GLOBES AND MAPS

A TEACHERS MANUAL

ON O. WISWELL

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Studying the relation of the earth and the sun by means of a globe

GLOBES AND MAPS
IN ELEMENTARY SCHOOLS

A TEACHERS' MANUAL

By

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PREFATORY NOTE

EVERY intelligent dweller on the earth, whose comfort and happiness from hour to hour and even whose existence depend on the relative positions of the earth and the sun, ought to have a general knowledge of the relations of those bodies to each other, and of the causes of certain remarkable phenomena which they exhibit. It is not well for the rising generations to pass their lives unappreciative in the presence of such stupendous creations. The mind expands in the study of the greatness and power which they evidence. A correct conception of the world as a whole gives a clear understanding of the just relations of its parts. Therefore no child can justly be denied the early advantage of globe lessons; they will tend to make some geography lessons simpler, easier, and more interesting.

Very few of the facts indicated in these pages are to be given to the pupils; they are to be elicited from them. A distinction should be made between telling and teaching. There would be little or no advantage to be gained by any pupil in merely committing the facts to memory and reciting them. The skillful teacher will first see that step by step the various conditions here described are illustrated by the pupils with a globe in hand, and as each step is reached will obtain from individuals correct statements of the facts observed. If the teacher has the power to make the lessons thoroughly enjoyable, so much the better. An unused globe may be an indication of some lack of preparation or of efficiency on the part of the teacher, and it is assumed that he will gladly free himself from the possibility of such a charge as he has opportunity.

THE AUTHOR

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GLOBES AND MAPS

IN

ELEMENTARY SCHOOLS

GLOBE LESSONS

FIRST SERIES: FOR GRADES 4, 5, AND 6

The earth. The earth is a great ball which swings in vast space and is held in its course by the attraction of the sun. It is of immense size, being about 25,000 miles around, so that if a fast railroad train going fifty miles an hour could pass clear around without a stop, it would require about twenty-one days, going night and day, to make the journey. To get a fair idea how the earth as a whole appears, look at the moon, which is another great ball but is much smaller than the earth.

A sphere. Referring now to the globe and speaking as if it were the real earth, observe that it is round. As there are different ways of being round, it is not sufficient to say merely that a thing is round. A plate is round, so is a stovepipe. The earth is round like a ball, so it is called a sphere. Only one half of it can be seen at any one time. This half is called a hemisphere (*hemi* means half). There is always a corresponding hemisphere on the other side. A different hemisphere is presented to the eye every time the position of the earth or the observer is changed.

Land and water. Observe the land and water forms. Point out the continents and oceans, naming each. Point out the United States, the state of New York, and the location of home. Observe the so-called eastern hemisphere; the so-called western; the northern; the southern. Find a hemisphere that has much more land than water; find one that has much more water than land.

Rotation. The earth turns like a wheel, and this motion is called rotation (*rota* means wheel). The line around which it turns is the axis (*axis* means axle). The northern end of the axis is the North Pole, the southern end is the South Pole.

Directions. Draw out definitions of up and down, showing that *up* means *above* and *down* means *beneath.* To a man standing erect, *up* is directly overhead and *down* is toward his feet or toward the center of the earth. Carefully show that this is true in every position of the globe.

To a man standing with his face toward the north, east is toward his right, west is toward his left, and south is behind him. Show that this is true in every position of the earth. Teach the mid-directions, northeast, southeast, northwest, and southwest. Teach the abbreviations, N., S., E., W., N. E., etc.

Circles. As the location of a building in a city may sometimes be described best by naming two streets near or on both of which it stands, as, for instance, at the corner of 42d Street and 5th Avenue, so the location of any point on the earth may sometimes be described best by naming two established lines at the intersection of which it stands. Men have laid out hundreds of lines on the earth, for this and other purposes. They are not really drawn on the earth, but many of them are drawn on maps and globes, and any astronomer or ship navigator, and some surveyors, can easily find their places on the earth. It will be seen that because the earth is spherical these lines cannot be straight; they must be curved. In fact, they are circles. Some of these are now to be studied.

Parallels. Passing around the earth exactly midway between the poles is a circle called the Equator (*aequus* means equal), which divides the earth's surface into two equal parts and which marks the line of separation between the Northern Hemisphere and the Southern Hemisphere.

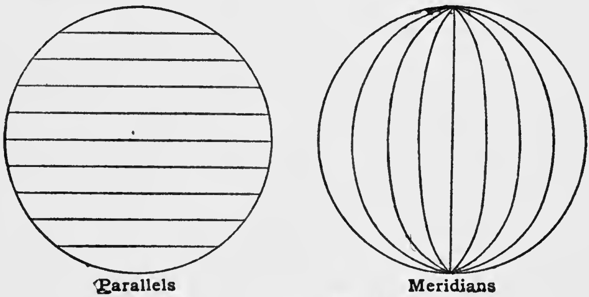

FIG. 1. *Parallels and Meridians*

Observe that both north and south of the Equator other circles are drawn east and west on the globe map parallel to the Equator and to each other, that is, extending in the same direction. These are called parallels. They diminish in size toward the poles; and because each divides the earth's surface into two unequal parts they are called small circles. Circles that divide the earth's surface equally are called great circles.

Meridians. Other lines are drawn north and south from pole to pole, some of them being marked on the globe. These are called meridians (*medius* means mid; *dies* means day), because when the sun stands directly over any one of them it is exactly midday or noon at every place through which it passes. Observe that the meridians are half circles, that they are not parallel, and that each meridian with its opposite makes a great circle.

Measurements. The unit of measure of parts of circles is a degree. Every circle, great or small, is said to measure 360 degrees (360°). It will be seen therefore that degrees on a circle vary in length according to the size of the circle. A semicircle (*semi* means half), measures 180 degrees (180°), and a quarter circle measures ninety degrees (90°). Note that, measuring on a meridian, it is 180° from the North Pole to the South Pole, and that it is 90° from the Equator to either pole.

Latitude. Latitude is distance north or south of the Equator. Draw out that all places on the same parallel have the same latitude, that the places which have the highest latitude are the North Pole, ninety degrees north latitude (90° N.), and the South Pole, ninety degrees south latitude (90° S.), and that because we begin at the Equator to reckon latitude all places through which it passes have no latitude (0°). Find on the globe the approximate latitude of various places, north and south, including your home. Find the difference in latitude between places north of the Equator, places south of the Equator, and places one of which is north of the Equator and the other south of it.

Longitude. Longitude is distance east or west of some meridian that is taken as a line at which to begin measuring. Such a meridian is called the prime meridian. The meridian most commonly agreed on as such a line is one which passes through a celebrated observatory at Greenwich, near London, England. Be careful to observe that in passing directly east or west from any point a parallel *must* be followed, that the parallels are circles, that they diminish in size toward the poles, and therefore that degrees of longitude vary in length, being longest at the Equator and shortest near the poles. At the Equator a degree measures 69.16 miles. Observe that, in reckoning the longitude of any place, measurement is made from the prime meridian to the meridian which passes through that place, and that all places on the same meridian have the same longitude. Likewise, in reckoning the latitude of any place, measurement is made from the Equator to the parallel which passes through that place, and all places on the same parallel have the same latitude.

Find the prime meridian. Find the longitude of places east of the prime meridian; of places west of it. Notice that the meridians which are marked on the globe are numbered in degrees along the Equator. Find the difference in longitude between two places east of the prime meridian; of two places west of it; of two places one of which is east of it and the other west of it. What is the meaning of 40°E.? of 40° W.? Find the meridian which is exactly opposite the prime meridian. Give its number in degrees. [180° east or west.] Find the location of points whose latitude and longitude are given.

Rotation and day and night. For the lessons on rotation and revolution, let some object in the room represent the sun; but give the pupils to understand that, to have the proportions right, if the globe is twelve inches in diameter, the object representing the sun should be a ball about 108 feet in diameter and it should be more than two miles away. Some object on a table around which the globe may be carried will be most satisfactory, especially for the lesson on revolution. Hold the globe in the position for one of the equinoxes as indicated in Fig. 7, the axis pointing upward and toward the north, and the sun shining vertically on the

Equator, thus giving a correct impression from the first and leaving nothing to be unlearned.

Then show that the earth rotates around its axis from west to east, that is, in a direction contrary to that taken by the hands of a watch placed at the North Pole, face up, and that it makes one complete turn every twenty-four hours. The side (hemisphere) toward the sun has day, the opposite side has night. As the earth rotates, follow places thereon from sunrise to noon; to sunset; to midnight. Show that to a man on the earth, the sun rises in the east and sets in the west.

Revolution and the seasons. Place the globe in some good position for a starting place, as, for instance, that for the summer solstice, June 21, indicated in Fig. 5, and, leaving most details for the advanced lessons, illustrate the two principal motions of the earth by passing the globe around the mimic sun in a direction contrary to that taken by the hands of a watch held face up, and at the same time rotating it as already described. Be careful to tip the axis a little toward the north, and to keep it pointing all the time as nearly as may be in the same direction. This motion around the sun is called the revolution. Each revolution requires just one year. The path the earth takes is called its orbit. (Fig. 4.) If the school globe is full mounted, that is, has a horizon circle, it should be lifted from the frame whenever there is occasion, as in presenting lessons on revolution.

