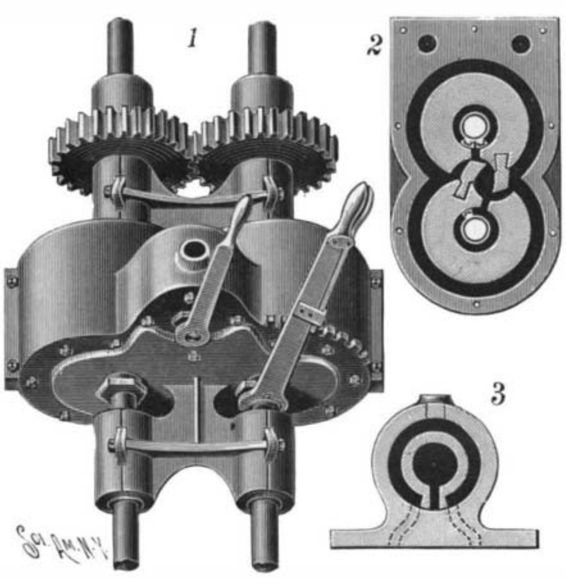
Action of Cathode Rays.

Goldstein was the first to discover that common salt is colored brown and potassium chloride violet by the action of the cathode rays, says The Engineering and Mining Journal. The discoverer attributed this phenomenon to some physical change undergone by the salts. Wiedemann and Schmidt attributed it to their partial conversion into subchloride, and Giesel actually succeeded in preparing similarly colored subchlorides in a chemical way. But the chemical hypothesis is now invalidated by the researches of R. Abegg. He obtained the salts in question in a pure and finely powdered state, so as to be able to color them all through. His first experiments showed that the coloring does not spoil the vacuum in the tube, as it would if chlorine were evolved. The salts were rendered colorless again by high exhaustion, producing rays with a strong heating effect. The substances could be colored and uncolored any number of times in succession. When the colored salt was dissolved it produced no reducing or alkaline reaction. When undissolved in a saturated solution it retained its color. All this tells against a chemical change. Moreover, an easily reduced chloride is not reduced by the cathode rays. It is well to remember that the coloration of these alkaline salts is a phenomenon not produced by light. On the other hand, cuprous chloride is blackened by light, but not acted upon by the cathode rays.

AN IMPROVED ROTARY ENGINE.

In the engine shown in the illustration all the movements are rotary, enabling the engine to be run at very high speed, as high as 8,000 to 10,000 revolutions per minute being claimed for it. It is fitted with valve gears adjustable to cut off the steam as desired, thus enabling the steam to be used expansively, and the valves are arranged to take up their own wear and always remain perfectly tight. The invention has been patented by Carl Engberg, of St. Joseph, Mich. Fig. 1 represents the engine in perspective, Fig. 2 being a sectional view of the cylinders and pistons and Fig. 3 a section of the steam chest and inlet valve. The shafts on which the pistons are secured are connected with each other by gear wheels, one of which is adjustable to bring the pistons in proper relation to each other, at the same time permitting the rotary motion of one shaft to be transmitted to the other, and in the body of each piston is dovetailed a piston head, the piston heads being adapted to pass each other in recesses formed in the pistons. The ends of the pistons, as well as their outer faces and the cylindrical heads adjacent thereto, are fitted with suitable packing to prevent leakage and take up wear. The recesses at either side of the piston heads are connected by ports with annular recesses in the pistons, surrounding the shaft, and into each of these recesses extends a sleeve whose outer end is adapted to receive a hand lever adapted to be locked to a notched segment, whereby the steam may be cut off at different points of the revolution of the piston. The annular recesses are also connected with ports leading to the steam chest, the inlet valve controlling which may be readily adjusted to reverse the engine. The engine is perfectly balanced, so that it can be run at a high speed without the least vibration, being thus especially valuable for running dynamos, and is very light for the power it is designed to develop.



ENGBERG'S ROTARY ENGINE.

PHOSPHORUS may be prepared in the electric furnace from calcium phosphate. A mixture of this salt with carbon and sand or alumina is heated in an atmosphere of some gas neutral to phosphorus, such as coal gas, and the phosphorus which distills over is collected under water. According to Mr. Readman, 86 per cent of the phosphorus contained in the original mixture is obtained, and the product is found to be very pure.—Stahl und Eisen.

THE PLANET VÉNUS.

