man. In the Antarctic Seas, however, into which man has not so often intruded, they are still very numerous; and it is to that quarter the attention of whale adventurers is now directed.

The spermaceti whale, so valuable for the oil principally found in its head, has its habitation in all the oceanic waters, except the Polar Seas. This huge animal, sometimes 75 feet in length, has been known to fight desperately when attacked by the whalemen, and has even destroyed ships by strokes of its enormous tail. The common black, or Greenland whale, the chief species pursued by man, is now found principally in the Arctic, and in the northern parts of the Atlantic and Pacific Oceans. It is valuable for its oil and bone. The Great Rorqual, of the Northern Atlantic, is the largest of living animals, being sometimes from 80 to 100 feet long.

The dolphins, so remarkable for their voracity, and the swiftness of their motions, are found in almost every latitude. Shoals of porpoises, spouting and tumbling in pursuit of the herring and mackerel which constitute their prey, may be seen in all parts of the Atlantic. The Grampus is the largest and fiercest animal of the porpoise tribe, sometimes even attacking the whale.

The Manatus, Dugong, and Stellerine, popularly known as sea-cows, sirens, and mermaids, are herbivorous animals, feeding on sea-weed, and the herbage at the bottom of streams. The Manati are chiefly found near the mouths of rivers which flow into the warmest parts of the Atlantic Ocean: as the Amazon, the Orinoco, and the rivers of Western Africa. The Dugong inhabits the shallow parts of the Indian Ocean. It sits upright when suckling its young, thus giving rise to the fable of the mermaid.

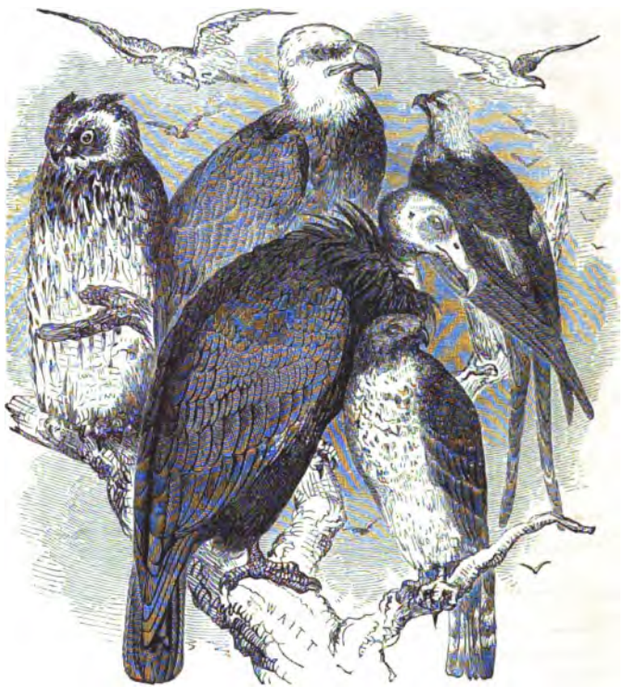
V. Birds constitute the second class of the vertebrated animals. They are the most favored of all animals in their powers of locomotion; yet, like the Mammalia, most species are confined by geographical laws to particular districts. The most beautiful varieties of birds are found within the Tropics; where, also, with the exception of two orders (the waders and swimmers), the number of species and individuals is greatest.

What does the term "Pacha of three tails" signify?—Name the two families of the order *Marine Mammalia*.—Which are the principal animals of the family *Amphibia*?—*Cetacea*?—How large is the sperm whale?—Where are the most beautiful birds found?

Birds are divided by Cuvier into the following six orders:—

1. *Rapaces* (birds of prey), eagle, hawk, vulture.
2. *Scansores* (climbers), parrot, wood-pecker.
3. *Oscines* (songsters), robin, humming-bird.
4. *Gallinacea* (*Gallina*, a hen), domestic fowl, partridge, grouse.
5. *Grallatores* (waders), snipe, heron, crane.
6. *Natatores* (swimmers), duck, penguin.

The entire known number of species exceeds 6000.



1. *Rapaces.* — The principal birds of prey are: Vultures, Eagles, Hawks, and Owls.

The condor, a species of the vulture family, is the largest of all flying birds, sometimes measuring fifteen feet from tip to tip of the wings. On one occasion, Humboldt saw this bird floating over the summit of Mount Chimborazo, at an elevation of 22,000 feet. The secretary bird, so called on account of the resemblance of the tuft of feathers upon the top of its head to a pen behind the ear of a man, is a species of the vulture family, which inhabits Southern Africa, and preys upon serpents.

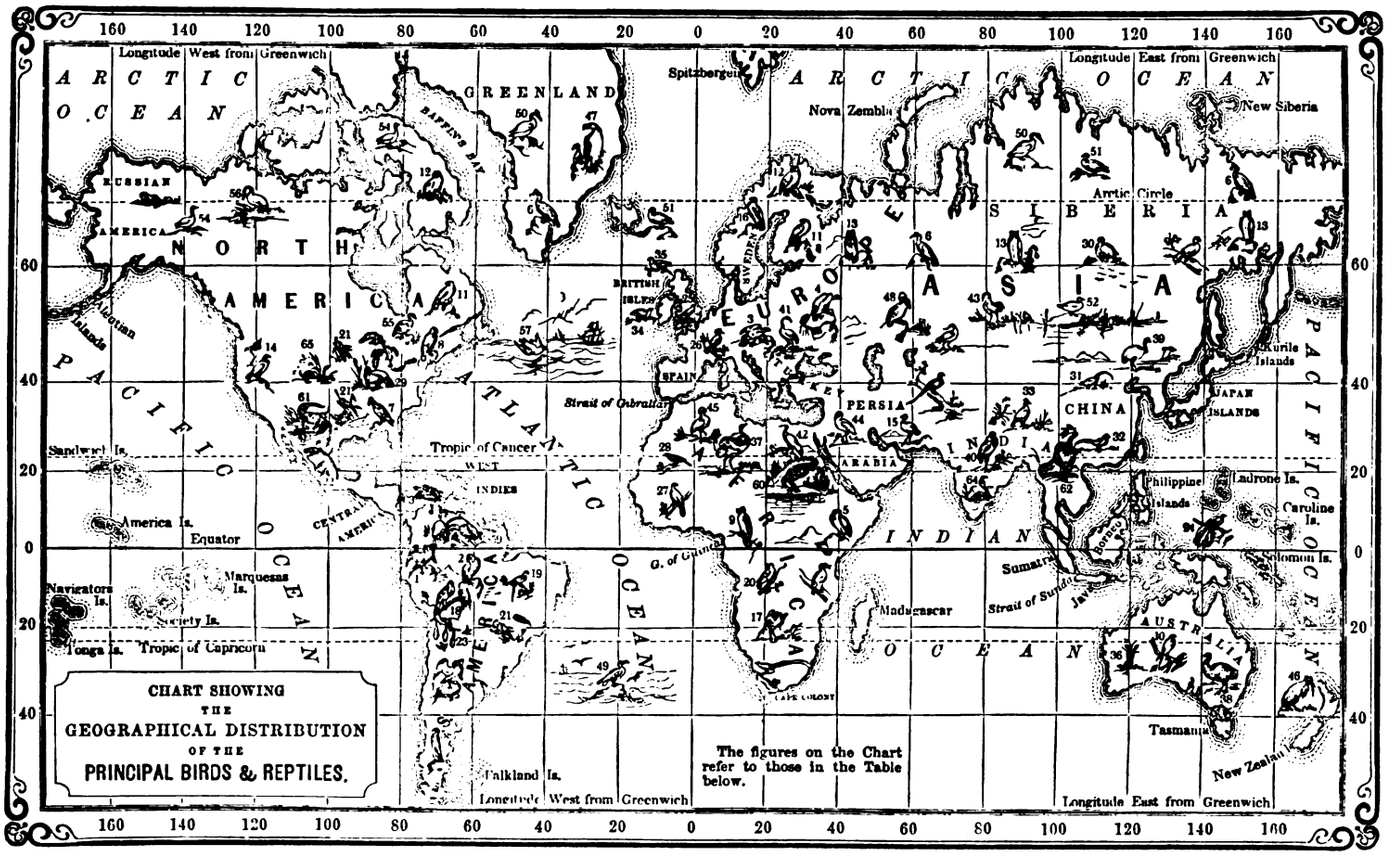
2. *Scansores.*—Parrots, Toucans, Wood-peckers, and Cuckoos, are birds of this order.

The birds of the parrot family are remarkable for the beautiful color of their plumage, and their power of imitating the human voice. They principally inhabit the tropical regions. The toucans are all natives of Tropical America. The wood-peckers are widely spread, being found in all quarters of the globe, except Australia.

3. *Oscines.*—The songsters constitute the most numerous order of birds, and include those most generally known in temperate regions: as the Lark, Robin, Swallow, and Sparrow. The Mocking-bird, of the southern part of the United States, one of the finest of song-birds, and remarkable for its great facility of imitating almost any sound, belongs to this order.

4. *Gallinacea.* — Birds of this order are much more numerous in the Old World than in the New; the greatest number of species being found in Tropical Asia. The domestic fowls, Quails, Pheasants, and Pigeons, are gallinaceous birds.

Name the six orders of birds.—What is the entire known number of species?—What are the principal birds of prey?—Name those of the order *Scansores*.—To what order does the Mocking-bird belong?—To what the domestic fowls, Quails, and Pheasants?



RAPACES.	12. Snowy Owl.	22. Resplendent Trogon.	33. Crowned Pheasant.	44. Crane.	55. Canada Goose.
1. Condor.	13. Owl.	23. Oriole.	34. Partridge.	45. White Spoonbill.	56. Whistling Swan.
2. King Vulture. [Alps.	14. California Vulture.	24. Bird of Paradise.	35. Ptarmigan.	46. Apteryx.	57. Stormy Petrel.
3. Great Vulture of the	15. Common Buzzard.	25. Nightingale.	36. Lyre Bird.	NATATORES.	58. Penguin.
4. Griffin Vulture.	16. Iceland Falcon.	26. Hoopoe.	GRALLATORES.	47. Great Auk.	REPTILES.
5. Sociable Vulture.	17. Secretary Bird.	27. Plaintain Eater.	37. Ostrich.	48. Cormorant.	59. Boa Constrictor.
6. Common Vulture.	SCANSORES.	28. Senegal Web-crest.	38. Emu.	49. Albatross.	60. Crocodile.
7. Turkey Buzzard.	18. Toucan.	GALLINACEA.	39. Cassowary.	50. Great North'n Diver.	61. Alligator.
8. Bald Eagle.	19. Macaw.	29. Turkey.	40. Adjutant.	51. Eider Duck.	62. Python.
9. Crowned Eagle.	20. Toothbill.	30. Black Grouse.	41. Flamingo.	52. Duck.	63. Green Turtle.
10. Wedge-tailed Eagle.	OSCINES.	31. Silver Pheasant.	42. Sacred Ibis.	53. Bernicle Goose.	64. Cobra de Capello.
11. Osprey.	21. Humming-Bird.	32. Gold Pheasant.	43. Stork.	54. Snow Goose.	65. Rattlesnake.

The turkey, a native of America, was introduced into Europe during the sixteenth century, and is now widely diffused throughout the Eastern Continent. The Guinea fowl, originally from Africa, is still found there in a wild state. The peacock, well known for the beauty of its plumage, is a native of Northern India.

5. *Grallatores* and *Natatores.*— The waders and swimmers are far more numerous in the temperate and polar regions than in tropical countries. The most remarkable species of waders, however, occur in tropical and southern climates. The African and South American Ostrich, the Cassowary, and Australian Emu, are among the most extraordinary as well as most gigantic birds.

Ducks, swan, geese, pelicans, penguins, and gulls, are among the principal birds of the order of swimmers: all more numerous in temperate than in tropical regions. The eider duck, valuable for its eggs and the down taken from its nest, is an important and interesting species, inhabiting the shores of the Arctic Ocean. Penguins are found along the coast of Patagonia. The black swan, a very curious species, lives in Australia.

The migration of birds is an interesting fact in Natural History. Some migrate singly — others in flocks — and others still in vast armies. Alexander Wilson estimated a flock of pigeons which passed above him, in Canada, for the greater part of a day, to have been a mile in breadth, and 240 miles in length; and to have contained (three birds being assigned to the square yard,) 2,230,272,000 pigeons. Many birds alternate regularly between two distant countries, as food becomes scarce or abundant by the change of season. The rice-bird of Carolina is known further north as the reed-bird of the marshes in the vicinity of the Chesapeake and Delaware Bays, and the bob-o-link of New England.

QUESTIONS ON THE CHART.

Which is the largest of the Rapacious birds? — What Grand Division does this bird inhabit?—On which Continent do you find the Bald Eagle?—In what part of the world the Secretary Bird?—To what order does the Macaw belong?—Where is this bird found?

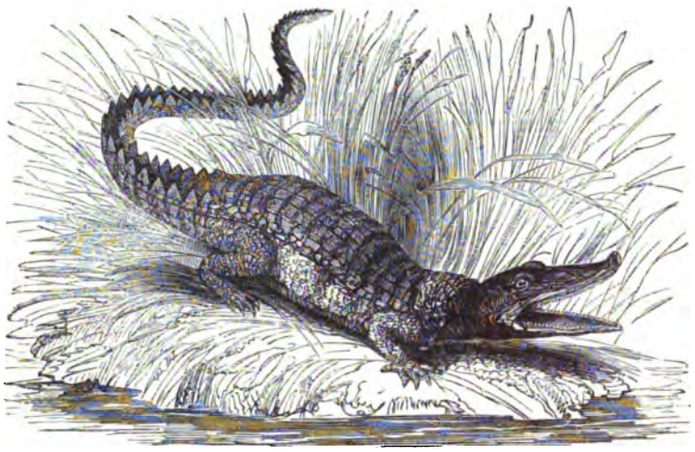
Name three birds of the order Oscines.—What part of the world does the Bird of Paradise inhabit?—Where do you find the Nightingale?—Where Humming-Birds?

Of what Grand Division is the Turkey a native?—The Guinea fowl?—The Peacock?—To what order do Quails, Pheasants, and Partridges belong?

Name five different birds of the order of Waders.—Which bird of this order is the largest?—What Grand Division does it inhabit?—Name a bird of this order which inhabits Australia.—Where do you find the Cassowary?—The Adjutant?

Name six birds belonging to the order of Swimmers.—Where are they to be found?

VI. *Reptiles*, of which there are 657 known species, diminish in number, size, and noxiousness, from the Equator to the Poles. Crocodiles and serpents are among the principal families of this class.



There are three tribes of the crocodile family, namely: the true crocodile, which is confined to the tropical rivers of Africa; the alligator, or cayman, which is exclusively an American species; and the gavial, which inhabits the Ganges and other Asiatic rivers. The alligators of the rivers and marshes of the southern part of the United States are more savage than those of South America, sometimes attacking men and animals.

The number of species of harmless serpents is more than three times, and the number of individuals more than twenty times, as great as that of the venomous. The rattlesnake, one of the most venomous of serpents, is exclusively an American family. The cobra de capello, the dancing snake of Indian jugglers, is a very venomous serpent, peculiar to Southern Asia. The boa constrictor, generally from ten to twenty feet long, lives in the great tropical forests of South America, where it often hangs from the boughs of trees to watch its prey. The python, which is exclusively a serpent of the Eastern Continent, is of about the same size as the boa constrictor.

Frogs and salamanders extend further towards the polar regions than any other reptiles, reaching, in North America, on the Mackenzie River, the 67th parallel of latitude.

Reptiles, in cold and temperate climates, bury themselves in the ground, and lie torpid during the winter; in hot climates, during the dry season, they also fall into a similar state.

VII. *Fishes* constitute the fourth class of vertebrated animals. Some of the species are widely distributed throughout all the oceanic waters, while others appear to be confined to particular localities.

The greater number of fish, used by man for food, frequent shoal water. The cod and mackerel are examples. Sharks roam in the deep ocean of tropical and warm climates. Flying-fish never go beyond the parallel of 40°; their most active enemies, known from their brilliant colors as "gilt heads," observing the same limit.

Several kinds of fish are eminently social and migratory. The herrings issue every year from the depths of the Arctic Ocean, and repair in vast shoals to the coasts of the United States, Western Europe, Kamtschatka, and the Aleutian Islands. Cod annually visit the coasts of Newfoundland, where vast numbers of them are caught.

Pike and salmon are the only species of fresh-water fish common to Europe and North America. The pike, however, is unknown west of the Rocky Mountains. Salmon go up rivers to spawn, and make extraordinary leaps over falls to reach the places suitable for depositing their eggs.

Name some of the principal families of Reptiles.—Which of the Crocodile family is found in America?—Africa?—Asia?—How does the number of harmless serpents compare with that of the venomous.—Describe the fourth class of vertebrated animals?

VIII. The inferior orders of the animal kingdom—the *Molluscous*, the *Articulated*, and the *Radiated* animals—are much more numerous than the *Vertebrated* division, which has already been described.

The division *Mollusca* comprises principally marine animals: as the oyster, and various species of shells. They are most remarkable for their size and beauty in the Torrid and Hot Zones; thus, the pearl-oyster only comes to perfection in the equatorial ocean.

Some families of the division *Articulated* animals are of direct utility to man: as the honey-bee, silk-worm, and cochineal insect. A far greater number indirectly promote his benefit: such, for example, as destroy animal and vegetable substances in a state of decomposition, and those that prey on other noxious tribes, and are thus instrumental in keeping them within due bounds.

Microscopic animals, which belong to the division *Radiated* animals, exist almost everywhere, and in numbers which baffle the power of arithmetic to express, or the mind to conceive. They live in fog, rain, snow, and ice, in the ocean, in stagnant water, in boiling springs, on the surface of the snow in the Arctic regions, in volcanic ashes, and in peat earth twenty feet below the surface soil. If a drop of water be examined with a microscope, it will be found literally to swarm with animal life.

Sir James Ross sent some surface ice, of a brownish-yellow color, which he collected near Mt. Erebus, in the Antarctic regions, and which he supposed was colored by volcanic ashes, to M. Ehrenberg, the noted Prussian microscopist, for examination. The coloring matter of this ice was found to consist of microscopic animals, almost the whole of which reached the great naturalist's residence at Berlin alive, four years after they were collected.

Such, indeed, is the tenacity of life in the microscopic animals, that they have been known to recover after an exposure to 248° of heat, and drying in vacuo for 28 days.

IX. *Recapitulation.*—It thus appears that the animals upon the globe comprise four principal divisions, the lower orders of which are far the most numerous, both in species and individuals. The Eastern Continent has contributed a much greater number of the higher orders, the vertebrated animals, to the domesticated races than the Western. The horse, ox, ass, camel, goat, hog, many sheep, dogs, and domestic fowls, being native animals of the Old World; while the llama, turkey, and some sheep and dogs, are the only domestic animals of importance native to America. The largest and most savage animals are also found on the Eastern Continent: as the elephant, rhinoceros, lion, and tiger.

The learner will not fail to recognise the wisdom and goodness of the Creator, in so constituting those animals which are most useful to man, that they can exist in different parts of the earth, under very different conditions. Thus, the lion and tiger cannot live in cold countries, nor can the white bear sustain the heat of the equatorial regions, while the patient ox can equally well endure severe cold or fervent heat.

Nor will he fail also to recognise the care of Providence in the remarkable adaptation of each animal to his natural condition. Thus, animals of the Torrid Zone, as the Barbary dog and the ape, are supplied with a slight coat of hair; while animals of the Arctic regions, as the sable, ermine, and bear, are provided with the thickest furs. Deer, hare, and other animals designed to seek safety in flight, have limbs expressly formed for speed; while those of the elephant are formed for strength, and adapted to support the enormous weight of his body.

