WHAT WE KNOW ABOUT SUN SPOTS.

Several spots have lately been discovered on the sun, one of which, at least, is remarkable for its enormous size of 70,000 miles. In other words, this terrestrial globe might be dropped into the central chasm as a pea into a thimble without touching the sides. The whole surface is changing and breaking up constantly. The other spots are two in number, each 40,000 miles in diameter, one at each side of the 70,000-mile spot. Prof. E. C. Pickering, director of Harvard College Observatory, has kindly placed at the editor's disposal the accompanying photographs of the spots.

If we only had behind us a hundred years of good meteorological observations, and also an unbroken record of observations of sun spots and prominences, we would be in a far better position to determine the influence of the sun on the weather and to refute or affirm assertions that laws have been discovered affecting the sun's influence on the weather in such a way that we can predict whether a coming year will be good or bad for a harvest.

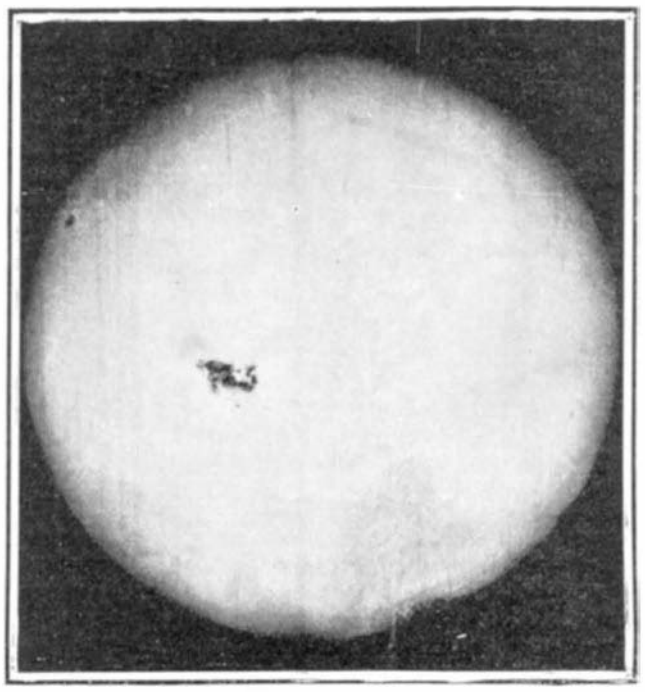
Unfortunately, meteorological records are not of any value farther back than about fifty years. In the case of solar phenomena the investigator is still more restricted; for although the observations of sun spots have been made in a more or less crude manner for many years, it was not until 1830 that systematic observation was adopted. Moreover, the solar prominences, important indicators of the sun's activity, were not recorded until 1872.

If the sun's disk be scanned from time to time, it will be found that sometimes there are spots and sometimes there are not. According to our present knowledge, these spots are projected by the descent of comparatively cool matter from the higher regions of the solar atmosphere, so that the more spots there are, the greater will be the quantity of matter descending. Since this falling material is the result of previous up-rushes of highly heated matter from the lower levels of the sun's atmosphere, it stands to reason that this spot phenomenon indicates great solar atmospheric disturbance and, therefore, greater activity, and consequently more intense heating capacity. Thus, we arrive at the conclusion that the greater the number of the sun spots, the greater the solar activity and, therefore, the hotter must be the sun.

It happens that there is a decided periodicity in the number of spots. During some years only a few spots can be seen; during others they are more numerous. This variation, it has been found, proceeds according to a fairly well defined law. The average period from one minimum to another is 11.1 years, and in every case the time from one minimum to the next maximum is less than from that on to the next minimum again. In other words the spot quantity decreases through a little over seven and increases through less than four years. We do not know in the least why this should be so; and although many attempts have been made to show that certain planets affect spots by their attraction, in the opinion of those who have considered the matter most judicially, there is no proof that they are due to any influence external to the sun itself. If the apparent law holds good, the approaching maximum will occur in about a little more than three years after the last minimum. This occurred in about the middle of 1901, and again at the end of the year 1904.