Of the planets, Venus is the one that approaches nearest to the earth; and her dimensions are almost the same as those of the latter. Nearer to the sun than we are, she effects her revolution around it in 224½ days; but her distance from the earth greatly varies. As her distance from the sun is about two-thirds of the radius of the terrestrial orbit, it will be seen that when she is in inferior conjunction, that is to say, between us and the sun, her distance from the earth is only a third of that of the sun from the latter. Her apparent dimensions naturally vary in inverse proportion; and, moreover, she presents the phenomenon of phases. At the epoch of inferior conjunction she turns toward us that one of her two hemispheres which is not illuminared and is consequently invisible to us.

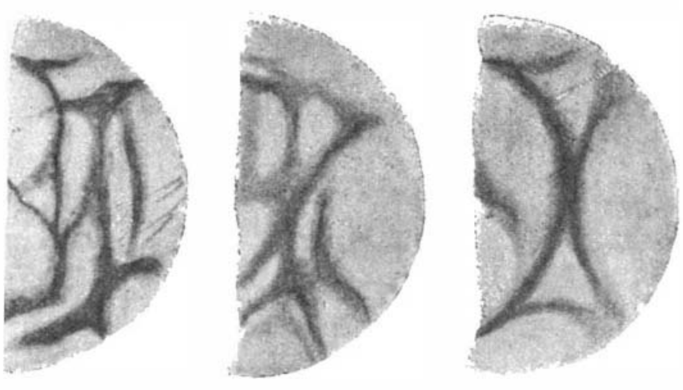


Fig. 2.—VENUS AS OBSERVED BY M. FONTSERE.

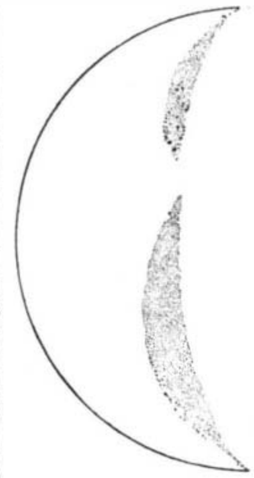


Fig. 1.—VENUS AS OBSERVED BY SIR WILLIAM HERSCHEL.

A few days afterward she appears to us in the form of a slender crescent, which continues to widen more and more in measure as she seems to become more distant from the sun on the west side. It is then that we see her shining in the morning before sunrise and that she is called the "Morning Star." She gradually assumes the form of a half moon, and then the visible part further enlarges, and finally comes the superior conjunction, in which she presents to us the whole of her illuminated hemisphere. Unfortunately, she then appears alongside of the sun and is lost in the splendor of his light. Then her apparent figure undergoes the same modifications in an opposite direction, while she appears in the evening to the east of the sun until the epoch of the new inferior conjunction. It must be added that, on account of the variations in the distance of Venus from the earth, the apparent diameter of the planet is so much the greater in proportion as the phase is more pronounced. It is when she appears in the form of a slender crescent that her diameter seems greatest. Fig. 4 shows the different aspects of the planet, with their relative apparent sizes. We shall not dwell upon this farther, but we have thought it well to recall all these circumstances in order to show how unfavorable they are for observations; added to which, among other difficulties, is the fact that we never see the planet's entire disk. So it is not surprising that the knowledge that we possess as to this planet is much less advanced than that which we have been able to acquire concerning the moon or the planet Mars.

There is one thing certain, however, and that is that Venus is surrounded by an atmosphere much denser and much higher than that of the earth. The existence and thickness of this atmosphere reveal themselves to our eyes (1) by the penumbra that accompanies the internal limit of the crescent, and that corresponds to the twilight of the places on Venus for which the sun rises and sets; (2) by the prolongation of the horns of the crescent beyond their geometrical limit; (3) by the fact that the external edge of the planet is always more brilliant than the central region; and (4) by the observations made at the time of the last passage of Venus over the sun's disk, and which showed, at the moment at which Venus' disk had half entered upon that of the sun in the form of a black semicircle, that the part of Venus remaining external to the sun was surrounded by a narrow luminous ring produced by the illumination of the atmosphere (Fig. 5). M. Bouquet de la Grye, who has discussed these observations, estimates that the atmosphere of Venus is five times higher than that of the earth. Finally, spectrum analysis has shown aqueous vapor in this atmosphere, and hence it is allowable to conclude that more or less opaque clouds exist. So this atmospheric stratum, which acts as a veil to conceal the solid part of the planet from us, constitutes still another difficulty.

