

### THE MAXIMUM OF THE PRESENT SOLAR CYCLE.

BY ROSE O'HALLORAN.

When last winter's sun shone forth between the rainclouds, it needed no magnifying power to discover that unwonted storms heaved its surface, and that the range of spottedness familiar to observers of recent solar cycles had been far surpassed. A dimmed area on December 8, a black streak in the middle of January, a rhomboidal discoloration in the beginning of February, an oval one in the end of that month, and another oval area in March, these were the successive signs of a sunspot maximum of unusual intensity. Two or three black markings distributed over as many years seem to be the amount of disturbance generally visible during maxima to the normal eye without magnifying power, but four giant spots within a period of two months is probably unparalleled in the memory of the present generation of observers.

The stage of departing minimum and approaching maximum ended with the appearance of the enormous spot of October 5, 1903, and though the succeeding fifteen months brought to view some large groups, they had not the size, motions, nor duration that challenge special interest. In 339 days of observation with a 4-inch lens, on only four was the disk unspotted.

A quadrangle of rapidly changing spots inclosing a tract of photospheric calmness, 70,000 miles across, extended from north heliographic latitude 10 to 20 deg. between the 7th and 16th of December, 1904. Too far apart to be classed as one group, they were suggestive of adjacent though separate causes. By the rotation of the sun on its axis, and meanwhile the motion of the earth in its orbit, each segment of the spot-zones is in view of the earth thirteen and a half days, and then unseen for an equal time; while our atmosphere, the inevitable night hours, solar vapors, and the effects of foreshortening also concur in hindering a prolonged view of the sun's features. Still, a coincidence as to time, position, and form often renders the identification of a disturbed area that has traversed the unseen side and come round again reasonably certain; but the quadrangular eruption had partly faded before it crossed the disk, and left no trace in the following rotation.

On the 2d, 3d, and 4th of January, 1905, the only group visible on the disk was a pair of enlarging spots in the southwest quadrant. The 5th of the month was cloudy, but on the 6th a small spot and several smaller companions were noticeable in the southeast quadrant. This was probably the first appearance of the stupendous eruption visible from January 28 to February 10. At the same time, the northeastern zones were

also tracts of latent possibilities, though there was nothing unusual to indicate the fact. A curving line of four unpretentious spots appeared there on the 7th, and when near the west limb developed an oval section 14,000 miles in length which seems to have returned on February 4, and again, for the third time, as the giant spot of March. When the curving line of four spots had passed toward the center on January 10, another small group, also teeming with possibilities, was inside the northeast limb, and in two days included two spots 17,000 miles in length connected by a sagging penumbral line. Before the 16th, this insignificant filament had become the main section of the enlarging group, which, like a long black streak one-seventh of the sun's diameter, was visible to the naked eye for several days. It extended 123,000 miles in north latitude 11 deg., and over the penumbral tracts, 30,000 miles wide in parts, ten umbrae were distributed. On the 19th, decrease was evident throughout, and the rapid central development, being especially transient, was reduced to one-half. The group was still visible on the 23d, but when due on the east limb on February 6, no allowance for unusual length or drift could, consistently with Carrington's law, identify it with any of the markings in the northeast quadrant of that date. On January 28, five days after its disappearance over the west limb, what was evidently another eruption of prodigious extent was well inside the southeast limb at 11 A. M., Pacific standard time. If the two were in existence during the previous five days on the invisible hemisphere they were not much more than a hundred degrees of the circumference apart. The newcomer was in south latitude 15 deg., and owing to width combined with length was found by measures taken at Greenwich to have no

equal in dimensions during the last thirty-three years. In the foreshortened view of the 30th at 11 A. M. it was chiefly penumbral, rhomboidal in form, with two large umbrae divided by a slender photospheric streak. At the same hour on the following morning this bridge had changed direction nearly ninety degrees, the cyclonic tendency being shared by a small adjacent umbra. At this stage the disturbance seems to have had its greatest extent when allowance is made for the effect of foreshortening. Between clouds on February 2 and 3 it was distinctly visible without magnifying power, and on the 4th, when central in south latitude 15 deg. was more than 100,000 miles in length and 60,000 in width. The slender bridge was gone and the two vortical sections formed one oval umbra 18,000 miles in diameter, while numerous small umbrae were scattered round.