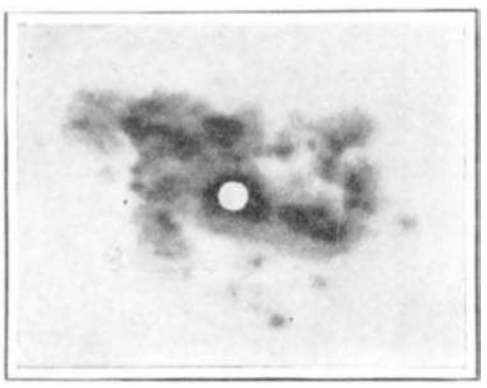
Another curious fact relating to the sun-spot cycle is that when the interval from minimum to maximum is shortest, the total number of spots included in the whole period from minimum to minimum is greatest.

Sun spots are of interest to us because we can hardly doubt that an increase or diminution of the sun's apparent surface is in some way of consequence to our lives on the earth, when, as we know, these hang from day to day on the maintenance of the earth's heat within certain limits. If there is any influence of sun spots on the earth, the best way to detect that influence is to compare the earth's harvests with sun-spot activity in any given period. This can be done by drawing curves in the manner familiar to every engineer. Prof. Langley, by means of this method, has shown that the variations of Jupiter certainly present a striking coincidence with the changes in spot formation. This may indicate a real connection between the phenomena; but before we decide that they certainly do so, we must remember that the number of cycles of change presented by the possible combination of planetary periods is infinite. As Prof. Langley has shown, we can safely undertake, with study enough, to find a curve depending solely on certain planetary configurations which will represent with quite striking agreement, for a time, the rise and fall of any given railroad stock, the relative number of Democratic and Republican Congressmen from year to year, or anything else with which the heavenly bodies have in reality little to do.



PHOTOGRAPH OF THE NEW 70,000-MILE SUN SPOT, TAKEN AT HARVARD COLLEGE OBSERVATORY.

The earth could be dropped into this spot, like a pea into a thimble, without grazing the sides.