The first problem to be solved would be that of the determination of the rotation of the planet and of the position of its axis. Now, as regards this, the opinions of astronomers have singularly varied. The reason of this is that, in order to solve the problem, it would be necessary to distinguish persistent spots upon the surface of the planet and follow their apparent motion, as has been done with the moon, the sun, Mars and Jupiter. Unfortunately, we see almost nothing upon the planet Venus. Many astronomers have never seen here anything but a surface of a uniform white. Others have seen, or thought they have seen, dark or white spots. But such spots are scarcely perceptible and without exact contours, and are nothing more than fugacious and ill-determined shadows. Another curious circumstance is that, although the drawings made by the same observer present some resemblances to each other, those obtained by different observers are entirely dissimilar, as one may convince himself by examining the engravings which accompany this article. It has never been possible to identify upon Venus, as it has been upon Mars, two spots seen by different observers. So the maps of Venus that have been published a little too hastily are absolutely illusory.

The first observations date back to Dominique Cassini, who made them at Bologna in 1666 and 1667. We give (Fig. 3, No. 1) one of Cassini's sketches repro

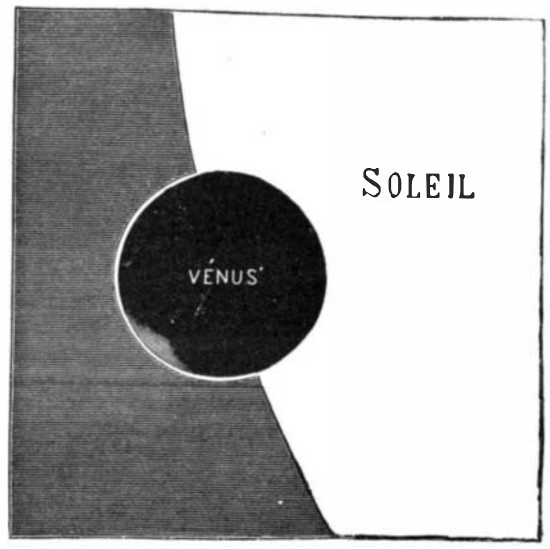


Fig 5.—LUMINOUS RING PRODUCED AROUND VENUS BY THE REFRACTION OF THE SOLAR LIGHT THROUGH ITS ATMOSPHERE AT THE MOMENT OF ITS PASSAGE OVER THE SOLAR DISK.

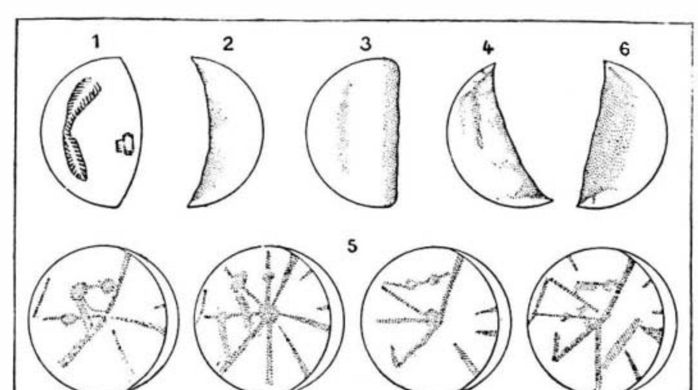


Fig. 3.—OBSERVATIONS OF VENUS.

No. 1, by Cassini; No. 2, by Bianchini; No. 3, by Schroeter; No. 4, by Schiaparelli; No. 5, by Lowell; No. 6, by Flammarion and Antoniadi.

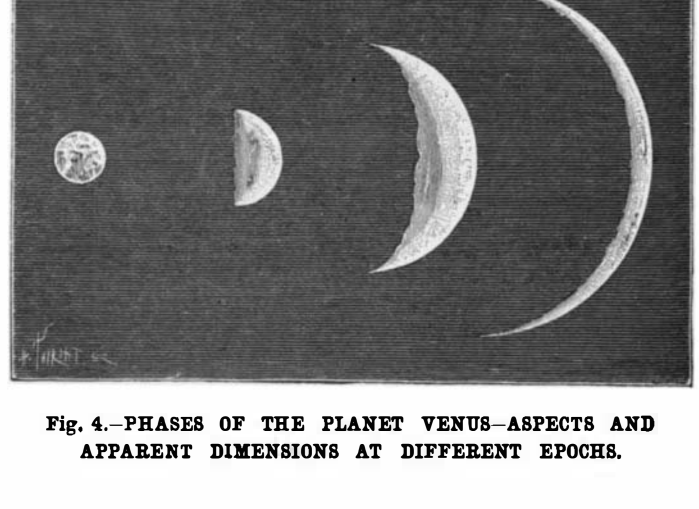


Fig. 4.—PHASES OF THE PLANET VENUS—ASPECTS AND APPARENT DIMENSIONS AT DIFFERENT EPOCHS.