On the morning of the 5th an immense breach in a north-and-south direction had divided the western part of the penumbra, development or a greater velocity had noticeably advanced the lower part of the fragment and many changes were also evident in the minor umbrae. Notwithstanding the effects of foreshortening, a decrease in the size and in the number of the small nuclei, it was visible to the naked eye on the 6th, and telescopically until the 10th, when it passed from view. As Carrington in the middle of the last century devoted many years to a vigilant study of returning spots and their individual periods, his laws seem the best general index to latitudinal difference in solar rotation. Fifteen degrees from the equator, the mean position of this latter spot, is accredited with a rate somewhat less than twenty-five and a half days.

On January 28, 11 A. M., a screen image of the sun was arranged to measure one foot in diameter and the spot was then one-eighth of an inch inside the

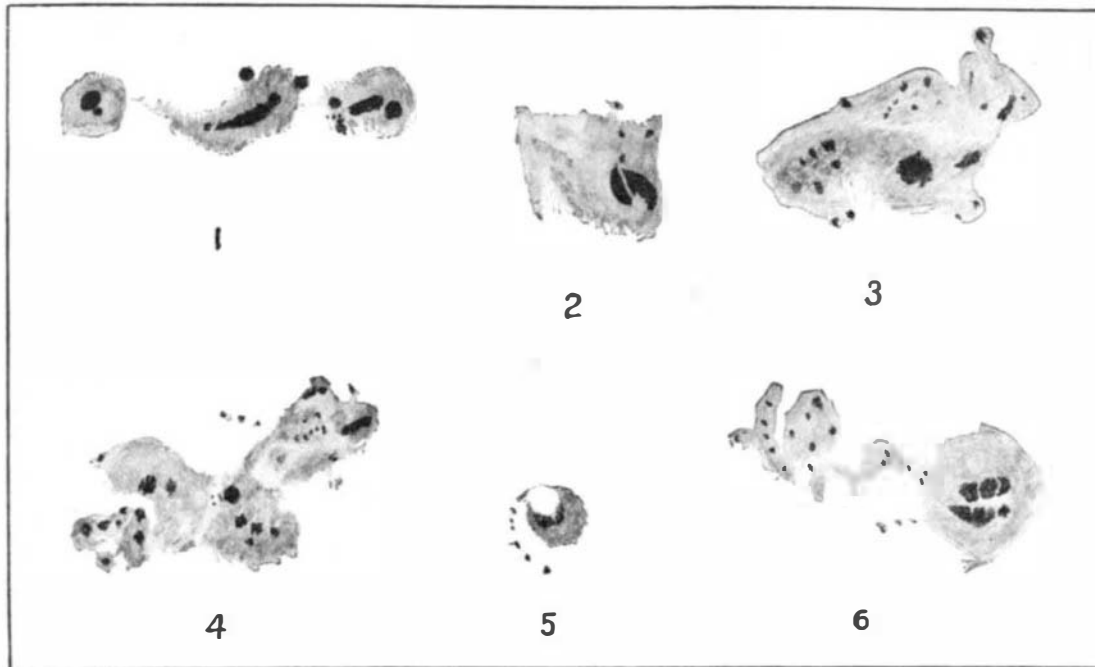
evident, the middle of the dimmed area cleared, leaving only a porous border, which soon was undiscernible in the general decrease and foreshortening that followed. These belated rotations, if such they were, end the history of one of the largest solar eruptions that have ever been measured, according to some estimates, surpassing all, even the historic spot of September, 1858. In April there was no marking in the same zones that could be classed as a fourth return.

Perhaps the strangest fact is that, in March, solar activity was far from being exhausted by the unusual displays of the previous months. On March 1, when marveling at the succession of sun scenes already presented, another portentous gap broke the symmetry of the eastern limb.