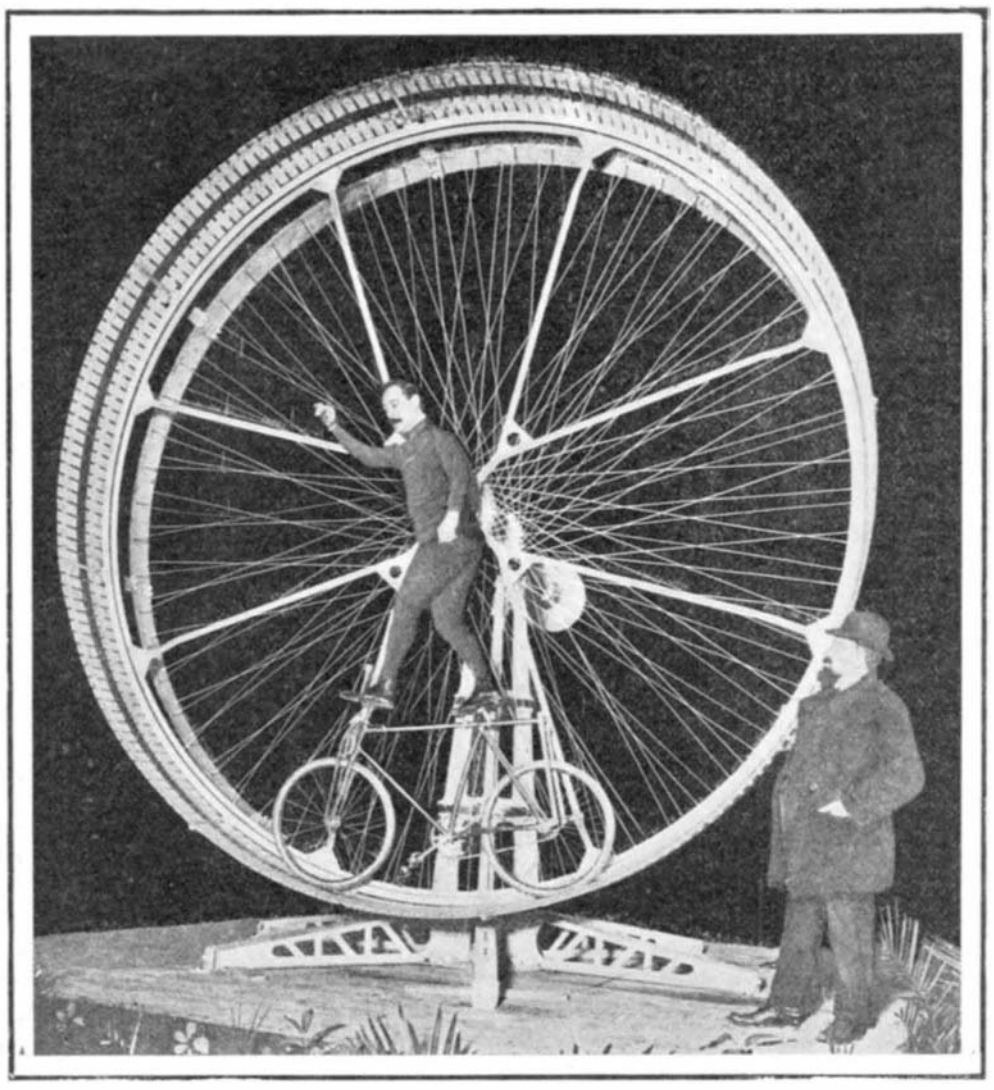


RELATIVE SIZES OF THE 70,000-MILE SUN SPOT AND THE EARTH. WHITE SPOT REPRESENTS THE EARTH.

It has been found that the spots travel across the sun's face in about thirteen days and disappear around the western side, many of them (not all) reappearing at the east again in about thirteen days more. All the spots lie to the north or south of the equator, none of them on it. They move in belts roughly corresponding with our temperate zones. Those near the equator rotate in less time than those near the poles, very much as though the rim of a great flywheel were to make fewer revolutions per minute than one of its spokes; or the outer end of the spoke more revolutions per minute than a part nearer the axle. This may seem a mechanical paradox, and yet this is what occurs on the sun. A spot is not a solid or a liquid, but a mass of glowing vapor. It is therefore possible that one part of it may burn faster than the other. That explains the curious rotation phenomenon described. Why this should be so no one knows. We must not forget, however, that at the enormous temperatures and pressures that prevail on the sun, the conditions must be very different from any familiar to us here, so that when we speak of clouds and use like expressions, we are to be understood as applying an analogy, rather than an exact resemblance. There must be a perpetual commotion in one of these spots compared with which the most violent earthquake would seem but a gentle ripple.

Examined through a telescope of considerable magnifying power, a spot appears like an immense ragged hole in the crust of the solar surface, followed by a number of similar size. A spot is a cavity and not an elevation. As the spot turns from us, the phenomenon is similar to that of looking across the edge of a great shallow saucer, only that the outline is irregular and that where the bottom should be there is nothing but the blackness of what seems an immeasurably deep chasm. These vast cavities, as we have said, are not solid things and not properly to be compared even with masses of slag swimming on molten metal. They are rents in that bright cloudy surface of the sun which we call the photosphere, and through which we look down to lower regions. Their shape may be very rudely likened to a funnel with sides at first slowly sloping (*penumbra*), and then suddenly going down into the central darkness (*umbra*). This central darkness has its gradations of shade, for cloudy formations may be seen very obscurely glowing far down its depths; solid bottom we never see.

Near the edge of the sun's disk the spots appear to rise up through the obscuring atmosphere and gather here and there in groups of hundreds to form white cloud-like patches (*faculæ*), which may sometimes be seen even with a spyglass. Looking straight into a spot through a very large telescope, the penumbra is seen to be made up of long white filaments twisted into curious rope-like formations, while the central part is like a great flame ending in fiery spires. Over these hang what look like clouds, such as we sometimes see in our sky; but more transparent than the finest lace veil and having, not the fleecy look of our clouds, but the appearance of being filled with almost infinitely delicate threads of light. With all this there is something crystalline about the appearance of a spot, not unlike frost figures on a window pane. Indeed, the intense whiteness of everything is suggestive of something very cold.



A NEW FORM OF LOOPING THE LOOP.

The bicyclist is whirled around several times by the large revolving wheel.

ANOTHER FORM OF LOOPING THE LOOP.

Our French contemporary Armée et Marine publishes the accompanying illustration of a fearful, hair-raising contrivance, compared with which the ordinary form of loop the loop seems as harmless as an ordinary highway.

The account given of this apparatus is not over-lucid. It seems that the performer, who rejoices in the name of Yags, throws himself within a revoluble wheel and sets it in motion by rather smart pedaling on his bicycle. When the cyclist has whipped up the speed of the large wheel sufficiently, he suddenly stops, we are assured, and allows himself to be whirled by the large wheel around and around. It is said that the cyclist in this fashion loops the loop five or six times in succession.