Explain that the sun not only lights the earth but heats it, and that it heats most those parts which are turned directly toward it. Those parts of the earth which receive only slanting rays for a long time are cold, while those which receive none at all are very cold. Show that in the region of the Equator the climate is always warm (torrid) and that in the region of the poles it is always cold (frigid). The intermediate regions on the north and the south are neither very cold nor very warm (temperate). Each of these broad regions or belts is called a zone. There are thus two frigid zones, two temperate zones, and one torrid zone, five in all. Show that in one part of the earth's course the Northern Hemisphere is inclined somewhat toward the sun while at the same time the Southern Hemisphere is turned partly away from it. At that time of year the Northern Hemisphere has summer while the Southern Hemisphere has winter. In another part of its course the Southern Hemisphere is turned toward the sun somewhat while the Northern Hemisphere is turned away from it. Then the seasons are reversed.

Follow your home through the change of seasons.

Second Series: For Grades 7 and 8

Review. Review any parts of the first series of lessons that need attention.

North. In these lessons the term north refers to the true north, not to some other direction assumed to be north. An approximation is all that is here expected. The principal guide to mariners and scientists in determining the direction of north has for ages been the North Star, whose scientific name is *Polaris.* The axis of the earth points almost exactly toward it. See diagram and show pupils how to find it. They should look first for the group of stars commonly called the Big Dipper (the scientists speak of it as the constellation of *Ursa Major; ursa* means bear, *major* means greater), which may be found in different positions in the northern heavens, as it seems to move around the North Star.

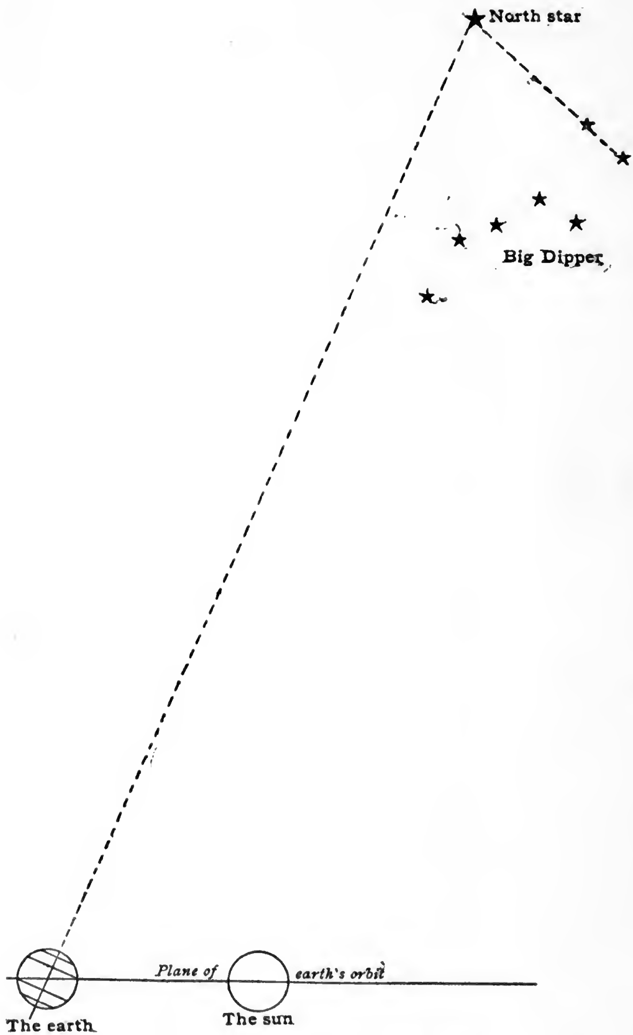

FIG. 2. *Finding the North Star*

Two stars in the Big Dipper opposite the handle indicate the direction toward the North Star, which, though not very bright, is the first very noticeable star in line. (Fig. 2.)

Two motions. Hold the globe level with the mimic sun, incline the axis toward the north somewhat. Rotate it as described under Rotation on page 14, and pass it around the sun in a direction opposite to that taken by the hands of a watch held face up, and with the axis all the while pointing toward the north. This represents one complete circuit around the sun, which requires one year. The path taken by the earth is called its orbit. As seen from the earth, the sun appears to be following the same path, and this apparent course of the sun is called the ecliptic. (Fig. 4.)

Plane of earth's orbit. A plane is a perfectly flat surface, real or imaginary. It may be represented by the side of any smooth, flat object. A plane has length and width but no thickness. Now imagine a plane which passes through the center of the sun and the center of the earth, and extends far in every direction. As the earth revolves around the sun, the center of it lies continually in such a plane; in other words, every part of the earth's course lies in what is called the plane of its orbit. (Fig. 5 or 6.)

Angle of inclination of earth's axis. Explain that circles are used to measure angles. Draw a quarter circle on the blackboard and draw thereon straight lines to illustrate various angles, as, 30°, 45°, 60°, 66½°, 90°. An angle of 90° is called a right angle. Note that a line making an angle of 66½° with the base is inclined 23½° from the perpendicular, and so illustrates the position of the earth's axis. (90° − 66½° = 23½°.) Place the axis of the globe

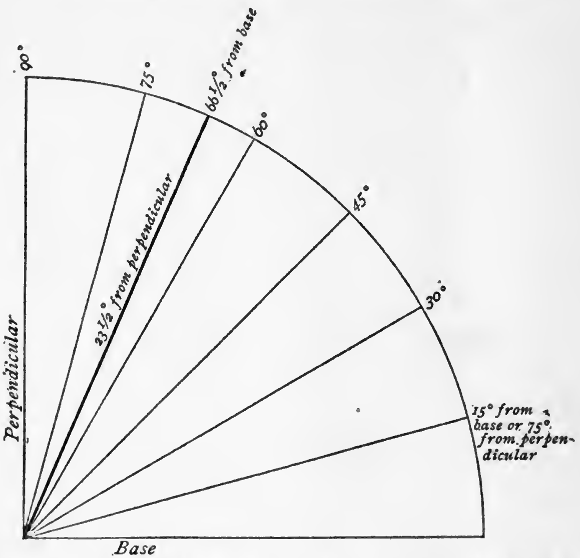

FIG. 3. *A quadrant, or one fourth of a circle. The oblique lines indicate various angles with the base. The heavy line indicates the inclination of the earth's axis as compared with the plane of its orbit, which is represented by the base*

wholly in the plane of its orbit as nearly as may be; vertical to the plane. Incline the axis toward the north and 23½° from the vertical position. This is approximately the direction which the axis of the earth takes the year round. (Fig. 4.) The axis of a globe having a graduated metallic meridian circle can easily be set at an angle of 23½° from a vertical position, or any other angle, by adjusting the meridian with reference to the attached orbital plane.

Day and night and the equinoxes. Call attention to the fact that the apparent passing of the sun across the heavens from east to west is an illusion which deceived the wisest men for ages, and illustrate the first appearance of the sun in the morning to a man standing near your school. Imagine him as standing facing the east with his left hand toward the north and his right hand toward the south. Obviously, if the position of the globe is not correct and it is not rotated in the right direction, the sun will not seem to rise in front of the man. The teacher should make sure about these points before she gives the lesson, and should in advance consult some one who knows if she is doubtful.

Show that in the earth's revolution around the sun there comes a time when, owing to the inclination of the earth's axis, the sun's rays meet the earth's surface vertically at a point 23½° north of the Equator, and that at the same time they extend 23½° beyond the North Pole while they lack 23½° of reaching the South Pole. (Figs. 5 and 6.) This condition marks the location of three circles on the earth, one 23½° from the North Pole, called the Arctic or North Polar Circle, another 23½° from the South Pole called the Antarctic or South Polar Circle, and a third 23½° north of the Equator called the Tropic of Cancer. The marking of the Tropic of Cancer or either of the other circles may perhaps be more clearly understood if a ray of sunlight be imagined as an immovable pencil with the point touching the earth. Such a pencil would mark a circle at each rotation.

The teacher should dwell with patience on these relative positions of the earth and the sun, as they appear on June 21 of each year, till the facts are clearly understood, for otherwise the causes of the seasons and of long and short days will not be clear.

Observe that by a man standing on the Tropic of Cancer on this day, the sun, at noon, is seen directly overhead;

that to one standing north of the Arctic Circle there is no night, the sun being in sight during the entire rotation; that one standing anywhere between the Equator and the Arctic Circle has the day longer than the night; that toward the north the day grows longer and the night shorter; that a man standing south of the Antarctic Circle has no day, the sun being out of sight during the entire rotation; that a man standing anywhere between the equator and the Antarctic Circle has the night longer than the day; that toward the south the night grows longer and the day shorter; and that at any point on the Equator the day and the night are exactly equal. On this date occur the longest day and the shortest night in the Northern Hemisphere, while in the Southern Hemisphere occur the shortest day and the longest night.

