

the latter is diffused over the whole of the rubbed bar in every pass, and so not only appears over its totality, but remains attached to it.

In these experiments I used two bars, of which the rubbed one was eighteen inches; the rubber, rather larger and stouter, twenty-four inches long. Let us now examine the process of rubbing, first upon the rubbed bar, then on the rubber; and in the first place with regard to the odic incandescence, and afterwards to the odic flame.

414. A.—*Odic incandescence of the rubbed bar.* I laid a steel bar, which was only weakly magnetic, upon a table, in the meridian. It possessed weak odic incandescence in the dark, so that its northward half seemed to have merely gray instead of blue light, its southward half only whitish-yellow instead of yellowish red, both opaque and dull.

I laid the rubber, westward of the former, in the parallel, upon the same table, and moved the northward poles of both towards each other, in such a manner that the two magnets enclosed a right angle between them. Then I began to do exactly as one does when wishing to rub one bar with the other, only with the distinction that I brought both bars into the horizontal position, while it is usual to bring them together in a vertical plane, which might not be exactly the same thing in the essentials of the matter.

The behaviour was as follows :

a. First, on contact of the two negative poles, the northward pole of the rubbed bar appeared blue odically incandescent over half its length toward the south; the southern, somewhat shorter half, red incandescent.

b. When the rubber had been moved a quarter of the length along the rubbed bar, the same condition appeared, but now almost three-fifths of its northern part were blue, and only two-fifths remained red at the south.

c. When the rubber reached the middle, the blue incandescence had grown to three-fourths of the rubbed bar; in

another experiment, however, in which the latter already possessed some magnetic strength from former passes, the blue northern incandescence terminated at the middle and the red, the southward began thence.

d. The rubber, advanced three fourths, now reached the red odic incandescence of the rubbed.

e. The rubber arrived at the southern end, the blue appeared to have become shorter, and carried back one half of the length of the rubbed bar, and the red increased at the other end. The red had now grown much more luminous and intense.

415. B.—*Odic flame of the rubbed bar*; and first, the

1. *Blue northward flame*, which was originally weak, and only two inches long.

a. When the northward poles of the rubber and rubbed were brought into contact, this blue flame vanished entirely.

b. When the rubber had advanced only two-fifths of an inch along the rubbed bar, the blue flame again made its appearance on the latter, at first only two-fifths of an inch long.

c. The rubber advanced one quarter; the blue had increased to about an inch and a half long.

d. The rubber in the middle: it had elongated to nearly two inches and a half.

e. The rubber advanced three-fifths: it had risen to three inches.

f. The rubber arrived at the southward extremity of the rubbed bar: the blue flame of the northward end attained its maximum, namely, five inches.

2. Now the *red southward flame*, which originally was only about an inch and a quarter long.

a. When the northward poles of the rubber and rubbed were brought together, the size reached three inches, which was its maximum.

b. The rubber arrived at one fourth the length of the rubbed bar : the red flame appeared only two inches long.

c. The rubber, advancing from north to south, and arrived at the middle of the rubbed bar ; the red flame had diminished to a little more than one inch.

d. The rubber advanced to three-fourths : the red flame diminished to four-fifths of an inch.

e. The rubber at the southward pole of the rubbed bar : all red colour had disappeared.

The course of development in the red southward flame was thus exactly opposed to that of the blue northward flame.

We now pass to the rubber.

416. *c.—Odic incandescence of the rubber.* As it lay originally, and before the contact with the rubbed bar, in the magnetic parallel, it was bluish incandescent in its negative northward half, and reddish in its positive southward half ; the two halves were about equal in size.

a. When the northward poles of the two bars (as above stated, forming a right angle in the horizontal plane, since the rubbed bar lay in the meridian) were brought in contact, there appeared at the point of contact of the rubber, which was originally blue, a small patch of red about four-fifths of an inch long ; further up it was blue incandescent for about six inches ; then followed a length of two inches of gray,—that is, a weak indifferent point,—and beyond this a red incandescent tract, which occupied all the rest of the bar ; therefore about seventeen inches. It is striking, and worthy of note, that in this, the stronger of the two magnets, the odic polarity was nevertheless reversed at its northward pole a certain, although but a short, distance from the rubbed bar, and blue changed into red, so that a series of patches or zones appeared upon the rubber ; its northward polarity was thus enclosed between two southward polarities. There

was consequently the commencement of a triple condition in the rubber.

b. As soon as the rubber had advanced but about two-thirds of its own diameter, that is about two-thirds of an inch, along the rubbed bar, so that it was no longer applied against it as in Fig. 17, but as in Fig. 18, the red terminal spot had disappeared from the rubber, but at the same time a blue coating, of the diameter of the rubbed bar, was formed, which then, with the fur-

ther advance of the rubber, grew up into the little blue flame of *B a*, and then into a larger flame. As soon as this terminal red spot disappeared, the rubber was only divided into two fields of odic incandescence ; the blue one of its northward half, and the red of its southward.

c. Advanced to a quarter of the rubbed bar : the blue part of the rubber amounted to two-fifths, the red to three-fifths of its length.

d. Brought to the middle : the blue amounted to somewhat more.

e. Carried three-fourths of the distance over the rubbed bar : the blue share made three-fourths, the red only one-fourth of its length.

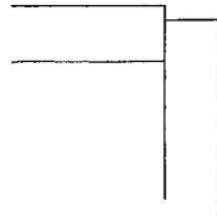
417. *d.—Odic flame of the rubber.*

Its blue northward flame, originally four inches long, was extinguished by the contact with the rubbed bar, over which this pole passed : we have therefore only to examine its southward flame, the red one. In all these experiments it lay as has been stated in the parallels, its southward pole turned toward the west.

FIG. 17.



FIG. 18.



- a. The two northward poles being brought together, the southward flame of the rubber appeared three inches long.
- b. The rubber advanced to one fourth of the rubbed bar: the red flame was shortened and brought to two inches.
- c. When the rubber arrived at the middle, it bore a flame only an inch and a quarter long.
- d. When the rubber had passed over three fourths, its flame rapidly increased in strength again, and rose to three inches.
- e. When the rubber had reached the southward pole of the rubbed bar, its terminal red flame attained its maximum; namely, a length of nearly four inches.

When I now made a movement with the rubber out of the parallel, into the meridian of the rubbed bar, and brought it into straight line with it—the north pole of the rubber in contact with the south pole of the rubbed bar, so that the latter was made to have twice the length—both the northward flame of the latter, and the southward of the former, increased to double their original length; in accordance with experiments and laws already unfolded, § 401. These laws will be seen to declare themselves in all places throughout the whole series of these paragraphs.

418. A further application of these occurs in the *preparation of horse-shoe magnets by rubbing*; to which we now come. I used as *rubber* a strong five-layered horse-shoe, and, as the rubbed, a one-layered horse-shoe, which had in great part lost its magnetism. The manner in which I proceeded consisted simply in this: I laid the five-layered rubber upon the table in such a manner that both its poles projected over the edge, and its curvature was turned toward the middle of the table. The horse-shoe was heavy enough to remain motionless in this position during the passes, and so strong that it held the single-layer-rubbed magnet fast in any position; this was applied to its poles. I held the single horse-shoe vertical, with the curvature constantly di-

rected downwards, and the poles upwards. The single magnet had originally and independently in the dark (that is, to the sight at that time of Josephine Zinkel), a little blue flame of about two-fifths of an inch high on its northward pole, but only a reddish smoke on the southward. The five-layered horse-shoe had a northward flame a hand's length, and a southward a finger's length. Both steel magnets were luminous, on the one side with bluish, on the other with yellowish-red odic incandescence; the smaller duller, the larger incomparably more vivid. This incandescence was almost imperceptible at the curvature, and increased continually to its greatest intensity at the poles.

I began with applying the curvature of the single magnet to the two poles of the five-layered, friendly, unlike poles upon each other; it was immediately held fast in the upright position. The result was, that

419. A.—*The odic incandescence of the rubbed magnet* (the single horse-shoe) appeared in greater brightness at the curvature, (*a*) distinctly separated into two halves, into a red and a blue, the first lying on the negative, the second on the positive pole of the rubber; that, moreover, both the limbs of the rubbed magnet at the same time *came into stronger incandescence*, and of the same colours in the said sides, but with increased strength of luminosity. When I now drew the single magnet down upon the rubber, till poles were applied to poles, the incandescence of the curvature increased in both colours, which met in the middle, and passed into each other: on the other hand, the incandescent light was weakened on both limbs, became duller and grayer; but all this did not alter the colours of the odic incandescence; the northward limb of the rubbed magnet always remained blue, the southward limb red. The odic quality thus remained equally negative in all these cases—namely, first, when the single magnet was free; secondly, when its curvature was applied to the five-layered, north to south; and

thirdly, when pole was applied to pole in like manner. But the quantitative distribution of Od and magnetism did not remain the same.

420. b.—*The odic flame of the rubbed* (single horse-shoe). When the curvature of this was applied to the five-layered, and it thus closed it like an armature, the little blue flame of its northward pole, which had been only two-fifths of an inch high, rapidly grew to five inches long, and the reddish smoke of its southward pole simultaneously changed into a red flame one to one and three-quarters of an inch long, with dense yellowish-gray smoke above it. In the succeeding experiments, in which the single horse-shoe had become magnetically charged by the rubbing, and its independent odic flame was two and a half inches long, this rose on the application of the curvature to the rubber to nearly five inches on the blue side, and then to two and a half on the red.

When I now drew the rubbed single magnet slowly down the rubbing five-layered, its polar flames were gradually diminished; that on the southward pole soon vanished, that on the northward decreased, and became duller, while the curvature began to get brighter. When the poles of both magnets were applied together, all the flames were extinguished.

In these processes, in whichever of their different phases they might be examined, whatever part of the rubbed magnet was applied to the poles of the rubber, every part of each limb retained its colour. The halves of the curvature, the limbs above and below the part rubbed, the odic flames over the poles, the sparks, streaks, and fiery mist around the limbs, all without exception remained blue on the one, red on the other limb, during the whole procedure. In no case did polar quality, but only the intensity of the light—that is, the odic quantity—suffer modification from the rubber.

421. c.—*Odic incandescence of the rubber*, the five-fold horse-shoe. As soon as the curvature of the single horse-shoe was laid before it, and connected its poles, the odic incandescence was heightened in the curvature of the five-fold magnet, and became more brilliant ; but the light of the odic incandescence of its two limbs—and still more of its two poles—became weakened in proportion, the northward limb gray-blue, and the southward yellowish-red. Here, also, the curvature possessed both colours, which passed suddenly into each other in the centre. When I drew the rubbed magnet slowly downwards, the two poles of the rubber became gradually more incandescent. They attained their greatest brightness when all the poles were applied together ; but still this did not come up to the brightness of the curvature. The odic incandescence of the rubbing magnet thus took an almost converse course from that of the rubbed, at the same time agreeing with the general rules already known.

As soon as I pulled off the rubbed magnet from the poles of the rubber, the curvature and limbs of the latter decreased in incandescence, but its poles increased in luminosity. No odic flame of the rubber can here be subjected to examination ; since, as neither of its poles were ever free, but always applied to the rubbed magnet, no odic flame existed.

422. An experiment of rubbing horse-shoes with their like poles together, in the manner adopted with the magnetic bars mentioned at § 403, gave similar results, and served to confirm the former. I laid the northward pole of the single horse-shoe on the northward pole of the five-fold one ; the southward poles in like manner together, at right angles, as before, and now rubbed from the poles toward the curvature : the poles having been previously reversed, when the pass was also reversed, the effect should coincide with the preceding one. The behaviour of the odic incandescence here was as follows :—As soon as the corners of

the like poles came in contact, a little patch of red odic incandescence, only two-fifths of an inch long, appeared on the blue northward pole of the rubbed single magnet ; and on the red southward pole of the same a similar little patch of blue odic incandescence, likewise two-fifths of an inch long. As soon as I had pushed the single magnet two-fifths of an inch forward, these spots of light both vanished, and the northward pole became blue, the southward red, exactly in their regular way, and they remained so during the remainder of the passage of the magnet. These two terminal patches of reverse odic incandescence are the same that we became acquainted with on one side at the negative poles of the bar magnet—a reversal of the polarity of one pole by means of the other of like quality. The single magnet was thus many-poled at the first moment ; two-fifths blue, then the whole length of a limb red, the other limb blue, and lastly, two-fifths red at the other extremity.

423. *The force which prevails in these objects is consequently never uniformly distributed; not even when the magnetic circuit appears closed.* The state of continuity, as we have seen above in the intermixture of the poles in the magnetic flames, § 404 to 407, is probably never perfect ; and hence, leaving out of the question the disturbances of equilibrium through the influence of terrestrial magnetism, these constant inequalities in the distribution of the force. New examples of this are afforded by some investigations on the

424. *Influence of the armature on the phenomena of the odic flame of magnets.* We have seen above, that the armature, applied to the horse-shoe, weakens the odic incandescence of this, while at the same time it heightens that of the curvature. But the odic flames, according to all the sensitives who possessed the power of seeing these lights, were immediately extinguished when an armature was applied to

a horse-shoe : observations particularly bearing this out are noticed in my journal on experiments, from Madame Kienesberger, Misses Winter, Dorfer, Friedrich Weidlich, the healthy Josephine Zinkel, Madame Josephine Fenzl, Baron von Oberländer, Professor Endlicher, Baroness von Augustin, and others.

425. When I applied the armature to the horse-shoe, low down, on the curvature, before the first of the above-named observers, in the darkened chamber, this, as was to be expected, had no particular influence upon the flames of the poles. But as I moved the armature slowly up along the horse-shoe toward the poles, keeping it always across the limbs, a continual weakening of the odic flame of both poles resulted, these always diminishing until I brought the armature to the poles, when the flames were wholly extinguished, and the armature covered them. When I proceeded in the opposite direction, that is, passing the armature gradually down from the poles to the curvature, a similarly gradual restoration of the odic flames of the poles resulted. The course was as follows : as the armature passed upward the beholder saw the polar flames at first become duller, the blue became grayish, while the red passed into a dull yellowish ; during this the length of the flames was gradually diminished. When it came to the middle of the limb and went above this, the reddish yellow of the southward pole disappeared, and now only a reddish smoke remained over it ; the diminished bluish northward flame was discoloured quite into gray. When it arrived near the poles, this was also extinguished and converted into gray smoke, and this finally vanished altogether when the armature was applied upon the poles. In the passage downward all these phenomena occurred in the reverse order : at first a gray smoke appeared at the negative pole ; then followed gray flame, next red smoke at the positive, after that the blue, and then the red flame, at first small, growing larger ;

finally, when the armature arrived at the curvature, all the original phenomena of the odic light were fully represented. The odic incandescence of the horse-shoe was originally very weak at the curvature, strong at the poles ; but, with the removal of the armature upwards, the curvature gradually became visible, and as the poles were rendered more dull in their incandescence by the advance of the armature, the incandescence of the curvature was, step by step, increased, till at last, when the armature covered the poles, it almost equalled the limbs and poles in brightness.