Name the three inferior orders of the animal kingdom.—Describe the Molluscous animals.—Name some of the Articulated animals most useful to man.—What is said of the number of Microscopic animals?—Recapitulate the subjects of this chapter.

CHAPTER III.

ETHNOGRAPHY.

I. ETHNOGRAPHY treats of the different varieties of the human race, and their geographical distribution.

Man, the head of the animal kingdom, and lord of the creation, has the whole earth for his abode. He can adapt himself to every variety of climate, soil, and situation; and deriving nourishment from all kinds of food, his habitations extend to the farthest bounds of animated nature.

II. Owing mainly to the flexibility of his constitution, although obtaining much artificial aid, man can subsist under the greatest climatic extremes. The Esquimaux endure the cold between the parallels of 70° and 80°; the African negroes live under the burning sun of the Equator; while Europeans, accustomed to an intermediate temperature, have borne the rigor of the highest accessible latitude, and the fiercest heat of the Torrid Zone.

The power of the human frame to resist cold, appears to depend greatly on the amount of food which the individual consumes. It is well known that the Esquimaux eat as much as ten or twelve pounds weight of animal food in twenty-four hours, its effect being heightened by its fat and oily quality. A much larger supply of animal than vegetable food is required in a cold climate; while amid torrid heat, rice and fruit form an appropriate diet.

The human race can also adapt itself to very different states of the atmosphere as to density, though with a varying capacity in different individuals. Some travellers are very painfully affected by the rarity of the atmosphere upon lofty elevations, while others suffer very little inconvenience. Mr. Darwin, who experienced much difficulty in breathing on crossing the Portillo pass of the Chilian Andes, intimates that, at Potosi, about 13,000 feet above the sea, though strangers suffer at first from the atmosphere, no inconvenience is felt after a short stay. Lieut. Herndon, who, in 1851, crossed the Ataranga pass of the Alps, 16,044 feet in height, experienced no inconvenience whatever, though one of his companions suffered exceedingly.

III. The human race are not confined to any particular diet, but subsist in different situations with equal facility on very different kinds of food. Vegetables are the chief food of the nations within the Tropics; animals, of the polar tribes; both animals and vegetables contributing to support the inhabitants of temperate climates.

In high latitudes, where the ground is covered with snow throughout the greater portion of the year, and vegetation is very scanty, entire hordes live on fish and seals. Towards the Equator, where vegetation flourishes most, vast numbers thrive, with no other articles of support than cocoa-nuts, bananas, yams, and rice. In the intermediate districts, the special region of the cereal grains, where animal food can also be as readily procured, a mixed diet prevails.

IV. Few portions of the globe have been discovered destitute of a native human population. Among the principal of them are Spitzbergen, Nova Zembla, Iceland, St. Helena, the Madeira and Falkland Islands, and the Antarctic Lands.

V. The leading physical differences observable among mankind are varieties of strength, stature, proportion of the limbs, texture of the skin, color, character of the hair, and the form of the skull.

Both barbarous and civilized races exhibit the diversities of physical power which are found in individual families; but, contrary to popular opinion, upon comparing the two together, the result of experiment shows the savage to be inferior to the civilized man in muscular energy and capacity of endurance: though some of his senses, as sight and hearing, are remarkably vigorous.

While a difference in stature will be observed in the same families, there are examples of tribes departing generally from the ordinary height. The Esquimaux, Laplanders, and Hottentots, are examples of diminutive size. The Patagonians, Caribs, Tonga islanders, and some of the tribes of Central Africa, are tall.

Among the Bosjesmen of Southern Africa, the average height of the men is stated to be about four and a half feet, and that of the women four feet. The Patagonians average six feet, and very frequently exceed it.

VI. Mankind differ in the proportional size of parts of the bony skeleton, and in the texture of the skin and hair. Such differences are observable in individuals of various families, but they seem to be peculiar to particular tribes. Thus, some of the negro tribes have broad flat feet, a projecting heel, and a greater length of the fore-arm, measured in proportion to the upper arm and height of the body.

The skin of the negro is also very soft and velvety, a characteristic of some of the South Sea Islanders. The hair has likewise that peculiar character which has led to the African nations being styled in general "woolly haired," fine, wiry, and crisp; while that of the Mongolian tribes is strong, straight, and scanty; and that of the Europeans, long, soft, and flowing.

VII. A difference in the color of the skin, hair, and eyes, is one of the most obvious distinctions of mankind. The African nations are black; the American Indians are copper-colored; and the inhabitants of Europe and the United States have a fair skin, with color in their cheeks. Omitting exceptional cases, there is a mutual correspondence between the color of the skin, hair, and eyes. Light hair is generally found to be accompanied by a fair, transparent skin, and light blue or grey eyes; and a dark skin has usually associated with it black hair and dark eyes.

A most remarkable individual variety, not constituting tribes or nations, is the Albino. The hair is of a milky-white or cream tinge; the color of the skin is the same, occasionally of a pinkish hue; and the eye is pink, the pupil being intensely red. Albinos are usually of negro parentage, but occur in other races.

VIII. The last important physical diversity apparent among mankind is the form of the skull, which varies remarkably, presenting several well-defined shapes, distinctive of great groups of the human population.

IX. A great difference is also observable among mankind with reference to language, degree of civilization, religion, and form of government.

The entire number of known languages and dialects in the world is 3664, distributed as follows: — American, 1624; Asiatic, 937; European, 587; African, 276; Oceanic, 240.

Some modern writers on philology classify this large number of languages and dialects into a few great divisions, each containing those which bear a grammatical resemblance to each other. Those of the Old World are considered by Chevalier Bunsen to constitute but five divisions.

Of what does Ethnography treat? — Under what different conditions can man live? — On what does the power to resist cold appear to depend? — Is any inconvenience experienced in ascending high mountains? — Why? — What sort of food is principally eaten in the Arctic regions? — In the Torrid Zone? — In Temperate climates? — Name some portions of the globe which contained no native human population.

What are the principal physical differences observable among mankind? — Which is strongest, the barbarous or civilized races? — Name some varieties of the human race noted for their stature. — Name some noted for peculiarities in the formation of the skeleton. — Name others noted for peculiarities in their skin, hair, or eyes. — State some diversities, other than physical, observable among mankind.

The degree of civilization which various tribes have attained, and the forms of government under which they live, are very different. In some countries, the United States and Great Britain for example, life and property are under the protection of the law, and held sacred. In other parts of the world, as Dahomey, in Africa, life is taken at the will of the king, on the most trifling pretexts.

Most, if not all, of the different varieties of the human race appear to have some idea of a Supreme Being, though with many rude tribes it is very imperfect. The Christian religion, as taught in the Holy Scriptures, only prevails among the most highly civilized nations. The forms of worship vary in other nations, becoming, in many cases, the lowest and most degrading superstitions.

X. Taking into consideration the diversities of mankind which have been heretofore enumerated, the entire human family may be regarded as constituting five races, each distinguished by marked and characteristic peculiarities. These races are severally named as follows: — 1. The Caucasian, or white race; 2. The Mongolian, or yellow race; 3. The Ethiopian, or black race; 4. The Malay, or brown race; 5. The American, or red race.

Naturalists of the past and present century have arrived at very different conclusions, as to the number of races into which mankind may be divided. The distinguished Baron Cuvier writes, "that of certain hereditary peculiarities of conformation which constitute what are termed races, three in particular appear eminently distinct: the Caucasian, or white; the Mongolian, or yellow; and the Ethiopian, or Negro." But this naturalist was undecided whether to refer to either of these, the Malays, the Papuans, the Australians, South Sea Islanders, and Indians of America.

Dr. Prichard, a very high authority, observes that "comparing the principal varieties of form and structure which distinguish the inhabitants of different countries, there are seven classes of nations, which may be separated from each other by strongly marked lines." The Ethiopian and Malay races, in the classification adopted in this work, are each considered by Dr. Prichard as constituting two races.

Dr. Pickering, the naturalist of the United States' Exploring Expedition, and a gentleman probably whose own individual observation has exceeded that of any of the naturalists who have written on this subject, in the first chapter of his very excellent and interesting work, says: "I have seen, in all, eleven races of men; and though I am hardly prepared to fix a positive limit to their number, I confess, after having visited so many different parts of the globe, that I am at a loss where to look for others."

In his classification, the races are arranged under four colors: the white includes the Arab and Abyssinian; the brown, the Mongolian, Hottentot, and Malay; the blackish-brown, the Papuan, Negrillo, Indian of Hindoostan (also called Telingan), and Ethiopian; and the black, the Australian and Negro races. In the classification of this book, the Arab, Abyssinian, Telingan, and part of the Ethiopian races, of Dr. Pickering's classification, are included in the Caucasian; and the Papuan, Negrillo, Hottentot, Australian, Negro, and remainder of the Ethiopian races, are included in the Ethiopian. The race described in this work as American is included by Dr. Pickering in his Mongolian and Malay races. Other writers of greater or less note have adopted still different classifications.

The classification adopted in this book is that of Blumenbach, and is essentially the same with that previously made by the great naturalist, Buffon. In the light of modern ethnographical science it may or may not be the most correct, but since it is that most generally known, it is most convenient for the purposes of this work — which is not so much to show the history of the different races, as their present geographical distribution.

The pupil who wishes further to investigate this most interesting subject, is referred to the works of Dr. Prichard, the "Races of Men," by Dr. Pickering, and the "History of the Human Species," by Col. Hamilton Smith.

State some facts to show the difference in the civilization of different countries. — In what nations does the Christian religion prevail? — Into how many races may the whole human family be divided? — What was the classification of Baron Cuvier? — What was Dr. Prichard's? — Quote the language of Dr. Pickering upon this subject.

XI. The Caucasian race comprises the inhabitants of Hindoostan, Afghanistan, Persia, Turkey, Arabia, Georgia, Circassia, and a section of Chinese and Independent Tartary, in Asia; the Great Desert, Barbary States, Egypt, Nubia, and Abyssinia, in Africa; all of Europe (except the Finns, Laplanders, Magyars of Hungary, and Turks), and the descendants of Europeans in America and other parts of the globe.

CAUCASIAN RACE.

1. European. 2. Circassian Chief. 3. Georgian Girl.
4. Arab Chief. 5. Brahmin, or Hindoo Priest. 6. Western Hunter.

This vast section of the human family comprehends at present, and has ever done since the date of authentic history, the most perfectly formed, vigorous, and intellectual of mankind. The Egyptians, Hindoos, Assyrians, Babylonians, Medo-Persians, Greeks, and Romans, successively represented the civilization of past ages. They founded mighty empires, and obtained paramount influence in the world — a heritage which has descended to the nations of Western Europe, and their off-shoot in the United States.

The Caucasian race received its name from the supposition that it originated in the mountains of Caucasus, whence it is supposed to have spread into Europe and Asia. Col. Hamilton Smith conceives the true origin of the race to have been in the beautiful valleys where the Indus, Amoo, and Cashgar have their upper courses, among the mountains of Hindoo Koosh, the true Caucasus of the ancients.

A small, beautifully-shaped head, oval face, expanded forehead, small mouth, regular features, symmetrical shape; fine, copious, and flowing hair; complexion generally white, but of all shades — fair, florid, olive, swarthy, and even black — are the peculiar characteristics of the Caucasian race. It is only in this race we find the full-bearded man, and the clear, transparent skin, which admits the soft-spreading blush of woman.

The European and American divisions of this race, the Abyssinians of Africa, and Armenians of Turkey and Persia, profess the Christian religion. The Arabs of Asia and Northern Africa; the Berbers, Egyptians, and Moors of Northern Africa; and the Persians, Afghans, and some other tribes of Asia are Mohammedans. The Hindoos are Pagans.

What does the Caucasian race comprise? — What has been the character of this race in past times? — What is its present character? — From what does it derive its name? — Describe this race. — Which nations profess the Christian religion? — Which the Mohammedan? — Name the principal Pagan nations of this race.

The entire number of the Caucasian race is estimated at 500,000,000, distributed as follows: —

Inhabitants of Europe	250,000,000
European colonists and their descendants in America	33,000,000
European colonists and their descendants in other parts of the globe,	2,000,000
Arabs, Berbers, Moors, Egyptians, Abyssinians, and other tribes of Northern Africa	22,000,000
Inhabitants of South-western Asia	193,000,000
Total	500,000,000

XII. The Mongolian, or yellow race, comprises the Esquimaux of America; the Finns, Laplanders, Osmans of Turkey, and Magyars of Hungary, in Europe; the inhabitants of Ceylon and the Japanese Islands, the Siberian and Tartar tribes, the natives of China, and all South-eastern Asia, except the Malays of Malacca.

Mongolian Race.

1. Thibetian Priest. 2. Chinese Mandarin. 3. Mongol Tartar
4. Lapland Woman. 5. Kamtschatdale. 6. Esquimaux.

The Mongolian race ranks in numbers next to the Caucasian; and probably so, also, in other respects. It derives its name from Mongolia, in Central Asia, where it is supposed to have originated.

A yellow, or sallow, olive complexion; dark eyes, small, and obliquely set; long, straight, black hair — with little, if any, beard, eye-brows, or eye-lashes; broad skulls, and high cheek-bones, are peculiarities of the Mongolian race.

Different varieties of this race vary greatly in stature and personal appearance. The Esquimaux of America, the Finns and Laplanders of Europe, and the Samoides and other tribes of Siberia, are of a diminutive size, equally ugly in face and form. The Kalmucks, and other Tartar tribes of Central Asia, whose whole employment is the chase, war, and the tending of cattle, are rather a handsome people; and like all who lead a savage life, are endowed with very acute senses of seeing and hearing.

The Chinese and Japanese have made very considerable advancements in the arts of civilization, and their institutions date back for a long period; yet they are inferior to many of the lower families of the Caucasian race.

What is the entire number of the Caucasian race? — What nations does the Mongolian race comprise? — How does this race rank with reference to the Caucasian? — State some particulars with reference to different varieties of this race.

The Osmans of Turkey, the true Turks, and present rulers of the country, are Mongolians; and from being one of the ugliest families in Europe, by frequent intermixtures with other races, have become one of the handsomest. The Magyars of Hungary are a bold, handsome family, of Mongolian origin, which established themselves in Europe in the ninth century, and became Christians in the eleventh century.

The Finns, Laplanders, and Magyars profess the Christian religion; the Turks, and some of the Tartar tribes, are Mohammedans; the remainder of the race are attached to different systems of the Pagan religion.

The Mongolian race is estimated to number about 450,800,000, distributed as follows: —

Esquimaux of Northern America, and Chinese of California, America,	100,000
Finns, Laplanders, Magyars, and Osmans of Turkey, — Europe	15,500,000
Inhabitants of Asia and Asiatic Islands	435,200,000
Total	450,800,000

XIII. The Ethiopian, or black race, comprises the natives of Africa, south of the Great Desert and Abyssinia; the inhabitants of the islands of Australia, Papua, or New Guinea, New Hebrides, New Caledonia, Solomon's Archipelago, the Feejee Islands, a part of Madagascar, and several tribes of the Malaysian Islands. A large number of this race are held in slavery in America.

Ethiopian Race.

1. Mandingo. 2. Galla. 3. Foulah Woman.
4. Papuan. 5. Australian. 6. Bushman.

The head of the Ethiopian is narrow, and compressed at the sides; the nose is broad and flat; the lips, especially the upper one, are very thick; the eyes are black, large, and prominent; the hair is black and woolly; and the skin is dark-colored, often jet black.

A great difference is observable in individuals and tribes of this race. Some of the tribes south of the Great Desert are tall, finely-shaped, and exhibit much intelligence; while the Bushmen and Hottentots of South Africa, classified by some writers as a different race, are among the most hideous creatures in existence.

What does the Ethiopian race comprise? — Describe the general appearance of this race. — Is there much difference in the individuals and tribes of this race? — State some facts to illustrate your statement.

The Gallas principally inhabit Eastern Africa, south of Abyssinia. They are a tall, black people, divided into many tribes, all of which appear to be equally cruel and ferocious. The Mandingoes and Foulahs inhabit Western Africa. They are handsome varieties, considerably advanced in civilization.

The Papuans of New Guinea, New Caledonia, and the Feejee Islands, classed by Dr. Pickering as a separate race, are a family of robust blacks, among the most ferocious upon the globe. They are cannibals. The individuals of this race present a singular personal appearance, on account of their enormous heads of hair.

The Australians, and some rude tribes of blacks who inhabit the interior of many of the islands of Malaysia, (classified by Dr. Pickering as constituting two separate races,) are in many respects the most degraded of human beings. The natives of one of the New Hebrides Islands are described by a sea-captain, who visited them, as more resembling monkeys than men.

The Ethiopian race is computed to number 53,500,000, distributed as follows: —

Slaves and free blacks in America	13,000,000
Natives of Africa	36,100,000
Natives of Madagascar	2,000,000
Papuans, Australians, and other tribes of islands in the Pacific and Indian Oceans	2,400,000
Total	53,500,000

XIV. The Malay, or brown race, comprises the chief part of the native inhabitants of the peninsula of Malacca, the islands of Malaysia, New Zealand, and Polynesia (except the Feejee Islands), and a part of Madagascar.

MALAY RACE.

1. Malay of Malacca. 2. Javanese Chief. 3. Madegasy of Madagascar.
4. Hawaiian. 5. Tahitian Woman. 6. New Zealand Chief.

The Malayans have a reddish-brown complexion; long, coarse, black hair; deep-set, black eyes; flat faces, and a low forehead.

Considering the race as constituting two divisions — the Malay and Polynesian, the latter inhabiting the islands of Polynesia — a great difference will be observed in their stature. The Polynesians are very tall, while the natives of the islands of Malaysia are decidedly below the general average.

Describe the Gallas.—Papuans.—Australians.—What does the Malay race comprise? —Describe the general appearance of this race.—Name the two divisions of the Malay race. — What is said of their respective heights?

The Polynesians are generally mild and gentle in their disposition. Many of them have adopted the Christian religion. On islands where the white men have established themselves, the Sandwich Islands for example, the native population has much decreased, and ultimately will probably become extinct.

Many of the Malays are Mohammedans; and the natives of some of the islands are far advanced in social life, while in others they are rude, ferocious, and vindictive.

The entire number of the race is estimated at about 23,500,000, distributed as follows: —

Malays of Malacca	500,000
Malays of Madagascar	2,000,000
Inhabitants of Polynesia	350,000
Inhabitants of Malaysia	20,650,000
Total	23,500,000

XV. The American, or red race, three centuries and a half ago, occupied the entire American Continent. Decreasing in numbers, they are rapidly disappearing before the white man; and seem destined, at no distant day, to become extinct. The entire number of the race is estimated not to exceed eleven millions.

