of a vein fourteen feet in thickness, some four miles below the Old States Road, on Rabbit Ear Creek.

Mora County has not been so much surveyed, and we cannot, therefore, give exact localities of coal deposits.

Here, in San Miguel County, we have, a few miles above Las Vegas on the Gallinas river, some splendid deposits of coal, sufficient to supply our town with fuel, if anybody wanted to use such; but as long as wood can be bought at twenty-five cents a *burro* load, nobody cares to invest in coal. Below here, on the eastern slope of the Chupaines mountain, we have again coal beds, as well as on the Pecos river, a few miles above Anton Chico.

Before reaching the Rio Grande Valley we come to the anthracite coal beds, in the Old Placer mountains near Santa Fé, in close proximity to gold, silver, and copper mining districts. The New Mexico Mining Company used this class of coal, to a large extent, in their stamp mills, and it is pronounced to be fully equal to the Pennsylvania anthracite, and better than any other of the kind in the Great Southwest. In the same county of Santa Fé, we know of bituminous coal beds on the Tezuque and Galisteo rivers, as well as near Santa Fé creek, in the mountains above the territorial capital.

In the Sandia mountains there is a four and a half feet thick vein of coal, near the little town of Tijeras, not far from Albuquerque, which the engineers of the Atlantic and Pacific Railroad, some years ago, traced for a distance of nearly two miles.

During the late war the volunteer forces stationed at Los Lunas used some splendid coal brought from the Rio Puerco, and the Quartermaster Department at Fort Craig, further south, used to be supplied with coal from a six feet vein near the town of San Pedro.

Below the *Jornada del Muerto*, our southern contemporaries, at various times reported bituminous coal beds near Doña Ana and Mesilla, on either side of the Rio Grande.

West of the Rio Grande we know of coal beds on the Puerco, and around the Navajoe Reservation, indeed as far as Zuñi.

Very few of all the deposits enumerated here are worked to any extent; but as soon as one town after another springs up on the untimbered plains and mesas of New Mexico, fuel will have to be brought them from the mountain districts, especially if we ever are to have a railroad, and all we need here in this Territory to render it "the peer of any of the States and Territories famous for their mineral deposits and coal fields," is the application of capital and machinery and if we go on attracting the attention of enterprising men from the Atlantic as well as the Pacific States, as we have done during the present decade, New Mexico will not much longer remain the unknown and despised region it used to be. Ah! indeed, our star of fortune is daily growing brighter, and the wise men from the far East commence to see its destiny emblazoned in the horizon in visible chirography—New Mexico, the Eldorado of the southwest!—*Las Vegas Gazette*.

EXAMINATION OF VOLCANIC DUST.

PROFESSOR NORDENSKIÖLD, in a paper which has been translated by the "Geological Magazine," gives the following account of the dust which was brought down by a snow-storm on the hot-beds of one of the Royal Swedish residences. He states that "some of the dust was collected and examined under the microscope, and found to consist for the greater part of small, translucent (or transparent), angular, uncolored, glass-like particles, which formed elongated filaments, bent sabre-fashion, or sharp-cornered flat bodies, partly plain, partly connected together in the form of Y or T. The filaments are commonly full of cavities, or pierced in the direction of their lengths by hollow canals, whereby they are often light enough to be able to float on water. On being examined in polarized light, most of the grains of dust are found to be isotropic—that is, without action on the polarization plane of the light passing through them. Only exceptionally can there be discovered under the microscope doubly refracting crystalline particles, presumably of au ite or felspar, and non-transparent black grains of magnetic iron ore, that may be drawn out with the magnet. No traces of metallic particles could be discovered in the dust by trituration in an agate mortar and washing, nor did chemical reagents show the presence of cobalt or nickel." He gives the following explanation of its origin: "Under the microscope the Haga dust has in many respects a striking likeness to the finest dust from a so-called 'Bologna drop' that has sprung asunder; that is, a drop of glass which has been cooled suddenly, and therefore, from the most inconsiderable cause, for example, a scratch with a file on its surface, falls asunder to a fine powder. Here we have possibly a hint as to the formation of this dust. On the outbreak of the volcano, an immense quantity of superheated steam and strongly compressed gases has violently escaped out of the crater's lava-sea, and brought along with it masses of its glowing contents more or less finely divided. Naturally the particles of lava, which at first are in a molten state, not only solidify suddenly, but are also cooled to a very low temperature in the upper strata of the atmosphere, and thereby obtain the property of the 'Bologna drop,' of springing asunder, with the least concussion or shaking, to a fine dust."