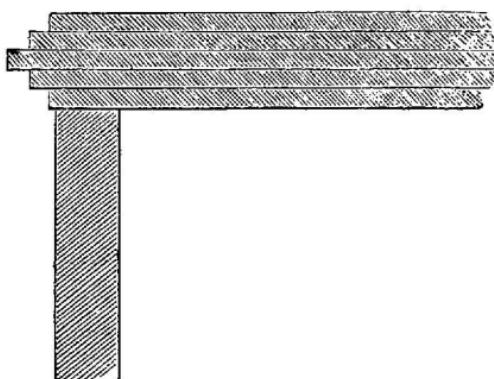
426. But the armature itself also gained and lost odic incandescence during this. When it lay upon the curvature it was grey and scarcely visible ; when it lay upon the pole it had become more strongly incandescent and coloured, on the side turned toward the northward pole of the horse-shoe reddish, on that toward the southward pole bluish ; at all the intermediate stages it possessed corresponding transitional luminosities : it was itself converted into an induced magnet, and bore the colours of odic incandescence regularly corresponding to this. But they were always rather duller than those of the inducing magnet poles. These phenomena explain themselves, if we in each case regard the part of the horse-shoe from the curvature to the armature as a piece cut off from the whole. The larger this is, the smaller remains the residuum of the limb ; the shorter, therefore, will be the polar flames remaining to it, and *vice versâ*.

427. I endeavoured to test *the conditions and effects of the armature upon the horse-shoe magnet during the pass*. This was done with Josephine Zinkel, in the opportunity afforded by the experiments just now discussed, with a five-layered rubber and a single rubbed horse-shoe, when under the above described conditions (§ 418, at the end), while the curvature of the rubbed magnet was attached to the poles of the rubber, and this was thus closed by it as by an armature ; the odic flames then blazed most vividly

above the poles of the rubbed magnet. I applied the armature to them; it adhered firmly, was converted into an induced magnet, with strong odic incandescence, the colours being opposed to those of the poles of the horse-shoe. The limbs themselves were considerably weakened in their incandescence, the negative blue became bluish gray, the positive red dullish yellow-red.

428. When I drew the rubbed horse-shoe down the rubber till their poles met and the armature was again applied to the rubbed magnet, as is shown in fig. 19, it in like manner became firmly attached, and was again converted into an induced magnet with stronger odic incandescence, but the *colours of the incandescence were now reversed*, no longer opposed to the colours of the poles of the rubbed horse-shoe,

FIG. 19.



but of the same colour as them, and therefore *opposed to those of the rubber*. From this it follows, that the armature was no longer within the influence of the rubbed magnet on which it lay, but had come under dominion of the rubber: and this not, indeed, immediately, but by means of the little tract of steel constituting the polar extremities of the rubbed horse-shoe. These must have been first converted into short induced magnets, and then, from these, was the armature changed into an induction magnet of the rubber. Here all these processes presented themselves quite clearly to the eyes of the sensitive, which the science that would hitherto make no use of the capacities of the sensitive, could only discover by tedious and uncertain methods.

429. The question now presented itself, *when and where*

does this remarkable reversal of the poles in the armature of the rubbed single horse-shoe take place? To find this out, I closed the five-layer with the curvature of the single horse-shoe, closed the upward directed poles of the latter with the armature, and drew it slowly down the rubber, allowing the sensitives to observe and describe the armature to me from time to time. When the single horse-shoe had passed down two-thirds of its length, so that only one-third stood above the rubber, the armature, which when first applied had been attracted very strongly, fell off of its own accord. I applied it again, but found that it did not adhere in the least, and the single horse-shoe had lost all attraction for it. This continued until I had drawn down the single horse-shoe three-fourths of its length. Then the armature again began to acquire attraction toward the poles of the single horse-shoe, which went on increasing as I drew it farther down, and was strongest when I applied it to the poles of the rubber. During this the behaviour of the colours of the odic incandescence was as follows: at first the armature was coloured oppositely to the single horse-shoe,—it formed an induction magnet of it. As I drew the single magnet downwards the intensity of the light and colours of the armature decreased, became duller, the colours more indistinct, confused; and when I had moved it down two-thirds, all the colour had disappeared from the armature; it now possessed only a dim uniform gray, like any other piece of iron. Thus it remained till I had passed it more than three-fourths down; from hence it again began to get brighter, then its two halves to acquire distinct colours, but now the reverse of what they had before; its red and blue were now no longer opposed, as before, to the rubbed single horse-shoe to which it was applied, but to the rubbing five-layered magnet, to the poles of which it had now approached. Thus the indifference point of the colouring coincided with the indifference point of the polar

attractions ; and these results beautifully support the parallelism of these two phenomena under common circumstances.

430. It is also found that in the condition of the armature, in which it has no attraction for the single magnet, and remains uncoloured in gray odic incandescence, the curvature of the same horse-shoe has also become light again on one side, but has only an uniformly gray luminosity. *Thus there appears to be a condition of neutralized indifference both above in the armature and below in the curvature*, when the single horse-shoe adheres at two-thirds to three-fourths of the length of its limbs to the five-layered rubber.

431. Once, in the condition of menstruation, when the sight of the observer was three or four times stronger than usual, she saw the single horse-shoe, which, from the repeated passes, was now in the magnetic condition, with a blue flame of six inches long at the northward pole, and a reddish of two inches and a half at the southward. When I now laid its curvature on the poles of the five-layer, friendly, unlike sides together, both the blue and the red flames at once increased about one-half. When I drew the single magnet downwards, its polar flames decreased ; and by the time they had come back to their original lengths of six and two and a half inches, I had moved down one-third of the limb ; in this position, therefore, *the effect of the rubber upon the odic flame of the rubbed magnet equals O* : the flames were thus brought into a certain equilibrium, that of the rubber upon the poles of the rubbed horse-shoe being removed, at least *in odic respects*. When I drew the single horse-shoe further down, to two-thirds of the length of its limbs, I arrived at the *point of magnetic indifference*, where the magnetic forces were removed from the poles of the rubbed magnet on to the rubber.

432. But the divergence between the *odic and magnetic*

activities, which manifested itself in these processes, was very remarkable. In the experiment just detailed (which was also repeated at various times, also that of the menstruating period), when the magnetism of the rubbed horse-shoe was = O at the poles, and the armature fell off, this was by no means the case with the odic flame. It was, indeed, depressed and diminished on the blue side down to one and a quarter inch ; and on the red, reduced to red smoke ; thus altogether brought down to about a fourth or fifth of its original and proper size, but not by any means destroyed as the magnetic attraction was. Nay, more ; when I drew the single magnet down three-quarters and more, and the colour of the armature lying upon it changed in such a manner that its side lying on the negative limb of the single magnet became blue (according to § 427), yet the residue of the odic flame remained permanently blue. This little flame decreased as I brought the poles of the single horse-shoe down to those of the five-layered, from one and a quarter to four-fifths, two-fifths, one-fifth, one-twenty-fifth, to the thickness of a sheet of paper, at last waving as a delicate blue mist over the negative polar extremity ; but always blue and blue gray down to the last moment, when pole joined pole, and all flame vanished entirely.

433. Here the *difference between the behaviour of Od and magnetism* comes strongly into view. While the negative magnetism of the northward limb of the single magnet was reversed above into + M, the flame attached to it remained blue, and persisted in — Od ; from steel which gave out + M, and induced — M in the armature in contact with it, issued the blue manifestation of — Od, unrestrainedly, so long as the armature remained off : *positive magnetism and negative Od may thus co-exist simultaneously in one and the same steel bar.*

434. As *electro-magnetism* is a means of producing odic incandescence in iron, (see above, § 374), so it is also of

calling forth odic flame, and this in an uncommonly high degree (§ 12). In the experiment just cited, and to which I refer for the sake of brevity, the healthy and imperfect seer of odic light, Baroness Pauline von Natorp, perceived on a large iron horse-shoe converted into an electro-magnet, not, indeed, flame, but an appearance of luminous vapour rising a hand's length high, in the dark. Madame von Tessendik detected the same subsequently in about equal degree. M. Pauer saw a luminous flame, from twelve to sixteen inches, like a mass of luminous vapour, upon each pole. Madame Josephine Fenzl saw flames ascend from both poles of the same electro-magnet, the stronger ten inches high, the negative more gray, the positive more yellowish. Baroness von Augustin saw at both poles a flame-like luminosity, about twenty inches broad, and almost of a man's height, ascending perpendicularly toward the ceiling of the dark chamber; their upper halves were blue, the middles brighter and whitish, and the lower parts duller again. They were unsteady, and passed above into clouds of smoke. Stephan Kollar, with a simple Simee's apparatus, at first saw only the negative pole, but with two pairs, both poles, flaming about twenty inches high, and with smoke ascending a long distance. The far more sensitive Madame Kienesberger saw a coloured flame of eighteen to twenty inches blaze perpendicularly upward on the negative pole, and on the positive a smaller red one of six inches, both vanishing into smoke. She described both flames as rather more unsteady than those of the common permanent magnet, and somewhat jumping, like the light of a tallow candle. This jumping, a constant alteration of size, a continual vibration between greater and less height, was doubtless caused by the varying quantity of electricity developed from the Simee's battery and conducted through the wire coil at different intervals; that is, by an ebb and flow in the inducing agent, depending upon inequality of chemical activity among the elements of

the battery. I must observe here---what I shall return to subsequently---that both the conducting polar wire, and the coil upon the iron horse-shoe, were enveloped in flaming appearances of odic light. And these flames were more luminous towards the poles, and duller towards, and at the curvature of, the electro-magnet. In the order of time she first saw odic incandescence ; then, after the lapse of more than a minute, sometimes two minutes or more, the flames were found at the poles ; at first grayish and weak, and then developing into colours as they increased. The reverse occurred when the voltaic current was interrupted : first the colours of the flames disappeared, then their gray shape became invisible ; at length the odic incandescence vanished. Professor Endlicher saw an electro-magnet decked with vertically ascending emissions of light at both poles, forty inches high, moving unsteadily, variously coloured, and sending up dimly luminous smoke to the ceiling, which appeared lighted up by it. M. Delhez saw flames almost as large, but he could scarcely distinguish colours ; he found the columns of light duller (red) below, brighter (yellow) in the middle, and duller again (blue) above. Wilhelmine Glaser saw the same electro-magnet furnished with flames sixty inches high at its poles. Smoke ascended from these up to the ceiling, and the flames displayed the most brilliant colouring,—blue prevailing at the northward pole, and reddish yellow at the southward. The odic flames of the electro-magnet were observed more accurately and more frequently by Josephine Zinkel. Under the circumstances above described, she saw flames forty inches long upon the northward pole, and about thirteen inches upon the southward, both coloured ; the first with predominance of blue ; in the second more red. She described the flaming appearances upon the polar wires, the coil, the voltaic battery, and the order of succession of the appearance and disappearance of these phenomena, always exactly like Madame Kiencsberger.

She once found, however, five or six minutes necessary for the complete development of the odic flames ; another time she declared that they did not unfold to their persistent size until after about ten minutes. In the last experiment with her I had used a Smee's apparatus, with five square feet of zinc and silver surface. The columns of light ascending from the two poles astonished the observer with their beauty and size. The negative flame was higher than a man ; the positive, of an arm's length. They constantly trembled and leaped up and down, like a monstrous candle flame, decorated with the most beautiful prismatic colours. Sparks flew off in streams into the smoke, and off to the sides. The smoke came in contact with the ceiling, and was diverted by it.*

I showed to Miss Reichel a Schweigger's multiplier in the dark, sending a weak voltaic current through the coil. She saw the wire, and then the steel needle, become odically incandescent, and next a delicate stream of odic flame break out from the points of both its poles, flowing onwards in the direction of their length on each side ; but, as the case was too narrow to allow of their flowing straight out, they ran against the sides, turned upwards on them, then again met the glass cover, were diverted once more, and, finally, flowed over the surface of the glass till they vanished from the eye.

435. The part which the *electrical atmosphere* plays in odic phenomena, we already know, from the odic incandescence (§ 370), to be influential ; but in the flaming appearances it asserts especial importance. Miss Reichel found the flames increase whenever I brought a magnet

* Many remarkable corroborations of the facts in this paragraph have been witnessed, at my house, by several persons who have seen my experiments upon at least twenty somnambules with Smee's batteries, electro-magnets, and helices.

within the electrical sphere of action. Miss Atzmannsdorfer showed me the same on many occasions ; the account was already different from these two. M. Hochstetter saw the usually twelve-inches high flame of the 9-layer magnet rise to twenty-four inches. Miss Sophie Pauer saw the same 9-layer magnet triple its odic flames in the electrical atmosphere, in some degree illuminating the ceiling. M. Fernolendt saw the sixteen-inch flame of the same rise to thirty-six inches, and throw light upon the ceiling. Wilhelmine Glaser saw the flame of a bar-magnet twenty-five inches long, when the negative pole was brought within forty inches of the conductor of the electrical machine, become four times as long,—namely, increase from three inches to twelve. She observed the common flame of sixteen inches upon the 9-layer magnet ; when I brought it into the vicinity of the electrical conductor, she discovered an elevation to sixty-four inches—thus to the height of a man, with illumination of the ceiling. Madame Bauer saw pretty nearly the same phenomena under the same circumstances. Baroness von Augustin, when the 9-layer magnet was brought with its negative side to within about twenty inches of the electrical conductor, saw its blue flame enlarge to twice or three times the size, and light up the ceiling of the room. I laid the 9-layer horse-shoe before the girl Zinkel, in the dark chamber, at a distance of forty inches from the conductor of a powerful electrical machine, which I set in motion. It stood with the poles turned upwards, and the limbs equidistant from the conductor. The odic flame was originally four inches on the negative pole, and about one and a half on the positive ; the former now rose to twenty, and the latter to six inches. The size of both was thus increased from four to five times. The colouring was rendered more vivid in the blue, and bedimmed in the red.

As soon as I stopped turning the plate of the machine, the odic flames sank down to their previous size. This was frequently repeated at different times.

