STRANGE SCIENTIFIC ANOMALIES AT THE NORTH POLE.

BY JAMES ARTHUR.

In the illustration, Fig. 1, *N S* is the earth's axis, on which it rotates, *with reference to the sun*, in 24 hours of *mean* or clock time. This axis is purely imaginary; yet the fixity of its position is one of the fundamental facts in astronomy. The same remark applies to the earth's rotation on this imaginary axis. When we remember that the earth is nearly as heavy as a ball of iron, and that the surface velocity at the equator is about 17 miles per minute, we can form some conception of this uniformity. Mathematicians lead us to conclude that this rotation and its axis, or center line of motion, are not eternal and that they will change; but for the historic period we may consider them uniform and permanent. Finally, they are the nearest to absolute uniformity and fixity that we know of. A minute slowing of the rotation would not disturb anything, beyond keeping the astronomers busy correcting their tables, including those of our erratic neighbor, the moon.

Did you ever think what would happen if the axis of rotation changed a little? The polar diameter of the earth is about 26 miles shorter than the equatorial diameter; therefore each pole is "flattened" 13 miles; so the section of the earth, if split through the plane of a meridian, would be elliptical. Remember, this is the *sea level* form of the earth. Now let us suppose the axis to be changed so as to *reduce* the latitude of New York by bringing the new equator nearer to the city. The city would then be covered by the waters of the Atlantic and the land near the new poles would be left high and dry. That is, the ocean level would *rise* on New York and *fall* at the new polar region. On this assumption—that the axis could be changed on the meridian plane of New York—two very interesting and impressive questions arise.

1st. What diminution of latitude would raise the waters of New York Bay one thousand feet, and thus cover the city with Atlantic water?

2nd. What increase of latitude would lower the waters of the bay forty feet, and leave all New York docks simply mud holes?

Clearly it is perilous to disturb the earth's axis.

Refer to Fig. 1, where the sun *A* is shown *on the line* at the spring equinox. An observer on the equator at *E* would see the sun on the celestial equator just where he is; that is, half his face on each side of the celestial equator. An observer at the North Pole *N* would see the sun the breadth of his face higher at *B* than his real position *A*. An observer at *S* would see him at *C*. This is caused by the refraction of the sun's rays in passing through the atmosphere; and it is a remarkable fact that the average amount of this refraction, at the horizon, is just about the breadth of the sun's face, so that the three suns seen by the observers *N E S* would touch one another as shown.

Now let us assume level land within the Arctic circle and that we have built an astronomical observatory on the pole. To make things balance, let the observatory be built in the form of an Irish "round tower." How would we know the location of the pole so that we could build an observatory on it? "Oh," you say, "that would be easy. Just build it plumb under the pole star." Not at all. If we did that, we would be about 85 miles from the pole. The reason of this is that the so-called "pole star" is only the nearest bright star to the "polar point." This popular pole star makes a daily circle around the "polar point" about 4⅓ times as broad as the sun's face, and we must make the sharp cone of our round tower point to the center of this circle. Then we would have a "pole" worth speaking about.

Sitting in the top of this tower what would you see? The sun sweeping around the horizon once in 24 hours, but a little higher each day in a grand spiral course in the celestial sphere, as compared with the horizon. In a little over three months he would be above the horizon 23½ degrees, and this would be the middle of the "great day"—and the longest day at New York.