CROTON CHLORAL IN WHOOPING COUGH.

DR. WM. PAULSON, of Leicestershire, Eng., writes to the London *Lancet*: "I do not know if the administration of croton-chloral in whooping cough has any originality; but, after a somewhat extended trial, I regard it as almost a specific, and should be glad to have the opinion of other medical men as to its results. I have given it in gradually increasing doses, commencing with one grain twice or thrice a day, and almost without exception there has been a very marked reduction, both in the violence and the frequency of the attacks."

THE SAFE ADMINISTRATION OF CHLOROFORM.

DURING a recent discussion of this subject before the N. Y. Academy of Medicine, Dr. L. A. Sayre objected to the use of ether because of the struggling on the part of the patient as well as the slowness of its action. He had always employed chloroform, had never had any accident attend its use, and believed that safety depended upon administering it in a peculiar manner. His method was to place five drops, at most ten, in some convenient receptacle by means of which all atmospheric air could be excluded from the mouth and nose of the patient. If all atmospheric air was excluded, such small quantity would quickly and safely produce anesthesia. If unpleasant symptoms were developed, artificial respiration would keep the patient alive until the effect from such small quantity of chloroform had passed away; whereas when alarming symptoms developed, after the

patient had been inhaling the *diluted* gas for some time, it was not easy, and perhaps impossible, to resuscitate him. Used in that manner, a pound of chloroform would last him a year. Dr. Otis said it would last him ten years.

SCHOOL LIFE AND ITS INFLUENCE ON SIGHT.

By GEORGE REULING, M. D.,
Surgeon in charge of the Maryland Eye and Ear Institute, Baltimore.

If we could be taken back to the walks of the Academy, to the age of Socrates and Plato, when instruction was restricted almost entirely to oral communication, we would find almost all learners to have clear vision. The same immunity from painful and weak sight is discoverable in our days among all people who do not use their eyes to any extent for near work, as among the aborigines of this country, the Indians.

Modern usage, however, has changed all this. The vast amount of learning which the progress of industry has called forth, the many fields of science which it has unclosed and rendered fruitful, are too numerous to impress themselves on the mind simply through the channel of verbal instruction. Close application is absolutely necessary nowadays in order to keep pace with the requirements of our civilization. This being the case, it is of the first importance to make this necessity as little baneful in its effects as possible.

The human eye is very delicately constructed, and a continuous strain upon its muscular apparatus is painful, the more so if light is not adequately and well provided, and if the position occupied while studying is improper. But these conditions give rise not only to painful vision but to permanent injury as well.

The human eye is subject to three distinct formations: the normal or emmetropic eye, in which the image is focused upon the retina; the myopic or short-sighted eye, in which it is focused in front of it; and the hypermetropic or over-sighted eye, in which it is focused behind it.

The normal eye is spheroidal in shape, and is so constructed that rays of light coming from a distance, that is, parallel rays, come to a focus upon the retina, which is the nervous internal lining membrane of our eyes. This takes place without effort or fatigue. When, however, the shape of the eye is not that of a sphere, but when it is too flat in the direction from before backwards, then parallel rays of light cannot be brought to a focus upon the retina; on account of the shortening of the axis of the eye, this takes place behind it. Such an eye is not normal, but hypermetropic or *over-sight*.