As before intimated, a small group occupied its place in January and again in February, while the periods of return were in good accordance with the law of Carrington for ten degrees of latitude. Extending between 8 to 16 deg. north from March 1 to 13, it measured 117,000 miles in length, and was in fact longer than the compact eruption of January 28, but, being somewhat cruciform, covered a smaller area. A simple method of comparing the areas when seemingly largest, indicated that it tinted about one-fourth less of the sun's surface. Its characteristics were a rather deep-hued penumbra sprinkled with numerous small umbrae, and the absence throughout of a large umbra. Seldom has such an interesting sun picture been presented as on March 4, when a previous great storm drifted westward toward decline while the incoming leviathan surged onward with foreshortened coils giving promise of vast length. Seemingly one-fourth of the disk apart, both were discernible without magnifying power.

When this later discoloration was past the center, decrease in tint and disintegration were noticeable, and as early as the 9th of the month only a fragmentary outline was there, which lingered until the 13th when close to the west limb. Survival in any form during another rotation is improbable, as the small group that came in toward the end of March was in a higher latitude. Of this notable series of sun spots, the second and the fourth were comparable with the largest on record.

In the subsequent three months, phenomena of the sun's surface equaled the average condition during ordinary maxima. A spot of medium size in south latitude 20 deg. indicated vortical motion in aspect, as well as by the changed position of its umbra from April 13 to 17; two good-sized groups transited in May; and on the 23d and 24th of that month the visible photosphere as seen in a 4-inch telescope was entirely



1. Sunspot of January 16, 1905, 10:40 A. M. 2. Sunspot of January 30, 1905, 11 A. M. 3. Sunspot of February 5, 1905, 9:40 A. M. 4. Sunspot of March 7, 1905, 9 A. M. 5. Cyclonic sunspot, April 17, 1905, 9:45 A. M. 6. Sunspot of July 15, 1905, noon.

#### SUNSPOT STUDIES.

east limb. If centrally situated, this photospheric tract would be 9,000 miles across, but in the position of extreme foreshortening represented about half a day's journey. Allowing two days for the earth's advance onward, the spot was overdue on the morning of the 24th, as its size should have hastened a reappearance, but it was looked for in vain. Early on the 25th, a large spot was well inside the limb and, when less foreshortened, bore a general resemblance to the expected marking in its decline. It also proved to be in the same latitude, 15 deg. south. Flecks of sea-foam sinking from crest to hollow of the rolling billows are not more elusive as to identity than these signals of solar disturbance. It may have been a new spot in an adjoining tract. If the same, it was no exemplar of Carrington's law. Though of lesser dimensions than during its supposed previous transit it was visible without magnifying power for several days when central on the disk, and was close to the west limb on March 10. Again in accordance with a rotation period of four weeks, and in the selfsame latitude, a spot was within the east limb on the morning of March 25. In one respect it was remarkable. Having enlarged to medium size, six small umbrae were formed, and in two days faded out, though what may be called pores became discernible in the same tract, while a triangular area of the adjoining surface on the eastern side assumed a dimmed aspect. Forty thousand miles in length and more than half that in width, it was too faint to be classed as penumbra, too distinct to be overlooked. When near the center of the disk it was oblong in form, and the disappearance of pores on the border and the development of minute spots throughout the area was an interesting stage of transition. As the formation of umbrae became more