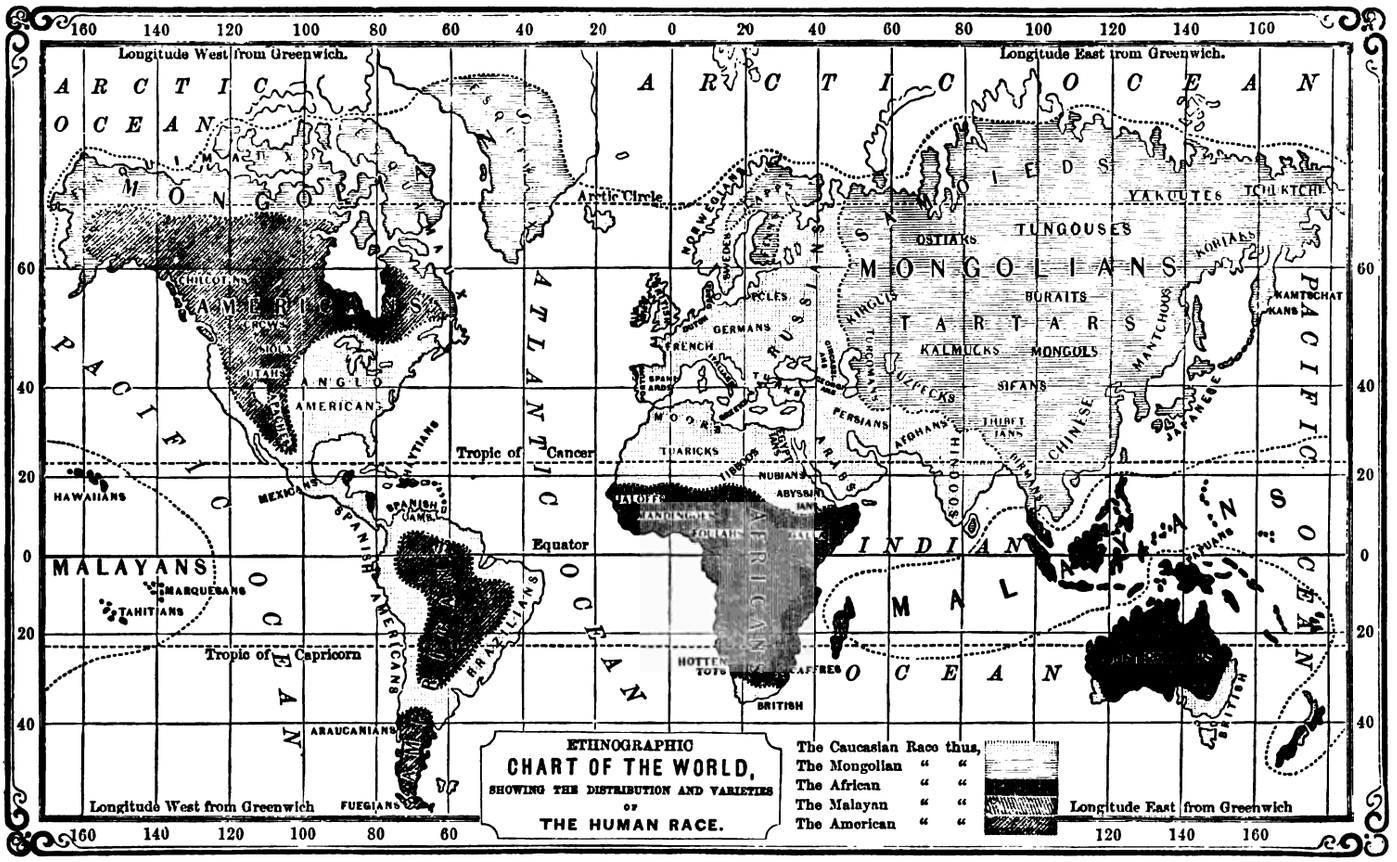
AMERICAN RACE.

1. Pawnee Chief. 2. Comanche. 3. Digger, or Snake Indian.
4. Araucanian. 5. Patagonian. 6. Fuegian.

A copper-colored complexion; long, coarse, black hair; scanty beard; black, sunken eyes; large mouth, and high cheek-bones, are peculiar characteristics of this race. In many respects it much resembles the Mongolian, with which it is often classed.

A few of the North American tribes, the Cherokees and Choctaws for example, are civilized — practising the arts of agriculture, and living in towns, where they have established schools and churches. By far the greater part, however, still retain their savage habits; roaming over the entire western section of the country, from Mexico to the region of the Esquimaux; subsisting by war, robbery, or the chase. The Chenooks,

Describe the Polynesian division.—What is the estimated number of the Malay race? —Are the red race increasing or decreasing in numbers? — What race does it most resemble? — Describe some of the tribes.



inhabitants of Nootka Sound, and other north-western tribes, are among the most degraded of mankind.

The Snake Indians, popularly known as Diggers, inhabit the desert region of the Great Basin of Utah. They are a thieving, miserable tribe, who subsist chiefly upon roots dug from the ground. Lizards and crickets also form a portion of their food. The Comanches and Apachees are warlike tribes, which roam over the plateaus and plains of Texas and New Mexico.

In Mexico, Central America, and in South America, in all of which the Indians have much intermixed with other varieties, they are a half-civilized people, living in villages, and practising the rude arts of agriculture. Some tribes, as the natives of Terra del Fuego, and the dirt-eaters of the Orinoco region, are very degraded. The Caribs of Venezuela, and the Patagonians, who inhabit the desolate parts of the southern extremity of the continent, are very tall. The Araucanians of Southern Chili are a brave tribe, who live mostly by the chase, and who have successfully defended their country against the all-conquering whites.

Though ranging through many climates, and subsisting on very different kinds of food, the Indian race has the same general appearance in Patagonia, Brazil, Mexico, and Oregon.

XVI. The following is a summary of the present population of the globe, arranged in races, and by territorial divisions. The estimates are made from the most recent and reliable authorities, but in many cases they are mere estimates.

Caucasian Race	500,000,000	Asia	630,700,000
Mongolian "	450,800,000	Europe	265,400,000
Ethiopian "	53,500,000	Africa	61,700,000
Malay "	23,500,000	America	57,600,000
American "	11,000,000	Oceanica	23,400,000
Total	1,038,800,000	Total	1,038,800,000

QUESTIONS ON THE CHART.

In which of the Grand Divisions of the globe are the Caucasian race most numerous? — In which the Mongolian? — The Ethiopian? — Which race principally inhabit Islands?—On which Continent do you find the American race?—On which the greater part of the Mongolian race?

To what race do the Hindoos belong? — The Nubians?—The Arabs? — Are all the varieties of the Caucasian race alike advanced in civilization?—Which do you think the more enterprising people, the English or the Persians? — The French or the Arabs?—The Germans or the Abyssinians? — The Nubians or Swedes?

Are the men who inhabit the northern parts of the Continent inferior or superior to those who live in the North Temperate Zone? — How do the people who inhabit the Torrid Zone compare with those who reside in the Temperate? — Which are usually the most enterprising class: those who live on islands, or those who dwell on continents? — Give illustrations to prove your statement.

To what race do the Chinese belong?—The Japanese?—Which of these two varieties inhabit islands? — In what Grand Division of the globe do you find Birmans? — What part of the American Continent is inhabited by a variety of the Mongolian race?—Which is most advanced in civilization, this variety or the Chinese?

Is there any difference in the physical appearance of the various tribes of the Ethiopian race?—What kind of a people are the Australians?—To what race do they belong?—Which are usually the tallest, Hottentots or Patagonians?—Which are most advanced in civilization, Foulahs or Australians? — To what race do the Papuans belong? — To what the Haytians?

What is the color of the Malays?—Do they principally inhabit islands or continents?—In what Grand Division are they found? — To what race do the inhabitants of the Sandwich Islands belong?

What race formerly inhabited nearly all of America?—What is the present character of this race? — Is it increasing or decreasing in numbers?—Who inhabit the northern part of America? — To what race do they belong? — Name the tribe inhabiting the most southern portion of the American Continent?

Which Grand Division contains the greatest population?—Which the least?—Which race is most numerous? — Which is least in number? — Which race is most numerous, the Malay or the Indian? — The Ethiopian or Mongolian?

PHYSICAL GEOGRAPHY

OF

THE UNITED STATES.

CHAPTER I.

GEOGRAPHICAL POSITION AND EXTENT.—PENINSULAS, CAPES, AND ISLANDS.

I. THE UNITED STATES occupy the central part of the northern division of the American Continent. They are washed by the Atlantic Ocean on the east, and the Pacific on the west; by the chain of great lakes on the north, and the Gulf of Mexico on the south.

The United States extend through 24½° of latitude, from the parallel of Key West, in Florida, 24° 32′, to the parallel of 49°; and through 57° of longitude, from the 67th to the 124th meridian,—nearly one-sixth of the distance round the globe. A line drawn on the 40th parallel of latitude, from their eastern to their western boundary, would have an extent of 2650 miles; and one drawn on the 98th meridian of longitude, from their northern to their southern boundary, would have an extent of 1600 miles. The entire area of the country may be stated at about three millions of square miles.

II. The coast-line of the United States is comparatively unbroken, the sea rarely penetrating far into the land; and on the other hand, the land in but few cases projects any great distance into the ocean.

In these respects, there is a wide difference between the United States and Europe, which is especially noted for its deep and extensive inland seas, branches of the great ocean, so valuable for purposes of navigation. The United States, however, are amply compensated for their want of such facilities, by numerous navigable rivers, and the chain of great lakes which forms a part of the northern boundary.

The extent of the coast-line is estimated as follows:—

Atlantic Coast, from mouth of St. Croix River, Maine, to Cape Sable, Florida	2525 miles.
Coast of Gulf of Mexico, from Cape Sable to mouth of Rio Grande	1925 "
Pacific Coast, from the Parallel of 32° 30′ to that of 49°	1750 "
Total	6200 "

The principal branches of the sea extending into the land are Chesapeake, Delaware, and Massachusetts Bays, and Albemarle and Pamlico Sounds on the Atlantic coast, and the Bay of San Francisco on the Pacific coast. The principal bodies of land projecting into the sea are the Peninsulas of Florida on the south-east, and Cape Cod on the east, both extending into the Atlantic Ocean.

Give the boundaries and extent of the United States.—How does its coast-line compare with that of Europe?—Name the principal bodies of water projecting into the land.—Name the principal points of land extending into the ocean.

Most peninsulas have the line of their greatest extent from north to south, as Florida. The Peninsula of Cape Cod is an exception, extending first in an easterly direction, then turning to the north, and terminating in a low, sandy point.

The Golden Gate is the channel connecting the Bay of San Francisco with the Pacific. Long Island Sound is a shallow body of water north of Long Island, through which is carried on much of the commercial intercourse between the city of New York and the New England States.

III. Many inferior projections of land, known as capes or points, extending a short distance into the ocean, mark the entrance of bodies of water into the land, or the pointed termination of bodies of land in the ocean.

Cape Ann and Cape Cod, the terminating point of the Peninsula of Cape Cod, mark the entrance of Massachusetts Bay. Montauk Point is the eastern extremity of Long Island. Sandy Hook marks the entrance of New York harbor; Cape Henlopen and Cape May, of Delaware Bay; Cape Charles and Cape Henry, of Chesapeake Bay.

Cape Hatteras (the dread of mariners), Cape Lookout, Cape Fear, Cape Canaveral, and Cape Florida, are low, sandy points, projecting into the Atlantic Ocean. Cape Sable is the south-west point of the Peninsula of Florida. Cape Romans and Cape St. Blas are points extending into the Gulf of Mexico. Points Conception and Delgado, and Capes Mendocino, Orford, Foulweather, Lookout, and Flattery, project into the Pacific. Cape Orford is the most western point of land in the United States.

IV. Numerous islands are scattered along the various coasts of the United States, most, if not all, of which give evidence, both by their geological structure and geographical position, that they were once a part of the main land, and have been separated from it by some convulsion of nature, or violent storm, or by the long-continued action of the waters of rivers and the ocean.

The islands of the Atlantic coast, north of the Peninsula of Cape Cod, are mostly of granite formation, and considerably elevated above the sea. Mount Desert Island, on the coast of Maine, containing an area of about 150 miles, is the largest.

South of this peninsula, on the Atlantic coast, and on the coast of the Gulf of Mexico, the islands are generally low and sandy. Long Island, east of New York, containing an area of 1450 miles, is the largest. Nantucket Island, and Martha's Vineyard, east of Long Island, and the Tortugas and Florida reefs, south-west of Florida, are the other principal islands.

The Santa Barbara Islands are a barren, rocky group, situated in the Pacific Ocean, off the coast of California. They contain several good harbors.

Name the principal capes along the coast of the United States.—What is the character of the islands north of Cape Cod Peninsula?—What of those on the Atlantic coast south of Cape Cod, and on the coast of the Gulf of Mexico?—Describe the Santa Barbara Islands

CHAPTER II.

MOUNTAINS.

I. THE mountain-chains of the United States may be considered as constituting three different systems, namely: the Alleghany, or Appalachian; the Rocky Mountain, and the California systems.

II. The Alleghany system extends in a south-west direction, in a line nearly parallel with the Atlantic coast, from the Gulf of St. Lawrence to about the 34th parallel of latitude, or within about 200 miles of the Gulf of Mexico. In some parts of its extent, this system consists of a single chain; but it is generally composed of several parallel ranges, with valleys between them.

For a more particular description of this system, let the Highlands of the Hudson River, which have an elevation of from 1000 to 1700 feet, be assumed as a starting-point.

From the Highlands, in a south-west direction, at a distance from the Atlantic varying from 50 to 300 miles, is a nearly continuous chain, the most eastern range of the system, which is finally lost in a series of slight elevations, between the head-waters of the Savannah and Chattahoochee Rivers, about latitude 34°. South of the 40th parallel, this chain is known as the Blue Ridge; north of it, as the Kittatinny, or Blue Mountains. Mount Mitchell, a peak of the Blue Ridge, is the highest elevation of the Alleghany system.

West of this range are several ridges, known in different parts of their extent by different and local names. The principal of them, named in the order from east to west in which they occur, are the Alleghany Mountains, Laurel Ridge, Chestnut Ridge, and the Cumberland Mountains.

From the Highlands, in a north-east direction, a continuous chain may be traced, through Connecticut, Massachusetts, and Vermont, into Canada. In Vermont, this chain is known as the Green Mountains.

View of the Willey House and Notch, White Mountains.

The White Mountains of New Hampshire, so noted for their grand and beautiful scenery, are a spur from the Appalachian system. An irregular chain of high lands, which extend across the State of Maine, above the head-waters of the Penobscot and Kennebec Rivers, may also be regarded as an outlying spur of the same system. Mount Katahdin, 5000 feet high, and Mars Hill, 1683 feet in height, are the principal elevations of the Maine Highlands.

North of the Highlands, in the State of New York, are the two groups of the Catskill and Adirondack Mountains. The Catskill Mountains are much visited by tourists, and greatly admired for the beautiful scenery in which they abound.

Regarding the Alleghany system as a continuous chain, its entire length from the northern boundary of Vermont, Lat. 45°, to where it disappears in the low lands of Alabama, Lat. 33° 30′, may be stated at 1300 miles. The system ranges in width from 30 to 150 miles, averaging, perhaps, about 60 miles. The average elevation is from 2000 to 3000 feet.

Between the different ranges are many valleys of greater or less extent. The Valley of Virginia, west of the Blue Ridge, is the most extensive of them, and has been long noted for its beauty and fertility.

III. The Rocky Mountain system of the United States is a part of the great American chain which extends from the Arctic Ocean to the Straits of Magellan.

The main chain of this system extends in a southerly direction, entirely across the United States, forming the water-shed between the Atlantic and the Pacific Oceans. From the northern boundary of the country to the 38th parallel of latitude, this chain is known as the Rocky Mountains — thence to the southern boundary, as the Sierra Madre.

A spur, called the Black Hills, branches off at about the 40th parallel, and extends in a north-east direction, nearly to the Missouri River. From about the same parallel, a nearly continuous chain may be traced in a southerly direction, east of the Rio Grande, into Texas. In various parts of its extent this chain is known by different and local names. The Guadalupe Mountains and Sierra Diavolo are among the principal ranges.

The Wahsatch Mountains are an important branch of the main chain. They extend in a south-west direction, from about the 42d parallel, nearly, or quite, into the State of California; perhaps uniting the Rocky Mountain and California systems.

IV. The California system of the United States comprises the mountain-chains of the country west of the Rocky Mountain system. The principal ranges are the Cascade, the Sierra Nevada, the Coast, and the Blue Mountains.

The Coast Mountains, the most western chain, extend along the Pacific coast from the southern boundary of California to the Strait of Fuca. They are of inconsiderable elevation, rarely rising more than 2000 or 3000 feet; their distance from the ocean varying from 30 to 60 miles.

The Sierra Nevada Mountains branch off from the coast-range at about the 35th parallel, and extend in a northerly direction to about the 43d parallel, where they are merged in the Cascade range. The gold-producing valleys of the Sacramento and San Joaquin Rivers lie between the Sierra Nevada and the Coast Mountains.

The Cascade range extends from about the 40th parallel, between the Sierra Nevada and Coast Mountains, across the Territories of Oregon and Washington into British America. It is the loftiest chain of mountains in the United States. Several of the peaks are volcanic, and from some of them smoke and ashes still occasionally issue. The Blue Mountains are a spur from the Cascade range, which extend in a north-eastern direction from about the 43d parallel to Lewis River.

The entire country between the Cascade range and Sierra Nevada on the west, and the Rocky Mountains on the east, (a more particular description of which will be found in the next chapter,) is an elevated table-land, traversed by many mountain-chains and broken ridges, which frequently unite the two mountain-systems just described.

V. Most of the ranges of the Alleghany system, as well as the Coast chain of California, are covered with vegetation to their summits; while the loftier heights of the Cascade range, Sierra Nevada, and Rocky Mountains, are barren and inaccessible: many of the peaks being perpetually covered with snow, and vegetation only occurring on their lower slope and at their base.

Name the three mountain-systems of the United States.—Which of them borders the Atlantic coast? — Name the principal ranges of the Alleghany system south of the Hudson River. — Name those north-east of the Hudson.—Which are the principal elevations of the Maine Highlands? — Name the two mountain-groups in the State of New York. — Where is the Valley of Virginia?

Of what great chain is the Rocky Mountain system a part?—Name some of the principal spurs of this system.—What does the California system comprise?—Describe the Coast chain.—Cascade range.—Sierra Nevada.—What is the character of the country between the Rocky Mountains and the Cascade range and Sierra Nevada? — What is said of the growth of vegetation on these mountains?

CHAPTER III.

GENERAL SURFACE OF THE COUNTRY.

I. The diversities in the surface of the United States may be most conveniently described by considering the entire country as constituting seven distinct Hydrographical regions, or sections, the waters of which flow in opposite directions into different bodies of water, or different parts of the same body. Their names and areas are as follows: —

	Area in Square Miles.
1. The St. Lawrence Basin	130,000
2. The Atlantic Slope	420,000
3. The Mississippi Valley	1,300,000
4. The Texas Slope	280,000
5. The Pacific Slope	630,000
6. The Inland Basin of Utah (Great or Fremont Basin)	220,000
7. The Basin of the Red River of the North	20,000
Total	3,000,000

The water-shed separating the different regions is, in some cases, a mountain-chain — as the Rocky Mountains, which separate the Mississippi Valley and the Pacific slope; and in others, it is a very slight elevation of the general surface — as the water-shed dividing the St. Lawrence Basin from the Valley of the Mississippi, on the prairies of Illinois and Wisconsin — the elevation of which is scarcely perceptible.

II. The St. Lawrence Basin includes that portion of the United States, the waters of which flow into the St. Lawrence River, or into the chain of great lakes, of which that river is the outlet.

It embraces a part of Vermont, New York, Pennsylvania, Ohio, Indiana, Illinois, Wisconsin, Minnesota, and all of Michigan. The entire region is a well-wooded, fertile plain, varying in elevation above the level of the sea from 300 to 1500 feet.

III. The Atlantic Slope includes the region drained by rivers flowing into the Atlantic or Gulf of Mexico, from the River St. Croix to the Mississippi.

It embraces all the New England States, except a part of Vermont; all of New Jersey, Delaware, the District of Columbia, South Carolina, and Florida; and a part of New York, Pennsylvania, Virginia, Maryland, North Carolina, Georgia, Alabama, and Mississippi.

The north-eastern section of this slope extends from the River St. Croix to the Hudson. It is a hilly and generally fertile country, abounding in limpid streams, clear lakes, and ponds. It increases in width from the Hudson towards the north-east.