We are now in a position to make some wonderful and unusual experiments and observations. One of the delicate experiments would be to determine the length of a pendulum beating seconds at the pole. This would enable the mathematicians to correct their figures as to the form and density of the earth, two matters of great astronomical importance. In this observatory we would determine any meridian such as Greenwich and get its local time as easily as in any observatory south. Now stand with your back to the pole (round tower) facing south on the "first meridian" and walk down this meridian a little over three and one-half miles till you come to a circle of latitude 24 miles in circumference *G*, Fig. 2. Now face west with your right hand to the pole, and stand there till your shadow points straight to the pole. This would be noon at Greenwich. Start walking due west on the circle *G M* at the rate of one mile per hour. As you walk what changes would you see? None whatever; for your shadow would steadily point to the North Pole (round tower) and the sun would appear to stand still in the sky. You could see only the motion of your feet over the ground. What were you doing during this 24-hour walk? With respect to the sun you were not moving; but simply *treading the ground* with your feet. On this 24-mile circle of latitude you were walking one mile an hour *west*; but as the earth rotates one mile an hour *east* on this circle you were just neutralizing its motion and making no headway with reference to the sun. Let us now go out to a circle of latitude of 48 miles circumference *O P*, and on each of the 24 meridians here draw a circle two miles diameter. These circles would just touch one another, as shown on Fig. 2. Set up a flagstaff in the center of each of these circles. Divide each circle into 24 hours, marking 12 on the meridian, on the side of each circle toward the pole. Only the Greenwich and New York dials are divided in this illustration. You have now 24 sundials, each one giving the local time of its meridian, and it would be *noon* on each meridian when the shadow of the staff pointed straight to the round tower on the pole. Now consider the shadow of our round tower observatory at Greenwich noon

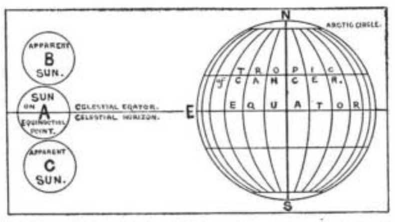

Fig. 1.—APPARENT POSITION OF THE SUN AT THE EQUATOR AND AT THE POLES.

when the staff shadow points to the pole on the meridian of zero; then the shadow of the sharp tip of the tower would fall on meridian 180 degrees and indicate midnight, or 24 o'clock on that meridian, and so for all other meridians. We would thus have *noon* and *midnight* on each of the 24 meridians every day. These 24 dials would read, consecutively, one hour apart. This 180th meridian is the theoretical "date line," or beginning and ending of a date. Since a day is always beginning and ending at the 180th meridian, you could walk from to-day into to-morrow or from to-day into yesterday as often as you pleased. But if you sat in the center of the observatory, on the pole, you would have all times in the 24 hours and no particular time. No local time—no north, east, or west. You could move only south, at the first move. Your parallel of latitude would be a point. Your meridian would be all the meridians—and none of them! Any wind passing over the pole would blow *from* the south and also *toward* the south at the same time. If you tried to go farther north, you would be going south.

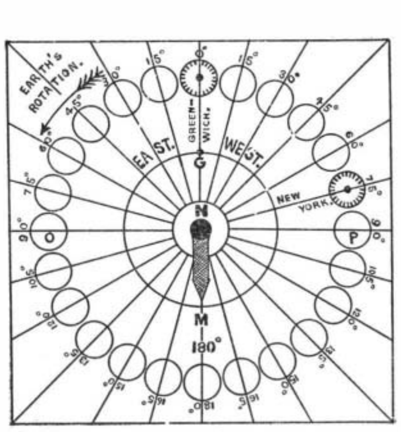

Fig. 2.—DIAGRAM ILLUSTRATING ANOMALIES OF TIME AT THE POLE.

These suppositions have been made for about the middle of the great polar day; but this day is worthy of some attention. Probably you suppose that it means simply six months day and six months night. You are wrong. As shown above, in connection with refraction the sun at the spring equinox is clear above the horizon and the same at the autumnal equinox, as shown in Fig. 1. If you will add to this refraction, the slight dip of the horizon, as seen from the tower observatory, and also a few days of twilight morning and evening of the "great day," you will have several days more than half a year. But this is not all; for the sun is almost four days more than half a year *above* the celestial equator; that is, four days longer than half a year between the spring and autumnal equinoxes. All these lengthen the "great day"; so that it would be a good practical working day of about seven months. Remembering our assumption of *level land* and clear weather in the polar region, the apparent motion of the sun would be wonderful. He would appear simply to rise straight up and then down; but his daily course *around* could be observed only by shadows, or from the observatory; so that in the open, for a short period, he would appear absolutely fixed in the celestial sphere.