unspotted. But the mysterious source of discoloration was not yet on the wane. After a month of moderate activity another series of leviathans came into view. The first was 96,000 miles in length, and when central a few degrees north of the equator, on June 26, 70 degrees of vortical motion was noticeable in its bridged umbra. The elongated group still discernible inside the west limb on July 1 was followed in five days by another 73,000 miles long. This latter would have been scarcely visible to the unaided eye but that a large umbra developed on July 8 and was perceptible on the south side of the disk for some days. When still central, a stupendous umbra encircled by a wide penumbra emerged into view at the east limb. This foremost section of an incoming group measured 45,000 miles across and was visible to the naked eye on July 13, three days before it was central. A serpentine appendage in the rear brought the entire length to 118,000 miles. It was eight degrees north of the equator and changed little in transit. A suggestive incident in its career as it neared the western limb was the outbreak of a spot about fourteen degrees behind it which, in the much foreshortened view, measured 62,000 miles. Such a repetition of activity in the rear is frequent, may be more than accidental, and would account for seemingly belated returns. Two rapidly changing groups between 30,000 and 40,000 miles in length were the chief features of the August sun; and widely scattered disturbances of lesser size in September indicated that subsidence of activity was slow and gradual.

A brief summary dating back to the beginning of October, 1903, when the intermediate stage from minimum to maximum was clearly passed, shows that activity has been pretty evenly distributed between the

northern and southern spot-zones in these two years. In deducing results the term "spot" is used to denote a discoloration whether single or in parts, provided the components are sufficiently near to indicate a common origin. As the largest eruptions are rarely spread beyond an area twenty degrees in diameter, a group scattered over that extent of surface is classed as one disturbance or spot. According to this classification, in 613 days when observations were obtainable, 263 spots appeared on the disk, 118 being in the northern hemisphere, 108 in the southern, while the positions of 37 were unascertained. On only six days was the disk unspotted in a four-inch lens. Of these 263 spots, 115 appeared from January 1 to September 30 of the present year (1905). This denotes an increase in the average number as well as in size during these tempestuous months. The proportion in the hemispheres was nearly preserved, 53 being north of the solar equator, 47 south, and 15 unlocated. As explained in the foregoing account, the northern tracts also had the larger share of the seven stupendous eruptions described. A comparison of those of lesser size—neither vast nor faint—shows that during this same critical period about 18 appeared north and 15 south of the equator, from latitudes 5 to 20 being the chief zones of activity.

When the great spot of October, 1903, heralded the beginning of maximum, widespread magnetic disturbance encompassed our globe, but it is a circumstance of much interest that during the past nine months, when tempest-tossed areas of still greater extent faced earthward again and again, neither auroras nor electrical phenomena were in notable co-operation with this climax of maximum spottedness.

**CAPTIVE HIPPOPOTAMI.**

While few menageries or zoological gardens include hippopotami among the members of the animal world which they contain, the general public is nevertheless quite familiar with the appearance and characteristics of the great ungulates. They have been described in word and picture by innumerable naturalists, historians, and writers, even of the earliest times. We find unmistakable reference to them in the records of the ancient Egyptians, and to-day there is little doubt that the behemoth of the Bible was identical with the hippopotamus. The Central Park Zoo, of New York city, is particularly fortunate in the possession of three splendid specimens, a pair of older animals and a young one. The pair, Caliph and Miss Murphy, are well known, not only to those directly interested in these matters, but also to the reading public, for the huge brutes have been repeatedly described and pictured in various publications.

Caliph, the great male which is the subject of the accompanying interesting engravings, has been in the Central Park Zoo since 1889, while his mate, Miss Murphy, has been included in the collection for a somewhat shorter period. These two have proven remarkably prolific, and have presented an admiring public with eight healthy offspring, and these, with the exception of the young one at present in the Park, have been sold to other menageries. This is not an exceptional case, for strangely enough these curious

beasts thrive well in captivity, and breed not infrequently. Were it not for the difficulty formerly experienced in securing original pairs, they would to-day be far more common in zoological parks. Needless to say, it is very difficult to capture the hippopotamus in a wild state and transport the animal uninjured to civilization, though if this be accomplished successfully, he takes kindly to captivity, and often lives contentedly for many years. In fact, a single specimen existed in the Zoological Park in London for over twenty-eight years.

Hippopotami in captivity do not require the excessive care and attention which are usually necessary for the well-being of tropical animals. One factor which is of considerable advantage in this respect is the fact that the animals lack the restlessness and nervousness so commonly found in wild creatures. Though terrible fighters if aroused, they are even-tempered and fairly intelligent, and learn to obey the word of command of their keepers. They appear to appreciate kindness, and seldom if ever require punishment.