Again, if, instead of being spheroidal, the eyeball is too long or egg-shaped, then the axis is lengthened and rays of light which are parallel, that is, come from a distance, are brought to a focus in front of the retina. Such an eye is *myopic* or short-sighted. In neither case, however, can a correct image be found on the retina; neither when the eyeball is too flat nor when it is egg-shaped, and difficulty in seeing, accompanied by pain, is the result in each condition.

Improper illumination and an incorrect posture are, as has been said, productive of bad results; the worst of these is the state of the eye just mentioned, *i.e.*, short sight. It is a fact that this affection is first noticed when children go to school. People often wonder that this should be so, but it can be readily accounted for. As thus: when we look at near objects a change takes place in the interior of the eye, which change is associated with a certain exertion. The eye being an optical instrument is supplied with a lens which increases in convexity according to the proximity of the object. This increased curvature is brought about in the following manner: The anterior surface of the lens gets to be more convex and moves forward, whilst the posterior surface, although it also becomes more convex, does not change its position. The ciliary muscle, or the muscle of the accommodation, as it is also called, contracts and thereby lengthens the fibres of the ligament which subtends the lens, and by this means the change in the curvature of the lens is produced. When we look in the distance this muscle is inactive, since, in the observation of distant objects, the lens requires only its ordinary curvature; to look in the distance, therefore, is not painful under normal circumstances.

But whenever the ciliary muscle is called into requisition, or, in other words, whenever we observe near objects, the fluid within the back part of the eye, owing to this increased muscular action, as well as to the action of the muscles which pull the eyes towards the nose, is under a higher pressure. The membranes of the eye, however, of which there are three, are very fragile; on dissection, the two inner ones are found to be extremely thin. This is even more so in the case of children.

When the child goes to school and first makes use of its eyes, therefore, the following is found to result: The ciliary muscle—or the muscle of the accommodation, as it is also called—being frequently employed, the hydrostatic pressure within the eye is increased; this pressure being continued and the membranes being very impressible, the most yielding portions, *i.e.*, those situated at the furthest depth of the eye, where the nerve of sight enters the ball, yield, and become expanded or bulge out, thereby lengthening the axis of the eye. The *axis of the eye* is a name given to an imaginary straight line drawn from the center of the cornea (the glistening portion covering what is popularly called the "sight" of the eye), to the center of the retina, the internal lining membrane of the eyeball. When this is too long, rays of light which come from a distance cannot be united upon the retina as they ought to be, but come together *in front* of it, and the eye becomes near-sighted.

The pressure, however, is increased, not only when the child uses its eyes for too long a time or under unfavorable circumstances for reading or writing; whenever the eyeball is overfilled with blood the same effect is produced. This surcharge of blood always ensues when the head is bent forward for any length of time; this position, therefore, is also able to produce short sight.

Since it is an established fact that continued observation of near objects, and a position which causes the body to lean forward, are able to render a healthy eye near-sighted and a naturally near-sighted one yet more so, it is very important to pay attention to the school accommodations of children, more especially to the structure of the desks and seats which they are obliged to occupy.

But it is not alone the desks and seats which are of importance to us; the means and manner of lighting the apartment in which the children are congregated ought to be considered as well. The worse the illumination, the closer must the child approach its eyes to the reading or writing matter, that is to say, the more must it incline its head while reading or writing. This position, however, increases the

supply of blood within the eye, and thus materially adds to already existing short sight, and not unfrequently calls it forth.

But it may be asked is short sight a disease? Are its effects so pernicious as to necessitate prevention by the employment of all possible means at our command?