Revolve the earth one fourth the distance around the sun, with the axis still directed toward the north as described, and observe that the direct vertical rays of the sun meet the earth at the Equator, and that the sunlight covers a hemisphere that on the north extends just to the North Pole and on the south just to the South Pole. Observe also that on this day, September 22, the days and nights are equal over the entire earth. This is called the autumn equinox (*aequus* means equal, *nox* means night).

Revolve the earth another fourth of the distance around the sun, still pointing the axis toward the north. This brings them to a time representing December 21. (Figs 4 and 6.) Observe that the conditions with regard to day and night are exactly the reverse of those which existed on June 21. The sun shines vertically over a point on the earth's surface 23½° south of the Equator and so marks the position of a circle called the

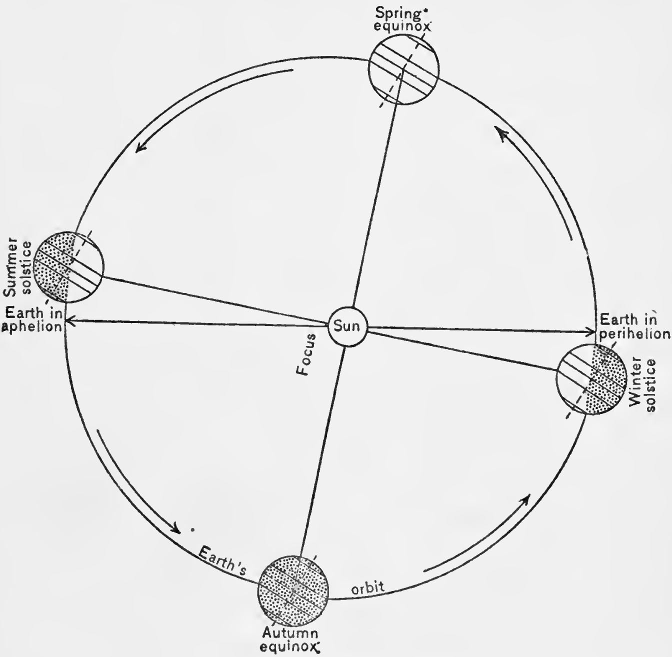

FIG. 4. *Relative positions of the earth and the sun during the spring equinox, the summer solstice, the autumn equinox, and the winter solstice*

Tropic of Capricorn. North of the Arctic Circle there is continuous night, south of the Antarctic Circle there is continuous day, between the Equator and the Arctic Circle the nights are longer than the days, and between the Equator and the Antarctic Circle the days are longer than the nights. On this date occur the shortest day and the longest night of the year in the Northern Hemisphere, while in the Southern Hemisphere occur the longest day and the shortest night. It will be seen that from June 21 to December 21 the days in the Northern

Hemisphere have become gradually shorter and the nights correspondingly longer, while on the other hand the days in the Southern Hemisphere have become gradually longer and the nights shorter. On the Equator the days and nights are still exactly equal.

Observe also that during this period of six months the sun has seemed to move gradually toward the south, daily rising and setting a little lower. Every child in the class has observed the fact that the sun moves lower in the south in winter than in summer, but by the use of the globe both the cause and the effect of this phenomenon can be made quite clear.

In continuing the revolution of the earth around the sun, lead the pupils to observe that the changes in the lengths of day and night, for the next six months after December 21, are the reverse of those during the preceding six months; that is, north of the Equator the days lengthen and the nights correspondingly shorten, while south of the Equator the days shorten and the nights correspondingly lengthen. Note also that in the position halfway between that for December 21 and that for June 21, there is a day when again the direct vertical rays of the sun shine upon the Equator and daylight extends over a hemisphere reaching from the North Pole to the South Pole. This is March 21, the spring equinox. (Fig. 7.) Observe that then again the days and nights over the entire earth are equal. Note further that on the Equator they have been found equal all the time. At the equinoxes, when the sun seems to move across the Equator, it is said to "cross the line."

The horizon. The line where the earth and the sky seem to meet is commonly called the horizon. Scientists use the term to indicate (*a*) the plane passing through

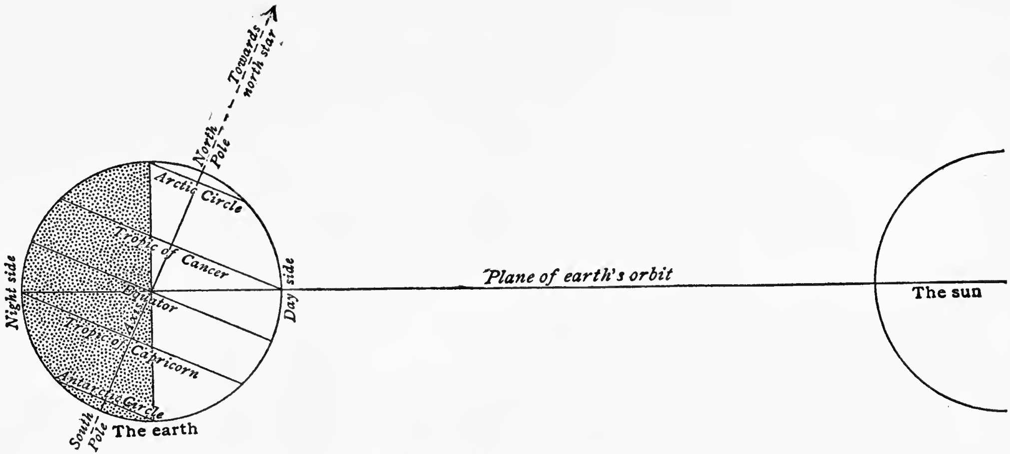

FIG. 5. *Relative positions of the earth and the sun on June 21, the summer solstice. Summer and long days north of the Equator; winter and short days south of it*

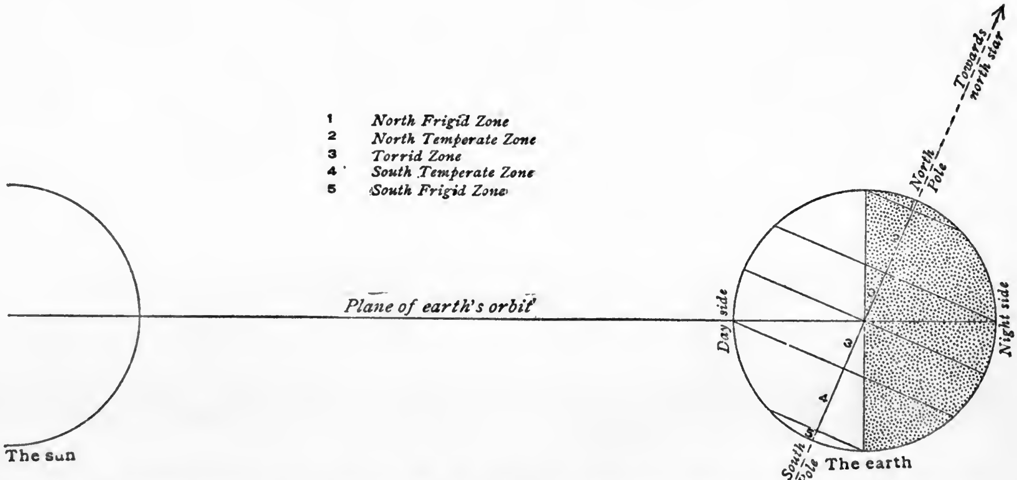

FIG. 6. *Relative positions of the earth and the sun on December 21, the winter solstice. Winter and short days north of the Equator; summer and long days south of it*

the eye of the observer at right angles to the vertical at any given point, called the sensible horizon; and (*b*) the plane passing through the center of the earth parallel to the sensible horizon, called the rational horizon.

The solstices. Observe that in the earth's swing around the sun, which we began to study in the position for June 21, it reaches a position halfway around on December 21, and that thereafter it passes upon its return journey. The sun which from day to day had seemed to men on the earth to move toward the south, on that day reaches its farthest limit, and thereafter seems to move toward the north; but on that day it seems to move neither north nor south. Hence the day is called the solstice (*sol* means sun; *sistere* means to stand). This is called the winter solstice; there is a similar day on June 21, which is known as the summer solstice.

The seasons. Every child knows that the chief source of heat as well as light is the sun. In the study of day and night, light has been a fundamental factor; in a study of the seasons, heat is a fundamental factor. First compare the effects of vertical rays of heat with those of slanting or oblique rays.

Distance, of course, affects the intensity of heat, the intensity diminishing as the distance increases, and conversely; but the amount of heat which a surface receives depends also upon the relative direction whence it comes. If, for instance, the rays meet the surface, vertically, it receives far more heat than it would if the rays were very slanting, for it intercepts a far greater number of them. These statements may not be understood by the pupils, but they may be made clear by the use of a lamp and a piece of cardboard or any similar apparatus. The broader general truth may be formulated somewhat as follows: The more nearly vertical the rays, the greater the heat; and conversely, the more slanting the rays, the less the heat.