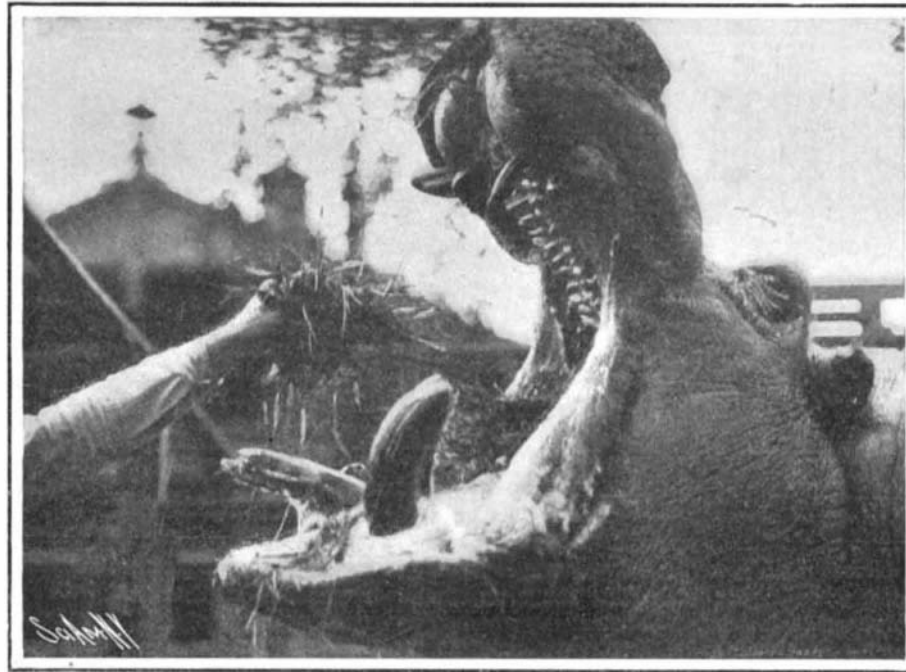
Hippopotami are purely herbivorous, and in the wild state feed upon grasses, various water plants, rice, millet, maize, and similar growths. This diet is approximated as nearly as possible in captivity. They are fed every day, usually early in the afternoon, on fresh grass or hay, various vegetables, and bread. They have very healthy appetites, and we can imagine the quantity of food that a "hippo" can consume, when we consider that the stomach of a large specimen will measure as much as eleven feet in length.

The hippopotamus is heir to few troubles. Mutual attrition keeps his teeth, which grow throughout his lifetime, within proper bounds. One of the accompanying illustrations clearly portrays the molar characteristics of the animal. As he not only spends most of his waking hours in the water, but often sleeps there also, the frequent immersions keep his thick skin in a healthy condition. The water must have a temperature of not less than fifty-five degrees, and must be maintained at this point the year around. With the exception of the usual attention regarding the cleanliness of the habitation, other necessary care includes merely the proper preparation of his food and the regulation of the temperature.