436. After the Baroness von Augustin had seen the great increase of the blue magnetic flame on the negative pole in the vicinity of the charged conductor, I turned the 9-fold horse-shoe round in such a way that the southward pole was towards the conductor, both poles pointing upwards. In a short time she no longer saw reddish odic flame over it, but blue. In this arrangement the odic colours of the two poles were reversed. When, in other experiments with Josephine Zinkel, I turned the blue, negative pole of the 9-fold magnet to the conductor, so that the positive red flame was turned away, the latter appeared grayish red, the former brilliant blue, and developed prismatic colours, above which smoke and sparks ascended almost to the ceiling. The flame was so brightly luminous that the beholder could not conceive how it was that I saw nothing of it. But when I turned the magnet round, so that the red-flaming positive side was turned towards the positively charged conductor, while the blue, negative side was turned away in the opposite direction ; the former, the red, first quickly became dull gray, and then, in half a minute, changed to blue, whilst the opposite blue upon the negative pole became violet gray ; the blue of the former then increased, and that which had become reddish gray, shrank away : thus here, as in the odic incandescence (§ 371), there was a *reversal of the odic polarity* of the odic flame, without this being accompanied by any simultaneous reversal of the magnetic polarity. The electrical polarity here dictated the law ; it reversed the odic, but was not capable of reversing the magnetic polarity. When I now reversed the electricity, and charged the conductor negatively, I obtained the same, only correspondingly reversed, manifestations of odic light : now the red flame turned

toward the conductor became exalted, and when I turned the negative side of the magnet to it, the blue was changed into red, the — Od was converted into + Od, and this at the negative pole of the magnet.

437. To work out these facts more clearly, I repeated them with the application of bar-magnets instead of horse-shoes. Two bars, one twenty-six inches, and the other six inches long, were placed, unisolated, on the parallels, lying upon a table at a distance of forty inches from the conductor. When I turned the blue-flamed poles to it, the blue flames flowing from these grew to three or four times their length, stretching out towards the positive electrical conductor; when I turned the red-flamed poles to it, the flame first became bedimmed and weakened, and then, after a contest of the dynamics here in action, rendered visible by lambent flames playing up and down upon the bars, it was converted into blue, and within two minutes raised to considerable size and thickness. As often as I discharged the conductor the flame sprang back, and returned to its original condition of polarity and magnitude; the struggling, lambent flames, resembling dying flames of spirit of wine, played up and down upon the steel rods, till all was carried back into the true condition in which magnetism ruled.

438. The phenomenon displayed itself still more beautifully when I brought the magnetic bars nearer to the conductor. I did this both with a rod of square and one of equal size of circular section, both held in a wooden Guidoni's holder. While they remained at some distance, the polar flames were always blue on one side and red on the other. But as I approached the bars gradually towards the conductor, and the vividness, luminosity, and brilliancy of the flame increased with this, other colours were by degrees developed out of these two, till at length, when I had brought them within about a foot of the conductor, all

the prismatic colours displayed themselves in full splendour to the eyes of the sensitive observers. I shall recur to this, for more complete details, when I speak of the odic colours.

438. *b.* We thus see here the odic flames subject to the same effect from the electrical atmosphere as occurs in a similar manner to the odic incandescence ; and, as in most of the phenomena, hitherto, *we have seen magnetism holding to a certain extent the upper hand over Od, we here see electricity, alone, claiming dominion over it, with greater force.* It is evident Od is more intimately connected with electricity than with magnetism,—that the dependence upon the poles of magnetism is soluble, variable, and not one of necessity,—that it shows the mobility of electricity rather than the fixity of magnetism, that it only so far partakes of the fixity of the latter at the poles of magnets, as this fixity dwells in the magnetism,—to which the Od is to a certain extent connected. Therefore *Od* here shows itself more clearly than anywhere else, *in a kind of mean between electricity and magnetism.*

439. The *influence of terrestrial magnetism* upon the size and brilliancy of the odic flame of the magnet is manifested pretty strongly, and proceeds parallel with its influence upon the odic incandescence. When a bar magnet lies conformably in the magnetic meridian, its flames are longest and most luminous. When turned round and placed unconformably, with its northward pole toward the south, the blue northward flame was depressed, dull, inclined toward grey, dim, misty, less apparent, more difficult to see, and diminished in size ; the reddish southward polar flame weakened in like manner ; rather yellowish gray than red. Josephine Zinkel saw the flames somewhat modified in every point of the compass. The same was the case when I placed a horseshoe magnet before her with its poles upward ; if the northward limb was then turned to the north, the blue and red flames were then

vivid and brilliant; but if the southward polar limb was on the north side, and consequently the northward polar limb on the south side, the beholder perceived only dull, troubled, and weakly-coloured odic flames, sometimes both only grey, or even passing into mere grey smoke.

440. The same circumstances presented themselves when I brought the magnets—in the vertical plane of the meridian—into different angles with the dip. The condition of the odic flame altered in size and colouring with each position: this was the case even when horse-shoes were closed by their armatures.

441. Even *mere pieces of iron* turned upon their axes in the plane of the meridian, exhibited odic flames, and modifications of them according to the difference of the directions. I shall enter more minutely into this subject in its proper place. Madame Kienesberger woke up one very dark night. Looking round the room, she perceived a flaming appearance at the window. She started up in a fright to extinguish it, under the apprehension that something had taken fire. But when she came close to the window, she could see nothing; the appearance of fire had vanished. Returning to her bed, she saw the fiery brightness again at the same spot; she went towards it again, and again lost sight of it. It was an iron window-bar, which, standing perpendicular, emitted odic flame at the top.

442. But not only do magnetic and electrical influences affect the odic flame, even purely odic react independently upon it. To these belong, in the first place, *crystals* of all kinds, of earthy or saline compounds, in which we have never hitherto known of properties of the kind which occur in magnets in the strict sense. We have seen above that when a magnetic bar is appended to another of equal size and strength, the intermediate flames become dull, and the flames of the extremities increase almost to twice the size.

A crystal produces the same effect. When I applied to a bar magnet, a crystal of equal length of rock crystal, selenite, or heavy spar, the negative pole of the crystal to the southward pole of the magnet, holding the two in a straight line, Josephine Zinkel, Mr. Kiesnesberger, Miss Atzmannsdorfer, Freidrich Weidlech, and Wilhelmine Glaser, saw the blue flame of the northward pole of the magnetic bar almost double its length. When I did this at the other end of the magnetic bar, with the positive pole of the crystal, the same sensitives saw the end flame of the southward pole of the magnetic bar become elongated. *Thus, the crystal acted just as powerfully upon the odic flames of the magnet as a magnet itself, although it did not increase the supporting power of the magnet a single grain.* The independence of the odic action is thus most evident here.

443. If this experiment were accurate, it should be confirmed by a controlling experiment ; namely, the behaviour of the magnet flames when crystal flames were held against, and approximated to them, in the way the flames of the magnetic poles were brought together, described above, § 401. To test this, I placed before Josephine Zinkel a magnetic bar six inches long, brought it into conformity with the meridian, and approached its southward pole to the negative pole of a selenite, the blue flame of which measured about two inches. As soon as the two poles (the polar objects being in a straight line) came within about a foot of each other, both flames became more slender and elongated, flowed towards and appeared to seek one another. When, by a closer approximation, they should have met, this did not take place ; they did not join, but gradually became thicker and shorter again, accumulated around their own poles, and went out as soon as these came in contact. But when I brought together hostile,—that is, like poles, the beholder saw no elongation

of the approximated polar flames, but a speedy contraction ; and, finally, on the complete contact of the two solid bodies, an introversion of the odic flames around their own poles,— all agreeing with the luminous phenomena of two approximated steel magnets, one of the magnets being here completely replaced by a crystal of selenite.

444. *Animal organs,* especially the human hands,* con-

* There is no subject, in the range of philosophy, which admits more extensive application of thought than that of light. Its relations are quite universal. The most sublime idea of the theologian when he endeavours to embrace an impossibility, the boundary of time, space, and eternity, is that magnificent sentence, “God said, let there be light, and there was light.” A sentence pregnant with the germs of all the laws regulating the universe,—of all the clearness of radiant matter, and of all the darkness which envelops the confusions of mental and physical philosophy.

The finest devotion of the humble moralist to the best idol of poetic fancy, is the attempted imagining of truth in the shape of ethereal light, an impersonation of the Deity. It is absolute humility in the worship of perfect goodness and perfect intelligence; the seal upon the fiat, that without the whole truth to *enlighten* our judgments, all our conclusions must swerve more or less from the standard of pure justice.

Pride cannot guide the search for truth, although it lead the chamois to desire the mountain top, and the votary of severe physical science to the highest altitude of ambitious man’s enjoyment,—the pinnacle of human fame ! The natural philosopher, whose researches dive into all depths, is not permitted, by the laws of justice, to arrogate to himself the habits of the bigot, or the claims of scientific authority. Happy he, if where his studies lead to thoughts which establish numerous important facts, he be permitted to approach in his speculations the lamps illuminating the temples of truth. An unsettled wanderer, his is never the privilege, for petty selfish advantage, to fix his abode. Like the humble miner he gropes, and helps, with his dark lantern, to find the ore which enriches him who has not tasted of the labour expended in its production. If it be thought that Newton, who poured floods of mental light into optics, was an exception to this rule, that thought is erroneous, for never was humility more tenderly striking than in his character, and, when the extent and importance of his discoveries are regarded, never, in his own time, did man reap less personal reward. So striking is the inference, in fact, that in the yearnings and efforts made for the summit of felicity,

stitute, perhaps, a still more striking means of strengthening the odic flames. I fastened a magnetic bar of about

by even the most exalted human character of several ages, that middle course which lies between two extremes or poles, the happy medium of moderate desires, the pursuit of truth in humility, the indulgence in the love of science for its own pleasures, in the calm light of a contented mind, is more to be coveted than any brilliant blaze of dazzling fame. It is evident that in the researches of the Baron von Reichenbach, the bold love of truth has stimulated an industry guided by the severe training of a correct logic; and if in these notes any passages are found reflecting on the Baron's thoughts, their aim is more to guide the attention to facts,—which are sneered at only by those whose brains are unfortunately formed, or by those in whom the happier influences of justice have failed to correct the pressure of silly prejudices,—than to evince the very slightest disrespect to extensive acquirement guided by moral excellence.

To show here that "*animal organs*" have been observed under various circumstances to emit light, and that there exist probabilities of the analogies afforded by phenomena, long ago observed by inquiring philosophers, to those which have been the subject of our author's investigations, will not be irrelevant, how much soever some of the speculations naturally arising may be distasteful to that school of philosophy, which retains the right of rejecting all knowledge, not based on those foundations, laid by certain instruments and tools, in common use, by its own artificers. The Baron von Reichenbach has done well in admitting oral testimony into science, for now the germs of much future progress in knowledge may be watched by greater numbers in their development. The combined music of truth from such sources may, in choral harmony as it were, be attuned and reverberated by many statistical aids. If the relation of single or isolated facts be rejected,—though wise students would never rudely or heedlessly pass them by,—the repetitions of a thousand different observers, each having had multiplied opportunities of verification, would constitute a statistical value, which the severest devotee to prejudice could not wholly underrate. In drawing attention to facts long ago noticed, perhaps then isolated, but since observed by very numerous persons, the importance of the state of somnambulism in such researches as those recorded in our author's text must be again vindicated. In the interesting "*Journal du Traitement Magnétique de la Demoiselle N.*" (pp. 56-57), M. Tardy de Montravel relates that on the 13th of April, 1785, the lady who was the subject of his observations perceived, upon the surface of the baquet, a very light vapour,

eight inches length into a wooden Guidoni's holder, brought it into the conformable direction with the meridian, and

which appeared to be in motion, and which, rising along the iron rods then used in the practice of animal magnetism, seemed to be *attracted* by the patients. At first she was interested by this phenomenon, but soon her head became heavy, and she had a sensation of movement about the frontal sinuses. She had no desire to sleep, but had a palpitation which was perceived by the bystanders. Here was a case in which, according to my view, the vapour contained Reichenbach's odic force negative, or the mesmeric imponderable agent repulsive, increased in its unpleasant effects by an iron conductor. In other cases the same description of vapour has been observed of a grey colour. M. Tardy, in trying to get his patient to observe the mesmeric fluid emanating from himself, learned from her, when she was asleep, that his thumbs shed brilliant sparks of light (p. 63), that the palms of his hands shed a vapour, not brilliant, (p. 64.) In repeating his observations and varying his experiments, he arrived at the Baron von Reichenbach's conclusion, that the light emanating from the thumb of the right hand was rather larger in volume than that from the left (p. 70.) With his face to the north M. Tardy mesmerised some milk, and his patient saw the sparks of light proceeding from his thumbs, and the surface of the milk glittering' with sparks. (p. 72.) Various other experiments were made, the results of which were, that the light was seen conveyed along rods of steel, through planks of wood, at the spots corresponding with those touched on the side proximate to himself. On other occasions she indicated the season of the year when the fluid had the greatest amount of force. Less in winter than in summer. Then, as to particular times of the day, more from eleven o'clock in the morning until three in the afternoon (p. 12.) The sources of the fluid ? The earth and the air. That from the air is the purer, &c. &c. The sun is the most abundant source of this fluid (126.) Its direction is influenced by currents of air (p. 127.) It can traverse glass (p. 137.) Disregarding the hypothesis of an universal fluid, so fashionable for a time among the cultivators of mesmeric science, the remark may be allowed, that the Od of Reichenbach is embraced in an idea, somewhat analogous in some of its properties and relations to that supposition, based, however, upon a very different course of investigation. We are constrained, nevertheless, to allow that although the Baron is more close in his train of philosophy, the *facts* brought out are, in many cases, analogous—almost identical. It has been on purpose that Tardy has been selected, on account of the date of works, but from his period to the present day the facts on the emission

led Miss Atzmannsdorfer to it in the dark. When I let her grasp the southward pole of the little bar with the

of light from the fingers, pit of the stomach, eyes, nostrils, mouth, and, in a less remarkable degree, from the whole surface of the human skin, as seen by many somnambulists, are too numerous, and too well vouched for, to admit of any reasonable doubt. I have, myself, been very frequently present, on occasions when numerous persons, on other occasions when individuals knowing nothing of each other, and in presence of myself alone, having been placed in a condition of sleep-waking, have stated facts *corroborating every statement* made by Tardy de Montravel. I have seen many individuals, male and female, who could, in ordinary wakefulness, in full vigilance, perceive blue, green, or yellow emanations of light from the ends of the fingers of other persons, from the eyes, and during the expiration of breathing from the mouth and nostrils. Persons of a very highly sensitive nervous organization are not uncommon, who, in the shade of a sombre room, have the power of perceiving these appearances. A lady lately residing at the Mesmeric Infirmary is a remarkable example of the possession of this faculty. Long ago such things ought to have excited greater attention, for the facts connected with animal light are well known, and have attracted the notice of philosophers of no common calibre of intellect. My late revered friend and preceptor, Dr. James Macartney, professor of anatomy in the University of Dublin, published in the year 1810, in the Transactions of the Royal Society, a remarkable memoir on this subject, so full of the just feeling for investigation which distinguished him as an active and ingenious philosopher, that any one who knew of the vast amount of knowledge he had accumulated could not but deeply regret his not having left behind him, in some printed form, the marrow of a most extensive course of lectures which annually stimulated the intellects of a large concourse of admiring and affectionate pupils. His copious fund of original facts, and his novel and correct trains of reasoning, impressed convictions on the minds of many a student who has gone forth to contribute his master's ideas, as well as sometimes his own share of information, to the general stock of useful knowledge, but the venerated preceptor has left little that could add to his own fame, besides the remarkably original thoughts in his work on Inflammation; the translation of Cuvier's Comparative Anatomy; and a few papers communicated to learned associations, and I should add, the noble museum of anatomy now in the University of Cambridge. Macartney established by his discoveries on the evolution of light from the bodies of living animals, certain propositions that were highly important, which must, in due course, meet

fingers of her right hand, she saw the odic flame of the northward pole of the magnet grow longer, and the in-

our attention; but subsequent labourers in the same field have much advanced our knowledge of the natural history of animals emitting light. The researches of Professor E. Forbes, published by the Ray Society, in his Monograph of the British Naked-eyed Medusæ, is a work remarkable for extensive erdition, and evincing the power of the author's mind in the exercise of deep thought. The student investigating this subject will find an interesting bibliography in this work. The best *summary* of the knowledge on animal luminousness is to be found in Todd's Cyclopedia of Anatomy and Physiology, from the masterly pen of Dr. Coldstream.