Again place the globe in the position for June 21, as already described on page 19. (See also Fig. 5.) Observe that the sun's heat rays as well as its light rays meet the earth vertically on the Tropic of Cancer, that they reach the entire Northern Hemisphere, becoming very slanting at the far north, that they become more and more slanting from the Tropic of Cancer to the Antarctic Circle, where they cease, and that all south of the Antarctic Circle is shut off from direct rays of heat as well as light. Reason from these observations that it is very warm at that time of year for some distance north and south of the Tropic of Cancer, that it is cold in the region of the North Pole, that it is far colder in the region of the South Pole, and that there is a middle region on both the north and the south where the climate is neither very hot nor very cold. Observe that in June the Northern Hemisphere, having long days and short nights and receiving more directly the heat rays of the sun, must be warmer than the Southern Hemisphere, which has long nights and short days and receives less directly the heat rays of the sun. It is then summer in the Northern Hemisphere and winter in the Southern. June 21 would be midsummer in the Northern Hemisphere and midwinter in the southern were it not that, as the earth warms so slowly after winter and cools so slowly after summer, the seasons all lag behind the sun. Hence it is that this date is only the beginning of summer, as the astronomers count it.

On passing the globe around the sun again, as before,

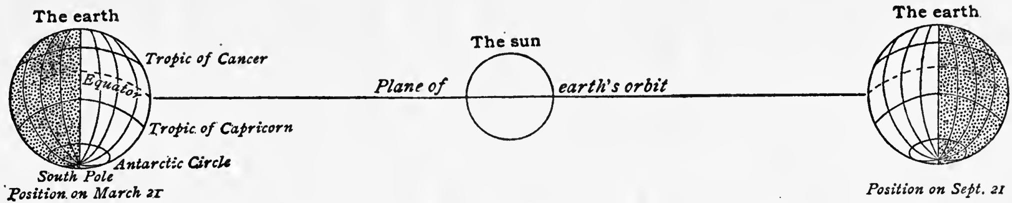

FIG. 7. *Relative positions of the earth and the sun on March 21 (spring equinox) and September 21 (autumn equinox) as seen from the position occupied by the earth on June 21 (summer solstice). Rays of light and heat meet the earth vertically at the Equator, and the days and nights are everywhere of equal length.* (See Fig. 4.)

it can be seen that between June 21 and December 21 the conditions with regard to both heat and light become reversed so that on the latter date there is summer in the Southern Hemisphere while there is winter in the Northern. (Figs. 4 and 6.) Midway between these dates, on March 21 and September 22, when the cold of winter on one hand and the heat of summer on the other hand have become moderate, occur the spring or vernal equinox and the autumn equinox, the beginning of spring and autumn respectively in the middle latitudes. (Fig. 7.) Winter is said to begin on December 21, the winter solstice.

Observe that as the vertical rays of the sun pass from the Tropic of Cancer to the Tropic of Capricorn and back each year and are never far from the Equator, the region of the Equator must be very warm the year round. The continued exposure to the sun of each frigid zone for months at a time without any night would make it unbearably, even dangerously, hot were it not that the heat rays there meet the surface of the earth very slantingly, and so impart little heat.

Zones. It will be seen that there are on the earth five broad regions or belts (zones) in each of which the weather conditions (climate) have marked characteristics. There is the very warm belt between the tropics, called the Torrid Zone; there are the two very cold regions about the poles, the one on the north extending south to the Arctic Circle and called the North Frigid Zone, the other on the south extending north to the Antarctic Circle and called the South Frigid Zone; and there are the two intermediate regions called respectively the North Temperate Zone and the South Temperate Zone. (Fig. 6.)

An interesting discussion may be started by inquiring what the effect would be if the axis of the earth were perpendicular to the plane of its orbit. Would there be any change of seasons? The following diagram (Fig. 8) indicates the position in which the globe should be held while the pupils are studying the question.

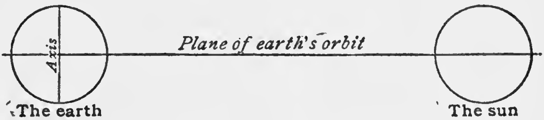

FIG. 8. *The earth shown as it would be if its axis were perpendicular to the plane of the orbit.*

Distances in miles. To find the distance in miles between any two points on the earth, stretch a narrow strip of writing paper from one to the other as indicated on the globe, and mark the distance on the paper; then measure off the same distance on the Equator where the degrees are numbered, beginning at the prime meridian, and so ascertain the distance in degrees. As one degree on a great circle is $69\frac{1}{6}$ miles, multiply this number by the number of degrees indicated. If, for instance, they are 60° apart, they are sixty times $69\frac{1}{6}$ miles apart, or 4,150 miles. Along the meridian of 30° W. or elsewhere, at the intersection of the parallel lines, may be found Arabic numerals. These indicate the length of a degree of longitude on the small circles on which they stand. The sun is about 95,000,000 miles distant. The moon is about 235,000 miles distant, and is about 2,000 miles in diameter. The earth is about 8,000 miles in diameter and about 25,000 miles in circumference.

Third Series: For Upper Elementary or Lower Secondary Grades[1]

Direction of the sun. Illustrating with a globe, lead pupils to see that to a man standing on the Arctic Circle on June 21, the sun at noon appears rather high in the heavens in the south, that at midnight it is on the horizon in the north, and that during the entire twenty-four hours it does not set. Lead them to see that to a man standing at the North Pole on that date it seems merely to swing around the heavens, some distance above the horizon, but all the time in the south. At the North Pole there is no north, east, or west.

To people living south of the Equator the sun always appears in the north at noon.

When the sun appears to you on the horizon on the morning of June 21, its rays, which then reach you very slantingly, meet the earth vertically at a point on the Tropic of Cancer. (Fig. 5.) At that point it is noon. To determine just where the point is, learn from an almanac at what time the sun rises at your home. If, for instance, it rises at 4.30 A.M., it will require 7½ hours to pass over to your meridian and mark twelve o'clock, noon, for you (12 hr. – 4½ hr. = 7½ hr.). As it passes over 15° of longitude in one hr. (see p. 32), in 7½ hr. it will pass

[1] The following lessons are here inserted for such use as teachers may choose to make of them. The substance of some of them appears in the regular high-school courses in physical geography and astronomy, though they are often pursued with little or no reference to a globe. All treat of topics which every intelligent person wishes to understand. Some or all of them may be given in the upper elementary grades, or they may be given in the advanced grades, or they may be omitted, at the discretion of the teacher. The fact is not to be overlooked that, to be effective, they must be based on actual observation of the globe and of the celestial bodies named. None of them is intended to give more than the merest simple outline.

over $7\frac{1}{2}$ times 15°, which are $112\frac{1}{2}^\circ$. It is seen therefore that when the sun first appears to you on that morning, it is shining vertically on the Tropic of Cancer at a point $112\frac{1}{2}^\circ$ east of your meridian. Suppose your meridian to be 75° W. Then the point referred to is in longitude $37\frac{1}{2}^\circ$ E. Make this clear. ($75^\circ + 37\frac{1}{2}^\circ = 112\frac{1}{2}^\circ$.) Find the point on the Tropic of Cancer at $37\frac{1}{2}^\circ$ E. With a piece of cord mark the most direct line on the globe between your home and that point. This indicates the direction in which on that morning you must look to see the sun rise. You may be surprised to find that you must look toward the northeast, as you may discover by comparing the direction of the cord with the direction of the parallels.

In similar manner the direction of the sun at sunset (northwest) or at any other time of day may be found. But in applying this rule it is necessary to know the declination of the sun on the particular date, that is, its distance north or south of the Equator, which varies according to the time of year. The declination on each of the solstices ($23\frac{1}{2}^\circ$ north or south) and each of the equinoxes (0°) is known. For any other date, see the analemma.

If it is remembered that direction east and west on the globe is indicated by the parallels, some idea of the direction of the sun from any point on the earth may be gained from Fig. 5 or 6.

To a man traveling north, the North Star seems to rise in the heavens. At the North Pole it would seem to be directly overhead. It is invisible in the Southern Hemisphere.

Longitude and time. From any one meridian around the earth directly east or west to the same meridian, as measured on any parallel, there are 360° of distance. In the rotation of the earth, the sun is caused apparently to pass over this distance from east to west in twenty-four hours. In one hour therefore the sun passes over 15° (1-24 of 360° = 15°). Noon by the sun arrives at any place when the sun shines vertically on the meridian which passes through that place. It follows that when, for instance, it is noon at any one point, it is 11 A.M. at any other point located 15° west, the sun not having reached it, and it is 1 P.M. at any other point, 15° east, the sun having passed it. It is therefore seen that, toward the west from any point, time by the sun is earlier (slower), while toward the east it is later (faster). The variation is at the rate of one hour for 15°, or four minutes for one degree. Note that the meridians are marked along the Equator on the globe in multiples of 15, as 15°, 30°, 45°, etc., thus making it possible easily to find the difference in time between any two meridians.