duced in the Bulletin of the Astronomical Society of France. Upon the right, near the terminator, we observe a white spot which has never been seen since, and from which Jacques Cassini, son of Dominique, concluded that the planet made one rotation in a little less than twenty-four hours around an axis lying nearly in the plane of the orbit.

In 1726, Bianchini, one of whose sketches is reproduced in No. 2 of Fig. 3, concluded on a period of revolution of 24 days and 8 hours. No. 3 of Fig. 3 shows us a drawing by Schroeter made in 1788. This astronomer estimates the duration of the rotation at 23 hours and 21 minutes; but he must have allowed himself to be influenced by Cassini's figures, since a profound discussion of his drawings scarcely permits of deducing anything therefrom. William Herschel, whose ability and patience are well known, gave up the observation of Venus, and judged that the spots often assume the aspect of optical illusions. Fig. 1 reproduces one of his drawings. In 1878, Schiaparelli announced that the very careful observations that he had made at Milan could not be made to agree with the rotation of twenty-four hours nor with that of twenty-three days, nor even with any relatively short period. It must be admitted that the period of rotation of Venus on its axis is just equal to that of its revolution around the sun, so that the planet would always turn the same hemisphere toward the sun in the same manner that the moon always presents the same face to us. In this hypothesis, one of the halves of Venus would have light and heat eternally, while the other would remain eternally in cold and darkness. Schiaparelli's opinion is based especially upon the persistence of a spot or rather of a shadow near the southern horn (Fig. 3, No. 4). As the drawing is reversed, the southern horn is the upper one. This shadow remains visible at the same place for hours, days, months and years.

Finally, in 1896, Mr. Percival Lowell, whose remarkable observations relative to the planet Mars we have recently referred to, obtained at his observatory, under excellent atmospheric conditions, some drawings, a few of which we reproduce herewith (Fig. 3, No. 5). The planet was observed in broad daylight at an epoch near that of the superior conjunction. These singular configurations underwent but little change from one hour to another, and Mr. Lowell saw therein a confirmation of Schiaparelli's ideas and of the duration of axial rotation equal to that of the revolution. If it be added that Mr. Barnard, at the Lick Observatory, declares that he has never been able to distinguish any certain spot upon the planet, save once, and if a few other observations be taken into account, particularly those made at Juvisy by MM. Flammarion and Antoniadi (Fig. 3, No. 6) and in Spain by M. Fontsere (Fig. 2), we shall have all the elements of the question.

It remains to discuss all these observations and to draw a conclusion therefrom. This is what M. Flammarion has recently tried to do. In the first place, the want of resemblance of all the drawings leads to the supposition that many of the configurations sketched are pure illusions. The surprising drawings of Mr. Lowell, notwithstanding the authority of that astronomer, appear to come under this head. If we reflect upon the radiating aspect of the black lines observed and upon the fact that analogous configurations have been observed upon other planetary disks, notably upon the satellites of Jupiter, we shall be led to see therein an effect of optics due to the passage of the light through the glasses of the telescope, diffractions, interferences, etc. If we examine the other drawings, we shall find therein nothing in common except a sort of shadow which starts from each of the horns of the crescent and spreads out over the central part of the disk. According to Schiaparelli, this shadow is larger and more pronounced in the vicinity of the southern horn, and it is the persistence of it that has led to the admission of one revolution in 224 days. Now M. Flammarion remarks that the very form of this shadow leads one to think that it is produced in the atmosphere of Venus and has more relation with the phase and with the solar illumination than with the body itself of the planet. In other words, this shadow is a consequence of the manner in which the planet is illuminated, and that may occur in two ways: it may happen that it is an effect of optics, of which, it is true, it would remain to explain the cause; but it may happen also that it has an objective existence in the atmosphere of the planet. Do we not see upon the earth itself, for several days in succession, the same atmospheric conditions reproduce themselves at the same hours—fog in the morning, clouds in the daytime and clear spots toward the end of the day and at sunset? An observer who should see the earth from afar, under such circumstances, would evidently perceive atmospheric shadows that occupied an invariable place with respect to the line of the points in which the sun sets or rises, that is to say, with respect to the terminator. This is probably what happens upon Venus. The points in which we see Schiaparelli's persistent shadow are always at the same hour, and have, if we may so express ourselves, the same meteorological heavens for a longer or shorter period. So the persistence of this shadow no longer implies the absence of relative rotation of the planet. The latter really revolves, but the atmospheric shadows follow the illumination, and we see them always at the same place, although in reality they shift about with respect to the regions of Venus.