If we ask ourselves the question, what is light? what do we know of light? shall we, reflecting upon the facts of Reichenbach, or upon the luminousness of animals, leap to the conclusions that we may search for the essential causes of this imponderable phenomenon in the natural history of organised beings? or shall we be content, in treading the beaten path of knowledge, to conclude that a proper definition of light is, that it is "the cause of those sensations which we refer to the eyes, or that which produces the sense of seeing,"—aware that thus we shall discard from our attention all the curious facts connected with mesmeric science, and others relating to animal light. To define a matter, we should give some account of its characteristic properties. Is it a property of light to cause the pain inflicted by the sharp end of a pair of scissors upon the eye, or that of an ulcer left by small-pox or any other morbific poison? Each may be "the cause" or antecedent to "the sensations we may justly refer to the eye." But is it not absurd to admit that light can be *thus defined*? We cannot see without light; but then, in such case, we acknowledge it only as one of the conditions necessary to the exercise of the faculty of vision. Jane M., a clairvoyante, was for several weeks an inmate at my house in Grosvenor Street. I have now narrowly watched her for more than two years. Hundreds of persons have witnessed many curious and delicate mesmeric phenomena in her case. I have occasionally shut her up in a dark chamber, in which she has occupied herself with great perseverance in the darkness of night, without the possibility of getting at a candle, or any other source of incident light, in making a very large patchwork quilt, containing many hundreds of lozenge-shaped pieces of printed calico. She threaded her needles, and worked night after night, in her sleep, at this quilt, until she had completed it. She has, under the same conditions, written letters. She has carefully folded them,

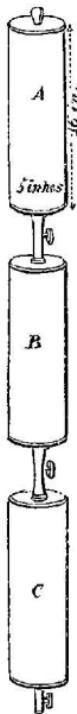
tensity of its light increase. When she did the same with her left hand at the negative pole, the flame of the southward pole increased. When she took hold of the same poles with the reverse hands—the southward pole with the left hand, and, *vice versa*—she saw the odic flame of the

closed them with wafers, and, after writing the address, has attached a post-office stamp in the proper place. The Marquis de Puységur (see Mem. pour servir, &c.) has given the case of a countryman whom he locked up in a dark room, without the possibility of his getting at any source of incident light; and, on several occasions, this man, having pens, ink, and paper, wrote essays evincing philosophical power of thought. It cannot be contended that light was in these cases the *cause* of the faculty of seeing; unless, indeed, it was light invisible to persons in the condition of ordinary vigilance,—light emanating from the brain or nerves of the individuals in question,—certainly not light incident from sources external to the individuals. To deny the existence of such phenomena is to attempt stupidly and mulishly to arrest the progress of science. I myself have so often seen what I have related, that there can be no mistake about the matter. I have, at various hours of the night, gone upstairs to watch Jane at her operations, and have stood with the door in one hand, and, with a candle in the other, giving only sufficient light to enable me to see her at needle-work or writing during her sleep. How many well-authenticated cases of a similar kind are extant in the works of Sauvages, of Wienholt, and of others! The individual who exclaims, as some poor creatures do, "*I do not believe it,*" is an object of pity, as a rude denial of the truth proceeds from vulgar arrogance,—itself the product of an ill-educated or a badly-organized brain; perhaps of one unfortunately incapable of the expansion enjoyed by refined intellects. It is not contended that clairvoyants see without light, but that, seeing with a light emanating from themselves, the ordinary definition of this imponderable is not sufficient to enable us to form a clear idea. The difficulty of defining light is not denied, for truly we are lost in our conjectures and speculations as to its essence. How much of light or of lumine is there in what we call darkness or opacity? We say that light radiates in all directions from luminous bodies. We think we know that, in homogeneous media, it moves in straight lines; that, however great its velocity, time is necessary for its journey from one point to another; that, *all things being relative*, the relation of light to time and space, under present circumstances, is very nearly that of one second to 209,000 miles. We are aware that when, during its passage, light meets with any obstacle, its direction and quantity are modified by the nature of the

other end become weaker and duller. I repeated the same experiments a year later with Josephine Zinkel, with the same

obstructing medium.¹ If it be incident on a smooth and polished surface, a portion of it is reflected or thrown off from that surface at an angle equal to the angle at which it impinged, and that then it again follows

¹ My friend Mr. Crosse, of Bromfield, has devised a very pretty illustration of this fact, which at once exhibits the modifications effected by an obstructing medium on light, and the material nature of this imponderable agent. He takes three sufficiently strong cylinders of glass,



properly capped with brass, and furnished with convenient stop-cocks; each cylinder being at least sixteen inches long and five inches in diameter. These are each first placed in relation with an air-pump. Then, A is to be exhausted by the greatest power of the pump; B to a degree sufficient to give *one inch* greater pressure of the barometric gauge; C to give *two inches* greater pressure than A, and *one inch* greater than B. They are to be screwed one on another, A being uppermost. An electric shock is to be passed through the whole, from A downwards, in the dark. A will appear filled with one uniform cylinder of purple flame; B with parallel columns of a reddish purple flame; and through C will pass a falling star.

results. *Their hands thus acted upon the flame exactly like magnets.* The application of their own negative hands

its course in a straight line. The nature of the surface on which the light impinges, together with its angle of incidence, determines the quantity reflected. Supposing a beam of light, having an intensity to be represented by 1000, to fall on water, so as to make an angle of incidence equal to $0^{\circ} 30''$, the intensity of the reflected light would be represented by 721. If the angle formed at the surface of the water were 15° , the intensity of the reflected light would be reduced to 211; at an angle of 30° , to 65; at an angle of from 60° to 90° , to 18. Mercury, an opaque body with a very bright surface, may not reflect more than three-fourths of the light incident on it even at a very small angle.

Light, regarded as subject to laws regulating its reflection, must arrest the attention of deep thinkers; for in this fact alone of the subtraction of some degree of its intensity, much is left unaccounted for. But how vast a field opens up when we regard the laws regulating the refraction of light; or the deviation which occurs when a ray of light, having travelled in a straight line through one medium, enters another of a different density. The divergence from its original path develops phenomena, which, however wild the idea may appear, would seem to warrant the speculation that there may exist crystalline forms of lumine. It is not the purpose now to follow up the elements of dioptrics, to trace the philosophy of the refractive powers of different media, their influence on the dispersion of light, their powers in determining the relations of the primitive colours, although this last part of the subject has an intimate relation to the chemism of light proper or lumine, and to the unexplored field of the influence of colour associated with various crystalline agencies on the human organism under the condition of mesmeric clairvoyance,—a subject which must be studied in order to liberate from its crudities the relations of the *interference* of light to the theories proposed to account for its nature. It is impossible to conceive of the extent to which scientific knowledge may be corrected, when a just faith is established in the laws regulating phrenological and mesmeric science. Philosophers have laboured hard to account for the extinction of light under the laws of its own *interference*,—a phenomenon most remarkable, but one not more calculated to arrest attention and to excite inquiry than the fact established by Macartney of the “luminous exhibitions of living animals being not only independent of all foreign light, but being frequently destroyed by” the impingement or incidence on these animals of any foreign light. “I have always found the shining of the Medusæ,” he

to the positive pole of the magnet considerably increased the odic current at the opposite negative pole of the magnet,

says, "to cease upon the rising of the moon, or at the approach of day; and, when out of the sea, I never could excite them to throw out light until they had been kept for some time in the dark; all the luminous insects likewise secrete themselves as much as possible during the day-time, and go abroad only at night." An exception to this general fact occurs in the *Scolopendra electrica*, which does not shine unless it has been previously exposed to solar light. The chemist who observes that camphor appears to require the presence of light for its crystallization has only to try Mr. Crosse's experiment of endeavouring to form, by means of electrical aid, crystals of sulphate of strontia in the broad glare of daylight. He will inevitably fail; but in the darkened cellars of the house at Bromfield there has been great success in crystallizing this substance. In the experiments of the Baron von Reichenbach, the darkened chamber gave him results which appear incredible to persons who have not faith in the goodness of the Baron's character, or who have not reflected on the strong analogies of phenomena previously observed by other philosophers. The electric relations of the Scolopendra may in some measure account for its aberrations from a norma; and this consideration introduces a difficulty in tracing the laws relating to the luminous properties of animals, of no mean importance, derived from the modifications which complicated organisms may introduce into the associations of imponderable agencies.

If we consult the essay of Dr. Coldstream (Todd's Cyclopædia of Anatomy and Physiology, vol. iii. p. 197, article Luminousness, Animal), we shall find that, according to the observations hitherto made, "the animals which possess the property of emitting light are almost entirely invertebrate, and chiefly marine." Those which manifest, constantly and distinctly, this function, belong to the Mollusca, Crustacea, Insecta, Myriapoda, Annelida, Echinodermata, Acalephæ, Zoophyta, and Infusoria. Though nearly seventy species among these classes have been observed to emit light, it seems that the colour of the light, with exceptions easily accounted for, has belonged to one or other of those named primitive by Tobias Mayer, and since acknowledged to be such by the reasonings of Sir David Brewster. The same animal may at different times emit different colours, and of different degrees of intensity. The Pholas dactylus has been observed to shed a *bluish white light*. In the Lampyris noctiluca the light has been observed to be greenish with a shade of blue,—the green owing, probably, to the yellow rings of integument covering the light-emitting organ

but without increasing in the least its magnetic power of supporting iron ; it was an addition of (*sit venia verbo*)

of the insect. The Elater noctilucus sheds a green light, with spots of "the most beautiful golden blue." The Fulgora pyrrhocynclus emits a deep purple and scarlet light. In the marine animals, the light is of various shades of blue. The Lampyris italicica, the glow-worm of Italy, emits *bright blue light*. A curious phenomenon attaches to this, as well as to another beetle in New Holland, that there are alternate emissions and extinctions of light, apparently synchronous with its circulating current, visible in the wing cases of the insect. Have these any relation to the polarities derived from the crystalline spheroidal or globular molecules of the circulating fluid ? The Baron von Reichenbach's discoveries, backed by the aid of mesmeric researches, tend to the hypothesis that crystalline light belongs to the odic properties of organized beings.

In the sea of the Straits of Malacca, near Penang and Queda, I have repeatedly but coarsely examined the minute Medusæ scintillantes, and can fully testify to the accuracy of the account given by my old friend Mr. Langstaff, quoted by Dr. Macartney at page 269 of the volume of the Philosophical Transactions for 1816. If, while in a boat passing through a surface of the slime covering the sea, some of this substance be caught in the hand, sheets of light will be perceived wherever the fluid mucus is spread over the surface of the skin ; and sometimes numbers of the medusæ, most of them not so large as a pin's head, may be distinguished ; at others, the quantity of slimy fluid will preponderate, with little or no evolution of light. I never could bring myself to believe that the masses of light I have so often witnessed, on the milky surface of a tropical sea, were wholly owing to the shining of the tentacles of a few animals like Thaumantias Hemispherica, though in a different kind of night, when the milky slime is not present ; but when the sea is unusually clear, and its depths are magnificently studded with those beautiful jewels with which Nature adorns her in the shape of the luminous Holothuria and other Mollusca, in thousands, and when Thaumantias, stimulated by the moving water, send forth brilliant glittering light from its tentacles ; when the bows of the ship, in rolling the salt water over, plough up, as it were, sheets of sparkling light, there is no doubt but that more than one little animal contributes its share to the illumination. Dr. Macculloch, in his work on the Western Islands of Scotland, as well as in the article Phosphorescence in the Edinburgh Encyclopædia, has, among some philosophical ideas and curious facts on luminous animals, some that are crude and ill-digested ; but he has started the highly probable conjecture that there exist some marine animals which,

Biod to Magnetod ; and the result was doubled odic flame. *And in the present experiments the human hands did exactly what crystals had done in the last experiments.*

in their dimensions, resemble some of the Infusoria¹; and that these, whether in the state of spawn or fully grown, may be possessed of the faculty of emitting light ; and he distinguishes with respect to the nature of the light, as appearing in two distinct forms, and in these cases apparently arising from two sources. "The twinkling appearance seems always to proceed from the animals, and to be the result of their own actions," taking place when the water is at rest. "The diffused light appears to originate rather from detached luminous matter dispersed through the water." Macculloch calls the diffused light fainter ; but if he had witnessed the great variety in this respect that obtains at night in the waters of the Straits of Malacca at certain seasons of the year, he would not have arrived at this conclusion. The diffused light is often very brilliant, and may often be compared to an illuminated blue sky reflected on the water ; while on other nights the green water of the sea is seen clear at certain limited depths, if watched out of the stern cabins of a ship, "illuminated by the pale blue light, shed off numerous points, from thousands of animals of various sizes belonging to the genera Holothuria and Beroe." Macculloch, anxious to find uses for all that the great Planner of the universe has arranged, supposed that the power of emitting light belongs to the marine animals of the lower grades for the purpose of their serving as link-lights to guide other animals to prey upon them : he thought, considering the absolute darkness that exists in the ocean at eight hundred or one thousand feet deep, owing to the light of the sun ceasing to be transmitted to such depths, the luminousness of marine animals may be "a substitute for the light of the sun," and may be a means of their discovering one another, as well as their prey. It is remarkable that some philosophic minds love to wander from the path of obvious facts to the captivating speculations of false secondary causes. All the facts tend to conclusions diametrically opposed to those calculated to infer a wisdom for God other than his own. The greatest brilliancy of light, a point on which Macculloch insisted, is given out by those very inferior animals that scintillate their flashes on the surface, and give out no light in the deep. The numerical proportion of those that shine in the deep, and those at no great distance from the surface, bear a very trifling ratio to the scintillating meduse. Dr. Macculloch was more

¹ Dr. Coldstream states that many species of the Infusoria belonging to the genera Cerearea, Volvox, Vibrio, Trichoda, Lincophœa, emit light.