Along the Equator, Roman numerals, clock fashion, may also be found adjacent to the meridians whose numbers in degrees are divisible by 15. These numerals indicate the time on each meridian when it is twelve o'clock on the prime meridian. Find the difference in longitude and in time between two given meridians both of which are in east longitude; between two in west longitude; between two meridians, one of which is east and the other west.

Give problems, as: An event happens at 6 P.M. at a point on the prime meridian and the news is sent by telegraph to a point 75° west without loss of time. At what time is the news received at the latter? The difference in longitude is 75°, hence the difference in time is five hours. (75 ÷ 15 = 5.) As time toward the west is earlier (slower), the news was received at 1 P.M. of the same day.

For exact measurements a degree is divided into sixty equal parts called minutes (marked ′) and each minute is divided into sixty equal parts called seconds (marked ″).

TABLE

60″	make	1′
60′	"	1°
360°	"	1 circle

1′ is one nautical mile.

If the difference in time between any two places is given in hours, minutes, and seconds, the difference in longitude may be found by multiplying by 15 and calling the result respectively degrees, minutes, and seconds.

Time dial. The small, loose metal plate attached to each pole of the globe is a time dial. It is divided into twenty-four equal parts corresponding to the twenty-four hours of the day; generally into two sets of twelve each, marked to correspond to the clock record. By adjusting it to any meridian so as to show the time thereon, the time on any other meridian at the same moment is indicated. With this information, the pupil can easily determine the difference in time between the two meridians.

Standard or railroad time. If the people in every place reckoned time by the sun, no two whose longitude differ would have the same standard and there would be great confusion. In the latitude of central New York, a difference of about eleven miles, east and west, makes a difference of one minute in time by the sun. Difference in location north and south makes no difference in time. Why? A man whose watch is correct for his home would find it one minute slow if he were to go eleven miles toward the east or one minute fast if he were to go eleven miles toward the west. After traveling any considerable distance east or west, no man could learn the exact local time by consulting his watch. Watches and clocks would be of less use, railroad trains could not be run safely, and time-tables would lose most of their value. Business would be seriously hampered. All inconvenience and loss on this account are avoided by the adoption in America and elsewhere of a simple expedient called standard or railroad time. This is based on the knowledge that a difference of 15° in longitude makes a difference of one hour in time, and on the convenience of counting no changes of time except in full hours.

The meridian of 75° W., which passes through the middle of the state of New York, differs from the prime meridian in time exactly five hours. The meridian of 90° W. differs six hours; of 105° W., seven hours; of 115° W., eight hours. The plan is to give to all the territory in the region of each meridian whose number in degrees is divisible by 15 the time of that meridian. For instance, when it is twelve o'clock, noon, on the 75th meridian, it is counted twelve o'clock over a region halfway to the 60th meridian on the east and halfway to the 90th meridian on the west. By this plan, the United States is divided into four time-belts or zones extending north and south, the middle of each being marked by one of the four meridians just mentioned. A traveler in the United States therefore takes no account of any change in time unless he passes into another time-zone, and then the change is exactly one hour. For illustration, if he is going west, and his watch indicates four o'clock on passing into the next time-zone, he knows that by standard time it is there three o'clock. On the other hand, if he is going east and his watch indicates four o'clock on passing into the next time-zone, he knows that by standard time it is there five o'clock.

Time is spoken of as Eastern, Central, Mountain, or Pacific according as the zone had in mind is marked by the meridian of 75°, 90°, 105°, or 115°. In practice, the boundaries between the zones are irregular.

International date line and days of the week. Hold the globe so as to represent noon at your home, say 75° W. Call the day, let us say, Monday. Now rotate the globe properly and note that as each successive meridian passes under the vertical sun it is Monday noon on that meridian. When your home again passes under the vertical sun, it is again noon there, but what day? You who have remained at home will say, Tuesday. Then when and where was the change made from Monday to Tuesday?

By agreement between civilized nations a line has been chosen where such changes can be made with least inconvenience, and that line is the meridian of 180°, exactly opposite the prime meridian, and passing through the Pacific Ocean, where fewest people live. It is called the International Date Line. Find it on the globe, and observe that in some places it is drawn to one side of the direct course. These diversions of it have been agreed upon to accommodate the people who live on the islands included. So when the line passes the vertical sun on Monday noon as just seen, the people on the west side of it immediately begin to call the time Tuesday noon.

Place the globe in a position to represent noon on the prime meridian (Greenwich), call the day Monday, and trace the day both eastward and westward. At the longitude of 90° E. the sun is just passing out of sight; it is sunset. Farther east it is evening, Monday evening, while just west of the Date Line it is nearly midnight at the end of Monday. On the other hand, at the longitude of 90° W. the sun is just rising on Monday morning, while farther west and near the Date Line it is very early in the morning of Monday. It will be seen therefore that at the moment when it is noon on the prime meridian it is midnight on the Date Line, that Monday is just beginning immediately at the east of the line while it is almost ended immediately at the west of the line. Over the whole earth it is Monday, and both the beginning and the end of that day occur on the Date Line.

If the globe be rotated ever so little so as to bring the prime meridian past noon, midnight, which marks the division between two days, moves to the west of the Date Line a corresponding distance. As Monday was ended on the Date Line at midnight, the next moment Tuesday begins right there.

Rotate the globe still farther and observe the effect. When it is noon 15° W. it is midnight (Monday-Tuesday) 15° west of the Date Line, which is the same as 165° E. (180°–15° = 165°). It is then one o'clock Monday afternoon on the prime meridian, while on the Date Line it is either one o'clock in the early morning of Monday or one o'clock in the early morning of Tuesday, according to whether it is considered from the east side or from the west. If a traveler going westward could at that moment stand on the east side of the Date Line, to him it is 1 A.M. Monday; but the instant he steps across the line, to him it is 1 A.M. Tuesday. So he would be obliged to add a day to his reckoning. This is precisely what all seamen do who are sailing westward. In a similar manner it may be shown that travelers going east must subtract a day on crossing the Date Line. For instance, if the ship, going east, reaches the Date Line on Tuesday at 8 A.M., the seamen immediately change their record to 8 A.M. Monday.

From the foregoing it will be seen that there may be two consecutive days of the week on the earth at the same time, and it may easily be shown that as the later, beginning at the Date Line, spreads steadily over the whole earth the earlier recedes before it and vanishes at the Date Line at midnight. When it is noon on the Date Line the earth is divided equally between two days.

Lead pupils to see that from the moment when a day begins at midnight on the 180th meridian to the moment when it ends in the same place, forty-eight hours must elapse, and the earth must make two complete rotations. At the end of the first rotation, the day covers the entire earth.

A.M. and P.M. The day as here meant is the mean solar day of twenty-four hours as measured by the clock. Solar days vary in length, as will be seen by reference to the paragraphs on *The Analemma*. The mean solar day is found by adding together the exact lengths of all the solar days in the year and dividing the sum by the number of days in the year. Each day of the week is reckoned from midnight to midnight. As now commonly made, clocks keep a record for twelve hours only and then repeat. This makes it necessary to add an extra description to distinguish any two points of time in each of the two series for the day. For instance, eight o'clock is described as 8 A.M. (eight ante meridiem; *ante* means before, *meridiem* means midday, noon), or 8 P.M. (eight post meridiem; *post* means after) 8 A.M. means not eight hours before noon, but the eight by the clock which comes before noon. Clocks have been made to record time in series of twenty-four hours, but they are not common.

Ocean currents. Observe that the waters of the oceans flow about in regular and well marked currents. Trace the courses of a few of the most noticeable. Give particular attention to the famous Gulf Stream, which pours a vast volume of warm water from the tropical region northward along the east coast of the United States, thence diagonally across the ocean to the British Isles and Norway. What effect has this on the climate of those European countries? Note also the Labrador current, which brings icy water south from the Arctic region. What effect has this on the climate of Labrador?

Ocean cables. Observe the courses of the principal ocean telegraph cables.

Isotherms. An isotherm (*iso* means equal or same, *therm* means heat) is a line that connects places on the earth's surface that have the same temperature at a given time or that have the same average or mean temperature during the same period. Observe the isothermal lines on the globe. There may be two sets, one for January and one for July. It will be seen that latitude (distance from the equator) does not alone govern the temperature of any place. Elevation above the sea, distance from the sea, the character of ocean currents that are near, and other conditions are factors that also affect the temperature.