This theory evidently supposes that we never see the solid surface of the planet and that we observe the atmosphere only. Now, there are strong reasons for thinking that this is the case. In the first place, among these is the undecided character of the spots observed, and especially the thickness of the atmosphere of Venus. Being given the relative proximity of the sun, the heat that results therefrom and the activity of the evaporation that is the consequence of it, it would not be surprising if the atmosphere of Venus were constantly filled with clouds, as so often happens with that of the earth.

In this case it is evident that we should see only such uniform stratum of clouds. But this hypothesis is not necessary.

Even though the atmosphere of Venus were as pure as our serenest sky, it is almost certain that it would again prevent us from seeing the solid surface. In order to convince ourselves of this, it suffices to observe that the terrestrial atmosphere absorbs more than a third of the solar light. This absorbed light is not destroyed, but is diffused in all directions, and is what produces the blue brilliancy of the sky. Seen from the exterior, the atmosphere would be as luminous as is the serene sky, and this continuous brilliancy would certainly much interfere with, if not entirely prevent, a view of the details of the surface. Let us add the light reflected by the sun would also lose another third of its intensity in traversing the atmosphere anew; whence it follows that, to an external observer, the presence of the atmosphere would diminish the brilliancy of the terrestrial surface by two-thirds and produce, besides, a luminous field upon which the details of the surface would be lost. Under such conditions, it is very likely that the observer would be able to distinguish our seas and our continents only with the greatest difficulty. As regards Venus, the atmosphere of which is much denser, this effect is assuredly more marked. Upon Mars, the atmosphere, although relatively rare, effaces the configurations in the vicinity of the edge, where the luminous rays traverse it obliquely upon a greater thickness. Upon Venus such effect of effacement is likely produced as far as to the center.

Such are the new ideas which M. Flammarion has just submitted to astronomers in the October number of the Bulletin of the Astronomical Society, and which by word of mouth he laid before the members at the session of November 3. It is impossible not to recognize with what likelihood they present themselves. One may regret that they end in the impossibility of determining the rotation of the planet by an observation of the disk, but the fact that a theory leads to disagreeable conclusions does not diminish its degree of probability. Fortunately, there is another manner of attacking the problem, and that is by spectrum analysis and the application of the Fizeau-Doppler method. But the latter method, as concerns the planets, presents special difficulties, and it will perhaps be necessary to wait a long time before it is possible to obtain any serious results by this means. The above article was contributed to La Nature by M. Fouché.

The Current Supplement.

The current number of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 1153, contains a number of articles which are specially interesting to the general reader. These articles take up the topics of the day, such as "Prince Henry and His Fleet," "The Dreyfus Trouble in Paris," "China of To-Day," "Opening of the Sarcophagi of Voltaire and Rousseau." All of these articles, except the one on China, are well illustrated. Technology is represented by an important paper by J. A. Brashear on "Optical Glass." In the electrical field will be found articles on "Electricity in Cotton Mills" and "Effect of Electric Currents on Adjacent and Surrounding Buildings." The usual notes present the shorter matter gathered from the press of the world. "A Drowned Continent" and "Raindrops: Their Size and Rate of Fall" are interesting scientific articles.

Exhibition at Dijon, France, This Year.

Information has been received from the Foreign Office, through the Science and Art Department, that a universal and international exhibition will be opened at Dijon on June 1, 1898. The exhibition will remain open until October 31. There will be 14 sections —(1) Fine Arts, (2) Social Economy, (3) Hygiene, (4) Salvage, (5) Industrial and Decorative Arts, Liberal Arts, Science, (6) Heating and Ventilation, (7) Electricity, Traction, (8) Military Art, (9) Manufactures, (10) Sport, (11) Exercises, Popular Games, (12) Conferences on Agriculture and Horticulture, (13) Education and Work of Women, (14) Commerce, Colonies. All communications should be addressed to the General Manager or Organizing Committee, Rue Monge 38, Dijon.