445. I subsequently made a controlling experiment with the healthy Wilhelmine Glaser. In the dark chamber I

exact when he stated that he had himself observed the luminous property in certain fishes, the larger and more perfect of the marine animals. "I have hitherto observed it," he states, "only in the pilchard, the sardine, the whiting, the mackerel, and the gar, but have little doubt that it is far more widely diffused. It has been remarked, by different navigators, that the genus *Squalus* shines at night; and the flying-fish has also been observed to emit a pale light, which Captain Ross compares to that of the moon." "Great flashes have been described as seen at a considerable depth in the sea, a phenomenon which I have often witnessed among the Western Islands :" after the observations on the sources of fallacy in such matters, he concludes that there is "the probability, however, that fish actually possess the luminous property, which is strengthened by our knowledge of the light they so readily yield after death; a phenomenon by no means connected with putrefaction, but independent of that process;" a point Dr. Hulme had long ago established. In traversing the ocean I have seen several fish caught, which, while dying, have exhibited numerous changes in their hues of colour, and I have inferred that the organized vital surfaces, capable of dissecting or of evanescently crystallizing incident light to such a remarkable extent, might under other circumstances possess the power of emitting their own light. Dr. Macculloch has stated the fact that "if a noise be made by striking the gunwale of a boat when a shoal of pilchards is under it, the whole will in an instant become luminous, exhibiting the splendid appearance of a continuous sheet of light, momentary, but renewable on repeating the same alarming sound." Notwithstanding this direct testimony, it is right to observe that Dr. Coldstream has hesitated to admit fishes on the list of truly luminous animals. Dr. Macartney, before Dr. Macculloch's time, had withheld his assent to the fact, repeatedly asserted. Again, the analogies afforded by the investigations of the Baron von Reichenbach may be indicated, and the probability hinted at that Dr. Macculloch was right.

It is possible that animal light may be emitted, under certain circumstances, by all organised living beings; but the question as to whether there exist varieties in the power of exercising an animal function, or of manifesting such a property as belonging to vital structures, is quite a different affair. Certain mollusca, and some of the species of elater, appear to shine without intermission. In Italy, and in various parts of the tropics, the illuminating powers of this insect, the fire-fly, is so great that I have known a beautiful star-like picture produced by enclosing numbers of them in meshes of thin black crape, which was thrown as a

grasped a magnetic bar eight inches long in my own hand ; when I did this below, at the southward pole, with my right

veil over a lady, who desired to appear in the character of Night. In the West Indies (particularly at St. Domingo, where they are abundant), Dr. Coldstream states "that the natives use them instead of candles in their houses. They also tie them to their feet and heads in travelling at night, to give light to their path through the forest." But most of the light-emitting animals appear to use their peculiar function only occasionally, and in most instances under the stimulus of some exciting cause. One remarkable fact, that is striking in its analogies, appears to be dependent on temperature and climate. The greater number of luminous animals are found in warm climates ; and though among the marine animals some are seen in all latitudes, even the coldest, yet these are not so numerous, and their light is not so splendid. It is well known from the concurrent testimony of all voyagers, that they are more abundant and shine with greater brilliancy in tropical regions. The glowworms of temperate countries shine only in summer and autumn. In England it is found between June and September. It seems that "no aerial insects give out light under a temperature of about 50° Fahrenheit and upwards ; and the higher the natural temperature, the brighter is the light emitted." But whether the animals be insects or belong to marine families, changes in the state of the medium in which they live, derived from altered conditions of temperature or of electricity, appear to affect them manifestly. I have myself seen sudden changes in the appearance of the surface in tropical seas, which have gone off in the course of half an hour, occasioned by the appearance of luminous animals, which have retreated as suddenly as they appeared. During the rainy monsoon, a few degrees distance from the coast of Malabar, at midnight, the weather being cloudy, and the night very dark, Captain Horsburgh saw the sea suddenly assume a milky white appearance, and then a flaming colour all around : a similar appearance occasionally occurs in the Banda Sea.—(Macartney's Paper.) On these occasions, various observers have testified to the suddenness of the changes that have occurred either in the atmosphere or in the water. Before storms it has frequently been observed that the marine luminous animals are excited to give out their light with unusual splendour. Dr. Macartney, in experimenting upon the light of the medusæ, placed some of the individuals of *Thaumantias Hemispherica* in a glass vessel, and passed shocks of electricity through the water. At the moment, there was no appearance of light, but immediately afterwards they shone like illuminated wheels for some seconds, and with greater brilliancy than before. Humboldt corroborates this fact. It appears that the condition of an electric circuit

hand, the blue northward flame at the top grew to twice the size; when I did it at the opposite, the northward

is essential for the production of an increased light in glowworms; for Macaire, quoted by Dr. Coldstream, found that one pole only of the galvanic battery produced no effect. I have been led to infer that there is an induced imponderable agency from the closed circle of a single electro-dynamic coil, as illustrated by certain mesmeric phenomena, which, in very susceptible cases, are rendered evident by that agency. It would be very interesting to communicate this agency to glowworms, and to fluids in which marine luminous animals were present.

It is fashionable to sneer at isolated facts, and to withhold belief from any which appear extraordinary, and that can be accounted for only by the hypothesis of the existence of unknown or unexamined imponderable agencies. Dr. Coldstream must have attached a certain value to "an extraordinary series of phenomena, connected with a particular display of the luminousness of the sea," which were reported by Mr. Henderson in a paper published in the 1st volume of the Transactions of the Medical and Physical Society of Calcutta. In the year 1821, on the 5th March, Mr. Henderson was on board of a ship in the Atlantic (lat. 2° , long. $21^{\circ} 20' W.$) and about 9 p. m. the sea became "unusually luminous. Every person who kept his eye fixed upon it, but for a short time, was immediately affected with giddiness, headache, pain in the eyeballs, and slight sickness. Although these symptoms varied in intensity amongst the spectators, yet there was not one on board who did not feel some degree of them; and all imputed them to the effect of the light proceeding from the surface of the ocean." Mr. Henderson remarks, "For my own part, the headache, &c., which followed immediately on my looking at the water, was particularly severe, nor did it go off until morning. The effects I experienced were like those produced by smoking too much tobacco." Although this be an isolated case of the physical effects of very intense light from this unusual source, I do not hesitate to give full credence to Mr. Henderson's statement. Having resided in Calcutta, where, at certain seasons, the light of day is most intense, and where the *repulsive agency* of this imponderable may be associated with other nocent powers, I have repeatedly suffered the illusss so well described by Mr. Henderson, on the too sudden admission of the glare into my sitting-room, or on going out, too suddenly, from a darkened house, into the fierce light abroad. *Repulsive sun-light*, as well as heat, is no unusual source of the biliary derangements of India.

We are apt to be startled by relations of things that are new to us, and the repulsive agency of certain organs in the brain is, in some persons,

pole, with my left, the odic flame at the free southward pole was doubled. When I did the same at both poles with

called into operation. In standing on the defensive, it is sometimes a property of our structures that we should become offensive ; and in refusing belief to things thought to be unusual, our self-esteem, and love of opposition, and cunning, and jealousy, and envy, derived from love of possession, the true gluttony of selfishness,—our cultivated obstinate vanity, assuring us that in piggish scepticism resides the philosophy which really buds only from the highest and most delicate organization, not allowing us to perceive how frequently we become illogical, teaches us to reject truths presented to us by our fellows in the best faith of their sincere feelings. I could mention the names of men, having high reputations in the world, who either have forgotten that love of justice which belongs to conscientiousness, and that love of truth that belongs to high moral natures, or who have laboured under such obliquity of intellect as to have been unaware that, in some cases, the arriving hastily at disgusting conclusions is the characteristic of the narrow intellect of low-bred blackguards, and not of polite gentlemen. But the charity that springs from a conviction of man being the creature of his organization, and the circumstances which impel him to his actions, covers such beings with the pity that falls to their share. Why should the relation of an extraordinary fact like that stated by Mr. Henderson not be believed ? It could not have resulted from fancy, although our judgment might truly lead us, in reading Mr. Bonnycastle's glowing accounts of the "blazing sheets of *awful* and most brilliant light" exhibited by the marine animals in a certain portion of the ocean, and in describing "many large fishes darting about *as if in consternation* at the scene," to the conclusion that in describing a truth, the author, being a person of ardent temperament, had given a fanciful colouring to his picture. So, if we had often handled light-emitting marine animals, and had never experienced an odour at all similar to that perceived around a highly charged electrical apparatus, we should hardly be guilty of philosophic stupidity, or of a want of good breeding, if we adjudged Messrs. Quoy and Gaimard to be occasionally influenced by fanciful ideas.

The fact of the luminosity of certain animals being admitted, let us inquire into the ideas that have been entertained as to the circumstances on which this phenomenon depends. It will hardly be necessary to discuss the insufficiency of the facts that might be adduced to prove that luminous animals imbibe light from the sun's rays, and give it out in the dark ; or to combat the idea, advanced by Spallanzani, that the light is produced by a kind of combustion of atmospheric air ; or that of Bragnatelli, that the light is swallowed with the food, and disengaged by

the reverse hands, the flames of the free extremities were dulled. Only weak magnets can be used in these experi-

peculiar organs. But when we meet with the view that the light is dependent in some way on phosphoric agency, we must examine if such an hypothesis will account for all the facts on the subject. Tiedemann thinks that the luminous phenomenon is dependent on a matter, the product of a secretion : a *liquid secretion, probably containing phosphorus*, or an analogous *combustible* substance, which combines with the oxygen of the air, or of aerated water at a medium temperature, and thus produces the disengagement of light. Hence his inference is, that the evolution of light in animals is a chemical operation, and as, *on several occasions*, the phenomenon has continued for whole days, and even after the death of the animal, it ought not to be regarded as *a vital act* (Comparative Physiology, translated by Drs. Gilly and Lane, i. 270.). Dr. Coldstream justly observes that this opinion coincides pretty nearly with those held by Darwin, Sir Humphry Davy, Heinrich, and some others who conjectured that a fluid containing phosphorus was secreted by the luminous organs, and shone on being exposed to the oxygen of the air introduced by respiration. Tiedemann, notwithstanding his high reputation, must be regarded more as an observer than as a correct thinker, and it is owing to the natural homage man is apt to pay to great industry, that the capacity of his mind has been overrated. One has only to read both sides of the controversy in which he was engaged with Gall, to estimate those mental forces which belong to the close, the logical, the clear and correctly reasoning head, and those qualities which distinguish the mere observer and collector of facts : a character so often proudly asserting its right to reason, while the clear perception of important relations is absolutely wanting. When will man learn to be humble, and to know that he is the victim of necessity ? If his brain be not formed to allow of his possessing the power of correct reasoning, of seizing the salient points of a complicated series of questions, and of elucidating, with happy illustration, the relations of a vast mass of facts, the crowding those facts together, without arrangement and without keys to their relations, is to offer them comprehensively for the purpose of reducing them to a mass of confusion. The great genius of Gall, like that of the wondrous Milton, shone in his power of illustrating truth, in controversy, when obscured by the cloudings of common minds. Spallanzani, in entertaining the idea of animal light being dependent on a combustion in the atmospheric oxygen, approached more nearly to the illogical chemical thoughts of Tiedemann. No explanation of a multiplicity of various phenomena can deserve the name of theory which is based on visionary conjecture, and which is insufficient to account for at least a majority of ascertained facts.

ments, or the results are not sufficiently distinct. They confirmed in every respect the result of the preceding paragraph.

What relations can the momentary flashes of light from the scintillating medusæ have with the combustion of phosphorus? What proof is there of phosphorus in the shining of the Holothuria, which continues for hours without emitting any luminous secretion into the sea-water surrounding it? This, and several other mollusca that inhabit the neighbourhood of Coralline Islands, may be handled without the discovery of any luminous matter adhering to the hands. In one of Dr. Macartney's experiments, luminous medusæ in salt water were submitted to the heat of a burning candle. The light ceased with the life of the animal, instead of being increased by heat and flaring up, as phosphorus would have done. From all his experiments it is easy to conclude that, when the strongest and most constant light was present, the presence of oxygen was wanting. In no circumstances did the animal light exhibit anything like combustion, or a capability of being inflamed.

Instances have been adduced of luminous appearances on the human body resulting from a large admixture, in certain cases of disease, of phosphoric matter with the perspiration; and when luminous appearances have been observed in particular conditions of urine, there can be little doubt that the presence of phosphorus may possibly have been perceived by means of chemical manipulations. Dr. Coldstream affirms that *it is said* the urine of *Viverra nephitis* and of *Viverra putorius* is always luminous. This may be true, and the light in urine may not improbably be owing to the presence of phosphorus; but the presence of this substance, because it may have been detected in a few isolated and quite exceptional cases, cannot be yielded as the one sole and sufficient mode of accounting for all animal light, in most instances of the presence of which not a trace of phosphorus has been discovered. Dr. Macartney's researches have established the more logical inference that animal luminousness emitted from animal organs is the effect solely of the action of vital forces. But it may be asked—How, in those instances in which Macartney himself allowed the existence of a light-emitting fluid, could the influence of vital forces alone account for the presence of light? and how in the glowworm and fire-fly, in which it has been asserted that the luminous organs may be cut out without the destruction of the light-emitting property which belongs to them? It is no argument against the existence of vitality in an organized fluid, that, for a certain time after its emission from the animal, it does not exhibit the chemical changes caused by death; nor does the mutilation of an animal of the lower grades establish the fact of death at once in all its parts. “Macaire

446. A somewhat modified but essentially similar experiment was gone through frequently with the girl Zinkel.

took some glowworms that had been kept for some time at a temperature of 50° Fah., plunged them into water at 55°, and gradually raised the temperature. Light was emitted for the first time at 77°, and increased in intensity until the water was at 105°. At this temperature the animals died, but the light continued until the temperature had reached 134° 5, when it wholly disappeared ;” the light-emitting organs retaining their vitality for some time after the suspension of life by other parts of the animal. “ When glowworms are thrown alive into water at 110° and upwards, they emit for a moment a brilliant light, and die instantly.” Under the receiver of an air-pump, a glowworm emits a faded light varying in degree of intensity as the air is abstracted, and the light is re-established as the air is readmitted. Kirby and Spence (Entomology, ii. 426) state that the luminous matter was by Mr. Sheppard removed from a glowworm. The wounds healed within two days, and the light-emitting organs were reproduced. These organs were first anatomically examined by Dr. Macartney, in whose paper appears this statement :—“ The only animals which appeared to me to possess a distinct organization for the production of light are the luminous species of Lampyris, Elater, Fulgora, and Pausns.