Observe particularly the isothermal lines that cross the United States. For instance, the line for January (winter) that passes through New York City and shows an average temperature of 30°, passes northeastward to Iceland and northern Norway, within the Frigid Zone, and, on the other hand, after dipping southward to Missouri, passes far to the northwest in southern Alaska. In January, therefore, these places all have the same temperature, and Iceland and southern Alaska are as warm as New York City. The land is then relatively colder than the sea. But in summer the conditions are different, so that in the same latitudes the land is warmer than the sea. For illustration, trace the isothermal line for July (summer) which passes through Boston, and shows an average temperature of 70°. Note that it passes far to the northwest into Canada, and then dips to the south opposite northern Mexico.

Earth's orbit elliptical. Stick two pins into a piece of cardboard one-half inch apart. Take a piece of cord 4½ inches long, and, after tying the ends together, lay it around the pins on the cardboard. Next, with a pencil draw the cord tightly to one side, and trace a line around both pins as far from them as the cord will permit. The figure so drawn is an ellipse, and the pinholes are the foci (singular, *focus;* plural, *forci*). The earth's orbit is an ellipse and the sun is one of the foci. It follows that the earth is nearer the sun in one part of its course than elsewhere. When it is nearest it is said to be in perihelion (*peri* means around; *helios* means sun), and when it is farthest away it is said to be in aphelion (*a* means from). Perihelion occurs in the northern winter and aphelion in the northern summer.

Attach a piece of cord to a weight and swing the latter around with differing lengths. Observe that the shorter the cord the swifter the circuits of the weight. This will illustrate the fact that the earth swings fastest when in perihelion, and slowest when it is in aphelion.

The analemma. The large diagram like a figure 8 on the globe is called the analemma, and it presents certain facts about the earth in its elliptical course around the sun. If it is to be understood, therefore, the pupils should, in consulting it, constantly bear in mind (or, better, illustrate) the relative position of the earth in its orbit. It is useful for two purposes. First, it shows the *declination of the sun*, that is, its distance north or south of the celestial equator day by day during the year, or, what is practically the same thing, the latitude at which on each day its vertical rays meet the earth. The celestial equator is an imaginary circle in the heavens directly above the terrestrial (earthly) Equator. As the sun never shines vertically beyond the tropics, it will be observed that the analemma extends only from one tropic to the other, that is, from 23½° N. to 23½° S.

Note that on the margin of the diagram are the names of the months and a scale to indicate every day of each month. Observe that the marginal scales change sides where the two loops meet. The mark for each day indicates the exact position of the parallel on which the sun shines vertically at the time. For instance, both March 21 and September 21 appear on the Equator, showing that on those dates the sun shines vertically on that circle. (See *The Equinoxes*.) Again, June 21 appears on the Tropic of Cancer, and December 21 on the Tropic of Capricorn, showing the circles which receive the vertical rays on those dates. On the former date the declination of the sun is said to be 23½° N.; on the latter, 23½° S. The latitude of the sun for any particular date may be found by using a metallic or a flexible meridian having a scale of degrees to measure north or south from the Equator, or, for illustrative purposes, by estimating the latitude as compared with a known parallel. Observe that in some months the sun seems to move north or south rapidly, the spaces for months and days, as in March and October, being wide, while in others it moves north or south very slowly, as in June and December. In the latter months occur the solstices. (See *The Solstices*.)

Second, the analemma shows certain interesting *facts about time as indicated by the sun and by a good clock.*

To begin with, if the earth merely rotated around its axis and did not revolve around the sun, one day would measure exactly one rotation; but because the earth swings around the sun, it is constantly changing its position, so that, counting from exact noon on any meridian, one rotation will not quite bring the same meridian under the sun, the earth having moved farther around in its orbit. From noon on any meridian, therefore, till noon the next day, the earth makes a little more than one rotation. A day as thus measured by the sun is called a solar day (*sol* means sun).

Bearing in mind that when in or near perihelion the earth swings faster than at other periods (see *Earth's Orbit Elliptical*), and that when in or near aphelion it swings more slowly, it will be seen that the distance around its orbit which it travels varies slightly from day to day. The farther it so travels in a given time, the farther it must rotate to bring any meridian under the sun twice in succession (from noon to next noon) and therefore the longer the day. The solar day accordingly varies in length; hence it is not perfectly adapted to commercial needs. To meet this objection, the average length of the solar days for a year (called by astronomers the mean solar day) has been found, and this is the exact, unvarying day as measured by the clock and as commonly meant by the word day in all civilized countries. This is the day of twenty-four hours.

The use of the words *average* and *mean* as just used, when understood, convey the idea that some solar days are longer than the average and some are shorter; hence, compared with time as recorded by a good clock, time as indicated by the sun is sometimes slow and sometimes fast. At twelve by the clock it is not always noon by the sun. The difference between them is called the *equation of time*. These variations would not occur if the orbit of the earth were circular.

Again referring to the analemma, observe that, at the point where the loops meet, a bar crosses the analemma, and on it are marked very short divisions to the right and to the left from the meridian which passes through the figure lengthwise. These divisions constitute a scale with which to compare the dates shown around the margin of the figure, and indicate the difference in minutes between sun time and clock time. To make the comparison, measure the distance from the central or dividing meridian to the inner margin of the figure opposite some date, and then measure off the same distance from the meridian on the minute scale or bar. This gives the difference in time between the sun and the clock on that date. On all the dates on one side of the meridian the sun is before the clock, on the dates on the other side the sun is after the clock. Note that, on four dates marked by the meridian, sun time and clock time are the same.

The zodiac.[1] Viewed from the earth in its passage around the sun, the sun seems to pass in the same path, and in the same direction in the opposite heavens, making the complete circuit in one year. The path it follows is called the ecliptic. The ecliptic is marked as an oblique great circle on most globes, but the orbital plane represented by the top of the circular wooden frame on a full mounted globe gives a clearer idea of it. Around the heavens astronomers have imagined a broad belt 16° wide (8° each side of the ecliptic), in the middle of which the

[1] This lesson explains familiar references to be found in every almanac, but it is of little practical value and may be omitted without much loss. The relations of the signs to various parts of the human body are merely fancied.

sun appears to pass, and this was centuries ago divided into twelve equal parts of 30° each. This belt is called the zodiac. Each part was named after a conspicuous group of stars (constellation; *stella* means star) which it included. Perhaps in order to make the location of particular stars easier of description, men who had made a study of them charted them ages ago by covering the heavens with various imaginary outlines of animals, persons, and other objects in such a way as to bring the brightest stars in certain definite places upon them. For instance, one group appears in the outline of Orion, who in classic mythology was a famous hunter. Three bright, noticeable stars in nearly a straight line form his belt.

The twelve constellations in the zodiac across which the sun seems to pass are as follows: Aries (meaning *the ram*, symbol, ♈), Taurus (*the bull*, symbol, ♉), Gemini (*the twins*, symbol, ♊), Cancer (*the crab*, symbol, ♋), Leo (*the lion*, symbol, ♌), Virgo (*the maiden*, symbol, ♍), Libra (*the balance*, symbol, ♎), Scorpio (*the scorpion*, symbol, ♏), Sagittarius (*the archer*, symbol, ♐), Capricornus (*the goat*, symbol, ♑), Aquarius (*the water-bearer*, symbol, ♒), and Pisces (*the fishes*, symbol, ♓). When the division of the zodiac was made over 2,000 years ago, the sun appeared to enter the constellation of Aries at the time of the spring equinox, about a month later to enter the constellation of Taurus, etc. The apparent position of the sun in the zodiac and therefore the time of year were indicated approximately by naming the constellation in which it appeared. If it was in Aries, for instance, the time was from about March 21 to April 21. Instead of the name of the constellation, the symbol or sign was often used, as ♉ for Taurus. Later, the twelve parts of the zodiac were called signs, and are so called to this day. For reasons which need not now be explained but which may be learned by consulting a good cyclopedia under the subject *Precession of the Equinoxes*, the signs as planned have every year gained on the constellations a little, or the constellations have fallen behind, so that now there is a difference or discrepancy of about 30°, the width of one entire division. The result is that each constellation now lies in the sign next in advance. For illustration, now, when the sun is said to be in the sign Taurus it is not in the constellation of Taurus as it was 2,000 years ago, but is in the constellation of Aries

The orbital plane on a full mounted globe indicates the signs of the zodiac, and the corresponding time in months and days over which each extends.

Planets. The earth is one of several large spheres or stars called planets which revolve around the sun at varying distances. They all revolve near the plane of the earth's orbit and in the same direction, and so are constantly changing their relative positions in the heavens as compared with the other stars. In the order of their distance from the sun, beginning with the nearest, they are Mercury, Venus, the Earth, Mars, a group of about 600 much smaller bodies called asteroids (*aster* means star; *oid* means like), Jupiter, Saturn, Uranus, and Neptune. Around some of these larger planets one or more smaller or secondary planets, often called satellites, revolve. All these planets and a few comets, together with the sun which holds them in place and around which they pass, comprise the Solar System. (*Sol* means sun.) All the other stars are immeasurably farther away, and as they are never seen to move they are called fixed stars.