The answer to this is decidedly in the affirmative. The tendency of short sight, if not arrested in its progress, is to destroy the eye. The popular belief, that near sighted eyes are the most durable, is in effect most baneful to the community. The reason why the fallacy has taken ground is because short-sighted eyes can see near objects at a time of life when normally constructed eyes must use convex glasses. This necessity, however, is the result simply of natural changes in the ciliary muscle as well as in the firmness of the lens, which is situated within the eye. When we look at objects close by, the muscle of the accommodation, *i.e.*, the ciliary muscle, by exerting pressure, increases the curvature of the lens. Now, as we get old, say from the forty-fifth year upwards, the lens becomes harder, and consequently will not quickly respond to the pressure exerted upon it by the little muscle; but since, in order to see near objects distinctly, a greater lenticular convexity is required by optical laws, and as the lens will no longer respond without effort to the action of the accommodative muscle artificial means are called for in order to remedy this condition; in other words, we must produce an additional convexity of the lens by placing a proper convex glass in front of the eye. Thus it will be seen that the necessity to wear convex glasses after a certain period is but the result of advancing years—merely a physiological condition.

Short sight, on the other hand, is virtually a disease. I have shown how pressure, exerted upon the soft, yielding membranes, may produce this condition; but it may also eventually call forth an atrophy, a degeneration, a thinness and gradual disappearance of a portion of the choroid membrane, situated in the vicinity of where the nerve of sight enters the eye. But not only may this result. After the eyeball has expanded to a certain extent, the membranes become so thinned, and their power of resistance is reduced to such a degree, that the greatest dangers are to be apprehended. A fluid may collect between the two internal lining membranes; they may in consequence become detached, and incurable blindness may result. On account of these considerations, it is necessary carefully to watch each case, and to pay stringent attention to all those surroundings which are calculated to produce or to develop this disease.

My friend, Dr. Cohn, a physician in Breslau, the metropolis of Silesia, having 33 schools, in which, on an average, 10,060 children are instructed, found, upon careful examination of all the pupils, that of this number one thousand and four, or *ten per cent.* of all the children, were near-sighted—a fearfully large percentage!

He further found that *no school* was free of short-sighted pupils, and that the number increased, and the degree of the disease grew more intense from the lowest to the highest class in each school.

He showed, moreover, that out of the entire number only 28 had inherited their short sight, that is, the father or the mother of only 28 out of 1,004 children were near-sighted. This small number proves that hereditary causes must be left out of all consideration; and that the increase of the disease, and, in the great majority of cases, its origin, are entirely due to the influence of school life.

How, therefore, ought the seats and the desks to be constructed, and in what manner should the school room be lighted in order to prevent the spread of this evil?

According to experiments made by Dr. Cohn and Dr. Fahrner, and repeated and verified by me, the seat should never be higher than the length of the child's leg, from the knee downward. According to measurement, this is two-sevenths of the height of the entire body.

In the second place, the difference in height between the desk and the seat must always be equal to the distance of the elbow from the latter, the arm hanging loosely down. This distance amounts to one-eighth of their size in the case of boys plus one inch; it amounts to one-seventh of their size in girls.

In the third place, the *horizontal* distance between seat and deskboard ought either to be equal to zero, or, which is preferable, the inner margin of the desk ought to extend about one inch beyond the external margin of the seat. By this means the pupil is enabled to take hold of the book without bending his body forwards and approaching his eyes too closely to the letters.

The deskboard should have a breadth of 18 to 19 inches, three of which occupy a horizontal and 15 to 16 an inclined position; the inclination should be equal to about 2 inches.

The proper distance at which the writing or reading matter is to be from the eyes of children, is from one and a quarter to one and a half feet.

The seat ought to have a width of ten inches at least, and should be supplied with a back high enough to act as a support to the lumbar vertebrae, that is to say, to the loins, *but not higher*.

It is important that the feet of the children touch the floor; for no child, especially when writing, can let its legs dangle in the air for an hour or more. In order to secure a firm foothold it will instinctively bend its leg backward, and will consequently bring its body just as far forwards as it endeavors to place its feet backward in order to reach the floor with its toes; hence a position is assumed which, as has been said, is productive of short sight.

All seats which are too high should therefore be supplied with footboards, the width of which need not be above 6, although 9 inches are preferable, and should be placed below the front margin of the seat in such a manner that even children of the lowest classes can conveniently place their entire feet upon them.