“ The light of the lampyrides is known to proceed from some of the last rings of the abdomen, which, when not illuminated, are of a pale yellow colour. Upon the internal surface of these rings there is spread a layer of a peculiar soft yellow substance, which has been compared to paste, but, by examination with a lens, I found it *to be organized*, like the common interstitial substance of the insect’s body, except that it is of a closer texture, and of a paler yellow colour,” &c. Macartney has remarked, that in the glowworm this peculiar substance is absorbed after the season for emitting light, and that its place is supplied by common interstitial substance.

In order to allow of the internal illumination being exposed, the segments of the abdomen are thin and transparent. In different species of lampyris there is a variety in the number of the luminous rings. Dr. Macartney discovered “in the common glowworm, besides the luminous substance, on the inner side of the last abdominal ring, two bodies, which to the naked eye appear more minute than the head of the smallest pin. These were sacs, containing a soft yellow substance. They were formed of two layers of silvery membrane, disposed in a circular direction, very elastic, although so delicate in structure. The light from these bodies is less under the control of the insect than that of the luminous substance

I let her bring her fingers near the poles of the magnetic bar. When she approached the collected points of the

spread under the rings: it is rarely ever extinguished in the season in which the glowworm gives out light, even during the day: and when all the other rings are dark, these sacs often shine brightly."

In the genus *Elater*, the light-producing organs, consisting of a peculiar yellow substance, are placed in the corcelet. In the dissection of the *Elater noctilucus*, Dr. Macartney found a "soft yellow substance of an oval figure lodged in the concavity of the yellow spots in the corcelet." A lens enabled him to establish its organic nature: it was composed of very minute lobules, closely packed together. In the *Pausus sphaerocerns*, the globes of the antennæ form the organs of light. Carradori thought that the lampyrides were enabled to moderate or extinguish their light by retracting the luminous substance under a membrane; but neither in this nor in any other luminous insect could Macartney detect an apparatus for such a purpose, and he observes that "the regulation of the kind and degree of the luminous appearance does not depend on any visible mechanism, but, like the production of the light itself, is accomplished by some inscrutable change in the luminous matter, which in some animals is a simple operation of organic life, in others is subject to the will."

It is worthy of remark, that in all the dissections of luminous insects made by Dr. Macartney, he did not find that the organs of light were better or differently supplied with either nerves or air-tubes than the other parts of the body. Dr. Coldstream says that "the luminous proboscis or snout of the *Fulgora* is hollow, and has a free communication with the external air by a narrow slit situated near the base of the organ. Its cavity is lined with a fine membrane, between which and the outer translucent corneous crust there is interspersed a soft tissue, of a pale reddish colour, arranged in lines longitudinally, which is supposed to be the seat of luminousness in this insect."

In those luminous insects, then, in which there is found a peculiar organization for the production of the light, there does not appear to be a question as to the existence of a fluid, from which the light emanates. There is a peculiar organic substance, consisting in some cases of aggregated lobules, but no proof exists as to the presence of so highly combustible a substance as phosphorus.

Dr. Macartney asserts that with the exception of the animals above mentioned the exhibition of light depends upon the presence of a fluid matter. He adduces the *Pholas dactylus*, in which the luminous fluid is very evident, and in vast quantity. Some naturalists assert that it is

fingers of her left hand to the northward pole, the flames of both sides flowed towards each other, becoming more

from the internal surface of its respiratory tubes that this Pholas gives out its light most strongly, and of course secretes the greatest abundance of this fluid. Pliny is an authority that this fluid is *like phosphorus*, rendering every object luminous with which it comes in contact. Reaumur, according to Macartney, found it diffusible in water or any other fluid in which the animal might be immersed.

Macartney observed that the shining of the Scolopendra electrica was always accompanied by the appearance of an effusion of a luminous fluid upon the surface of the animal, more particularly about the head; and this fluid may be received upon the hand or other bodies brought in contact with the insect at the moment, and the light thus transferred remains for a few seconds afterwards. "*This fluid, however,*" adds the Doctor, "*I never could discover in the form of a moisture, even upon the clearest glass, although examined immediately with the most scrupulous attention by a lens. It must, therefore, be extremely attenuated.*"

The same appearance was observed during the illumination of the Nereis noctiluca, by Fongeroux de Bonduroy. (*Mém. de l'Acad. des Sc.* 1767.) Godehue de Riville, in the 3d volume of the same Memoirs, gives an account of a luminous animal he had seen on the coast of Malabar, where he saw the sea having the same appearance of a plain of snow which Horsburgh and others have witnessed. In experiments with this animal, he observed it to emit a blue liquor which illuminated the water for several lines. Spallanzani relates (*Memoria sopra le Meduse forforische Mem. della Soc. Ital. tomo 7*) that the medusa, which he examined, communicated the property of shining to water, milk, and other fluids, on being rubbed or squeezed in them. Professor Forbes, in his monograph on the Naked-eyed Medusæ, quotes Ehrenberg and others to show that the medusæ give out their light from the bulbs of the tentacles, and particularly the Thaumantias hemispherica, noticed by Macartney; and he compares the light to a garland of sparks around the circumference of the umbrella. Ehrenberg regards the production of the light as an act of organic life, and he observes that it "appears frequently periodically produced either spontaneously or by excitement, frequently as rapidly produced sparks, resembling small electric discharges. This repeated sparkling converts a *mucous gelatinous fluid*, which is discharged more abundantly during the operation, into a secondary state of phosphorescence, which continues for a time, even after the death of the organism, or after the severing of its parts."

Macartney had previously noticed that in this animal the light was

slender and larger ; when she came nearer, however, they drew back, became shorter, contracted, and both disappeared

given out from the same spots, and, he adds, from the *centre* also. He says : "The central part and the spots round the margin are commonly seen to shine on lifting the animal out of the water into the air, presenting the appearance of an *illuminated wheel*, and when it is exposed to the water the *transparent* parts of its body are alone luminous." Forbes states that from *Dionaea appendiculata*, which is always a luminous species, the light proceeds from the reproductive glands. Ehrenberg found that in *Cydippe pileus*, and *Oceana pileata*, of the Baltic, the light issued from the neighbourhood of the ovaries, and in *Oceana hemispherica* from the basis of the cirri ; corroborating the idea of Professor Forbes, that "the light of the naked-eyed medusæ is developed by the reproductive and motor systems."

Dr. Coldstream says, "The luminous mucus is sometimes poured out even by very small animals in such quantity as to leave a luminous wake behind them, as in the instance mentioned by Quoy and Gaimard. These observers saw such luminous lines formed in the paths of certain extremely small creatures, so transparent that their forms could not be distinctly made out. The positions of their bodies were marked in the water by bright spots, which were followed in their course by luminous wakes, at first about an inch in breadth, but afterwards by the movements of the water spread out to the breadth of two or three inches. This luminous mucus is supposed to be the seat also of the remarkable stinging property possessed by many of the *acalephæ*. It retains its luminous ness in some instances for a day or two after being emitted by the animal, but *loses it whenever putrefaction commences*." Dr. Macculloch, who paid much attention to the subject, thought that in marine animals generally the coats of the stomach and intestines were the real light-emitting organs. Whatever differences of opinion may have existed on this part of the inquiry, it seems certain that from the momentary or from the sudden and periodical sparklike gleams or flashes, the light proceeds from the internal organs of the animal under conditions of an *exalted or stimulated vitality*, or from tentacles capable of assuming a spheroidal shape ; that it would seem to depend on the agency of some imponderable ; that this can attach itself to a vitalized mucus, which ceases to shine when death produces putrefaction ; that in the luminous insects this imponderable does not necessarily attach itself to a palpably moist fluid ; that in many cases there is no evidence of a fluid further than the presumption of a slight moisture accompanying the presence of the fatty matter belonging to the organs of light ; that in some of the

as soon as the finger-points came in contact with the poles of the magnet. But this did not always succeed equally

medusæ and some other luminous animals, there are fitful flashes of light without the appearance of subsequent trains or wakes of a light-containing fluid, affording the presumption that some stimulating influence may impel the organism in such animals to flash a vivid gleam of light which is not necessarily borne along on a vitalized mucus. It might be very logically contended that the cessation of the phenomena of light on the commencement of the process of putrefaction was a strong argument in favour of the vital origin of the light; but it is at the same time a cogent reason why the light is not necessarily connected with the presence of a nervous system. The desire to connect vital phenomena necessarily with certain known conditions of organization is a testimony of an inelastic mind, wanting the capacity of yielding, with delicacy, to numerous facts that must be ignored by stubborn refusals to embrace knowledge inconsistent with the conclusions established during the existence of a crude and unripe philosophy. An exalted state of vitality may be a necessary condition for the exercise of the functions of reproduction, but the presence of the organs of reproduction does not necessarily imply the existence of a nervous system, and the light-bearing mucus that is shed from certain medusæ may serve as a nidus for ova which escape from their ovaries. The lampyrides deposit eggs which have been said to be frequently luminous, and their luminosity has persisted for several days.

The experiments of the Baron von Reichenbach would tend to show that nature has a law of type in many of her operations besides those strictly anatomical, and the animal function of emitting light, belonging to the crystalline type, may be found to be a property of all organic spheroidal molecular matter. A strong analogy to the facts discovered and recorded by the Baron, I find in Dr. Coldstream's article, relating to the *Nyctipithecus trivirgatus*, a South American ape, quoted from a German work by Reugger (*Naturgesch. der Saugthiere von Paraguay*, S. 383.) This animal is nocturnal, and when the observations were made, it was under circumstances of total darkness. Reugger states that then, the luminousness of the ape's eye was distinctly seen, and the light was so brilliant, that objects could be clearly seen at the distance of eighteen inches from the eye which was illuminating them. Treviranus (*Biologie*, i. 439) endeavours to show the impossibility of this phenomenon, notwithstanding an admission that some dogs have an analogous power of generating light within the eyes; and he thinks he grants enough if he modifies the circumstances, under which the light is perceived, to those in which impressions are made that arouse the feelings of

well. If the magnet was small or weak its odic flame was extinguished, that of the hand not completely; in other

the animal, and that betray him into the expression of some instinct or passion. This physiologist had not been at the pains to have the fact, stated by Reugger, either subverted or corroborated. Nor had the reflection upon the similarity of structure in the brain of the dog and monkey families passed through his mind. The value of isolated observations is, in philosophy, often enhanced by the curious and subsequent corroborations afforded to them by the labours of inquirers who work with quite different objects, as we perceive by the Baron's new investigations. Dr. Coldstream has very pertinently remarked, that "If it should be proved that some of the higher animals really do emit light from their eyes, independently of the incidence and reflection of that from without, it will go far to render it probable that in luminous animals generally the development of light depends more upon the movements of some imponderable agent in and from their nervous system, than upon the nature and composition of the fluids poured out by the luminous organs." Modifying the conclusions to which my revered and lamented friend Dr. Macartney, had arrived, I would seize the admissions of Dr. Coldstream as a step towards a progress in the belief of facts established by mesmerism, while I would point to the hypothesis of my friend Ignotus, as to the possibility of all lumine being subject to the laws of chemism, imponderable, in itself the minutest form of spheroid developed from organic spheroidal matter; the lowest condition of which, within our ken, is that from the crystallization, which exists in the form of pure metallic aggregation; the highest, the form of light which emanates from the human being as the result of *will* or of *thought*. In this view, of course, there is no admission of the hypothesis assumed as a conjecture by Dr. Coldstream, that the development of light may, in luminous animals generally, depend upon some agency from their nervous systems, since in many of them it would be difficult to prove the existence of such systems. As easy might it be to prove the existence of blood-vessels in the medusæ, asserted to have been observed by Will. I should be inclined to advocate the severity with which Professor Forbes rejects all unproved assertions of the existence of certain, apparently to us, essential organs of living beings. The eagerness to establish the presence of vascular circulating systems in mollusca, because, in the highest classes, more exalted vital phenomena could not exist without them, is an example of the desire to account for every thing before we have sufficient evidence to guide our judgment. The logician is often heard to mix sneers with ridicule on the arguments derived from analogies. How, without analogy, are we to classify? How, without classification, are

cases the finger points were extinguished and the flame of the magnet-pole remained ; this was the case with larger

we to form categories ? It is the abuse of instruments that is productive of confusion in reasoning, and of the difficulty of arriving at just conclusions. The laws regulating nutrition, as well as reproduction, have yet to be carefully studied before we arrive at final decisions as to the means by which the ends are accomplished. To a certain extent we must confide in analogy ; but as events change our points of view, we must suspend judgment until more complete knowledge be acquired. The researches of the Baron von Reichenbach, as well as the daily developing new facts in mesmerism, are establishing the existence of the odic force ; and the phenomena produced by this power in controlling diseased growths, many of which may be regarded as subject to the laws regulating the existence of the lowest organisms, may lead, in future time, to the inference that those changes we now consider as essentially dependent on absorption and deposition, by means of a vascular apparatus, are but chemical compositions and decompositions effected by the agency of light, developed into activity from some latent form, or liberated from its association with that hitherto occult power, upon which the Baron von Reichenbach is shedding the luminous rays emanating from the crystallic arrangements of his highly organized brain.

It is unnecessary to ask the question as to the constitution of vitality ; for our knowledge is not sufficiently advanced to enable us to give a satisfactory reply. Chemical changes of a certain nature are the sources of the clearest definite idea we can form on the subject. The phenomena of life are dependent, probably, upon some imponderable agencies, the nature of which, man, in the present brutal condition of his civilization, studies at his peril ; for so keen is the bitterness of competition, that even the dignity of corporate bodies is occasionally compromised by the tacit countenance yielded to slander and calumny originating in the effort to distract public attention from gross private and individual professional incompetence ; and men are found, with pretensions to science and to social position, who can, in their eager desire to crush the truth, utter deplorable falsehoods, and quite forget the becoming characteristics of gentlemen. It is not to such judges that the researches into the curious phenomena of new imponderable agencies are submitted. With humble assurance that the investigations recorded are put forth to the world in the philosophic spirit of justice, the virulent attacks of malice are regarded with the pity to which their authors are entitled.