The moon. The moon is a sphere much smaller than the earth, which revolves as a satellite around the latter once in about twenty-eight days. If the earth be represented by a globe twelve inches in diameter, a ball three inches in diameter would represent the relative size of the moon. It rotates around its axis, but so slowly that it turns only once while it is making one entire revolution. The result is that the same face is always toward the earth. Using the globe and a ball, show that when the moon is on the side opposite the sun, light from the sun is reflected to the earth by a full hemisphere of the moon, thus showing a full round face. This phase is called the full moon. We then see the day side of it. If the ball be painted white and this lesson be given by lamplight, the phases of the moon can be shown more clearly. When the moon is on the same side as the sun, no light is reflected from it to the earth. It then appears dark, as the night side of it is toward us. When it begins to show its day side we say the moon is new.

Eclipses. When it occurs that the earth is exactly between the sun and the moon, the shadow of the earth passes across the moon, and we say there is an eclipse of the moon. The fact that this shadow is always round is one of the proofs that the earth is spherical. When the moon passes exactly between the sun and the earth, the body of the moon obscures the sun and we say there is an eclipse of the sun. (See Figs. 9 and 10.)

Tides. The earth, the sun, the moon, and all other bodies attract each other. The attraction of the sun, for instance, is strong enough to hold the earth in its course, as has been shown, and the attraction of the earth is strong enough to hold the moon in its course. On the other hand, the attraction of the moon is so strong that it

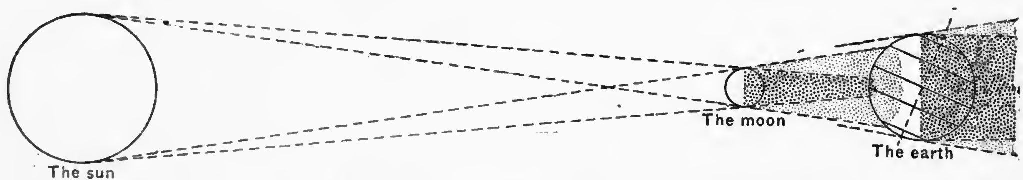

FIG. 9. *Eclipse of the sun. A dark shadow called the umbra and a light shadow called the penumbra are cast by the moon and by the earth. The day side and the night side of both the moon and the earth are shown here. To one standing in the moon's dark shadow the sun is invisible, and he sees its total eclipse. To one standing in the moon's light shadow some part of the sun is invisible, and he sees a partial eclipse of it. In this position the moon is new*

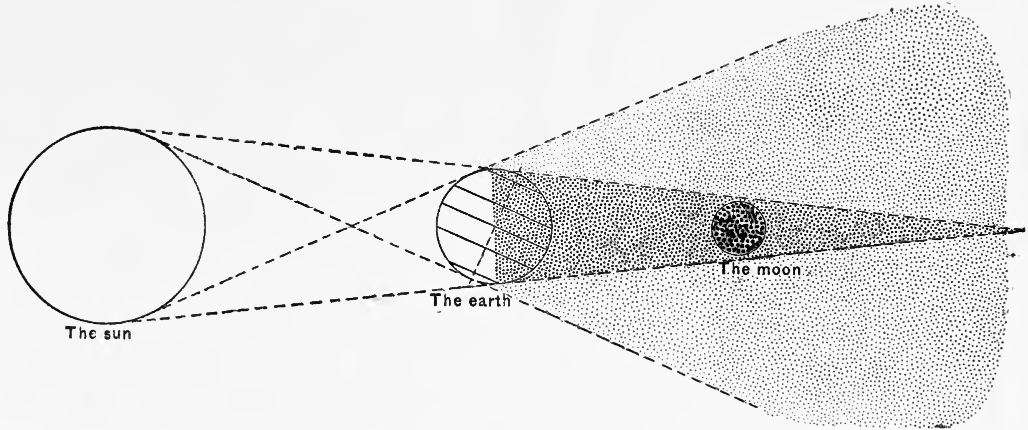

FIG. 10. *Eclipse of the moon. When the moon is in the umbra (dark shadow) no direct sunlight reaches it, and its eclipse is total. When the moon is in the penumbra (light shadow) it receives direct rays from that part of the sun which is not obscured by the earth, and its eclipse is partial. In a partial eclipse of the moon the shadow of the earth on the moon is always circular, a proof that the earth is spherical. In this position the moon is full*

draws toward it a little the water in the oceans and elsewhere. From far east and far west the water moves a little toward the point nearest the moon, and the summit or high water ridge follows under that body as, during the rotation of the earth, all parts of its surface are successively turned toward the moon. For reasons not so clearly explainable, the water is also heaped up slightly on the side opposite the moon. Each of these summits is both preceded and followed by a depression lying halfway between them. During the period therefore between two successive passages of the moon across any meridian, sometimes called a lunar day (*luna* means moon) and requiring about twenty-five hours, the water in all large bodies noticeably rises and falls twice. The variation ranges from a few inches to several feet. This alternate rising and falling is called the tide.

The sun affects the water in a similar manner, but though it is very many times larger than the moon it is so much more distant that its force in producing tides is reduced to one third that of the latter. When the sun acts in conjunction with the moon, that is, when the moon is either on the side of the earth toward the sun or on the side opposite the sun, the force of the sun is added to that of the moon and the tides run very high and very low. Such tides are called spring tides. Show that this condition occurs at new moon and at full moon when the sun, the moon, and the earth are in a line. But when the sun draws the water in a direction very different from that of the moon, the force of the sun operates against that of the moon and the tides that follow the moon run neither very high nor very low. Such tides are called neap tides. Show that they occur at the first and third quarters of the moon, when it and the sun appear 90° apart.

High tides would follow directly under the moon were it not that the continents lie across their course and intercept them, and that even islands and the bottom of the oceans retard them. So high tide lags behind the moon, and in some regions follows several hours after it.

THE USE OF MAPS

Direct observation for fundamental ideas. In the study of any object it is desirable to have the object itself at hand for observation, for conceptions gained by direct operation of the senses are most correct and clear. So the best way to learn local geography is actually to see the land and water forms, the plants and animals, the buildings, railroads, and other works of men. This is entirely practicable within a narrowly limited range, and it is adapted to small children and others who are just beginning to acquire fundamental ideas of the earth. Direct observation beyond this range would involve travel and expense that might be impossible; yet it is easy for any child to obtain a fairly correct idea of great land and water forms that are far distant by noting even tiny models, as found in a muddy road or built in sand on a molding board at school. Any such idea, though somewhat dim and incorrect, may be made vivid and true to a certain degree by the use of pictures. Pictures based on photographs or on direct observation are records of things seen, and so they may be used to bring to the mind of the learner scenes that others, more favored, have beheld with their eyes. They enable one to travel easily, cheaply, and widely by proxy, to see with the eyes of others. Pupils should be encouraged to collect pictures to illustrate the topics of study. These may be obtained from magazines, papers, and elsewhere. If they are neatly mounted on clean paper and are classified for convenient reference later, so much the better.

But pictures have their limitations. Each represents but a single view, from only one point, of only a small bit of the earth. Of course they appeal to only one sense, that of seeing. They do not clearly indicate direction, relative location, altitude, or other important facts.

The purpose of a map. It will be perceived that there is need of some means of obtaining certain fundamental ideas about the earth or parts thereof which cannot be obtained from pictures or from a succession of pictures or views from a car window. A map is one of the inventions to meet this need. It enables the student at a glance to grasp some of the essential features of a wide scope, such as relative location, direction, size, and distance, a knowledge of which forms a necessary framework that later shall be rounded out with innumerable ideas gained by the study of history, science, and commerce. No careful student of history fails to trace on a map the progress of events; no intelligent person undertakes a long journey without first having planned his route with the aid of a map. All knowledge which involves location on the earth is fixed more clearly in mind and is retained more securely in memory when it is assigned to its proper place by means of a map. But the mistake of considering a thorough understanding of maps the chief aim of geographic study must not be made. They serve mainly as an important and necessary means of making an orderly arrangement of more valuable knowledge of the earth's surface.

Beginnings of map drawing. That the child may learn to understand a map, he should first be taught to make a chart or map of some area close by and easily to be seen, such as the schoolroom or the school yard. Objects located therein should be indicated, and the whole should be correctly drawn to some convenient scale based on actual measurements, as one inch to four feet, or one inch to twenty feet.

Toward the top of the sheet is always considered north, and, until the child can read the map without confusion, the top of it should lie toward the true north. It is a curious fact that the practice of hanging maps on the wall or holding them upright, as it is very proper to do after a little time, has led to the universal misconception that toward the north is up, and that a river which flows north flows "up hill."

Course of instruction progressive. In general, the course of instruction will proceed from the home region outward, from the smaller unit to the larger, from the simpler to the more complex, as from the school yard to the school district, thence to the town, to the county, to the state, to the United States, to North America, to the other continents and the world. But this course should be reversed all along enough to show the true relations between the smaller units and the larger.