How would the moon behave? During the great day she would be only above the horizon along with the sun, and show only *third quarter—dark—first quarter;* so would be invisible in the glare of the sun. Let us now assume about the middle of the great night. The moon would rise in the first quarter, and as she slowly climbed up her face would come nearer to being *full* till in a little less than seven and a half days she would stand up full at her culmination of 23½ degrees above the horizon. She would sink at the same rate, gradually coming to the third quarter as she set. To use popular language, the moon would rise half face bright—creep up to full face—and then sink to half face again as she set, remaining up steadily for nearly fifteen days. During the time she was visible she would sweep the heavens—compared with the sun, not once in 24 hours—but once in 24 hours and 50 minutes. This is caused by her monthly motion, which is *against* her apparent motion in the sky. We thus see that the moon rises and sets each lunar month, just as the sun rises and sets each equinoctial year. City people do not notice this very often; but the old farmer needs the moon and puts it in round numbers, "the moon rises three-quarters of an hour later every night." All this is the average an observer would see, but by using instruments, he would find many variations in the moon's motions.

Let us suppose that the moon has set, thus leaving us in the black polar night till the next moon about a fortnight hence. What motions would you look for in the stars? None whatever; the whole celestial dome would appear to stand still day after day. Stars near the horizon would stay there and those overhead would show no motion. But if you went into the observatory and turned a telescope on any star, you would find it moving horizontally. Stars at the horizon would move the fastest, and as you pointed your telescope higher and higher they would move slower and slower till you reached the "pole star," which, as noticed above, would move in a little circle of less than 2½ degrees, the center being the "polar point," "dead plumb" under which stands our observatory. This slowness and fastness of the various stars is caused by the fact that they all make a horizontal circle in a "sidereal day" of approximately 23 hours 56 minutes. If you wish more information about this "sidereal day"—the 24-hour sun day, and the moon day of 24 hours and 50 minutes—you must go to your cyclopedia, or still better call at the Naval Observatory in Washington, D. C., as space cannot be taken here.

An Opinion of the Scientific American Supplement.

In The Publisher and Retailer for September, 1909, appears a communication which displays not a little knowledge of the Scientific American Supplement, not only from an editorial standpoint, but from the publisher's standpoint. The writer states:

"A remarkable periodical is the Scientific American Supplement, a sterling weekly established in 1876. The original idea was that it should run out that year and concern itself with the Centennial Exposition, which made Philadelphia famous. But the Supplement found itself firmly anchored at the time the owners had planned to kill it, and it has been continued weekly ever since. The remarkable things about it are several—perhaps the most so is that it prints no advertisements, though it is a meaty sixteen-pager of the size of Collier's. For revenue its publishers look only to the circulation end of the game. It is, so far as your uncle knows, the only *bona fide* advertisement-less periodical in existence. A file of the Supplement is, in a scientific way, the greatest of encyclopedias, nothing finding place in its pages unless of practically permanent interest and value. Even remarkabler, probably, is the fact that all numbers of the Scientific American Supplement are kept constantly in print—ten cents will purchase a copy ten, twenty, or thirty or more years old, as readily as a current issue. The sale of back numbers warrants the publishers in keeping in print the seventeen hundred issued since January, 1876. To make sale for the back numbers, a catalogue is issued from time to time, and in this is revealed the contents of all the issues which have gone before. Remarkablest, perhaps, is the fact that while the Scientific American is on sale to the trade, and for which there is no back-number sale, the Supplement is not, whereas one would think it is the one which should be made returnable, as returned copies would not be dead stock, as must be the case with the other publication."

The Publisher and Retailer circulates largely among newsstand dealers, and the Supplement is not designed primarily for newsstand circulation. Hence this opinion of its virtues, addressed to a class of dealers who are not likely to be interested in its editorial merits, is all the more acceptable.

From a report of comparative tests made by an American trunk line on the new ferro-titanium steel rails and those of the Bessemer type it is noted that the wear on the former showed 1.45 pounds per yard, as against 4.18 pounds per yard on the latter, which is nearly 300 per cent in favor of the new alloy steel.