The authority of Humboldt has been adduced to affix some remote probability to the idea that *dead* fish may be an occasional source of the

and stronger bars. The equilibrium was displayed soonest in bars of four to six inches long. But this shewed itself

luminous appearances met with on the ocean; for this celebrated philosopher "saw a great extent of the surface of the sea rendered almost gelatinous by the admixture of numbers of dead *Dugysæ* and *Medusæ*." We have seen that there is the testimony of Macculloch for the fact that living fish in shoals occasionally under conditions of excitement emit light. Whether, at the moment, their bodies yield a luminous fluid or not, is a question to which no reply can be given; but it is well known that the pilchard and the whiting, for a short time after what is called death, shed forth a shining light, which ceases before the truly putrefactive process has commenced. I have seen a large area of fields on which pilchards, destitute of odour, at all events at a short distance, have been spread for manure, shining brilliantly one night, and the next all was dark, when the offensive effluvium from them became quite sickening. If the fish be examined during the process of death, an oily moisture can be scraped off, which in the dark, for a very short time, is found to be luminous even on the surface of water; but it is said that the light may be observed diffused through the water if the mass of it be agitated. Those fish which are known to become putrid soonest are those which earliest shine. In Tuckey's voyage, Professor Smith's account of his own observations made in the Atlantic corroborates those of other voyagers, that the *bright sparkling* light of the surface of the ocean is always emitted by *living* animals, and that the duller light which Horsburgh and others, as well as I myself, have seen emanating from a milky appearance on the water, is the result of "a dissolved slimy matter." Professor Smith examined this slimy fluid under a powerful microscope, and he detected "the most minute glittering particles having the appearance of *solid spherules*." In what kind of spherules can vitality be said to reside?—Not in spherules of carbonates or sulphates of metals or metalloids,—not in siliceous spheroids aggregated in rock crystal,—not in the diamond; but in those belonging to organized matter, whether in the lower or higher states of organization,—in the slime of the ocean, in which occasionally *dead Dugysæ* and *Medusæ* may sometimes be found, but in which, in luminous states, it may safely be predicated living spherules are always present: in dying fish, oil, constituted of living spherules, but which, exhausted of the presence of the imponderable agency giving it the power of shedding a light, not incident upon it, becomes dead matter, no longer having living phenomena, dead matter once organic, once crystallic; now resolved by the laws of chemism into inorganic elements. Are we to deny the existence of living spherules,

differently with different persons, and doubtless in different degrees in the same persons in different odic conditions :

because we are not yet gifted with the power of distinguishing the varieties in the size of their diameters and the relative positions of their molecules? Are we to admit the probability of their existence in the slime on the ocean? in the abundant fluid from the *Pholas dactylus*? in the mucus shed by certain luminous centipedes inhabiting the islands of the Pacific, which, on being rubbed off by the fingers, leaves an odour behind not unlike that of muriatic acid? and to deny that there can possibly exist spherules in the *light* which Macartney wiped off from the *Scolopendra electrica*, and which astonished him because he could detect no moisture? In nature is there no *variety in degree* in the qualities of her phenomena? Is it not notorious that in our susceptibilities to impressions there is every variety of degree? Some can see, in ordinary wakefulness, and in daylight, the blue sparks emanating from human fingers. Some can see a blue or violet halo surrounding a person under certain conditions. Others can, in the ordinary waking state, see none of these things, but are enabled to perceive them immediately by being put into mesmeric sleep by the agency of the human will,—by passes, by pointing of the fingers, or by presenting the apex of a crystal to the face or eyes. This light so perceived is like all other light; in some cases it dazzles by its brilliancy and diffusion, or is, under other circumstances, subdued and limited. In some persons it is associated with a cloud,—blue, grey, or silvery; in others it is clear, and like the shining of the sun. Such great variety is offered by the phenomena of animal light, and so many facts to evince its intensity, its concentration, or its attenuation. Some medusæ have been known to shine with a light so intense that the human eye could not long be directed upon it. It dazzled like the sun, and yet the point whence this illumination was distributed was not, in diameter, equal to 1-200th of that of the animal itself. Animal light, then, is manifestly subject to the laws which regulate all other matter; it is condensable and expansible, capable of being very intense or very much attenuated, according to the structure whence it is liberated. The phenomena offered by light emanating from inorganized matter are quite analogous. Varieties in degree may be traced from the light emitted by electrical agency from the points of charcoal to that emitted in the dark from the poles of the magnet. Nor are there wanting facts to shew the probability of this imponderable matter, as we call it, being subservient to the laws of attraction and repulsion; and if this could be established, imponderability would no longer be a characteristic of light.

There is a strong probability that all spheroidal particles have their

my own finger often extinguished the same magnet which that of Zinkel would not wholly put out : this was equally

polar and equatorial relations operating with *plus* or *minus* energy ; capable of being modified by forces powerful enough to control them. The proofs of the existence of this probability should be offered only to minds that can admit the truths of mesmerism. To others, as they are incapable of appreciating the subtleties of fine reasoning upon subjects of an extremely delicate nature, it is loss of time to waste facts. To pigs, to some adult agricultural hinds, to the majority of members of medical colleges, a grunt, a meal, or a sneer, would be more appropriate to their tastes and capacities. In all classes, the stupidities and the cunning sordid must be separated from the rest, that progress may not be obstructed. The Baron von Reichenbach had had the opposition of the unphilosophical to contend with in Germany, as we have here ; and if he would make himself master of Gall's works, he would find many reasons to pity his opponents, and some facts to shew that Gall, in his day, met with *stupidities* !

Mesmeric agencies allow us to place very susceptible and delicate subjects in such relations as to enable us to regard them as excellent tests for the elimination of facts which the state of our knowledge does not at present permit us to arrive at by any other mode of investigation. If we take a certain number of such testing subjects and obtain from them the same testimony, we may feel satisfied that we have as good evidence as if we had a galvanometer applied for the testing of electricity. If we find that in these, certain stimulants or excitants, whether applied in the form of a train of actions or in the form of the application to certain organs of the body of a magnet—a piece of pure gold, of pure platinum, of titanium, of nickel, of cobalt, or other definite substance, produce invariably a rigid condition of the muscles,—a tonic spasm, and that other stimulants or excitants produce immediate relaxation of that rigidity,—a clonic condition, we have a right to class our agents or reagents accordingly. My experience having led me to infer that tonic agencies are to be classed as attractive, and clonic agencies as repulsive, I arrive at the conclusion that that train of actions which induces rigidity in my testing subject belongs to an attractive pole, and the contrary to one repulsive. If I take a tube of glass, of porcelain, of hard wood, or of paper, and blow through it upon the upper part of the forehead of a testing subject, and produce instant rigidity, I infer that the particles of air passing through the tube have a plus polarity ; a force attractive. If now I reverse the tube, and by blowing through it in the direction opposed to that of the first blast I produce an almost immediate relaxation

the case when her finger was more strongly luminous than mine, which occurred not unfrequently. She was tall and

of the rigid state of muscles, I infer that an influence was left in the tube which, on the first occasion, determined a molecular arrangement of the gaseous particles that gave them one polar arrangement—*plus*, and that on the second occasion the polar arrangement was reversed and became *minus*. If now, without the knowledge of the subject who is asleep, but in the condition of relaxed muscles, I pour on the head a phial full of mesmerised air, I render the muscles immediately rigid; and then, exhausting the phial of the air which has displaced the mesmerised air, I quickly apply it to the head, I relax the muscles and sometimes suddenly awaken the subject; thus showing that the polarity of the particles rushing into the bottle, communicated by an influence derived from the person of the subject, has been opposite to that polar state which has been productive of the tonic conditions of sleep and rigidity. But several somnambulists in another room have witnessed the filling of the phial with blue mesmeric light, so that Reichenbach's odic force has been the source of these phenomena; and the light which has been associated with that force has been subjected to the same polarities. How is this ascertained? By blowing strongly in a direction across the stream of mesmerised air while it is poured out of the phial: no rigidity is produced, and a somnambulist sees the blue light blown away from the testing subject. Light is in these cases associated with some agency that communicates a specific gravity to the air. May be a minute dose of carbon or nitrogen from the animal textures.

It may be argued in opposition to such facts and such views that the results obtained by each mesmeriser differ from those obtained by any other person. This is a very curious part of the affair, and is an additional motive for further inquiry. It is very true that Major Buckley can make my somnambules exhibit phenomena of high clairvoyance, which I cannot succeed in producing. I can, by my will, effect several phenomena which Dr. Elliotson does not seem capable of producing; and I have at his house in vain tried to produce rigidity of the muscles in one of his patients, in whom a touch of his finger has at once effected the object. The differences between the mesmeric forces of my friend Mr. H. S. Thompson and myself have been repeatedly pointed out. Mr. Joseph Hands had a patient (Garman) in whom he could produce several phenomena that baffled me when I attempted them. These modifications are important facts for investigation, but they do not invalidate any series of established truths. It is a fact that upwards of thirty persons, who have been in a clairvoyant state, have seen blue sparks in

stout, but had small hands, in which the result was concentrated, and thus appeared with more intensity. When,

great numbers issuing from hazel sticks, but because not more than seven of these have exhibited the phenomenon of being forcibly attracted to a hazel stick when it has been held in the direction of its growth, and have been repelled by it when it has been held with its smaller end downwards, is that a reason why the established fact as to a highly curious phenomenon should be completely thrown away?

The relations of the subject of light emitted from the hazel stick and from some other vegetable organisms to that of clairvoyance are curious and important. In a previous note I have endeavoured to call attention to this point. Lately I have had opportunities of making experiments upon an analogous set of phenomena relative to the influence of odic light emanating from water, from glass, or from crystals, upon the nervous systems of certain sensitive persons, which tend to illustrate clairvoyance. They are so easily repeated that time only is required for thousands of corroborations of the events I have noticed; and although we have in England many *stupidities*, who, like the Baron von Reichenbach's critics, will carp at facts, which their maladroit minds will turn to ridicule and calumny, the simplicity of the apparatus required for these phenomena will speedily ensure a sufficient number of verifications. The persons who form the subjects of these experiments should be of highly sensitive nervous systems, and, as far as I have observed, should have heads well developed about the organs of ideality, marvel, veneration, and hope; comparison, time, time, and constructiveness; adhesiveness, philoprogenitiveness, and caution; and rather the contrary as respects amativeness, combativeness, self-esteem, cunning, and acquisitiveness. A phial of clear colourless glass, capable of containing eight, ten, twelve, or more ounces of filtered water, or a clear globe holding a pint and a half or a quart of water, answers the purpose well. The vessel should be completely filled with water, clean and clear. It should be mesmerized by some healthy person with a large brain, by darting the odic sparks from the fingers upon the surface of the water, at several hundred strokes, and by breathing upon it for some minutes. The vessel should then be closed, so that no bubbles of air are admitted, and when properly secured, should be placed in the hands of the sensitive person, who is to look continuously into it, uninterrupted by the proximity of too many persons, whose odic forces may tend to spoil the experiment. The mesmeriser of the water may be near, but it is better that not more than one or two persons besides, agreeable to the sensitive person, should be present. I have placed vessels of water so prepared in the hands of numerous sensitive

however, she carried the points of the fingers of her right hand towards the northward pole of the bar, there was no

persons, most of them quite unaware of the object of my requesting them to look steadily at the water. Some, in the course of a few minutes, have seen beautiful visions of persons and things that have given them delight. Others have seen objects which have terrified them. Some have described, vividly, charming country scenes, with elegant companies of ladies and gentlemen gaily attired, at boat races on a river. Others have seen hunting gentlemen, in scarlet uniforms, on fine horses. Some have seen funerals and churchyards; others, sick rooms, with death's heads flitting about the surface of the bed of sickness. Some have truly predicted to me the approach, to the house, of friends who were to knock at my door at stated times. On one occasion, a visit from my friend Mr. Hoffmann, of Mayence, was predicted by a person, who described him accurately without ever having seen him, except by the agency of the crystalline bottle of water, which she then held in her hand for the first time in her life, and without knowing the object I had in view in requesting her to look into it. At the moment I had a conviction that Mr. Hoffmann was either at Macclesfield or at Liverpool, but he made his appearance in my room in ten minutes,—the time my sensitive subject had indicated. A number of people have now repeated such experiments, and I am told that several persons who had failed, at first, in perceiving anything in the vessels of mesmerised water, had, by dint of patience and perseverance, after many repetitions of trials for half an hour and an hour at a time, become highly clairvoyant. If my health and my various pursuits had permitted, I should have instituted many experiments upon this subject with vessels of glass of various colours, and containing fluids of various compositions. The curious facts that have excited so much attention in relation to a crystal ball, bought by Mr. Morrison at Lady Blessington's sale, and those relating to the numerous fits of clairvoyance induced in Mrs. Woodard, by her looking into an oval piece of polished glass, are analogous to those I have stated. The *stupidities* rely, in opposition, upon the numerous failures that occur in the attempts to repeat the exhibitions of these phenomena. If it were possible that such persons could practise humility, I would refer them to the study of the Baron's researches, in order to prepare them for a proper spirit of investigation. After witnessing very numerous instances of clairvoyance, I can have no doubt but that the brain, apt for the purpose, is stimulated to the production of the phenomena by some relation which it bears to light; perhaps to this imponderable matter in combination with the odic force. What that relation is, must be determined by future investigation. Why certain

attenuation, no approach of the flames ; the like-named poles did not attract one another. As the approximation was

individuals should feel the influence of currents of water to be highly pleasurable, and others should shudder at them ; why running streams, and mountain rills, and sheets of falling water, should have such powerful attractions for some, and be indifferent or even repulsive to others, are questions that have relations to the phenomena of mesmerism, odic forces, light, and clairvoyance ; perhaps to the theories entertained by our greatest philosophers on the essence of light. The most extraordinary of clairvoyants, Andrew Jackson Davis, the American, has spoken of the existence of unparticled matter, as Huygens and his followers have thought of an elastic medium. It is admitted that philosophers should not seek for too many facts to account for a satisfactory result : a surplus of truth would appear unnecessary. The human mind has the capacity only for a limited quantity. Among the ideas it cannot embrace is that of space being filled with particles, and still requiring the existence of an unparticled or an elastic medium in which to contain these particles. Why is not the elasticity of the myriads of infinitely minute molecular spherules, attenuated to the requisite *degree*, sufficient to fill up space without leaving vacuum ? Constructed as we are, the organization of the brain is incapable of framing the idea of a vacuum. If pumps could be constructed to remove from a scooped ball even the imponderable matter which occupied its internal area, the noun space would remain, and it is impossible to make nonentity of that. But space in itself must necessarily be made up of an infinite multiplication of points,—“of nothings,” some mathematicians would reply. He who would intrude such a thought must have a confused idea of the relations of numbers to matter. All is ratio. All elements, all forces, are *plus* or *minus* ; and however subtle may be the power of ratiocination in any man, his brain is quite incapable of conceiving of the multiplication of any definite surface without the idea of increase, or the sense of thickness ; or of the multiplication of a line without the idea of increase relative to the sense of width. The negative series of decimals can never come to absolute nothing. A mathematical point, however minute, is susceptible of multiplication, as well as attenuated matter of further division of attenuation.