The south-western section widens from the Hudson towards the Gulf of Mexico. This section embraces two distinct divisions. The first is a low, level plain, immediately adjoining the ocean, above which it rarely rises more than 100 feet. Along the Atlantic coast this division is about 100 miles wide. It includes all of the Peninsula of Florida, and a tract along the Gulf of Mexico 150 miles in width.

From the Hudson to the Roanoke River this is a sandy region, which, though not naturally fertile, is susceptible of being made highly productive by cultivation. South of the Roanoke, this plain abounds in swamps, though there are extensive tracts of sandy land covered with pine forests, and a considerable extent of rich alluvial soil.

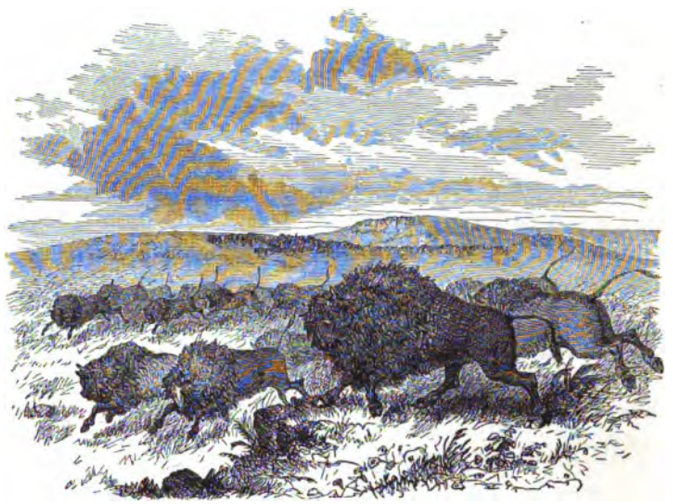
The tract of land between the mountains and the section already described, which has an average elevation of about 1000 feet, is a plain, sloping to the south-east. It is a well-watered, beautiful, and highly-fertile section; one of the most attractive and richest districts of the United States.

Name the Hydrographical regions into which the United States may be divided. — Describe the water-shed separating these regions. — What is the character of the land of the St. Lawrence Basin? — What States are included in this division? — Name the political divisions of the Atlantic Slope. — Describe each of the physical divisions.

IV. The Mississippi Valley includes the vast tract of country drained by the Mississippi River and its tributaries. It extends from the Alleghany to the Rocky Mountains, and from the Gulf of Mexico to the northern boundary of the country. Near the Gulf, this Valley is less than 100 miles wide, and on the 40th parallel of latitude its width is 1350 miles.

The political divisions embraced in this Valley are portions of New York, Pennsylvania, Maryland, Virginia, North Carolina, Georgia, Alabama, Mississippi, Louisiana, Ohio, Indiana, Illinois, Wisconsin, Minnesota, New Mexico, and Texas; and all of the States of Kentucky, Tennessee, Arkansas, Missouri, and Iowa — with Nebraska, Kansas, and Indian Territories.

The Mississippi Valley forms the chief part of the southern slope of the great North American Plain, described on page 17. It comprises more than two-fifths of the entire area of the United States, and is for the most part a region of unrivalled fertility.



View on a Western Prairie.

That portion of the Valley east of the Mississippi River has a very gradual ascent to the base of the Alleghany Mountains — the average elevation may be 500 feet. Almost the whole surface, with the exception of the prairie regions of Wisconsin and Illinois, was originally clothed with forests, and a large extent yet continues so.

From the Mississippi River, westward to within from 200 to 400 miles of the base of the Rocky Mountains, the land has a gradual ascent of about six feet to the mile. The greater part of this section is prairie country, on which there are no trees, except upon the borders of the streams. Some tracts of prairie land are very level, while others are undulating, all being covered with a heavy growth of grass.

The country east of the Rocky Mountains, for a distance varying from 200 to 400 miles, is a desert plateau, from 2000 to 5000 feet in elevation. "Recent explorations prove," says the Hon. Jefferson Davis, Secretary of War, in his recent report on the explorations for the Pacific Railroad, "that the soil of the greater part of this region is, from its constituent parts, necessarily sterile; and that the remaining part, although well constituted for fertility, is, from absence of rain at certain seasons, except where capable of irrigation, as uncultivable and unproductive as the other."

V. The Texas Slope includes all that portion of the United States, west of the Mississippi Valley, drained by rivers flowing into the Gulf of Mexico.

The political divisions of this region are nearly all of Texas, a part of Louisiana, and a large portion of the territory of New Mexico.

State the extent of the Mississippi Valley. — Name the political divisions included in this Valley. — What part of it is well wooded? — What part of it is prairie? — What portion is table-land? — Is any portion sterile? — What part of the United States is included in the Texas Slope? — Name the political divisions of this slope.

This slope comprises three separate divisions. The first is a low plain, from 30 to 60 miles wide, which borders immediately on the Gulf. This section is in general an extremely fertile region; the river-bottoms are remarkably productive. It contains extensive cane-brakes and some swamp lands.

The second division extends further inland, a distance of 150 or 200 miles. This is a gently undulating, prairie country, which gradually rises towards the north-west, to an elevation of about a thousand feet. This is also a fertile region, and admirably adapted for grazing.

The remaining division is a lofty table-land, which is traversed by several mountain-ranges. The eastern part of this plateau is called the Llano Estacado, or "staked plain." It was so named by the Mexicans, who drove stakes in the ground as a guide to their route across it. This plain is nearly as large as the entire State of Pennsylvania. It is at certain seasons of the year entirely destitute of water; it is scantily supplied with grass, and not a single tree is to be seen upon it.

The Valley of the Rio Grande, and some other narrow valleys, are perhaps the only fertile tracts embraced within this division.

Along the eastern borders of this sterile region, stretches a remarkable belt of wood-land, called the "Cross Timbers." It is about 400 miles long, and from ten to twenty-five miles wide, and separates the fertile low-land plains from the desert plateau.

VI. The Pacific Slope includes that portion of the United States drained by rivers flowing into the Pacific Ocean.

This section comprises the greater parts of the States of California and Oregon, nearly all of Washington Territory, and a part of Utah and New Mexico. It forms three separate divisions, the Western, Northern, and Southern.

The Western division embraces the country between the Coast Mountains and the Pacific, and the valleys between this chain and the Cascade range and Sierra Nevada. This is a region 1200 miles in length, by 120 miles in width, containing an area of about 140,000 square miles. It is a moderately elevated country, generally well watered and exceedingly fertile, and is the only extensive section of the Pacific slope capable of supporting a dense population.

The Northern division embraces the section north of the Great Basin, between the Rocky Mountains and the Cascade range. This entire region is a table-land, with an average elevation of from 2500 to 3000 feet, traversed by many broken mountain-ridges. It is described by the Hon. Jefferson Davis, as "a region of general sterility," to which "there are exceptions in the mountain valleys, where the soil is better constituted for fertility, and the rains are more abundant; but although portions of these are suitable for agricultural purposes, they are better adapted to grazing."

The Southern division of the Pacific slope includes the country lying between the Wahsatch and Rocky Mountains, which is drained by rivers flowing into the Gulf of California. It is in general a table-land, with an average elevation of about 4000 feet; and like the Northern division, is traversed by many broken mountain-ridges. Near the 32d parallel, the surface of this plateau is described by the Secretary of War, as being so level that scarcely any preparation is necessary (except through the mountain-passes,) to fit it to receive the superstructure for a rail-road.

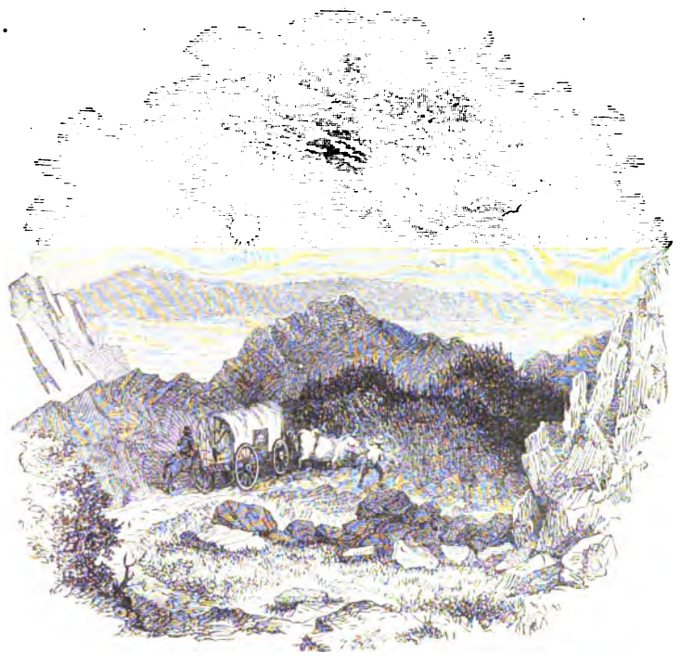
Like the Northern division, this region is one of general sterility. Some of the valleys and mountain slopes are fertile, and considerable tracts are well adapted for grazing; but it also contains extensive desert tracts, on which very little rain falls, and no vegetation is found.

VII. The Inland Basin of Utah (Great or Fremont Basin,) includes a considerable tract of country, the waters of which do not flow into the ocean, but are lost in the sand, or by evaporation, or flow into lakes which have no outlet.

This basin embraces most of the Territory of Utah and a small part of California, Oregon, Washington, and New Mexico.

Describe each of the three physical divisions of the Texas Slope.—Name the political divisions of the Pacific Slope. — The physical divisions. — Which of these divisions is fertile? — What is the general character of the soil of the other divisions?

The Great or Fremont Basin is a plateau with an average elevation of about 5000 feet, surrounded by rugged mountains. It is a dreary, desolate region, abounding in salt lakes; a few of the valleys on its eastern side are made fertile by irrigation, and these alone are inhabited by civilized man.



View of Salt Lake Valley, in Fremont Basin.

VIII. The Basin of the Red River of the North includes a small tract of country in the northern part of Dakota and Minnesota, the waters of which are drained by that river into Lake Winnipeg, and thence by Nelson's River into Hudson's Bay.

The section of country embraced in this basin is a plain, elevated about 1500 feet above the level of the sea. It is a tract similar in all respects to the adjoining regions, which are drained by the Mississippi and St. Lawrence Rivers.

The water-shed which separates the Mississippi Valley from this basin marks the highest elevation of the great North American plain, which extends from the Arctic Ocean to the Gulf of Mexico. From this line south to the Gulf of Mexico, and north to the Arctic Ocean, there is a gradual descent. The elevation of this water-shed is so slight, that during high water, caused by heavy rains, boats may pass from one basin to the other.

IX. From the preceding descriptions, it will be seen that the fertile slopes of the Pacific are separated from the rich prairies of the Mississippi Valley and Texas Slope by a belt of mountains and table-lands, varying in width from 700 to 1300 miles.

The soil of the country included in this belt is generally sterile; much of it is, from its nature, hopelessly so. There are other tracts, however, the soil of which is naturally fertile, and which is unproductive only on account of the want of moisture. Some sections, it is supposed, may be made fertile by irrigation; and other desert tracts may be made passable by digging wells, or sinking Artesian wells. Through some of the mountain-passes of this belt it is proposed to construct a rail-road to the Pacific.

It will also be perceived that this belt is the only sterile tract of country of any considerable extent in the United States; the Pacific Slope, and the entire region east of the barren plateau which stretches along the eastern base of the Rocky Mountains, being in general very fertile sections.

Describe the Inland Basin of Utah. — A portion of what Territories are included in this Basin? — Is the soil of this region fertile? — Describe the Basin of the Red River of the North.—The tract of country between the Pacific Slope and Mississippi Valley.

CHAPTER IV.

RIVERS AND LAKES.

I. The rivers and lakes of the United States may be considered in connection with the seven Hydrographical regions described in the preceding chapter.

II. The St. Lawrence Basin is of more importance to the United States, for its chain of great lakes, than for the St. Lawrence itself, or its tributaries: the rivers of this system within the United States being quite insignificant. It is estimated that the water of these lakes, if equally distributed, would cover the earth to the depth of three inches. Lake Michigan is entirely within the limits of the United States; each of the other lakes of the chain is one half in Canada.

Lake Superior, the largest body of fresh water upon the globe, is about the size of New Hampshire, Vermont, Massachusetts, and Connecticut. Its waters are discharged into Lake Huron by the River St. Mary's, which forms for half a mile of its course a rapid with a fall of 23 feet, entirely obstructing the natural channel of navigation. A ship canal now obviates this difficulty.

Lake Huron receives the waters of Lake Michigan by the Strait of Mackinaw, a narrow passage eight or ten miles in length, by four or five miles in width; and discharges its own waters by the River St. Clair.

Lake St. Clair, a shallow body of water, with an area of about 450 miles, may be regarded as the widening of the river which connects Lake Huron and Lake Erie. Lake Erie receives the waters of the upper lakes, and discharges them through the Niagara River over the Falls of Niagara, into Lake Ontario.

Lake Ontario, the smallest lake of the system, containing an area about one thousand miles less than Lake Erie, discharges its waters directly into the River St. Lawrence. Near the union of the lake and river are the "thousand isles" of the St. Lawrence. They are generally masses of rock, of small extent, covered with forest trees; and to the eye of the admiring tourist, who winds his way among them on the dark waters of the river, present a scene of indescribable beauty.

The water of these lakes is remarkable for its clearness and purity, and is deep enough for navigation by large vessels. For commercial purposes, the United States are as much indebted to this great chain of lakes as Europe is to the inland seas which indent her coast. The coast-line of the United States upon these lakes is more than 3000 miles long. It is remarkably regular, affording few harbors, except such as are formed by the mouths of the small rivers belonging to the system.

These river-harbors, which at best are narrow and difficult of entrance, determine the sites of the principal cities; Chicago, Buffalo, Cleveland, Milwaukie, and others, being thus situated. On account of this deficiency, the storms, which are as violent upon these lakes as upon the ocean, are very destructive to shipping. Artificial harbors, or breakwaters, have been here and there constructed to remedy the evil.

Lake Champlain, Lake George, the lakes of Central New York, and Winnebago Lake, in Wisconsin, are also tributaries of the St. Lawrence.

Lake Champlain is a beautiful sheet of water, 120 miles in length, and from one-half a mile to ten miles broad. It is navigable for large vessels, and affords excellent commercial advantages. A free navigation to the Atlantic Ocean has been effected by means of improvements in the River Richelieu, which forms its outlet to the St. Lawrence. By the Champlain Canal, which connects the lake with the Hudson River and Erie Canal, an unbroken water communication exists between Canada and New York.

In our wars with Great Britain, the natural communication by the River Richelieu, Lakes Champlain and George, and the Hudson River, was the only practicable route for an army between Canada and New York city; the country was accordingly twice invaded by this path.

III. The rivers of the Atlantic Slope generally flow through a mountainous or hilly country, and are obstructed by rapids not far from the sea. Except for a short distance, they are usually navigable only for vessels of a light draught. The Hudson River, however, admits of the ascent of large vessels to Hudson; the Delaware, to Philadelphia; and the Potomac, to Washington.

The rivers between the Hudson and Mississippi (except in Florida,) fall in cascades over the edge of the upland country. This point marks the limit of steam navigation, and determines the position of important cities and towns: as Paterson, Trenton, Richmond, and Augusta.

Harper's Ferry.

The passage of the Atlantic rivers, through mountain-gorges and over falls, is often marked by the most striking scenes of natural beauty — such as the Palisades of the Hudson, the Falls of the Passaic, the Delaware Gap, and the passage of the Potomac through the Blue Ridge at Harper's Ferry.

The water-power afforded by the rapids and falls of the rivers of this system is immense, and gives rise to large manufacturing cities — as Lowell and Manchester, on the Merrimack River. Where the country is hilly, the valleys of the rivers often afford the most practicable route for the construction of railways.

The hilly regions of New England contain many beautiful lakes, of which the rivers of this slope are the outlets. Moosehead Lake, in Maine, is the largest of them. Lake Winnipiseogee, in New Hampshire, is greatly admired for its beautiful scenery. The marshy regions of Florida also abound in lakes. Lake Okechobee is the principal one.

IV. The Valley of the Mississippi has an area inferior only to that of the Amazon, and, extending through so many degrees of latitude, embraces the climate and productions of three different zones. It is the finest portion of our country, and its vast resources of agricultural and mineral wealth are yet but partially developed.

For what is the St. Lawrence Basin most important? — Name and describe each of the great lakes of this system. — Are these lakes of much commercial importance? — What kind of harbors have they? — What river of the Atlantic Slope is connected with this basin by a canal?

Are the rivers of the Atlantic Slope generally navigable any great distance? — Why? — What point in their course marks the position of important cities? — Why? — Of what use are the rapids and falls of these rivers? — Name some of the lakes of this slope? — Describe the Valley of the Mississippi.

The Mississippi River rises in a marshy region, about 1500 feet above the level of the sea; and, in its passage to the Gulf, meets with only two obstructions — the Falls of St. Anthony, and of Peckagama. Above the mouth of the Missouri its waters are clear and bright; but that mighty stream pours in a turbid flood, which imparts a different character to the remainder of its course. In this latter division the river is remarkably winding; by a short cut of a mile or two, the traveller might sometimes save a circuit of thirty miles.

Below the Ohio, the low banks, subject to periodical overflow, afford few favorable sites for large towns, except upon the high bluffs on the east side; at these points, accordingly, Memphis, Natchez, Vicksburg, and others, are situated.

The Mississippi is navigated principally by steamboats, though large sailing vessels ascend to New Orleans, and might go much further. Above the Missouri the small tributaries are very numerous; but most of them are navigable only for steamers of light draught. Some of these steamers draw less than two feet of water.

V. The Missouri ("smoky water,") which is commonly classed as a tributary of the Mississippi, is, strictly speaking, the parent stream; for the Mississippi, before the union of the two rivers, is greatly inferior in size to the Missouri, and receives from it its most distinguishing characteristics.

The Missouri rises in the Rocky Mountains, and the springs which form its source are not more than a mile from the head-waters of the Columbia. At the distance of about 400 miles from its source, the Missouri flows through a mountain-gorge, called the "Gates of the Rocky Mountains." For a distance of six miles, the rocks rise perpendicularly from the water's edge to the height of 1200 feet; and for the first three miles, there is only one spot on which a man could stand between the water and the mountain-side. About 110 miles further down the river, are the Great Falls of the Missouri, which, next to Niagara, are the grandest in North America.

The Missouri is a wild and turbulent river. Its current is very rapid, and the channel is rendered exceedingly intricate by numerous sand-bars and snags. Yet, when not obstructed by ice, it is navigable for steamers drawing from eighteen to twenty inches of water, from its mouth to within fifteen miles of the Great Falls, a distance of nearly 2500 miles.

The Kansas, Nebraska, and Yellow Stone Rivers, are the three principal tributaries of the Missouri. The Kansas ("good potato") River, in the lower part of its course, drains an exceedingly fertile prairie country; and, with the exception of rapids, which could be obviated at a moderate cost, is navigable for 150 to 200 miles. The Nebraska ("flat water,") is a shallow stream, noted for its rapid current. It is not navigable, but derives importance from the fact that its valley forms the principal route of emigrants to California. The Yellow Stone is said to be navigable for 200 miles.