Reading the map. It will be seen that, very soon, the child takes up the study of units that extend far and farther beyond the limits of his vision and beyond the limits of his travels. It is then that he must rely on his ability to understand the conventional markings of the map to indicate shore lines, political boundaries, mountains, rivers, cities, etc., and to form a corresponding mental picture of the region which it represents. In doing this he must take account of relative distances and directions. Photographs or other pictures based on them should be used to supplement the map.

Map sketching. The map outlines should early be fixed in the memory, and this is done by copying them and by using them. As the eye observes the model, a corresponding map is outlined in the mind; and as the hand, in drawing, works out each form, a corresponding form is etched into the memory. Exact and laborious copying is neither necessary nor desirable. After close observation of a perfect map, a rapid sketch should be made from memory, on blackboard or paper, and compared with the original. If the sketch is very imperfect it should be destroyed and others should be drawn until one has been made that is at least fairly satisfactory. That the names may be closely associated with the corresponding objects, it is a good plan for each pupil to name orally every object as he draws it on the blackboard before the class, or to write the name if his sketch is on paper. A map of the immediate home region may contain considerable detail, but the amount of it should be diminished steadily from that place outward.

Maps flat and spherical. Wall maps are flat; and while they represent small areas well enough for most practical purposes, it is seen at once that they cannot perfectly represent large areas of the earth's surface owing to the radical difference between a plane or flat surface and a sphere. A wall map of a hemisphere, for instance, is a circular figure on a flat piece of paper, but a globe map of a hemisphere is more like the peel from one half an orange. The most correct idea of a large area is therefore to be gained from a globe. To picture the globe form on a map as closely as possible, meridians and parallels are drawn, so that by observing them from a little distance one can imagine that he is looking at a portion of a globe. In lessons on the globe it is learned that in passing north or south one must follow a meridian, and that in passing east or west one must follow a parallel. On wall maps, those are great curved lines. A little careful thought will show even young pupils that, on a map representing a wide region, toward the top may not be directly north and toward the right may not be directly east.

There is a kind of map called Mercator's which represents the earth in the form of a cylinder. It serves the purpose for which it was intended, but it is misleading to those who do not know how to use it properly.

Practical use. To gain full advantage of a map, not only must it be understood and the main features of it held in mind, but the habit of using it must be acquired. Whenever there is occasion it must be consulted, otherwise the ideas which involve relative location, distance, and direction are certain to be hazy, incorrect, and short lived. For the sake of economy of time and effort, which have a money equivalent, no school can afford to be without maps, and the services of a teacher who can and will make use of them are more valuable on that account.

No person can read history very intelligently or remember it very long without referring to a map. If, for instance, the topic of study be Burgoyne's campaign, the course of his army should be carefully followed. If a member of the school take an interesting journey, all will enjoy tracing it. In fact, throughout life, whatever be the subject of reading or discussion, the matter of location should receive due attention. That instruction is faulty which does not fix in the mind a good general idea of the land and water forms, political boundaries, cities, and railroads, and which does not inculcate the habit of promptly consulting a map as there is occasion for every unknown fact that it can show.

Care of Maps. Soiled, wrinkled, faded, or torn maps are repulsive and are therefore far less liable to be consulted than they would be if in good condition. The interests of economy, cleanliness, sanitation, and sound educational practice require that, like all other school property, maps, globes, books, and other school appliances shall be protected from abuse and shall be kept in good order. But protection of them should not be allowed to prohibit in the slightest degree the legitimate use of them. When maps are not in use, they should be rolled tightly to keep out dust and should be laid away carefully. Spring-roller cases for them are highly desirable.

A SUGGESTED COURSE OF LESSONS

The following brief outline of map lessons is appended merely to indicate an order of development and some things to be accomplished. It is not intended as a substitute for any part of the textbook on geography. The inexperienced teacher, who, uninformed regarding the full value of maps in geographic study, makes little or no use of those which liberal-minded trustees or directors have provided, may perhaps here get some hint of the possibilities that lie in a well-made school map. The course is to be modified at the discretion of the teacher. The exact number of years to be occupied depends entirely on local conditions.

Third and Fourth Years

MEASUREMENTS

Measuring lengths of various objects for practical knowledge of linear measure.

Estimating distances, then measuring, to train and test the judgment.

Using units of increasing lengths.

Comprehension of long distances.

- Acquired by traveling.
- Acquired by using time element in computation. (As, rate per hour and number of hours required to travel from one point to another are factors that would make comprehension easier.)

SCALES

Representing long lines by short ones.

Beginning with short measurements and easy ratios.

(As, measurements in inches and the ratio 1 to 2.)
Adapting ratio to new and longer measurements.
Continuing until the significance of scale is grasped, and the pupils, on noting the scale, can readily estimate with fair accuracy the distances indicated.

DIRECTION

Idea first to be obtained by observation of rising and setting sun.
Four cardinal points, north, east, etc.
Four intermediate points, northeast, southeast, etc.
If compass is shown, explain that needle is turned by magnetic force, and that it does not everywhere point exactly north.

MAP DRAWING

Small areas, near by, that can be measured. Scales.
Increasingly larger areas, measurements estimated.
Entering only important details.
At first, paper horizontal, pupil facing north.
Later, the positions of paper and pupil to suit convenience.
Explain custom of calling top of sheet north, the right side east, etc.

RELIEF MAPS

First maps based on assumption that ground is flat.
Variations in elevation as well as outline may be represented on a map.
Shaping models in sand, with glass for lakes, colored threads for political boundaries, etc.
Caution: To avoid badly distorted and very harmful view, care must be taken to make the proportions

correct if the work is undertaken at all. Tendency to exaggerate altitudes enormously.

Such models called relief maps. Drawings of such maps, also called relief maps; these may be of greatest value.

Relief features shown, but imperfectly, on political maps by lines of shading and use of colors.

READING MAPS

Use of maps a kind of reading in which arbitrary signs, as dots, lines, and colors, are made to stand for political and physical features. (Distinction between political and physical.)

Map not a picture any more than a sentence is a picture.

TOWN AND COUNTY

Extending study to town (or township as so called in some states), then to county.

School maps of these divisions.

Copying and enlarging small maps if none suitable are on the market.

Observing relative position and size of town (or township) in county, and of county in state.

Uniformity in size.

Early government surveys, in some regions, especially where country was comparatively level, made standard size of township about 36 square miles. More exactly, the south, east, and west boundaries measured 6 miles each, and the north boundary slightly less owing to the fact that the boundary lines on the east and the west took the direction of the respective meridians, and so converged a little toward the north. Each square mile (approximate measurement, as just shown) is called a section, and contains about 640 acres.

FIRST SURVEY OF THE CONTINENTS AND THE UNITED STATES

Use of globe for general ideas of earth, continents and oceans, climate, etc.

Globe lessons to be continued from time to time.

Preliminary study of North America and United States.

Of the remaining continents.

Outline of topics.

Position, form (outline), size, relief, drainage, political divisions, climate.

Earth lessons vital to thorough understanding of character and distribution of plants and animals, and of the characteristics, history, and activity of races and nations. These to have some attention.

FIFTH, SIXTH, AND SEVENTH YEARS

THE STATE

Relative position and size in United States.

Special wall map showing outline and bordering territory.

Should include counties, principal physical features such as mountains, lakes, and streams, main lines of railroad, canals, cities, and little, if anything, else. As far as practicable, lettered names visible at class distance.

Very much detail perplexes a child, who will carry away confused mental picture and fail to distinguish important from unimportant.

Outline of topics as under "First Survey."

Inferring much that is not stated. (As, if the streams flow east the land slopes that way; or if the country is hilly the principal occupation is liable to be mining or manufacturing or grazing.)

Asking questions that tell little and require much.

The inquiry, "Why?" may be repeated more frequently. (As, "Why is this county thickly settled while that is not?" Or "Why is a city here and none there?" Or "Why is this occupation followed here while that is followed there?")

Sketching of map by pupil may answer most satisfactorily a hundred possible questions.

One's own state and country deserve more careful study than any other state or country.

SECOND SURVEY

Fuller survey of North America, the United States, and the remaining continents, including not only a closer observation of details as shown by the maps and globes but also a broader study of the peoples of the earth. The physical features of a country and its climate determine the growth of vegetation, this in turn determines the character of the animal life, and all four, with the distribution of useful mineral deposits, are factors in determining the density of population and the occupations of the people. When the conditions under which people must live are known, it is easier to understand their manners and customs. And when the occupations are known, it is easier to trace the course of commercial currents and to account for the establishment of great steamship and railroad lines. Everywhere the chains of cause and effect are visible, and in this second survey the emphasis is to be laid on the larger facts of industrial and political life. It is this enlightening consummation of the study of elementary geography which justifies the careful preparation herein contemplated.

A good elementary work on physical geography would be useful to the teacher and would be interesting to some of the pupils, but the formal study of that subject is best adapted to more advanced grades. Good relief maps would be helpful.

The interests of intelligent people have become world-wide; and maps and globes, whose value and whose limitations are recognized, have never played so important a part in education as now.

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