In order that children can stand up while reciting and so forth, a contrivance ought to be made by which the desk-board can either be pushed back or turned over.

The desk must be just so high as to let the elbow rest upon it without displacing the shoulder.

The next question which presents itself is, How ought the school room to be lighted?

The windows ought always to be arranged in such a manner that sunlight enters from that side which is not hurtful to the eyes of pupils, while at the same time it illuminates their work sufficiently. Skylights are admirable in this respect, and, in addition, windows situated to the left of the pupils are advisable. They should never be situated on the right; as in that case the hand casts a shadow on the portion of paper which is to be written upon, and consequently necessitates a close approach of the eye, which position, as has been shown, is favorable to the production of short sight. The windows must be of sufficient height and width to give to each pupil his percentage of light.

A room in which 60 to 80 children are to be placed must

mediately it ceases, the field surrounding the wire immediately contracts, producing a current in the same direction as the battery current, and so prolonging its effects. Hence the spark. The effect of the soft iron core in the center of the bobbin is simply to intensify the field, and consequently the effects.

These currents are met with when cable core is coiled, as in a tank, especially when sheathed with iron wire. They then constitute what is termed "false discharge." Theoretically these currents are formed in straight wires, but to such a small amount as to be inappreciable; and even in theory and disturbances created in such a wire could be traced rather to Static than to Dynamic Induction. Distinct evidences of disturbance due to the latter cause are, however, found in telegraph wires, due to their proximity to the earth. They can be entirely eliminated in rheostats, etc., by double winding—i. e., winding half the wire round a bobbin in one direction and half in the other. Any currents set up are therefore opposed and therefore neutralize each other; but it is impossible to have recourse to such an expedient in electro-magnets, inasmuch as for the same reason we can obtain no magnetic effect.

MAXIMUM AND MINIMUM EFFECTS OF ELECTRO-MAGNETS.

An extended series of experiments was undertaken by the author of the Paper to ascertain the conditions necessary to obtain the maximum and minimum effects in electro-magnets. For this purpose, a Stroh's relay was so arranged that, in its normal condition, it allowed a permanent current to transverse the coil or coils of the electro-magnet under examination; but that immediately a key was depressed, a second battery current traversed the coils of the relay, thereby throwing the lever over against the opposite limiting stop, which action at once broke the circuit of the original current, and placed the magnet in direct circuit with a Thomson's galvanometer, so that any extra currents would be observed upon the latter instrument. The following were the results so obtained:

Regarding the current from a single bobbin and core as the unit, two bobbins and two cores (separate) connected in series gave a current of.....	17
The two placed end to end so as to form one long core, surrounded by two bobbins connected in series, gave a current of.....	184
The two cores being connected at the base by a bed or plate of iron, so as to resemble a horse-shoe magnet, the connections remaining the same, gave a current of.....	304
When connected at the base by a cross-piece and at the extremities by an armature, the connections as above gave a current of.....	2238

No increase of the length or size of the armature showed any visible variation from the last results.

The general results may be expressed as follows:

The nearer the form of the core approaches to that of a ring or closed curve of iron, and the greater the surface of iron surrounded to given thickness with wire, the greater the strength of the extra current.

If in the last-mentioned experiment the mechanical arrangements remained the same, but the coils were connected "for quantity," the result fell as low as 502. The following were the results obtained with the different relays in general use:

Siemens'.....	1688
Stroh's ordinary.....	1621
Stroh's polarized.....	1500
Thieler's No. 1.....	279
Thieler's No. 2, the base piece having been removed.....	26

STATIC AND DYNAMIC INDUCTION.

The effect of Static Induction in the case of telegraph lines is to delay the appearance of a current, and to prolong its duration. Time is required for the charge to dissipate itself, and reduction of the speed of working is the result. We have already shown that Dynamic Induction tends to produce similar effects. So that if the one can be made to counteract the influence of the other, the result of placing electro-magnets in a telegraph line will be a gain instead of a loss in speed.