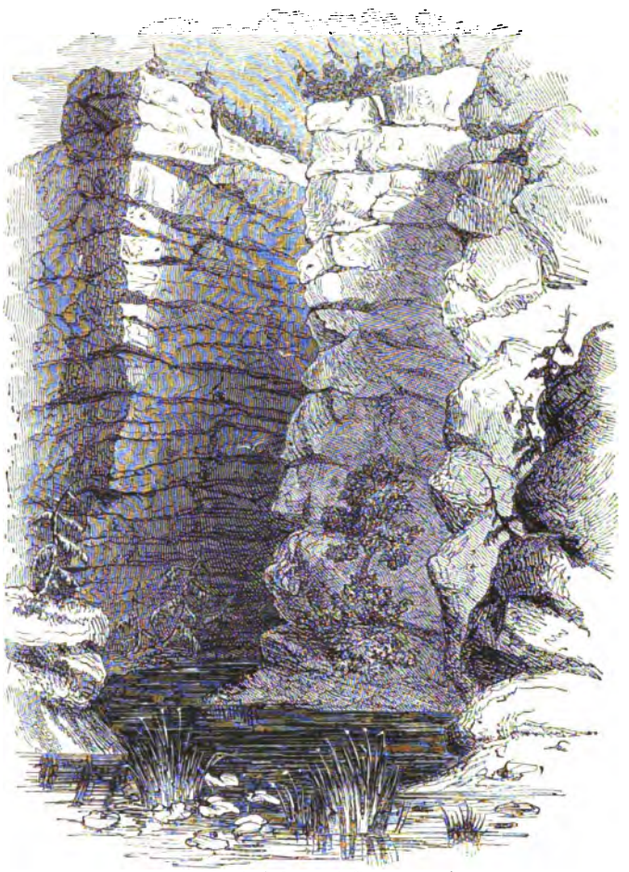
VI. The Ohio is, next to the Missouri, the most important tributary of the Mississippi River. The Basin of the Ohio affords about 5000 miles of navigable waters.

The Ohio is formed by the union of the Alleghany and Monongahela Rivers. Its current, though at first rapid, rarely exceeds a velocity of three miles an hour. There is no important obstruction to navigation, except the rapids at Louisville; which, however, are avoided by a ship canal. These rapids are not so great an obstacle as the shallowness of the river in the dry months of summer. The ice in winter is another serious disadvantage.

The rivers which flow into the Ohio, on its south side, generally rise on the declivity of the Alleghanies, or among the hills which branch off from that mountain-system. On this account, most of them are obstructed by rapids in some part of their course, requiring the construction of dams and locks to avoid the difficulty. The rivers upon the north side (except the Alleghany and Wabash,) are only navigable to a limited extent, but they are of great value in supplying water to the canals by which their course is accompanied. By such artificial means, navigation is extended to the remotest parts of the Ohio Basin.

The Wabash, Cumberland, and Tennessee, are the largest affluents of the Ohio River. The Wabash is navigable for more than 300 miles; the Cumberland, at high water, for large steamers to Nashville, 200 miles, and for small boats 300 miles farther. Steamers ascend the Tennessee River to the Muscle Shoal Rapids; above them, navigation is resumed, and extends to Knoxville, in Tennessee. The Alleghany, Monongahela, Great Kanawha, Muskingum, Kentucky, Licking, and Green Rivers, are all navigable.

VII. The Red River rises in the *Llano Estacado*. In the first sixty miles of its course, the river has worn for itself a channel, or *cañon*, so deep and narrow that the banks rise abruptly from the water's edge to the height of 500 to 800 feet. For 500 miles below the *Llano Estacado*, the river flows through a dry and sandy region, nearly destitute of trees. In the remainder of its course, the country is rich and well wooded.



Red River Cañon.

The Great Raft is the most important obstacle to navigation. It is formed by drift wood, which becomes lodged in the swampy expansion of the river, some distance above Shreveport, and obstructs the channel for a length of 70 miles. Both above and below the Great Raft, the Red River, during the greater part of the year, is capable of navigation, by small steamers, for several hundred miles. The Washita flows into the Red River a short distance above its junction with the Mississippi, and is navigable for about 300 miles.

VIII. The Arkansas River rises in the Rocky Mountains, and after flowing through the belt of sterile land which stretches eastward from their base, enters a fertile region near the borders of Arkansas. It is navigable for 800 miles during nine months in the year.

Which is the larger, the Mississippi or the Missouri River? — Describe the Missouri River. — Name its three principal tributaries. — Describe each of them. — What is the length of the navigable waters of the Ohio River?

Name the principal tributaries of the Ohio. — What other rivers of importance flow into it? — Describe the Red River. — What is the most important obstacle to its navigation? — Describe the Arkansas River.

Besides the great tributaries above described, the Mississippi receives many smaller affluents, most of which are navigable to a considerable distance. The Illinois River is the largest and most important of these minor streams. It flows through an extremely fertile country, and a canal, 100 miles in length, connects it with Lake Michigan. The Minnesota, Chippeway, Wisconsin, Iowa, Des Moines, St. Francis, and Yazoo Rivers, are all important.

Lakes. — There are many lakes in Minnesota and Wisconsin which contribute their waters to the Mississippi, to the St. Lawrence Basin, or to Hudson's Bay. These lakes, the largest of which is the Lake of the Woods, are beautiful sheets of water, from one to forty miles in extent. They have pebbly bottoms, and are well stocked with the finest fish. Lake Pontchartrain, in Louisiana, is a shallow body of salt water, and a branch of the Gulf of Mexico.

IX. *Texas Slope.* — The largest rivers of this system are the Rio Grande, Nueces, San Antonio, Guadalupe, Colorado, Brazos, Trinity, Neches, and Sabine.

Most of these rivers are navigable; the extent of the navigation depending upon the season of the year, and upon local obstructions. Small steamers are generally able to ascend to the distance of from 50 to 450 miles. The removal of a raft in the Colorado River, near its mouth, would give access to a large extent of country.

X. *Pacific Slope.* — The Columbia, Colorado, and the Sacramento Rivers, are the largest of this system.

The Basin of the Columbia is of great extent; yet it lies chiefly within a rugged and sterile region of mountains and highlands, where the rivers flow through narrow gorges, and over many falls and rapids. In some cases, the rivers flow through such deep clefts, that their beds are inaccessible to man or beast. The passage of the Columbia River through the Cascade Mountains, known as the "Cascades," is a scene of great beauty and grandeur.

The western section of this basin is drained by the Columbia, with its tributary, the Willamette, and by two small rivers, the Umpqua and Rogue, which flow directly into the Pacific. The mouth of the Columbia is somewhat obstructed by a sand-bar; but vessels of 200 or 300 tons burden can ascend the river to the Cascade range, a distance of about 140 miles. Beyond this point, no continuous navigation is possible, except for small boats. The Willamette, Umpqua, and Rogue Rivers, are navigable to a short distance by sea-vessels.

The Colorado, with its principal tributary, the Gila, flows through a barren and desolate region; and, though of great length, is of little commercial importance. The Sacramento, with its principal tributary, the San Joaquin, and many smaller affluents, drains one of the richest countries in the world. The Sacramento and many of its tributaries are navigable for steamboats far into the interior.

XI. *Utah Basin.*—This singular country has a system of lakes and rivers of its own, having no connection with the ocean. Great Salt Lake is 70 miles long, and 30 miles wide. Its waters are so salt that no living thing can exist in them. Utah Lake, a body of fresh water, communicates with it by the River Jordan. Humboldt River flows into Humboldt Lake, and forms part of the route for emigrants to California.

XII. The Red River of the North rises in Elbow Lake, in Minnesota, and empties into Lake Winnipeg. In the first 100 miles of its course, it forms the line of connection between a multitude of small lakes, which seem to be disposed along this stream like beads upon a thread.

Name the principal rivers of the Texas Slope. — Name the three principal ones of the Pacific Slope. — Does the Columbia River drain a fertile or sterile region of country? — Which does the Willamette? — The Colorado? — Into what does the Willamette flow?—Is the Sacramento an important river?—Why?—What is the peculiarity of the rivers of the Utah Basin? — Describe the Red River of the North.

XIII. *Recapitulation.* — The United States strikingly exhibit the effect of rivers upon the prosperity of a country. By their fertilizing power, and the means which they afford to commerce and manufactures, they sustain and promote the great branches of industry; and no considerable extent of country can prosper without them. By avoiding the occasional obstructions, our river-steamers (drawing sometimes only nine inches of water,) penetrate to almost every habitable part of the country, thousands of miles from the ocean.

The water-power of our rivers is not confined to the sites of the great manufacturing towns, but is found in almost every part of the Union. It will be observed that many of our largest cities are upon rivers, either at the mouth, or at the head of navigation — these two points being the natural centres of trade. The deficiency of forests in the Missouri Basin, permits rapid evaporation, and is one of the chief causes of the shallowness of this river and its tributaries in summer. The clearing of the wood-lands from the basin of the Ohio River is thought, also, to have diminished the volume of that river, and, in consequence, its navigability.

CHAPTER V.

CLIMATE, RAINFALL, AND PRODUCTIONS.

I. THE entire territory of the United States is comprised within three zones of climate, namely: the Hot, Warm, and Temperate.

II. The Hot Zone includes that part of the United States which lies south of the Isotherm of 70°. It comprises nearly all of the Peninsula of Florida, and a small part of Louisiana, Texas, New Mexico, and California.

The climate of this zone is remarkable for its uniformity. The mean annual temperature of eighteen different places, as deduced from many years' observation, reported in the Army Meteorological Register, is 72°·44 The mean summer temperature of the same places is 82°·73; and that of the winter, 60°·31. The mean annual temperature of Key West, in Florida, deduced from 14 years' observation, is 76°·51; that of the summer, 82°·51; of the winter, 69°·53. The mean annual temperature of New Orleans for 20 years is 69°·86; of the summer, 82°·27; of the winter, 56°·53.

Most of the productions of tropical countries may be successfully grown in this zone; and the sugar-cane, orange, and banana, are cultivated to a considerable extent.

III. The Warm Zone embraces the country between the Isothermal lines of 70° and 60°. A reference to the map will show the narrowness of this zone across the sterile regions of the Texas and Pacific Slopes, and the remarkable northward curve of its northern boundary near the Pacific, by which it includes the fertile valleys of the Sacramento and San Joaquin.

State some of the uses of rivers, and their effect upon the prosperity of a country.—Within what zones of climate is the territory of the United States comprised? — What part of it is in the Hot Zone? — For what is the climate of this zone remarkable? — Name some of its productions.—What portion of the United States is included in the Warm Zone? — In what part of the country is this zone narrowest?

The difference between the oceanic and continental climate is shown by a comparison between the temperature of various places in this zone, upon or near the coast, and of those situated in the interior. The mean annual temperature of two stations near the Pacific coast is 60°·95; of five stations near the Atlantic coast, 65°·16; and of ten stations in the interior, 63°·42. The mean summer temperature of the same places respectively is 72°·05, 80°·04, and 80°·11; the mean winter temperature, 49°·29, 52°·05, and 45°·60. It will thus be seen that the climate of the interior is considerably warmer in summer and colder in winter than that of the coasts.

The sugar-cane is cultivated in the southern part of this zone; and nearly all the rice and cotton produced in the United States is raised here.

IV. The whole country north of the Isothermal line of 60° is included in the Temperate Zone. From the Atlantic Ocean to about the 97th meridian, the temperature decreases quite regularly towards the north; the isothermal lines corresponding very nearly with the parallels of latitude. From the 97th meridian westward to the Pacific, as will be seen by an examination of the map, the isothermal lines diverge widely from the parallels of latitude, rising much higher on the Pacific than on the Atlantic coast.

This section furnishes many striking examples of the effects produced upon the temperature of a place, by its elevation, and its exposure to winds and currents. Thus the mean annual temperature of Fort Steilacoom, on Puget's Sound, Lat. 47° 10′, is 50°·82; that of Santa Fé, Lat. 35° 41′, at an elevation of 6846 feet, 50°·59; and that of Fort Laramie, Lat. 42° 10′, at an elevation of 4519 feet, is 50°·06.

Thus, it appears that Fort Steilacoom, owing to the warm south-west winds from the Pacific, and to the influence of the Japan Current, has a somewhat higher mean annual temperature than Santa Fé, 800 miles further to the south.

Contrasting the climate of the Pacific coast with that of the Atlantic and the interior, it will be found that the former is more uniform, and also that it varies much less with the latitude. This will be seen by an examination of the annexed table:—

		Temperature.				
	Latitude.	Spring.	Summer	Autumn	Winter.	Year.
Pacific Coast.						
Monterey	36° 36′	53°·99	58°·64	57°·29	51°·22	55°·29
San Francisco	37° 48′	54°·41	57°·33	56°·83	50°·86	54°·88
Astoria	46° 11′	51°·16	61°·58	53°·76	42°·43	52°·23
Interior.						
St. Louis Arsenal	38° 40′	54°·15	76°·19	55°·44	32°·27	54°·51
Chicago	41° 52′	44°·90	67°·33	48°·85	25°·90	46°·75
Fort Ripley	46° 19′	39°·33	64°·94	42°·91	10°·01	39°·30
Atlantic Coast.						
Fort Monroe, near Norfolk	37°	56°·87	76°·57	61°·68	40°·45	58°·89
Fort Columbus, N. Y. Harbor	40° 42′	48°·74	72°·10	54°·55	31°·38	51°·69
Fort Sullivan, Eastport	44° 15′	40°·15	60°·50	47°·52	23°·90	43°·02

From this table it will be perceived that Astoria, on the Pacific coast, and Fort Ripley, in the interior, are in about the same latitude. Astoria, though 650 miles north of Monterey, is only three degrees colder. Fort Ripley is *fifteen* degrees colder than St. Louis, although it is only about 500 miles further north.

San Francisco, St. Louis, and Fort Monroe, are in about the same latitude. The difference between the mean summer and winter temperature of San Francisco is less than *seven* degrees; of St. Louis, nearly *forty-four* degrees; and of Fort Monroe, *thirty-six* degrees. Eastport is two degrees south of Astoria, but is *nine* degrees colder.

The various food-plants common to temperate regions — as wheat, Indian corn, rye, oats, barley, and potatoes — are produced in great abundance in the Temperate Zone of the United States.

Give illustrations of the difference between the oceanic and continental climates.— Name some of the productions of the Warm Zone. — What is the extent of the Temperate Zone of the United States? — How does the climate of the Pacific coast compare with that of the Atlantic? — Of the interior? — Give examples to illustrate your statement. — What are some of the productions of this Zone?

V. The United States may be divided with reference to the fall of rain into three regions, namely: the Region of Periodical Rains, the Region of Frequent Rains, and the Region of Scanty Rains.

VI. The region of Periodical Rains comprises the western division of the Pacific Slope.

In that portion of this division south of the 40th parallel of latitude, scarcely any rain falls in summer, and very little in autumn. The quantity in winter somewhat exceeds that which falls during the spring. This appears from the annexed table:—

		Amount of Rain in Inches.				
	Latitude.	Spring.	Summer	Autumn	Winter.	Year.
San Diego	32° 42′	2·74	0·55	1·24	5·90	10·43
Monterey	36° 36′	4·43	0·21	1·65	5·91	12·20
San Francisco	37° 48′	8·81	0·03	3·37	11·38	23·59
Benicia	38° 13′	6·40	0·01	2·65	7·56	16·62
Sacramento	38° 33′	9·02	0·00	3·74	8·56	21·32

A much greater quantity of rain falls upon that part of the division north of Lat. 40° than south of it; but, as in the southern division, the largest amount belongs to the winter and spring. (See table.)

		Amount of Rain in Inches.				
	Latitude.	Spring.	Summer	Autumn	Winter.	Year.
Fort Orford	42° 44′	19·12	3·	19·60	26·80	68·52
Fort Vancouver	45° 40′	9·28	6·23	10·30	19·69	45·50
Fort Steilacoom	47° 10′	11·19	3·85	15·20	21·51	51·75

VII. The Region of Frequent Rains extends from the Atlantic coast westward to about the 100th meridian of longitude. This region, considered as a whole, is exceedingly well watered, the rain being quite equally distributed through the different seasons.

From an examination of the table, it will appear that along the Atlantic Slope, as far south as Washington, very nearly the same annual quantity of rain falls; and that it is very equally distributed throughout the year. In the Gulf States, and along the Atlantic Slope south of Washington, the annual amount of rain is much greater than in the other sections, and the summer rains are much more abundant than those of the winter. In the interior the annual quantity is less, and generally much less rain falls in winter than in the other seasons.

	Fall of Rain in Inches.				
	Spring.	Summer	Autumn	Winter.	Year.
Northern Atlantic Slope.					
Eastport	8·88	10·05	9·85	10·61	39·39
Providence (average 23 years)					39·71
Albany (average 20 years)					40·
New York	11·55	11·33	10·30	9·63	42·23
Philadelphia (average 28 years)					42·3
Baltimore	11·13	11·04	10·52	9·31	42·
Washington	10·45	10·53	10·15	10·07	41·20
Southern Atlantic Slope, and Gulf States.					
Charleston	9·89	17·45	10·06	7·52	44·92
Savannah (average 9 years)					49·43
St. Augustine	5·90	10·54	9·56	5·80	31·80
Key West	8·34	16·59	15·35	7·37	47·65
Pensacola	12·86	18·69	13·71	11·72	56·98
New Orleans	11·29	17·28	9·62	12·71	50·90
Baton Rouge	15·08	19·14	12·48	15·40	62·10
Interior.					
Burlington, Vt. (average 18 years)					33·9
Buffalo	8·50	9·23	13·54	7·53	38·80
Pittsburg	9·38	9·87	8·23	7·48	34·96
Detroit	8·51	9·29	7·41	4·86	30·07
St. Louis	12·86	14·09	8·71	6·29	41·95
Fort Snelling	6·61	10·92	5·98	1·92	25·43
Fort Ripley	6·31	12·62	8·42	2·13	29·48
Fort Leavenworth	7·97	12·24	7·33	2·75	30·29
Fort Smith	12.48	13·03	9·93	6·66	42·10

Into what regions may the United States be divided with respect to the fall of rain? —What part of the country is embraced in the region of Periodical Rains? — In what seasons of the year does rain fall here? — Give examples. — What part of the United States is embraced in the region of Frequent Rains?—In what part of this region does most rain fall? — In what part does least rain fall? — Give examples.

VIII. The Region of Scanty Rains embraces the country between about the 100th meridian of longitude and the Cascade and Sierra Nevada Mountains. It includes the northern and southern divisions of the Pacific Slope, the Inland Basin of Utah, the Table-lands of the Texas Slope, and the sterile region east of the Rocky Mountains.

Among the mountains of this region a considerable quantity of rain falls, and violent showers are experienced in all seasons of the year. Some of the mountain valleys are also well watered. Thus the annual fall of rain at Santa Fé, situated on a plateau enclosed by mountains, is 19·83 inches; and the fall at Fort Massachusetts, which is situated in a valley 100 miles further north, is 20·54 inches.

The annual fall of rain in the desert region, through which the Great Colorado flows, is estimated at three inches; that of the Inland Basin of Utah, at five inches; of the Great Plain, south of the Columbia River, ten inches; of the Llano Estacado, ten inches; and of the sterile region east of the Rocky Mountains, from fifteen to twenty inches. In all these sections, scarcely any rain falls in summer.

IX. The greatest amount of rain reported in the "Army Meteorological Register," for any given year, was the fall, in 1846, at Baton Rouge, of 116·6 inches; the least, a fall, in 1853, at Fort Yuma, California, of 1·78 inches.

CHAPTER VI.

MINERALOGY.

I. The mineral productions of any country may be divided into a few great classes: as the precious stones, the precious metals, the ordinary metals and ores, the ordinary stones, coal, and salt.

II. Few precious stones of value have been found in the United States. Diamonds are said to have been discovered in California; and one has been found in Rutherford County, North Carolina. Agates and cornelians are numerous along the banks of the Upper Mississippi, and the shores of Lake Superior.

III. The precious metals are gold, silver, and platinum, all of which are found in the United States.

Gold, in comparatively small quantities, has been obtained for many years from a region along the eastern base of the Alleghany Mountains, from Maryland to Alabama. It was first discovered in California in 1848, where the deposits are among the richest upon the globe. The entire product for the half century ending 1854, is stated in Lippincott's Gazetteer at three hundred and seven millions of dollars, of which two hundred and ninety-eight millions were from California.