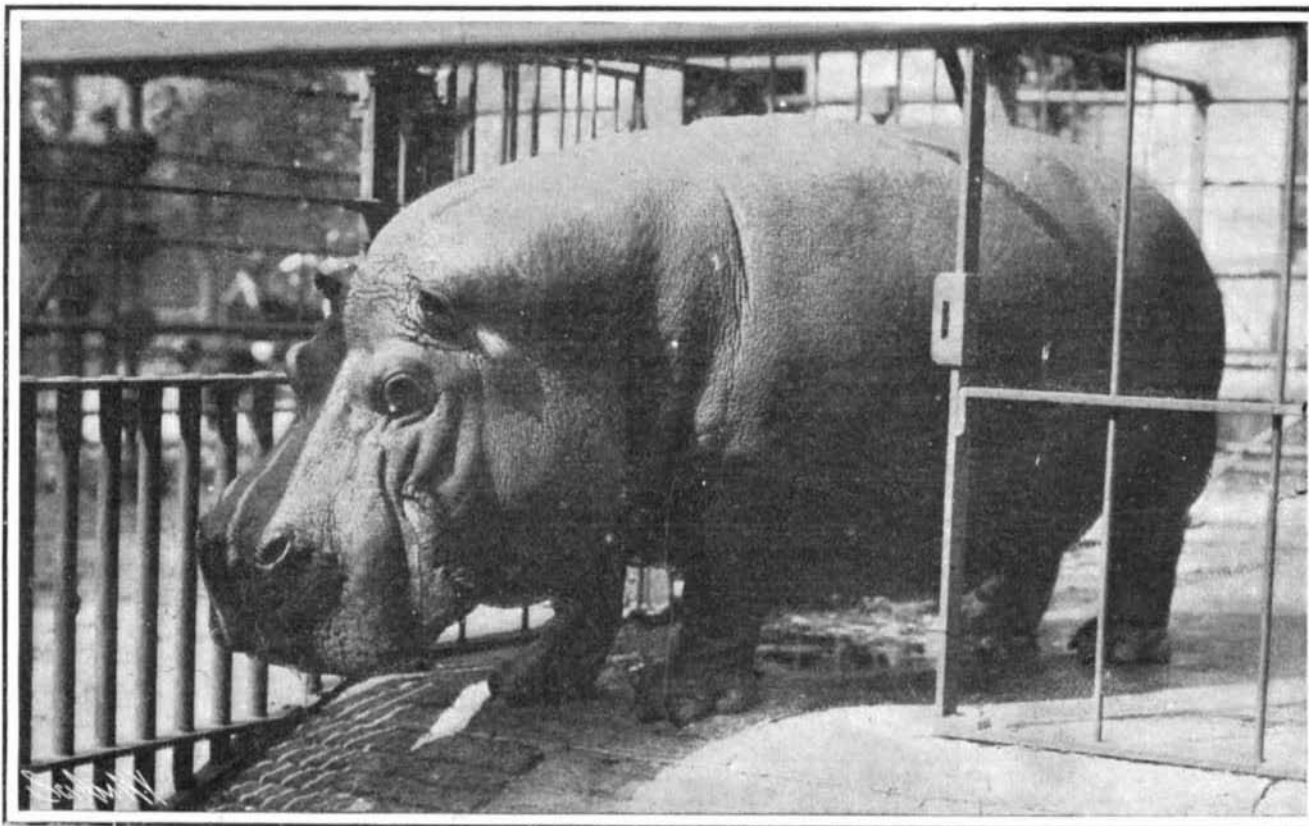
A large gas company of Paris has lately bought three patents for the commercial manufacture of a gas which is rich in methane, and this will allow the gas works to utilize the gas-carbon which is not easy to dispose of. Methane has a high calorific power and when used in connection with the incandescent gas mantles it gives a better light than is obtained with ordinary coal-gas. One of the patents provides for suppressing the carbon monoxide which may remain in the gas,

so that it can be employed generally and will not meet with the opposition which water-gas encounters in France and which prevents its extensive use. The principle of the process consists in making hydrogen react in a catalytic manner on oxide of carbon in the presence of nickel. To produce the right quantity of methane, CH<sub>4</sub>, we need a greater amount of hydrogen than ordinary water-gas contains, so that the new method seems to be summed up in the production first of water-gas, then of an excess of hydrogen, and the two gases are put in the presence of the catalytic agent in the right proportion. As yet the process is in the experimental stage. Tests made at Lyons show that the reactions on which it is based occur as was predicted, and it now remains to operate it on a large scale and find whether it has all the superiority that is claimed for it.

The use of tantalum as a filament for electric lamps is deprecated on account of its tendency to soften.



Feeding Time.



"Caliph," the Giant Hippopotamus of the Central Park Menagerie, New York City.



"Caliph" Musing  
CAPTIVE HIPPOPOTAMI.