When an electro-magnet situated on a line of telegraph is shunted by a rheostat or "simple shunt," that rheostat tends to become the path by which the extra currents are discharged, and so prolonged is the magnetization, that if the circuit be closed and opened with any degree of rapidity, the armature sticks or remains permanently attracted—a principle which has been employed by Mr. F. Higgins in double current translation. This retardation is at its maximum when the resistance of the shunt equals that of the electro-magnet. But should the shunt be a second electro-magnet, or, in other words, an "electro-magnetic shunt," then the extra current formed in it opposes that formed in the electro-magnet, and both send a current back into the line. The current from the shunt, however, may be so exalted as to neutralize and even overcome that formed in the electro-magnet itself. So that by a properly arranged electro-magnetic shunt, the magnetic retardation in the electro-magnet itself may be reduced to a minimum, while a current is sent back into the line immediately after each signal, thus tending to increase the speed at which that line can be worked.

Space prevents our taking even a brief glance at the numerous and varied uses of shunts, both to electro-metric and telegraphic purposes, save to mention the fact that so important has become their assistance, that no one who has ever given the matter his full attention can ignore the benefits which accrue from their employment. No delicate tests can be made without their aid, and of such growing importance is the part likely to be played by them in the field of practical telegraphy, that it is well-nigh impossible to over-estimate the benefits which may be derived from their employment.

At the close of the lecture, which, although extending over an hour and a half, had been listened to most attentively by a crowded meeting, a hearty vote of thanks was, on the motion of the President, unanimously accorded to Mr. Preece.—*Telegraphic Journal*.

AN ELECTRICAL CLOCK SETTER.

Messrs. Barraud and Lund, of Cornhill, are now putting on to the clock of the Banker's Clearing House a very simple electric control. A quadrant of a circle is cut through the figure XII, the center being above the quadrant. Through this project two studs, suspended from the center of the cir-

cle by two levers, which ordinarily hang wide apart, one at two minutes to, and one at two minutes past, the hour, both free of the minute hand, but so attached to the armature of an electro-magnet that they fall down sharply when connection is made and meet exactly at XII. They are long enough to engage the minute hand, and will do so every hour by the help of a current from Greenwich—granting that the clock keeps time within two minutes per hour, or forty-eight minutes per day! This will act on the white minute hand, which is permanently fixed five minutes in front of the black minute hand, the bankers being allowed that grace. The control is patented.

ELECTRICAL PHENOMENON AT SEA.

CAPT. HEDDERWICK, of the steamship Victoria, belonging to the Anchor Line, at Glasgow, from New York, reports that on the 18th February, when on the eastern edge of the Grand Banks, a terrific gale from the W. S. W. was encountered, and during the height of the storm there appeared on the trucks, yards, and stays large balls of fire of a phosphorescent nature, strung at intervals of one or two feet, and giving the ship the appearance of being decorated with Chinese lanterns, only the lights were far more brilliant. They settled on the vessel like a shower of meteors, and disappeared almost as suddenly as they appeared—an occasional one dropping from the yards and bursting with a loud report. One of them fell and burst almost in the face of the chief officer, but beyond dazing him for a moment, it caused him no inconvenience.

ROYAL ASTRONOMICAL SOCIETY.

The January meeting was held at the Society's rooms, Burlington House; William Huggins, Esq., D.C.L., President, in the chair.

Mr. Dunkin drew attention to a paper containing an Ephemeris of the Satellites of Uranus for 1877, and remarked that astronomical observers were greatly indebted to Mr. Marth for the labor he bestowed in calculating these Ephemerides. They occupy but little space when printed, but take considerable time to prepare.

Mr. Dunkin also called attention to an important paper by Mr. Knott, which will probably be printed in the memoirs of the society. It contains a very large number of micro-metrical measures of double stars which Mr. Knott has been some years making and preparing for publication. The measures have all been made with an 8-inch achromatic telescope, which was formerly the property of the Rev. W. R. Dawes.