Silver is found, in connection with copper, in the Lake Superior region, and also in California and other parts of the country. It is supposed to be most abundant in New Mexico. Platinum occurs in connection with gold in various quarters.

IV. The principal ordinary metals and ores of the United States are iron, copper, lead, zinc, and quicksilver or mercury.

Iron is the most important mineral, and it is widely diffused throughout the entire country. Nearly 600,000 tons of pig iron were made in 1850, (more than half of it in Pennsylvania); and it is estimated that the product of the present year (1856,) is twice as great. Vast quantities of iron ore of remarkable purity, forming entire mountains, have been discovered in Missouri, and in the mineral region south of Lake Superior.

The copper regions of Lake Superior are the richest in the world. The product of this section for 1855, was nearly ten millions of pounds, the estimated value of which was more than one and a half million of dollars. A mass of pure native copper was discovered during this year weighing 25 tons. Copper is also found in various other parts of the United States.

Great quantities of lead are obtained from the mines of Illinois, Iowa and Wisconsin. It is also found in Missouri, and in other States. Zinc is procured from the lead region of the Upper Mississippi, and is also found in Pennsylvania and New Jersey.

The only mines of quicksilver in the country are in California. The ore yields ten times more mineral than any which has yet been discovered elsewhere, and the production has already been sufficient to reduce its commercial value.

V. Granite, marble, sand-stone, and lime-stone, are the principal ordinary or building-stones of this country.

Granite is one of the most important articles of export from the New England States, and buildings constructed of this material may be found in all the principal places along the Atlantic coast, from Maine to Texas. Marble and sand-stone are abundant in various sections of the country. These are much used for the construction of buildings in the chief cities of the Atlantic slope: as New York, Philadelphia, and Baltimore. Lime-stone is the principal building-stone of the Mississippi Valley.

VI. The coal-beds of the United States are more extensive than those of any other part of the world. The coal is of two kinds, namely: anthracite and bituminous.

The principal deposit of anthracite coal is between the Delaware and Susquehanna Rivers, in Pennsylvania. About six millions of tons were sent to market from this region in 1854. The quantity contained in this district may be considered as inexhaustible.

There are three great bituminous coal regions. The Alleghany coal field extends from Pennsylvania to Alabama, and is estimated by Prof. Rogers to contain an area of 63,000 miles. The coal-field of Illinois and the Ohio Basin underlies the greater part of the State of Illinois, and a considerable portion of Indiana, Kentucky, Missouri, and Iowa. A third immense coal-field stretches along the eastern base of the Rocky Mountains. Coal has also been found in the Pacific Slope, near Puget's Sound, and in Oregon. There are deposits in other parts of the country which would be considered large, were it not for the immense extent of those already described.

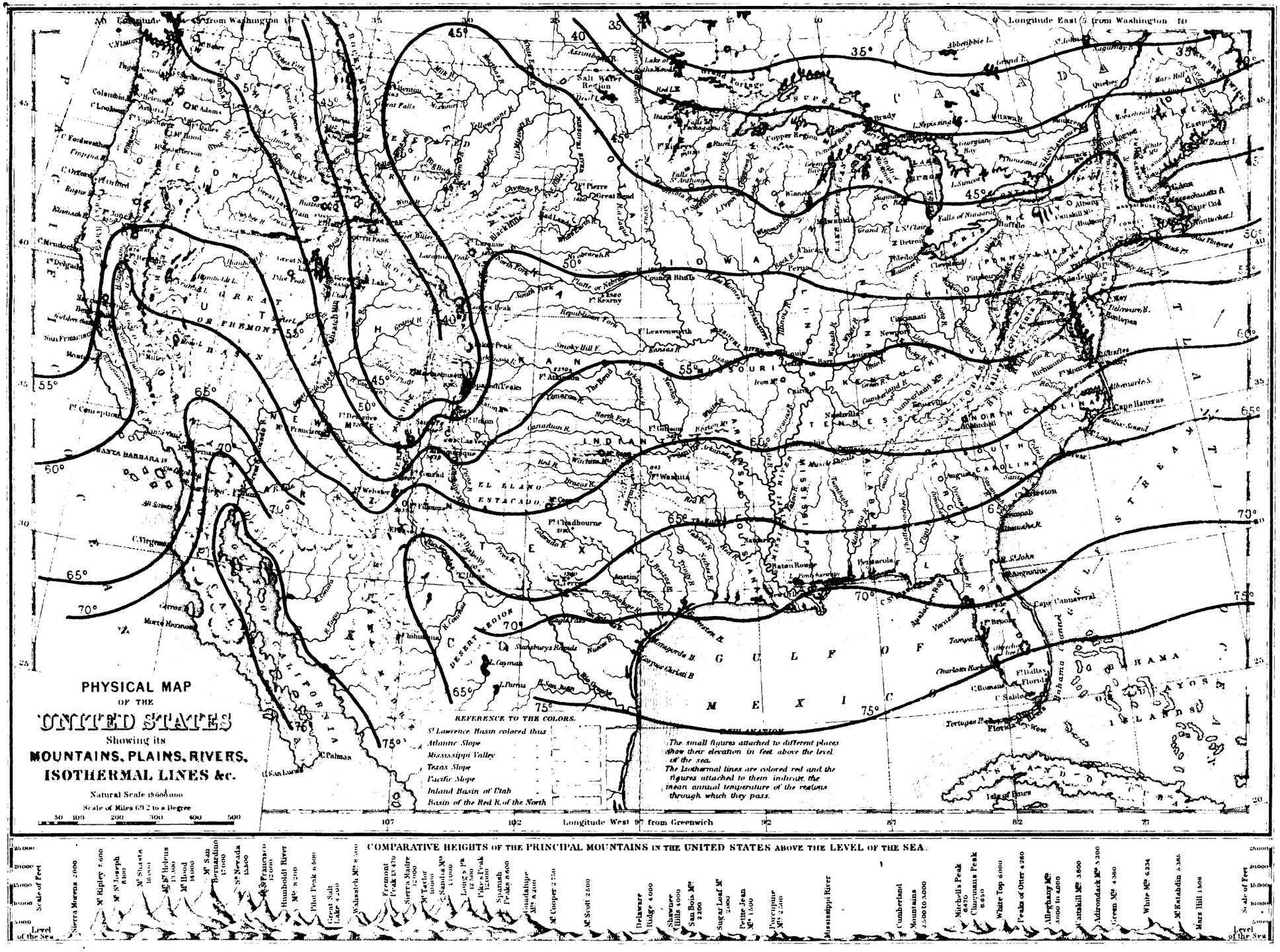
VII. In Europe there are extensive mines of rock-salt, and this mineral is dug from the ground as coal is in this country. In the United States, all the salt produced is obtained by the evaporation of salt water.

Salt springs are numerous in various sections of the country. The richest are those at Syracuse, in New York. From four to five millions of bushels are manufactured here annually. Large quantities are also produced from the salt springs of Western Pennsylvania, from those of the Kanawha Valley in Virginia, from those of Kentucky, and of Southern Ohio. Salt springs are also numerous in Texas, New Mexico, and Utah.

VIII. The Physical Geography of the United States exhibits the most extraordinary natural advantages. The mines are the richest in the world. The soil and climate are so excellent and so varied, that the productions of nearly every Zone are cultivated with success, while but a comparatively small extent of territory is barren or unhealthy. The rivers and lakes, equally adapted to commerce or manufactures, promote every branch of industry, and render all the resources of the country available.

What sections of the United States are included in the region of Scanty Rains?—State the greatest annual fall of rain recorded in the United States.—The least.—Into what classes may the mineral productions of any country be divided?—What precious stones have been found in the United States?—Which are the precious metals?

What are the principal ordinary metals and ores?—Describe the production of each.—Name the principal building-stones.—From what region is anthracite coal principally obtained?—Where is bituminous coal found?—How is salt obtained in the United States?—State some of the natural advantages of the United States.


PHYSICAL MAP
OF THE
UNITED STATES
Showing its
MOUNTAINS, PLAINS, RIVERS,
ISOTHERMAL LINES &c.
Natural Scale 19,660,000
Scale of Miles 69.2 to a Degree
50 100 200 300 400 500
REFERENCE TO THE COLORS.
St Lawrence Basin colored thus
Atlantic Slope
Mississippi Valley
Texas Slope
Pacific Slope
Inland Basin of Utah
Basin of the Red R. of the North
The small figures attached to different places show their elevation in feet above the level of the sea.
The Isothermal lines are colored red and the figures attached to them indicate the mean annual temperature of the regions through which they pass.
Longitude West from Washington
Longitude East from Washington
Longitude West 97 from Greenwich
COMPARATIVE HEIGHTS OF THE PRINCIPAL MOUNTAINS IN THE UNITED STATES ABOVE THE LEVEL OF THE SEA.
Scale of Feet
Level of the Sea
Sierra Morena 2000
Mt Ripley 7,600
Mt St Joseph 8,000
Mt Shasta 16,000
Mt Helena 15,500
Mt Hood 14,000
Mt San Bernardino 17,600
Mt Nevada 15,500
Mt St Francois 12,000
Humboldt River Mts 8,200
Pilot Peak 6,500
Great Salt Lake 4,200
Wahsatch Mts 8,500
Fremont Peak 13,470
Sierra Madre 12,000
Mt Taylor 11,000
Mt Santa Fe 11,000
Long's Pk 12,500
Pikes Peak 14,000
Spanish Peaks 13,000
Guadalupe Mts 8,400
Mt Cooper 2,750
Mt Scott 2,600
Delaware Ridge 1,000
Shawnee Hills 1,000
San Bois Mts 2,200
Sugar Loaf Mt 2,000
Petite Jean Mt 1,500
Porcupine Mts 2,200
Mississippi River
Cumberland Mountains 2,000 to 4,000
Mitchells Peak 6,470
Clingmans Peak 6,650
White Top 6,000
Peaks of Otter 4,260
Alleghany Mts 3,000 to 4,000
Catskill Mts 3,600
Adirondack Mts 5,300
Green Mts 4,360
White Mts 6,234
Mt Katahdin 5,385
Mars Hill 1,508

QUESTIONS ON THE UNITED STATES.

Position and Outline.

What part of North America do the United States occupy?—Between what meridians and parallels do they lie?—Which has the most compact form: Europe, or the United States?—State the area and length of coast-line.—Name the inlets of the sea on the Atlantic coast.—On the Gulf.—On the Pacific.

Name the projections of land in each of these divisions.—Trace the entire outline, naming all the inlets and projections in order.—Name the principal islands on the coast.—What is the character of those south of the peninsula of Cape Cod?—What rocky islands on the Pacific coast?

Mountains.

What is the general direction of the mountain-chains of the United States?—On which side of the United States is there the greatest mass of mountains and plateaus?—On which side do they approach nearest to the sea?—What is the average elevation of the Alleghany and Coast ranges?—What is the eastern range of the Alleghanies called?

By what names are the branches of the Alleghanies known in New England?—In New York?—What is the highest elevation of the Alleghany system?—Which are the most bare and rugged: the Alleghanies, or the Rocky and Cascade Mountains?—At what point in the south is the name "Rocky Mountains" first applied?—What name is given to the continuation of this system southward of that point?

Name the branches of the Rocky Mountains.—What different ranges of mountains would the traveller encounter in crossing from San Francisco to St. Louis?—In taking a direct course from the mouth of the Columbia to Santa Fé?—What are the principal ranges in California?—In Oregon?—What range contains the highest summits of the Pacific system?—What range contains volcanic peaks?

General Surface.

Name the position and limits of the seven sections of the country.—Which is the largest?—Which is the smallest?—Which contains the greatest amount of barren land?—Which section contains the prairies?

What is the area of the St. Lawrence section?—What is the general elevation?—Is it well wooded?—What States are included within it?—Into what two sections is the Atlantic Slope divided?—Is there any prairie land in the Atlantic Slope?—What is the character of the country along the coast of the Southern Atlantic States?—What is the character of the surface of New England?

Where are the prairies in the Mississippi Valley?—Are there any trees in the prairies?—Is the prairie land as heavily timbered as the rest of the country?—Are prairies level?—What kind of vegetation grows naturally upon them?—What part of the Mississippi Valley is sterile?—What are the causes of this sterility?—Is any part of the valley higher than Lake Itasca?

Into what sections is the Texas Slope divided?—Why is the coast section swampy?—Is there any prairie land in the Texas Slope?—What is the most useless section of this slope?—Why?—What are the "Cross Timbers"?—Are there any mountains in this slope?—In what sections are the largest towns likely to be established?

Into what three sections is the Pacific Slope divided?—Why do we make this division?—What part of this slope is available for extended civilization?—What mines are contained in this portion?—What is its area?—How many times as large as the State of Ohio?—Mention its various advantages.—Why is the rest of the Pacific Slope sterile?—What is its general elevation?

What is the general elevation of the Utah section?—Soil?—Rivers?—What, then, is the general character of the surface and soil of the region between the Cascade and Nevada on the west, and the Rocky Mountains on the east?—What is the width of this region?

Rivers and Lakes.

Which is the largest river-basin in the United States?—What river-basin is most important for its lakes?—Which of the seven river-systems affords the greatest length of natural communication?—What means are employed to extend the natural advantages of our rivers?—What kind of boats are generally used?

Of what use are our rivers and lakes?—What connection exists between rivers and lakes, and great towns?—Why would not Pittsburg be as well situated 50 miles up the Alleghany River?—Would not Chicago have prospered as well, if it had been first laid out ten miles north or south of its present site?—What natural feature has made Lowell and Manchester prosperous?

Trace an inland water-communication from New York to New Orleans.—Do they have steamers at Knoxville, (Tenn.)?—Can a steamer ascend from St. Louis to Knoxville?—What difficulty might a large, heavy-laden steamer sometimes have in going from Pittsburg to St. Louis in summer?—Is the Ohio always open to navigation in winter?—Could a Liverpool packet sail up to Austin, in Texas?

How far up the Columbia can sea-vessels go?—Can they ascend the Umpqua and Rogue Rivers?—By what class of vessels are the Sacramento and San Joaquin navigated?—What is the most valuable article brought down the Sacramento?

Name the important rivers of the Atlantic Slope.—Three of the Texas Slope.—What river drains the southern division of the Pacific Slope?—The northern division?—Are the rivers of the Utah Basin of large size?—Is the Red River of the North a very important river?

What prevents steamboats from ascending the Atlantic rivers higher than Augusta, Richmond, and Trenton?—What circumstance is necessary to produce water-power in a river?—Is there water-power at New Orleans?—Why?—At Richmond?—On the Hudson at its mouth?

Climate and Productions.

How many zones of climate are there in the United States?—What States are included in the Hot Zone?—In the Warm?—In the Temperate?—Is any part of Alabama in the Hot Zone?—In the Warm?—In what zone is South Carolina?—Tennessee?—California?—Why does the Warm Zone curve northward to the Pacific coast?—What part of California is included within this zone?

What contrast is presented by the climate of the Atlantic and Pacific coasts?—Between the sea-coasts and the interior?—Where is the winter generally most severe: in the eastern part of Virginia, in Kansas, or in the Sacramento Valley?—Why?—On what isotherm are Santa Fé, Fort Laramie, and Fort Steilacoom?—How do you account for their having nearly the same mean temperature?

How many degrees of latitude between Monterey and Astoria?—How many degrees of mean temperature?—How many degrees of latitude between Fort Monroe and Fort Sullivan?—What difference in mean temperature?—On which coast, then, does the mean temperature vary least with latitude?

In what zone is most of the cotton and rice produced?—Would a manufacturer buy his cotton at Charleston, or St. Louis?—Would a merchant buy his wheat in New Orleans, or in Chicago?—Do they export as much rice from Savannah as from Philadelphia?—Which fruit can a farmer near Nashville most easily raise: apples, or oranges?—What kind of vegetable productions are carried from Chicago to New Orleans?—From New Orleans to Chicago?

Rain-Fall.

Into what regions are the United States divided with regard to rain?—Describe the limits of these regions.—What exception to the general dryness exists within the limits of the region of Scanty Rains?—In the Periodical district, where is the rain most abundant: north or south of Lat. 40°?—What section of our country has the greatest amount of rain?—What is the greatest amount of rain reported in the Meteorological Register?—The least?

Mineralogy.

What metals are shipped on board vessels in Lake Superior?—Where are the richest quicksilver mines in the world?—What metals are exported from San Francisco?—What metals are transported through the great lakes?—What metals in Missouri?—In Illinois?—Wisconsin?—Do you find coal in Ohio?—What metals are sent out from Pittsburg?—Where is gold found?—What stone forms the principal mineral wealth of New England?—What building-stone is most used in the Mississippi Valley?—Where is silver most abundant?—Is there any coal west of the Rocky Mountains?—Is there any gold east of California?—Is salt found anywhere except on the sea-coast?—Where? Has any lead, coal, iron, or salt been found in your vicinity?

MISCELLANEOUS QUESTIONS FOR REVIEW.

A company of emigrants set out in the spring from St. Louis for California, by the overland route: what kind of surface do they find as far as the base of the Rocky Mountains?—Along what river-valley will they be likely to travel?—If detained at the mouth of the Nebraska River till summer, where will they probably first find difficulty in obtaining pasturage for their cattle?—What kind of surface will they cross between the Rocky Mountains and Sierra Nevada?

In what part of California will they be likely to settle, if they wish to become gold miners?—Would they find the summers as hot here as in St. Louis?—Would they find the winters as cold?—Would it be likely to rain much in the summer in this region?—Would the summits of the mountains at any time be covered with snow?—What ferocious animal might be encountered among the mountains?

One of the emigrants embarks for South America with a quantity of umbrellas for sale: will he be likely to find a good market at Lima?—Being of an adventurous turn, he resolves to cross the Andes, and descend the Amazon: what change in the temperature will he experience ascending the mountains?—Which way will the wind blow on the plains east of the mountains?—Will he find a wooded or an open country?—Will there be pine forests along the bank of the river?—What fierce animal may he encounter in these forests?—What dangerous creature would make it hazardous for him to bathe in the river?

Arriving at the mouth of the Rio Negro, he determines to cross over to the Orinoco: can he go by water?—If so, through what river?—He leaves the Orinoco, and proceeds by land to La Guayra, the port of Caraccas: what remarkable plains will he cross?—He finds these plains covered with verdure: at what season of the year does he undertake the journey?—Do any mountains intercept his path to the sea?

Setting sail from La Guayra for New Orleans, the ship is disabled in a hurricane: which way does it drift?—Saved from the wreck, he goes to New York, whence, in 1853, he embarks in Dr. Kane's Exploring Expedition: what new perils does he encounter?—What tribe of men does he meet in Greenland?—To what race do they belong?—He has met another variety of the same race while travelling in Europe: in what country was it?—What animals does he see in Greenland?—What birds?—Does he find any vegetation?—What does he ascertain about the open Polar Sea?

Returning to America, he settles as a farmer near Chicago, in Illinois, and raises the products of the country: what are they?—Is the country in which he is settled generally a level or a hilly country?

Another of the company, disappointed with California, sets sail from San Francisco to Canton: what winds favor his passage?—Would they be favorable at all seasons of the year?—What race of men will he find in China?—What are their physical characteristics?—Would he find any difficulty in making a straight course to the Sea of Aral?—What mountains, plateaus, plains, deserts, and rivers, would he cross in making the journey?—Within the limits of what race is his passage confined?

He crosses the country, and the Gulf of Oman, to Muscat: what difficulties does he encounter?—Does he find Muscat as hot as Canton?—He embarks upon a European ship, but is wrecked on the coast of Zanguebar, in the wet season: what hazard does he encounter from the climate?—Does he find a civilized race inhabiting the country?