Science Notes.

Mr. Thomas Fletcher has recently published an estimate of the amount of coal gas needed to maintain an ordinary small fire clay muffle at the proper temperature for various purposes, and using the gas in atmospheric burners. For hardening steel cutters, etc., which requires clear red heat, about 8 cubic feet of gas per hour are needed for every 10 square inches of floor area of the muffle. A yellow such as needed in silver assay work requires a consumption of 10 cubic feet of gas per hour, while the bright yellow used in gold assays requires about 11 cubic feet per hour. For still higher temperatures, such as needed in china enamels, etc., the consumption may go up to 14 cubic feet of gas per hour for every 10 square inches of the floor area of the muffle. Where metal muffles can be used, or the gas can be burned under pressure, a smaller consumption is needed.

It will be remembered that in 1895 the original MS. of Gilbert White's "Natural History of Selborne" was sold by Messrs. Sotheby for $1,470, says Nature. It is now announced that the same firm will offer for sale an even more interesting batch of writings by the same author. These MSS. are the original letters which were sent by post by Gilbert White to Thomas Pennant between August 10, 1767, and July 8, 1773. These letters were returned to Gilbert White when he first conceived the idea of writing his famous natural history and from them was drawn up the autograph MS. sold in 1895. The letters are all holograph but four, which are in the handwriting of an amanuensis, signed by Gilbert White, and all but three occupy four pages folio. They are additionally interesting and valuable from the fact that many of the details recorded in them were altered, omitted or augmented in the published work. The second lot of Gilbert White MSS. is "A Garden Kalendar," dating from 1751 to 1767. It is the author's holograph manuscript, and occupies 424 pages. This has never been published, excepting the portion May 1 to November 16, 1759; it is in the form of a consecutive diary, recording the writer's almost daily operations on his own land, and notes of the results of experiments tried by him in forcing and hothouse work. All the MSS. have been continuously in the possession of the White family.

Sun's Eclipse in India.

Press reports from India state that the weather was perfect and that favorable results were secured during the eclipse of January 22. The totality at Buxar lasted one and one-half minutes. Five special trains went to this place filled with Europeans. Immense crowds of natives bathed at Calcutta, Benares and at other centers during the eclipse. At Dumoraon seven good pictures of the corona were obtained. The spectacle was magnificent and excited awe and astonishment among all the beholders. It is a curious fact that the natives in many places regard the event as presaging the downfall of their British rulers. All the observations of the eclipse by E. W. Maunder and C. H. T. Waites at Talni, British India, were most successful. The sky was perfectly clear and light. During the middle of the totality it equaled a full moon. The general shape of the sun's corona was the same as in the eclipse of 1886 and 1896. The corona extended over two diameters from the sun and its greatest extent was along the sun's equator. Photographs were obtained on a scale of four-fifths of an inch to the sun's diameter and also on the scale of one-tenth of an inch to get the coronal extensions. Good spectrum photographs were also obtained. A cablegram received at Mt. Hamilton, California, from Prof. Campbell, who is in charge of the Lick Observatory expedition in India, states that most satisfying photographs of the corona were obtained by the expedition with three different telescopes. Prof. Campbell photographed the changes in the solar spectrum at the sun's edge with the aid of one of the spectroscopes.

The total solar eclipse was visible in Asia, Eastern and Central Europe and in northeast Central Africa. The belt of the shadow extended from the Pacific Ocean southwesterly through Korea, through the easterly and central provinces of China, India, the Arabian Sea and Indian Ocean to a point in Central Africa about half way between the source of the Niger and Nile Valley. Besides the official observations that were made at the native stations in China and India, the total eclipse was viewed in the Orient by astronomical expeditions from England, France, Germany and from the Lick Observatory. The last-named expedition has its quarters at Rutnagari, India. England sent three official expeditions to India. One was under the control of Sir Norman Lockyer and A. Fowler. The second comprised the Astronomer Royal, W. H. N. Christie, Prof. H. H. Turner, of Oxford, and Dr. A. A. Common. The third party consisted of E. H. Newall, of Cambridge, Capt. Hills and the Astronomer Royal of Scotland. Dr. Copeland. There were also various minor expeditions. Attached to one of the telescopes in Sir Norman's equipment was a cinemetograph which took pictures at the rate of six per second of the changes in the sola corona.