A paper by Prof. Harkness on the theory of the horizontal photoheliograph was read. The instrument consists of a heliostat and a long-focussed object-glass; the photographs are taken in the primary focus without any distortion, such as that which is met with in photographs taken with the Kew heliograph, an instrument in which the image is enlarged by secondary magnifiers. When the sun's center coincides with the center of the field, the allowance to be made for this distortion is troublesome. But when the center of the sun's image does not coincide with the center of the field, the calculations necessary to deduce the actual distance between any two points upon the sun's disk, from their apparent distance as measured on the distorted photograph, become very complicated. In making use of the horizontal photoheliograph a glass plate ruled with cross lines is placed over the sensitive plate during exposure, so that any shrinkage of the collodion film can be accurately determined, and a plumb-line is suspended so that it can be photographed on the plates, and affords a fiducial line from which the north point and other angles of position may be determined. The paper is one of considerable importance, and will probably be printed in the memoirs.

Mr. Brett read a paper on the bright ring seen round Venus during its passage across the sun's disk. He said, if, in addition to a burnished reflecting surface the existence of which I think I have already proved, we suppose Venus to have a translucent envelop of great density, all the elements for a complete explanation of the mystery of the bright ring seen around Venus when at transit are at hand, or, at all events, it is possible to produce a very similar phenomenon experimentally. A tube in which was suspended the bulb of a thermometer filled with mercury was shown by Mr. Brett upon the table. A beam of light was passed by a collimating lens in parallel rays past the bulb, and the appearance to an eye placed at the further end of the tube was that of a black disk upon which a ring of faint light encroached. Mr. Brett thought that this offered an analogy to the actual condition of the planet, which he assumed must be surrounded by a shell of vitreous matter. At superior conjunction of the planet we should see merely a small circular image of the sun, such as that which had been described by Mr. Christie. In the course of the planet's progress in its orbit, this image would, he thought, become longer and narrower; at greater elongation it would be crescent-shaped, and as the planet approached to superior conjunction, the bright patch of reflected light would, he conceived, extend further and further in latitude upon Venus, till at the time of superior con-

junction it would be represented by a ring of light all round the body of the planet. No other assumption would, he believed, account for the bright ring of light around the disk of Venus when on the sun, which was described by many of the observers as brighter than the sun's disk itself. He further wished to suggest that at the next transit of Venus the center of the planet should be carefully observed, in order to discover whether an image of the earth could not be seen upon it reflected from the vitreous surface he had just described.

Mr. Ranyard said that he would endeavor to explain how the bright ring of light, which had undoubtedly been seen by several observers around the body of the planet just before it entered upon the sun's disk, might be explained without making the assumption as to a vitreous envelop which Mr. Brett had suggested. If AB (Fig. 1) be the body of the planet, and SE the course of a ray through the upper part of the planet's atmosphere LL', we should expect to find its direction very little altered by refraction, while a ray passing through the atmosphere lower down (S'E') nearer to the planet's surface would be considerably bent. If the refraction of the atmosphere of Venus were equal to that of the earth's atmosphere, a ray passing low down, so as to graze the limb of the planet, would be refracted so as to make an angle of more than a degree with its former course. An observer in the direction E' looking at the limb of the planet before it comes into contact with the sun's limb, would, at a certain height in the planet's atmosphere, corresponding to the height where the deviation of the ray is sufficient to bring the sun's nearest limb into view, see a brilliant point of light corresponding to the sun's nearest limb. Lower down in the atmosphere of the planet the deviation of the ray would be greater, and more distant parts of the sun's body would be seen refracted through the planet's atmosphere. Only a few miles below the height where the upper limb of the sun is brought into view by refraction, we should expect to find the density of the planet's atmosphere increasing, so that the lower or more distant limb of the sun would be brought into view. The interval between these two altitudes would, to an observer on the earth, appear brilliantly illuminated with the sun's transmitted rays. In other words, the whole disk of the sun would be seen compressed into a line of light about the further limb of the planet. Without, therefore, making the extraordinary assumption as to the vitreous envelop about the planet assumed by Mr. Brett, it was possible to account for the observed phenomenon. The course of the ray in the glass envelop of the thermometer bulb could not correspond with the course of the ray in the planet's atmosphere, even supposing the surface of the planet to give the specular reflection assumed by Mr. Brett—for within the glass envelope of the thermometer bulb the ray would be reflected backwards and forwards from one surface to the other, so as to encroach upon and illuminate the dark hemisphere; but we cannot conceive of such reflection from within the upper surface of the atmosphere of Venus—for the intensity of a reflected ray depends, as is well known, upon the difference of refracted indices of the two media on the either side of the bounding surface from which the reflection takes place, and in this instance the intensity of the reflected ray would be almost nil.