He arrives at Cape Town: does he find the city inhabited by the Negro race?—How does the temperature compare with that of Muscat?—Of Canton?—He embarks for St. Helena: is it a continental or pelagic island?—Of volcanic or coral formation?—Are there any other islands near St. Helena?—He sails to Rio Janeiro: what winds aid his passage?

He wishes to ship a cargo of the productions of the country to Baltimore: what shall he purchase?—Trace his course to Baltimore, and tell what winds and currents would aid his passage.—He wishes to settle, and desires to purchase an interest in a copper-mine: where would you advise him to go?

During what months is the sun north of the Equator?—Do they have the rainy season at the north, or at the south of the Equator, during those months?—Can you give, then, a general law for determining the season of places within the Tropics at any month in the year?—Do the monsoons disturb the regularity of this law?—Are the Llanos of the Orinoco dried up in the months which constitute our summer, or our winter?

While it is summer with us, what season do they have in Rio Janeiro?—If you could make a steam-passage from Greenland to Buenos Ayres in *one month*, what changes of season would you experience in the month of November?—Which way does the wind blow at night on a tropical island?—Which way during the day?

What is the highest mountain in the world (see Table, page 91)?—What is the highest mountain in Asia?—In Europe?—Africa?—The Western Continent?—In North America?—In the United States?—Which is the highest peak of the Alleghany system?—How high is it?—Which is the highest peak of the Alps?—The Pyrenees?—The Andes?—The Ural Mountains?

Name six of those volcanoes which you have most frequently heard of?—Which is the most northern active volcano?—Is there a volcano on the plains of the Amazon?—Of the Orinoco?—In the Desert of Sahara?—What is the most destructive volcanic eruption that you can mention?—Do volcanoes ever appear suddenly?—Mention six of the most recent?—By what force are they created?—Are they of any use to man, or are they only intended for purposes of destruction?

Name the two greatest river-basins in the world.—In the Western Continent.—In the Eastern.—Do the same vessels which bring down the merchandize from St. Louis to New Orleans, convey it to New York or Europe?—Which is the shortest passage: from Cincinnati to New Orleans, or the return?—At what times would the passage up the river be most difficult?—Do the lakes of the St. Lawrence Basin ever overflow their banks?

Which is the longest river in the world?—The longest of the Atlantic system?—The Pacific?—The Arctic?—Which is the largest continental river?—Which system has the largest river-basins: the Atlantic, or the Pacific?—The Arctic, or the system of the Indian Ocean?—Are there any continental rivers in Europe?—In the United States?—To what system does the Orinoco belong?—The Orange?—Danube?—Yang-tse-Kiang?—Hoang Ho?—Zambeze?—Colorado?—Petchora?—Cambodia?—Columbia?—Volga?—Name the Grand Divisions in which these rivers are situated?

What races dwell in Africa?—America?—Europe?—Asia?—Australia?—To what race do the inhabitants of the Marquesas Islands belong?—Of Greenland?—Iceland?—Madagascar?—If you wished to visit every part of the world in which families of the Caucasian race exist, what countries must you seek?—Are there any families of the Mongolians south of the Equator?—Is the Ethiopian race chiefly north or south of the Equator?

To what race do the Sioux belong?—The Apaches?—The Brazilians?—The Hottentots?—The Caffres?—Gallas?—Mandingoes?—Papuans?—Foulahs?—Kalmucks?—Afghans?—Arabs?—Abyssinians?—Are all the families of the Caucasian race equally intelligent and enterprising?—Do the Europeans all belong to the Caucasian race?

What are the most important food-plants?—Which of them grow chiefly in the Torrid Zone?—In the Temperate Zones?—In the Warm Zones?—Is coffee produced within the Tropics?—Is tea?—Sugar?—Rice?—Maize?—The cocoa-nut?—Are Bananas?—Plantains?—Potatoes?—Is wheat a characteristic product of tropical countries?—Do grains grow well in Iceland?—Greenland?—Are pine forests characteristic of the Torrid Zone?

Which zone has generally the largest and most formidable animals?—Which continent?—What is the largest animal native to North America?—Are there any lions in Africa?—Hindostan?—Mongolia?—Are there any camels in Africa?—Asia?—Are camels native to Europe?—In which region do animals attain their greatest size and strength: the temperate, or the tropical?—In which does man reach the highest state of civilization?

PRONOUNCING VOCABULARY.

A.

Ad-i-ron'-dack.
Agulhas (*Ah-gool'-yas*).
Albino (*Al-be'-no*).
Al-le-gha'-ny.
Altai (*Al-ta'-i*, or *Ahl-ti'*), "gold mountains."
Amoo, or Amou (*Ah-moo'*)—called also the Oxus, the Ji-hoon', and the Gihon (*Je-hone'*).
Amoor (*Ah-moor'*).
Amorgo (*Ah-mor'-go*).
Anahuac (*Ah-na-wahk'*).
Anatolia (*Ah-na-to'-lia*), "the East."
Antilles (*An-til'-ees*).
Ap-pa-la'-chi-an.
Ar'-ab.
Ar'-a-go.
Ar'-al, "island"—Sea of Aral, "island sea."
Archipelago (*Ar-ke-pel'-a-go*).
Ar-o'-ca.
Ar-kan'-sas.
Artois (*Ar'-twaw*).
Atacama (*Ah-tah-cah'-mah*).
Au-ro'-ra Bo-re-a'-lis: Latin—Aurora, "day-break"; Borealis, "northern."
Auvergne (*O-vairn'*).
Az'-of.
Az'-ores.

B.

Bahia (*Bah-ee'-a*), "bay."
Balkan (*Bal'-kan*, or *Bahl-kahn'*).
Bar-ba'-does.
Basalt (*Ba-solt'*).
Baton Rouge (*Bat'-un Roosh'*),—"red stick."
Beled-el-jerid (*Be-led'-el-je-reed'*),—"land of dates."
Belor (*Be-lor'*), also called *Be-loor' Tagh*, or *Bo-lor' Tagh*.
Benicia (*Be-nish'-i-a*).
Ben Lo'-mond (*Ben* means "hill," or "mountain."
Bergen (*Bur'-ghen*).
Bermudas (*Ber-moo'-daz*).
Berne (*Burn*).
Biscay (*Bis'-ky*).
Blumenbach (*Bloo'-men-bahk*).
Bogota (*Bo-go-tah'*).
Bokhara (*Bo-kah'-ra*).
Bolan (*Bo-lahn'*).
Bonin Sima (*Bo-neen See'-ma*).
Bora (*Bo'-rah*).
Bourbon (*Boor'-bun*).
Brah-ma-poo'-tra, "Son of the Creator."
Brazil (*Brah-zeel'*).
Buenos Ayres (*Bo'-nus A'-riz*),—"good air."

C.

Cairo (*Ki'-ro*).
Cam'-el-o-pard.
Cam-er-oons'.
Can-av'-er-al.
Car-ac'-cas.
Car-ib-be'-an.
Car'-ib.
Car-niv'-o-ra, "flesh-eating."
Cassiquiare (*Cah-see-kee-ah'-re*).
Cau-ca'-si-an.
Cau'-ca-sus.
Cau'-ver-y.
Cayenne (*Ki-enn'*).
Ce'-re-al. Applied to plants that produce bread-corn. Derived from *Ceres*, the ancient fabled goddess of corn.
Ce-ta'-ce-a.
Cevennes (*Sa-ven'*).
Cey-lon'.
Charlemagne (*Sharl-mahn*).
Cheiroptera (*Ki-rop'-ter-a*).
Cherrapongi (*Cher-a-poon-jee'*).
Chicago (*She-kaw'-go*).
Chihuahua (*Chi-waw'-wa*).
Chili (*Chil'-le*).
Chim-bo-ra'-zo.
Chim-pan'-zee.
Cobi (*Co'-be*),—"sea of sand."
Coch'-i-neal.
Co'-chin Chi'-na.
Coimbra (*Co-eem'-bra*).
Colorado (*Co-lo-rah'-do*).
Cor-ri-en'-tes.
Cosiguina (*Co-se-ghee'-na*).
Costa Rica (*Kos'-tah Ree'-ka*),—"rich coast."
Cotopaxi (*Ko-to-pax'-ee*).
Cryp-tog'-a-mous.
Cumana (*Koo-mah-nah'*).
Cuzco (*Koos-ko*).

D.

Dahomey (*Dah-ho-may'*).
Dant'-zic.
Dar-da-nelles'.
Dec'-can.
Desaguadero (*Des-ah-gwa-da'-ro*),—"the outlet."
Des Moines (*De-moin'*).
Despoblado (*Des-po-blah'-do*),—"uninhabited."
Dig-it-i-gra'-da,—from Latin, *digitus*, "toe," and *gradus*, "step."
Disa Grandiflora (*Dee'-sa Gran-di-flo'-ra*).
Dwina (*Dwee'-na*).

E.

E-den-ta'-ta.
Eider (*I'-der*).
Ekaterinburg (*E-kat-e-ri'-nen-burg*),—"Catherine's town."
Elbrus, or Elburs (*El-broos'*, or *El-boorz'*).
Endogenous (*En-doj'-e-nous*).
Equador (*Ek-wa-dore'*).
Esmeralda (*Es-mer-ahl'-da*).
Eth-nog'-ra-phy.
Eu-phra'-tes.
Ex'-o-gens.

F.

Falkland (*Fawk'land.*)
Fa'-roe.
Fata Morgana (*Fah'-ta Mor-gah'-na*).
Fingal (*Fing-gawl'*); a district of Ireland, which was formerly settled by Fins—whence the name.
Fu-e'-gi-an.
Fun'-gi. Latin plural of *fungus*—a mushroom; a toadstool.

G.

Galapagos (*Gal-li-pa-gos*).
Gallinacea (*Gall-i-na'-she-a*)
Ganges (*Gan'-jez*),—"flowing through the earth to Heaven."
Gentian (*Jen'-shun*).
Ghauts (*Gawts*).
Gila (*Hee'-la*).
Glaciers (*Glas'-e-ers*).
Gneiss (*Nice*).
Gral-la-to'-res.
Great St. Ber-nard'.
Grenelle (*Gra-nel'*).
Guadalupe (*Gwaw-da-loop'*).
Guanaxuato (*Gwah-nah-hwa'-to*).
Guatemala (*Gwah-ta-mah'-la*).
Guayaquil (*Gwi-ah-keel'*).
Guiana (*Ghee-ah'-na*).
Guinea (*Ghin'-ee*).

H.

Han-hai (*Hahn-hi'*). *Hai*, *hae*, or *hay*, means "sea," in Chinese.
Hec'-la.
Hen-lo'-pen.
Her-cu-la'-ne-um.
Himalaya (*Him-a-li'-a*).
Hin-doo-stan'.
Hip-po-pot'-a-mus.
Hoang Ho (*Whahng'-ho'*),—"yellow river;" so named from the color which the clay banks give to its waters.
Hy-drog'-ra-phy.

I.

Ibarra (*E-bar'-ra*).
Ignis Fatuus. Latin,—*ignis*, "fire," and *fatuus*, "foolish."
Imbamburu (*Eem-bahm-boo'-roo*).
In-sect-iv'o-ra
I'-o-wa.
Iran (*E'-rahn*).
Irkoutsk (*Ir-kootsk'*).
Ir-ra-wad'-dy,—"the great river."
Irtysh (*Eer'-tish*).
Isalco (*E-sahl'-co*)
I-tas'-ca.

J.

Jag-u-ar'.
Jalapa (*Hah-lah'-pa*).
Jan Mayen (*Yan Mi'-en*).
Ja-pan'.
Jap-an-ese'.
Jorullo (*Ho-rool'-yo*).
Ju'-ra.
Jut'-land.

K.

Kamtschatka (*Kam-skat'-ka*).
Kanawha (*Kan-aw'-wah*).
Kan'-sas,—"smoky water."
Ka-tah'-din.
Khiva (*Kee'-va*).
Kilimandjaro (*Kil-e-mahn-jah-ro'*).
Kirghis (*Keer-gheez'*).
Kuen Lün (*Kwen-loon'*).
Kunchinginga (*Koon-chin-jing'-gah*)
Kurile (*Koo'-ril*).
Kuttenberg (*Koo'-ten-berg*).

L.

Lab'-ra-dor.
La-drones'. Islands of the "ladrones," or *thieves*—so named by Magellan, on account of the thievish disposition of the natives.
La-goon'.
Lar'-a-mie.
Lassa (*Hlahs'-sah*),—"Land of the Divine Intelligence."
Lava (*Lah'-va*).
Lianos (*Le-ah'-nos*).
Lich'-en.
Lima (*Lee'-mah*).
Lipari (*Lee-pah'-re*).
Llama (*Lah'-ma*).
Llano Estacado (*Le-ah'-no Es-tah-cah'-do*),—"staked plain."
Llanos (*Le-ah'-nos*).
Louisville (*Loo'-is-vil*).
Lupata (*Loo-pah'-tah*).

M.

Mack'-i-naw.
Madeira (*Ma-dee'-ra*). Derived from the magnificent forests with which these islands were formerly covered — the Portuguese word *Madera* signifying "timber."
Mad'-rid.
Maelstrom (*Male'-strum*), 'mill-stream.'
Mag-da-le'-na.
Magellan (*Ma-jel'-an*).
Magyar (*Mah'-yar*).
Mahabaleshwar, or Mahableshwur, (*Mah-hah-blesh-wur'*).
Mal-a-bar'.
Mal'-dive,—"thousand isles."
Mam-ma'-li-a.
Ma-na'-tus.
Man-tchoo'-ri-a.
Maritime (*Mar'-e-tim*),— from Latin, *mare*, "the sea."
Mar'-jo-ram.
Mar'-mo-ra.
Marquesas (*Mar-ka'-sae*).
Mar-su-pi-a'-li-a,—from Latin, *Marsupium*, a "pouch."
Mendocino (*Men-do-see'-no*).
Messina (*Mes-see'-nah*).
Met-a-mor'-phic,—from a Greek word, signifying "change."
Me-te-or-o-log'-i-cal.
Me-te-or-ol'-o-gy.
Mirage (*Me-razhe'*).
Mis-sis-sip'-pi,—"father of waters."
Mol-lus'-cous. Latin, *Molluscus*, "soft."
Mo-luc'-ca.
Mon-soon'.
Monte Nuevo (*Mon'-ta Noo-a'-vo*).
Monterey (*Mon-te-ray'*).
Mon-te Ros'-si.
Mont-mo-ren'-cy.
Moscow (*Mos'-ko*).
Mozambique (*Mo-zam-beek'*).
My-sore'.

N.

Nan-ling'.
Nat-a-tor'-es,— from Latin, *Nato*, "to swim."
Natch'-ez.
Ne-a-pol'-i-tan.
Neches (*Netch'-iz*).
Ner-bud'-dah.
New'-found-land.
New Gran-a'-da.
Ne-va'-do de So-ra'-ta,—"snow-clad."
Nic-a-ra'-gua.
Niger (*Ni'-jer*).
Nueces (*Noo-a'-ces*).
Nyöe (*Nee-er'*).

O.

O'-a-ses. Pl. of Oasis.
Obi (*O'-be*).
O-des'-sa.
O-hi'-o,—"the beautiful river."
O-ke-cho'-bee.
O'-ri-no'-co,—"coiled serpent."

P.

Pacha, or Pasha; and, as applied to Barbary, Bashaw (*Pa-shaw'*).
Pachydermata (*Pak-i-der'-ma-ta*).
Pam'-pas,—"treeless plains."
Pam'-pe-ros, —"violent winds which sweep over the Pampas."
Pam'-li-co.
Papua (*Pap'-oo-a*). Frizzled; from the enormous frizzled heads of hair of the natives.
Paraguay (*Par-a-gwa'*).
Parime, or Parima (*Puh-ree'-mah*).
Pas-sa'-ic.
Peck-a-ga'-ma.
Pelagic (*Pe-laj'-ic*). From Latin, *Pelagus*, "the sea."
Peling (*Pa-ling'*).
Per-en'-ni-al,—"perpetual."
Phæ-nog'-a-mus.
Phi-lol'-o-gy. The knowledge or study of the languages.
Philippine (*Fil'-i-pin*). Named after Philip II. of Spain.
Phos-pho-res'-cence. A feeble kind of light without heat.
Phys'-i-cal. Relating to matter.
Plan-ti-gra'-da.
Plat'-i-num.
Plu-ton'-ic. Relating to the regions of fire. Pluto was the fabled god of the infernal regions.
Pompeii (*Pom-pa'-ye*).
Pont-char-train'.
Popayan (*Po-pah-yahn'*).
Por'-to Bel'-lo,—"fine harbor."
Porto Rico (*Ree'-co*),—"rich harbor."
Potosi (*Po-to-see'*).
Prussia (*Prush'-e-a*).
Ptarmigan (*Tar'-mi-gan*).
Ptolemy (*Tol'-e-my*).
Pu'-get.
Pustza (*Poos'-tzah*).
Pyr'-en-ees.

Q.

Quad-ru-ma'-na.
Quito (*Kee'-to*).

R.

Ra-pa'-ces. Latin, *Rapax*, "greedy."
Rar'-i-fied. Rarified air is *thin*, in opposition to *condensed* air.
Reaumur (*Ro'-mer*).
Reikiavick (*Ri'-ke-a-vik*).
Richelieu (*Reesh'-el-yoo*).
Rio de la Plata (*Ree'-o da lah Plah'-tah*) —"river of silver."
Rio Grande (*Rio Grand'*).
Rio Janeiro. Commonly pronounced *Ri'-o Ja-nee'-ro*, "January River."
Rio Negro (*Ree'-o Ne'-gro*), —"Black River."
Russia (*Rush'-e-a*).
Ruth'-er-ford.

S.

Sa-bine'.
Sabrina (*Sah-bree'-nah*).
Sac-ra-men'-to.
Sahara (*Sah-hah'-rah*).
Saint Law'-rence.
Saltillo (*Sahl-teel'-yo*).
Sa'-mi-el.
Samoiedes (*Sam-oi-eedz'*).
San Diego (*San De-a'-go*).
San Joaquin (*San Ho-ah-keen'*), pronounced almost *Waw-keen*.
San Salvador (*San Sal-va-dore'*),— "Holy Saviour."
Santa Barbara (*San'-ta Bar'-bar-a*).
Santa Fé (*San'-ta Fa*),—"holy faith."
Santorini (*San-to-ree'-nee*).
Saxifrage (*Sax'-e-fraje*).
Scan-so'-res. Latin, "to climb."
Sco'-ri-a, (Pl. Sco'-ri-æ). Volcanic cinders.
Senegal (*Sen-e-gawl'*).
Se-rin-ga-pa-tam'.
Severo Vostochnoi (*Sa-va'-ro Vos-tok'-noi*).
Shanghai (*Shang-hi'*).
Si-be'-ri-a.
Sierra Diavolo. Sierra (*Se-er'-a,*) is a Spanish word, signifying "saw;" and is applied to a mountain-ridge, because at a distance it often presents a notched appearance. (*Sierra De-ah'-vo-lo*, "Devil's ridge.")
Sierra Leone (*Le-o'-na*).
Sierra Madre (*Mah'-dra*).
Sierra Morena (*Mo-ra'-nah*).
Sierra Nevada (*Na-vah'-dah*),—"snow-clad mountain-ridge."
Si-lo'-am.
Si-moom'.
Si-roc'-co.
Sirikol (*See-ree-kol'*).
Sit'-ka.
Snieuw Bergen (*Snow' Ber'-ghen*),— "snow-mountains."
Solano (*So-lah'-no*).
St. Anthony (*An'-to-ny*).
St. Ber-nard'.
St. Croix (*Croi*).
St. Gothard (*Go-tard*).
St. Hel-e'-na.
St. Louis (*Loo'-is*).
St. Roque (*Roke*).
Steilacoom (*Sti-la-coom'*).
Stellerine (*Stel-ler-een'*).
Steppes (*Steps*).
Stra'-ta. Pl. of Stratum. Layers or beds of anything: as sand, gravel, or rocks.
Stromboli (*Strom'-bo-lee*).
Su-ma'-tra.
Sumbawa (*Soom-baw'-wa*).
Sy'-phon. A bent tube used for drawing off water from casks.
Syr'-i-a.