Captain Noble said that Mr. Brett's assumption as to the vitreous envelope was of a most artificial character. He could hardly conceive that Mr. Brett seriously asked them to believe that we have in Venus a great thermometer bulb hung up in the heavens.

Mr. Christie said he thought that Mr. Brett's explanation of the ring round Venus was of great importance. At first he had not been able to see how specular reflection would enable one to account for the ring of light round Venus being brighter than the sun itself, but, on looking at the matter a little more closely, he had seen how clearly the assumption enabled all the phenomena to be explained by the ordinary laws of optics. Disregarding the hypothesis about a vitreous atmosphere, which was not essential, though he thought it was quite possible, he would discuss the question as if there were specular reflection from the surface of Venus, and refraction by an atmosphere. A ray from S (Fig. 2), which we will suppose is the north limb of the sun, would be reflected from the surface of the planet, and then refracted so as to enter the eye of an observer at E. A ray from S' would be reflected at another part of the planet, and then refracted, so that its ultimate course would be parallel to the ultimate course of the first ray from S. We should thus have light from the whole breadth of the sun gathered into a luminous ring apparently about the edge of the planet, and the light would consequently be very much condensed, and would, therefore, appear to be very much brighter than the light of the sun itself.

Mr. De la Rue asked Mr. Christie how he would account for the bright light seen around the limb of the moon on the sun's disk during a partial eclipse. It certainly could not be supposed that the surface of the moon was smooth enough to give specular reflection, or that there was sufficient atmosphere about the moon to bend the rays after reflection as he had described.

Mr. Christie said that no doubt the two phenomena could be accounted for on the same theory, but he should require a few moments' notice to consider the matter.

Mr. Neison said that there was certainly no specular reflection from the surface of the moon, and he thought, with regard to the passage of the ray past the limb of Venus, it was much simpler to assume, as Mr. Ranyard had done, that there was only a refraction in the atmosphere instead of a reflection and a refraction.

Mr. Ranyard said, with regard to the line of light which had been spoken of as existing round the moon's limb, there can be no doubt as to its presence on the photographs of partial phase eclipses. The line was observed over and over again in 1860; Mr. De la Rue and the Astronomer Royal had both noticed it, and referred it to an effect of contrast. After the 1869 eclipse in America Dr. Curtis noticed the band of increased brightness along the moon's limb in the partial phase photographs taken at Des Moines, and he had made some interesting experiments upon them, which showed that the band of brightness had an actual existence and was not merely due to contrast. He placed the negatives over a piece of paper on which were dots of various degrees of blackness, and he found that, on moving the negative over the paper, the increased opacity of the collodion at the part corresponding to the bright band was such that dots could not be seen through it which were distinctly visible through the collodion film of other parts of the sun's disk. Such a bright band was to be seen, if carefully looked for on every slightly over-exposed photograph, around every dark object that abutted on every bright field. He thought, however, that possibly, in the case of Venus, the bright band seen around the photographs of the planet when on the sun's disk might be due to the combined effect of the two causes he had referred to.

Captain Abney corroborated Mr. Ranyard as to the photographic origin of the bright band along the moon's disk in