T.

Ta-co'-ma.
Tahiti (*Tah-hee'-tee*).
Tasmania (*Taz-ma'-ne-a*). Named in honor of Tasman, its discoverer.
Tchad (*Chad*).
Tehama (*Ta-hah'-mah*),—"low land."
Tehuantepec (*Ta-wahn-ta-pec'*).
Teneriffe (*Ten-er-if'*).
Terra, or Tierra del Fuego (*Ter'-ra del Fu-e'-go*),—"land of fire."
Tequendama (*Ta-ken-dah'-mah*).
Thames (*Temz*).
Thian Shan (*Te-ahn' Shahn'*),—"Celestial Mountains."
Thibet (*Tib'-et*).
Tierras Calientes (*Te-er'-ras Cah-le-en'-tes*),—"hot lands."
Tierras Templadas (*Tem-plah'-das*),— "temperate lands."
Tierras Frias (*Free'-as*),—"cold lands."
Tolima (*To-lee'-mah*).
Torrecelli (*Tor-re-cel'-lee*).
Tortugas (*Tor-too'-gaz*),—"tortoises."
Trin-i-dad'.
Tripe de Roche (*Treep de Roshe*).
Tristan d'Acunha (*Tris-tahn' Dah-coon'-yah*.
Ty-phoon'.

U.

Utah (*U'-taw*).
Ural (*Yoo'-ral*, or *Oo-rahl'*).
Uruguay (*Oo-roo-gwi*).

V.

Valdai (*Vahl'-di*).
Valenciana (*Vah-len-se-ah'-nah*).
Vancouver (*Van-coo'-ver*).
Venezuela (*Ven-e-zwe'-la*).
Ver'-te-bra-ted.
Ve-su'-vi-us.
Vindhya (*Vind'-yah*).

W.

Wabash (*Waw'-bash*).
Wah-satch'.
Washita (*Wash'-e-taw*).
Winnipiseogee (*Win-e-pe-saw'-ke*),— "beautiful lake among the highlands."

X.

Xarayes (*Hah-ri'-ez*).

Y.

Yakoutsk (*Yah-kootsk'*).
Yang-tse-Kiang (*Yahng-tse-Kee'-ahng*) —"Son of the Sea."
Ya-zoo'.
Yenesei (*Yen-e-sa'-e*).
Yu-ca-tan'.
Yu'-ma.

Z.

Zambeze (*Zam-ba'-ze*).
Zoological (*Zo-o-loj'-i-cal*).
Zoology (*Zo-ol'-o-jy*).
Zoophytes (*Zo'-o-fites*).

APPENDIX.

TABLE OF THE HEIGHT OF SOME OF THE PRINCIPAL MOUNTAIN-PEAKS OF THE GLOBE.

	Feet.
North America.	
Mount St. Elias, Russian America	17,860
Popocatepetl, Mexico	17,717
Mount Brown, Rocky Mountains	16,000
Sierra Nevada, California	15,500
Mount Hood, Oregon Territory	14,000
Fremont's Peak, Rocky Mountains	13,470
Long's Peak, " "	12,500
Mount Mitchell, highest of the Blue Ridge, North Carolina	6470
Mount Washington, White Mountains, New Hampshire	6234
Mount Tahawus, or Marcy, New York	5300
South America.	
Aconcagua, Chili	23,910
Chimborazo, Equador	21,420
Sorato, Bolivia	21,286
Europe.	
Elbruz, the highest of the Caucasus Mountains, Russia	17,776
Mont Blanc, highest of the Alps	15,668
Mount Maladetta, highest of the Pyrenees	11,436
Mount Scardus, highest of the Balkan Mountains, Turkey	10,000
Konjakofski-Kamen, Ural Mountains	5397
Ben Nevis, highest of the Grampian Mountains, Scotland	4368
Snowdon, highest mountain in Wales	3571
Asia.	
Everest, Himalaya Mountains	29,100
Kunchinginga, " "	28,176
Dhawalaghiri, " "	28,000
Mount Ararat, Turkey in Asia	17,210
Mount Lebanon, Syria, Jeb-el-Makmel	12,000
Mount Olympus, Turkey in Asia	9100
Mount Sinai, Arabia	7497
Africa.	
Mount Kilimandjaro	20,000?
Mount Kenia	20,000?
Abba Yared, Abyssinia	15,200
Piton des Neiges, Isle of Bourbon	12,500
Mount Miltsin, highest of the Atlas, Morocco	11,400
Snowy Mountains, Cape Colony	10,000
Peak of Pico, Azores	7613
Oceanica.	
Mount Ophir, Sumatra	13,842
Semero Mountain, Island of Java	13,000
Mount Orohena, Society Islands	8500
Mount Kosciusko, New South Wales	6500
Mount Humboldt, Tasmania	5520

TABLE SHOWING THE LOCATION, ELEVATION, AND DATE OF THE LAST ERUPTION OF SEVERAL ACTIVE VOLCANOES.

Name of Volcano.	Location.	Height, in feet.	Date of last eruption.
Aconcagua.	Chili.	23,910	
Gualatieri.	Bolivia.	22,000	
Arequipa.	Peru.	20,320	1830
Antisani.	Equador.	19,137	
Cotopaxi.	Equador.	18,875	1803
Tolima.	New Granada.	18,020	
Popocatepetl.	Mexico.	17,717	
Pichincha.	Equador.	15,924	1831
Demavond.	Western Asia.	14,695	
St. Helen's.	United States.	13,300	
Mauna Loa.	Sandwich Islands.	13,120	1859
Erebus.	Antarctic Land.	12,400	
Teneriffe.	Canary Islands.	12,182	1798
Etna.	Sicily.	10,874	1852
Tomboro.	Island of Sumbawa.	7600	1815
Jan Mayen.	Island of Jan Mayen.	6874	
Morne Garou.	Island of St. Vincent's.	5007	1812
Jorullo.	Mexico.	4265	1759
Vesuvius.	Naples, (Italy).	3948	1858
Galung Gung.	Java.		1822
Pechan.	Central Asia.		1600?

TABLE SHOWING THE AREA OF THE BASINS, AND THE LENGTH OF THE PRINCIPAL RIVERS UPON THE GLOBE.*

Arctic System.	Area of Basin.	Length.	Authority.
Obi	1,233,000	2700	Johnston.
Yenesei	1,045,000	3250	"
Lena	792,500	2800	"
Kolyma	143,000	930	"
Dwina	142,000	1000	"
Petchora	65,000	700	"
Mackenzie's	588,800	2500	"
Back	45,000	600	J. H. Young.
Atlantic System.			
Nile	700,000?	2500?	Ansted.
Niger	600,000?	2600?	"
Senegal	1,000,000?	?	"
Orange		?	"
Gambia		?	"
Coanza		?	"
Rio Grande		?	"
Danube	273,000	1750	Johnston.
Dnieper	226,240	1260	"
Don	196,500	1120	"
Rhine	66,160	700	"
Elbe	49,000	800	"
Rhone	33,000	650	"
Amazon	2,016,000	3600	Johnston.
Mississippi	1,300,000	4100	J. H. Young.
Rio de La Plata	1,182,000	2240	Johnston.
Nelson's	480,000	2000	"
St. Lawrence	396,800	2100	"
Tocantins	388,000	1300	"
Orinoco	336,000	1600	"
San Francisco	249,600	1650	"
Rio Grande	240,000	2150	"
Pacific System.			
Amour	777,200	2800	Johnston.
Yang-tse-Kiang	730,400	3300	"
Hoang Ho	716,500	2700	"
Cambodia	270,000	2000	J. H. Young.
Columbia	340,000	1200	"
Colorado	225,000	1100	"
System of the Indian Ocean.			
Ganges (including the Basin of the Brahmaputra)	576,640	1960	Johnston.
Irrawaddy	441,600	2600?	"
Indus	416,000?	2300?	"
Euphrates	261,000	1750	"
Godavery	123,750	900	"
Zambeze	250,000	800?	Ansted.
Continental Rivers.			
Volga	530,000	2800	Johnston.
Sihon	317,200?	1400?	"
Amoo, or Oxus	258,000	1650	"
Ural	110,000	650?	"

* The area is given in English square miles, and the length in statute miles.

TABLE SHOWING THE AREA, AVERAGE DEPTH, AND ELEVATION OF THE PRINCIPAL LAKES ON THE GLOBE.

	Area in Square Miles.	Average Depth in feet.	Elevation of surface ab. level of the sea, in feet.	Depression of surface bel level of the sea, in feet.
Caspian Sea	145,000	250		83·4
Sea of Aral	30,000	100	36	
Dead Sea	300	200		1312
Lake Baikal	14,000		1535	
Lake Sir-i-kol			15,630	
Lake Superior	31,500	900	627	
Lake Michigan	23,150	1000	595	
Lake Huron	23,100	1000	595	
Lake Erie	7800	120	565	
Lake Ontario	6900	500	231	
Lake Nicaragua	4000	40	128	
Lake Titicaca	4000		12,795	
Great Salt Lake	1875		4200	

TABLE SHOWING THE LATITUDE AND LONGITUDE, THE ELEVATION ABOVE THE LEVEL OF THE SEA, THE MEAN ANNUAL TEMPERATURE, AND THE AVERAGE ANNUAL FALL OF RAIN AT VARIOUS PLACES IN THE UNITED STATES.

[This valuable Table is compiled from the "Army Meteorological Register," and presents the result of all the records, in the Army Medical Bureau, for 33 years, from 1822 to the close of 1854.]

Name of Place of Observation.	Latitude.	Longitude west from Greenwich.	Elevation above the level of the sea, in feet.	Mean Annual Temperature.	Average Annual Fall of Rain, in inches.
Fort Kent, Maine	47° 15′	68° 35′	575	37°·04	36·46
Fort Fairfield, Maine	46 46	67 49	415	38·11	
Hancock Barracks, Maine	46 07	67 49	620	40·51	36·97
Fort Sullivan, Eastport, Maine	44 54	66 58	70	43·02	39·39
Fort Preble, Portland, Maine	43 39	70 20	20	45·22	45·25
Fort Constitution, Portsmouth, N. H.	43 04	70 49	40	45·81	35·57
Fort Independence, Boston Harb., Mass.	42 20	71	50	48·92	35·30
Watertown Arsenal, Mass.	41 21	71 09		47·34	42·07
Fort Adams, Rhode Island	41 29	71 20	40	49·70	52·46
Fort Wolcott, Newport Harbor, R. I.	41 30	71 20	20	50·72	
Fort Trumbull, New London, Conn.	41 21	72 06	23	49·62	45·69
Fort Columbus, N. Y. Harbor	40 42	74 01	23	51·69	42·23
Fort Hamilton, N. Y. Harbor	40 37	74 02	25	51·54	43·65
West Point, New York	41 23	74	167	50·73	54·15
Watervliet Arsenal, New York	42 43	73 43	50?	48·07	34·55
Plattsburg Barracks, New York	44 41	73 25	186	44·	33·39
Sackett's Harbor, New York	43 57	76 15	262	46·38	39·78
Fort Ontario, New York	43 20	76 40	250	46·44	30·88
Fort Ningara, New York	43 18	79 08	250	47·91	31·77
Buffalo Barracks, New York	42 53	78 58	660	46·25	38·80
Alleghany Arsenal, Pittsburg, Pa.	40 32	80 02	704	50·56	34·96
Carlisle Barracks, Carlisle, Pa.	40 12	77 14	500	51·10	34·01
Fort Mifflin, Pa.	39 53	75 13	20	53·85	45·27
Fort Delaware, Del.	39 35	75 34	10	56·06	
Fort McHenry, Md.	39 17	71 35	36	54·36	42.
Fort Severn, Md.	38 58	76 27	20	55·42	48·61
Washington City, D. C.	38 53	77 02	50–90	56·14	41·20
Fort Washington, Md.	38 43	77 06	60	57·87	45·02
Bellona Arsenal, Richmond, Va.	37 20	77 25	120	59·27	
Fort Monroe, Va.	37	76 18	8	58·89	50·89
Fort Macon, N. C.	34 41	76 40	20	62·23	
Fort Johnston, N. C.	34	78 05	20	65·68	46·01
Augusta Arsenal, Ga.	33 28	81 53	600?	64·01	23·
Fort Moultrie, Charleston, S. C.	32 45	79 51	25	66·58	44·92
Oglethorpe Barracks, Ga.	32 05	81 07	40	67·44	53·33
Fort Marion, St. Augustine, Fla.	29 48	81 35	25	69·61	31·80
Fort Shannon, Pilatka, East Fla.	29 34	81 48	25	69·64	48·68
New Smyrna, East Fla.	28 54	81 02	20	69·17	
Fort Pierce, East Fla.	27 30	80 20	30	73·20	62·98
Fort Dallas, East Fla.	25 55	80 20	20	74·75	
Key West, Fla.	24 32	81 48	10	76·51	47·65
Fort Myers, South Fla.	26 38	82 02	50	75·04	62·26
Fort Brooke, Tampa Bay, Fla.	28	82 28	20	71·92	55·47
Fort Meade, Fla.	28 01	82	80	71·48	40·22
Fort Micanopy, Fla.	29 30	82 28	60?	70·09	
Fort King, Fla.	29 10	82 10	50	70·	
Cedar Keys, Fla.	29 07	83 03	35	69·60	48·50
Fort Fanning, Fla.	29 35	83	50	70·20	
Fort Barrancas, Pensacola, Fla.	30 18	87 27	20	68·74	56·98
Fort Morgan, Ala.	30 14	88	20	66·88	
Mt. Vernon Arsenal, Ala.	31 12	88 02	200?	65·84	63·50
Fort Pike, La.	30 10	89 38	10	69·86	71·92
Fort Wood, La.	30 08	89 51	20	69·25	60·63
New Orleans, La.	29 57	90	10	69·86	50·90
Baton Rouge, La.	30 26	91 78	41	68·14	62·10
Fort Jessup, La.	31 33	93 32	80?	66·34	45·85
Fort Towson, Ind. Ter.	34	95 33	300?	61·69	51·08
Fort Washita, Ind. Ter.	24 14	96 38	645	62·21	41·66
Fort Smith, Ark.	35° 23′	94° 29′	460	60°·02	42·10
Fort Gibson, Ind. Ter.	34 47	95 10	560	60·81	36·46
Fort Scott, Mo.	37 45	94 35	1000?	54·50	42·12
Jefferson Barracks, Mo.	38 28	90 15	472	55·46	37·83
St. Louis Arsenal, Mo.	38 40	90 05	450	54·51	41·95
Newport Barracks, Newport, Ky.	39 05	84 29	500	55·26	
Detroit, Mich.	42 20	82 58	580	47·25	30·07
Fort Gratiot, Mich.	42 55	82 23	598	46·29	32·62
Fort Mackinac, Mich.	45 51	84 33	728	40·65	23·87
Fort Dearborn, Chicago, Ill.	41 52	87 35	591	46·75	
Fort Brady, Mich.	46 30	84 43	600	40·37	31·35
Fort Wilkins, Mich.	47 30	88	620	41·	
Fort Howard, Wis.	44 30	88 05	620	44·49	34·65
Fort Winnebago, Wis.	43 31	89 28	770?	44·80	27·49
Fort Crawford, Wis.	43 05	91	642	47·63	31·40
Fort Armstrong, Ill.	41 30	90 40	528	50·31	
Fort Atkinson, Iowa	43	92	700?	45·50	39·74
Fort Des Moines, Iowa	41 32	93 38	780	49·74	26·56
Fort Ripley, Minnesota	46 19	94 19	1130	39·30	29·48
Fort Snelling, Min.	44 53	93 10	8:0	44·54	25·43
Fort Leavenworth, Kansas	39 21	94 44	896	52·78	30·29
Council Bluffs, Nebraska	41 30	95 48	1250	49·28	
Fort Kearney, Nebraska	40 38	98 57	2360	47·67	27·98
Fort Laramie, Nebraska	42 12	104 47	4519	50·06	19·98
Fort Arbuckle, Ind. Ter.	34 27	97 09	1000?	60·83	30·57
Fort Belknap, Texas	33 08	98 48	1600?	63·99	22·
Fort Worth, Texas	32 40	97 25	1100?	63·54	40·86
Phantom Hill, Texas	32 30	99 45	2300?	63·73	17·22
Fort Chadbourne, Texas	31 38	100 40	2120	62·38	31·88
Fort Graham, Texas	31 56	97 26	900?	65·76	40·58
Fort Gates, Texas	31 26	97 49	1000?	66·12	
Fort Croghan, Texas	30 40	98 31	1000?	65·74	36·56
San Antonio, Texas	29 25	98 25	600	69·25	33·77
Fort Merrill, Texas	28 17	98	150?	71·37	
Fort Ewell, Texas	28 05	98 57	200	71·30	
Corpus Christi, Texas	27 47	97 27	20	70·95	30·82
Fort Brown, Texas	25 54	97 26	50	73·75	33·65
Ringgold Barracks, Texas	26 23	99 02	200?	74·21	20·95
Fort McIntosh, Texas	27 31	99 21	400	73·24	18·66
Fort Duncan, Eagle Pass, Texas	28 42	100 30	800	70·85	22·20
Fort Inge, Texas	29 09	99 07	845	67·69	27·99
Fort Lincoln, Texas	29 22	99 33	900?	68·03	20·58
Fort Clark, Texas	29 17	100 25	1000?	67·04	21·80
Fort Fillmore, New Mexico	32 13	106 42	3937	63·98	9·28
Fort Webster, New Mexico	32 48	108 04	6350	54·84	8·79
Fort Conrad, New Mexico	33 34	107 09	4576	59·40	6·76
Albuquerque, New Mexico	35 06	106 38	5032	56·32	9·42
Cebolleta and Laguna, New Mexico	35 03	107 14	6000	55·12	12·05
Santa Fé, New Mexico	35 41	106 02	6846	50·59	19·83
Las Vegas, New Mexico	35 35	105 16	6418	49·14	19·24
Fort Union, New Mexico	35 54	104 57	6670	49·14	19·24
Fort Massachusetts, New Mexico	37 32	105 23	8365	49·11	20·54
Fort Defiance, New Mexico	35 44	109 15	7200?	46·92	16·64
Fort Yuma, California	32 43	114 36	120	73·62	3·24
San Diego, California	32 42	117 14	150	62·	10·43
Posts Del Chino and Jurupa, California	34	117 25	1000?	63·28	13·77
Monterey, California	36 36	121 52	140	55·29	12·20
Fort Miller, California	37	119 40	402	66·	24·51
San Francisco, California	37 48	122 26	150	54·88	23·59
Benicia Barracks, California	38 03	122 08	64	58·29	16·62
Sacramento, California	38 33	121 20	50	59·89	21·32
Fort Reading, California	40 30	122 05	674	62·09	29·02
Fort Humboldt, California	40 46	124 09	50	52·80	16·77
Fort Jones, California	41 36	122 52	2570	51·40	16·77
Fort Orford, California	42 44	124 29	50	53·62	68·52
Fort Vancouver, Oregon	45 40	122 30	50	52·65	45·50
Fort Dalles, Oregon	45 36	120 55	350	52·79	14·32
Fort Steilacoom, Washington Territory	47 10	122 25	300?	50·82	51·75
Astoria, Oregon	40 11	123 48	50	52·23	
Great Salt Lake, Utah	40 46	112 06	4351	53·24	

THE END.