The difficulty in allowing of the complete occupation of space by most extremely minute molecular particles arises from the limited nature of our organs ; and very few philosophers have been at the pains of obeying Locke's direction on the examination of the degree to which habits of thought have influenced their assent to the adoption of a theory. If I place Jane M. or Mary D. on a couch or in a chair, and imagine a circle

carried further, the flames both became contracted at their own poles, assumed a globular form, and finally were

around that couch or chair, silly people would say that I had environed the individual by a magic circle, for she has not, until I remove that imaginary circle, the power of moving from the position in which I have placed her. I am told by clairvoyants, and by the subject herself, that the circle is one of blue flaming light. If this be so, the light has resulted from an operation of certain organs of my brain; and whether it has reached the floor, on which it is perceived, by the transmission of a certain number of spheroidal molecules from my brain, or that the brain has communicated an impulse to certain pre-existing undulatory elastic matter, the effect is the establishment in that circle of a force which directly influences the subject. That light and that force have remained for hours, on repeated occasions; and Jane has, when afflicted with serious delirium, been calmed at once by my will, and has remained quiet in bed the whole night, under the influence of the luminous circle. When I perceive the fact of so highly attenuated and subtle an agent as a flame of light from the brain, issuing to a circular line, remaining there, exerting a power over the organic operations of another individual, I find it difficult to bend my habits of thought to assent to the proposition, that that circular flame is undulatory elastic matter exerting a force which reverberates on Jane. It is easier for me to embrace the idea that the light is composed of very minute spherules, which, by attractive affinities not yet understood, except in so far as the researches in the text are elucidating them, have a relation to certain forms of animal light residing in the nervous system of another human being. Undulations and curves, necessary conditions, requisite paths, for the passage of even the most attenuated fluids through one another, are convenient ideas, as expedients, to enable us to apply calculation to the relations of dynamics.

To apply the words spiritual and immaterial to the class of phenomena under discussion, is to remove them from the domain of physics into the region of the absence of ideas,—into a territory in which the existence of non-entities must be affirmed. The instant the human mind loses the idea of matter, it wanders in a haze in which clear consciousness is no longer present,—it approaches, in a degree, the state to which narcotics reduce the perceptive faculties, and which, carried to its extreme limits, proceeds to fatuity and unconsciousness,—a condition incompatible with immortality, and thus involving an absurdity. One can conceive that however light may be hidden by combination with other forms of matter, it may reappear, but can never be annihilated as long as space exists. For all we know, its destiny may be immortal; its nature may be to become

partially introverted when the fingers and the poles came in contact, but both flames were at the same time in a diminished, dull condition. At other poles the result was exactly the same in the reverse order. But the multifarious modified experiments prove the same thing ; namely, that *the points of fingers act upon the polar odic flames like crystals and like magnets, and may in all cases be substituted for them.*

446. b. The variations just mentioned, produced by unequal strength of the reacting odic poles, went so far, that in one particular case I found the polarity of the odic flames of a weak magnet directly reversed by powerful hands. This observation merits attention, because it affords a further proof of *the independence of Od in contrast to magnetism*, similar to that which we had just now at § 436. I gave to Josephine Zinkel a magnetic needle four inches long, which was not strongly magnetic ; she held it by the middle, between two fingers, conformably in the meridian. When I took hold of its positive end, turned toward the south, with the points of the fingers of my right hand, the blue odie flame at the other pole of the needle became twice as long as it was originally. This great increase proved the weakness of the needle in proportion to my hand. But when I took hold of the positive end of the needle with the tips of the fingers of my left hand, the blue colour of the northward flame was lost, and a red flame half the length took its place. When I made the experiment the other way, and put the tips of the fingers of my left hand to the negative end of the needle directed to the north, the red flame at the other pole became more luminous and

infinitely attenuated and purified. But whether it exists associated with heat, electricity, magnetism, chemism, or odism, the mesmeric facts of clairvoyance show that it is the vehicle in which thought is conveyed, and may be the punctum saliens of the lowest animated spherule, as well as of the highest organized being.

three times as long. But when I took hold of the same negative end of the needle with the right hand finger-tips, the red colour of the southward flame was lost, and a blue flame took its place. It clearly results from this that the odic force of my hands far exceeded that of the weakly magnetic needle in reference to odic polar quality ; so much so, that it converted its red or blue polar flames into blue or red, when its Od was opposed to that of the magnet at the other pole, *and without in the least disturbing the true magnetic polarity of the ends of the needle.* My hands, which possessed no magnetic capacity whatever, acted so strongly odically upon the needle, that its Magnetod was completely overcome by Biod, and the flames changed colour. (It acted exactly as we have seen electricity act.)

447. In contrast to these means of strengthening the odic flame, I have become acquainted with *means of weakening* it, and as yet with two. The first is *Heat*. I showed Miss Sophie Pauer a horse-shoe in the dark ; she found its polar flames from two to two and a half inches long when cold ; when I had warmed it to the heat of one's hand on the stove, she found the flames diminished to about four fifths of an inch. And when the magnet had cooled down again, she found its odic flames of the same size as at first. On the following day I repeated the experiment with a larger magnet : I raised the temperature to a rather higher degree ; she again saw its flames diminish considerably in size as it became hot, and increase again in proportion as the cooling progressed. Wilhelmine Glaser, in the dark chamber, saw a polar flame of six inches length on a single horse-shoe with limbs ten inches long, as long as it was cold. I laid it upon the heated stove, and when it had reached about 100° Fahr. I brought it to her again ; she now found its flame diminished to about three inches. I placed the magnet on the stove once more, and heated it to about 144° Fahr., so that I could no longer hold it well in my unprotected

hand. Now, when I brought it to her again, she saw the flame reduced to an inch and a half. But when I had let the horse-shoe cool down, with the armature applied, the flame was as large as it had been originally. Josephine Zinkel made similar observations on the same horse-shoe magnet. The diminution of the odic flame appeared to her more strikingly in bars, when they were heated, the luminosity almost entirely disappearing. Accordingly as the odic incandescence of magnets is diminished by elevation of temperature (§ 369), so also, and in a more remarkable degree, is the odic flame; by heating steel magnets to a little above the boiling point of water, the flame would perhaps be wholly extinguished. It consequently diminishes far more rapidly in steel, with the increase of temperature, than the magnetism, which indeed also sinks, but far more slowly.

448. A second cause of diminution of the odic flame lies in another circumstance, of much more importance to the experimenter, namely, *the proximity of surrounding objects*. We have already seen what crystals, hands, and the like, can effect; I shall discuss the influence exerted by metals, metalloids, alkalies, and acids, brought in considerable quantity into the vicinity of flaming magnets, in the chapter on the light of matter. I shall here only speak of the remarkable *influence of approaching persons*. Miss Atzmannsdorfer often observed to me that she only saw the magnets I showed her well, when I removed to some distance from them, and they were not too close to herself. Madame Kienesberger called my attention to the fact, that, when occupied in making a powerful electro-magnet, I came too near it, its odic light became bedimmed and diminished. Mr. Hochstetter, when I accidentally went very close to an upright magnetic bar, the flame of which rose six inches high, found this disappear wholly from his sight, and reappear as soon as I had moved away again. To control this, I placed the

nine-layer magnet conformably with poles upward, upon a table; he saw it flame up about a foot high. As I then approached the magnet, the flame became weaker; and when I came quite close, so that my body touched its top, it entirely disappeared from his view: he saw nothing but the incandescent steel. When I moved away a step, it was restored, and I could repeat this as often as I wished. Dr. Nied saw exactly the same with the nine-fold magnet standing on a chair. In like manner, also, Mr. Delhez and the Baroness von Augustin. Mr. Pauer saw odic flame flowing from the nine-fold magnet in the dark chamber. I walked slowly towards it; when I had come within about half a foot, he saw the odic flame become dull, and when I was quite close to the steel, the flame was wholly lost to his sight. His daughter, Miss Sophie, witnessed this strange phenomenon at various times. She saw smaller magnets as well as the nine-fold always first grow paler, then lose the flame, as I approached them, and in each case it was restored as soon as I drew back from them. Wilhelmine Glaser frequently perceived my approach produce extinction of the odic flame on the nine-fold magnet, and even when it had recently been rubbed, and its magnetic intensity was at the highest pitch. But when I drew back only a little way from it, it immediately began to form again, and was wholly restored when I had removed to the distance of a pace. Madame Bauer frequently communicated this observation to me unexpectedly: when I accidentally approached the odic flames of magnets under examination, during the course of experiments, she complained that I came too close to them, dulled, diminished, or extinguished the flame by my proximity, which interfering with her observations about what I was asking her, she warned me to move away. Josephine Zinkel explained to me that when my immediate proximity had weakened the flame of the nine-fold magnet down to invisibility, my retreat did not restore it directly, but only

gradually ; and it was requisite for me to move to the distance of about forty inches for the flame to reacquire the full strength of its light, and my vicinity to become quite imperceptible in the appearance of the flame.

449. In order to master this deceptive phenomenon, I instituted the following experiment. I placed the large nine-fold magnet vertically, with its poles turned upwards. I then turned the northward limb to the east and the southward limb to the west ; and another time the former to the west and the latter to the east. In the dark chamber, and in the presence of Josephine Zinkel, I slowly and alternately approached and removed from both poles at once on the north side, with my face toward them. As soon as I came near, the flames were extinguished on both poles, and restored directly I removed again. When I so modified the experiment that I approached only my right side to the two poles, their flames were no longer both extinguished, but only one, namely, the northward blue flame ; the southward red flame became brighter and more intense in its redness and luminosity. When, on the other hand, I approached both poles with my left side, the reverse occurred ; the southward pole lost colour and luminosity altogether, while the northward very much increased in blueness and intensity of light. This made the matter clear, and brings it under the regular law.

450. It is, therefore, the odic quality of the entire person which reacts as strongly upon a magnet, even on a very powerful one, as magnets do upon each other, and especially with their like poles. We have seen how these act upon each other, depressing and extinguishing flame, and the biodic poles also act and react upon the poles of magnets, even when we cannot at all, or at least as yet not in every case, clearly state where the animal poles exactly lie in the particular instances, and which or what of the many complicated odic axes of the body it actually is which causes the

observed extinction. But a cautious investigator will perceive here a boundless source of countless errors, countless misconceptions, countless incomprehensibilities and enigmas, which up to this time have pressed like a mountain upon the so-called animal and mineral magnetism, and without the removal of which it is clear that normal and harmonious observations cannot be attained. Every physicist saw something different, and each met every day with something different from what he saw the day before; nay, during one and the same experiment, the results were modified under the hands of the investigators as they changed their positions or their assistants, and as the number of bystanders increased. They were unaware of the cause, never knew how to attain a fixed point in the experiments, the scientific ground trembled everywhere under their feet, and the complications ran out into infinity.*

* May my good friends, the doctors and professors of the self-styled commission, take warning, and not merely learn to perceive the weakness of their experiments, but also to feel the disgrace they have brought upon themselves by their groundless accusations against poor Leopoldine Reichel. They made a dark chamber, of which they themselves relate that, in their haste, they stopped the crack of the door with pocket-handkerchiefs. (*Zeitschr. der Gesellschaft der Aerzte in Wien*, III. Jahrg. 138.) Whoever has worked long in a dark chamber, can imagine what kind of darkness it could have been that was improvised in this manner! In the narrow space of a small room, the sensitive was crowded constantly with ten to fifteen young men, and some of these *went out and in* every now and then (*loc. cit.* 119 and 139). We know that the momentary penetration of light, even only through the smallest crack, renders the eye *dazzled and almost insensible to odic light* for more than half an hour; and here we have, as at the beginning, the rude effect of opening the door for persons going out and in! This alone is more than sufficient to render the results of such clumsy experiments wholly useless and valueless, and to make any deduction based upon them altogether ridiculous. If Miss Reichel saw nothing under such circumstances, as the accounts frequently declare, she told the truth, because she *could not* see anything under such perverse arrangements, not because she did not possess the capacity, but because ignorantly

451. The odic flame, as we see, affords no conclusions as to the direction of the magnetic force : to express myself in

arranged experiments rendered it impossible to her. Finally, however, she did see somewhat, gave confused statements, and on this account was called a liar and a deceiver. Let us examine the statements of these gentlemen, and see where lying and deceit are to be found. Leopoldine Reichel was placed at a distance of three to six paces from the magnet, there was usually a doctor on each side of her, who were appointed to watch over her, and they frequently held both her hands. Opposite to her sat another doctor, holding a heavy horse-shoe magnet in his hands upon his knees, and moving it about. Close to him, in like manner, at each side, sat a doctor, directed to control the movements of the magnet. The sensitive was now to state how and where the magnet was luminous, while it was being moved up and down ; they pressed her to show her art, laughed at and mocked her when her statements were incorrect, irritated and angered her to such an extent that she more than once struck at the gentlemen, and once was in the act of boxing the ears of one of them, &c. In the first place it is impossible that a moderately sensitive person, as Miss Reichel was at that time, could perceive any magnetic light in a darkness which was continually interrupted by the entrance and exit of spectators. In the second place, the distance of three to six paces from the magnet is far too great; a sensitive of this degree cannot detect magnetic light with certainty beyond forty inches. In the third place, the heavy magnet, a nine-layered, was held in a man's hand, quite close to his body, and thus completely extinguished to the eyes of the observer. This proves a *triple impossibility of seeing any emanations of light from the magnet.* Thus gross errors were committed in the experiments, any one of which would have been alone sufficient to render all sensitive perception impossible. Therefore she actually saw nothing, or only scattered, uncertain, and variable appearances of light—doubtless here and there from a hand, from one or more of the collected heads, from collected heads and hands, from hands lying upon the magnet, and thus rendered stronger; from eyes, from breath, from the pits of the stomachs, or from the knees of the crowd of doctors, &c., where such things accidentally came in contact, and momentarily raised each other's odic intensity. Notwithstanding that I detailed fully, in my writings, how very luminous all these living organs are, scarcely any notice was taken of this by these gentlemen ; they moved the magnet about in every possible direction before Reichel, and when she nevertheless perceived light, it never struck any one that there were such things as faces, eyes, hands, pits of stomachs, genitals,

Mr. Faraday's words, no lines of magnetic force make their appearance in any odic phenomenon. In order to get some evidence on this point, if possible, I made an experiment with the magnetic curves which we obtain by filings. I laid a magnetic bar two feet long upon the floor, and covered it with a glass plate four feet four inches in diameter—thus more than twice as long. On this I strewed iron filings, tapped gently with my finger on all sides of it, and thus produced the well-known figures. I now led Miss Reichel to it in the dark, without her having seen anything of the arrangement previously. She no longer saw any flame upon the bar, but the magnetic curves were beauti-

&c., all of which are luminous, and this usually more strongly than the magnet. In this confusion of all the conditions of scientific investigations, the poor tormented girl knew no possible way to satisfy the questions that poured upon her; and when incongruous answers were the result of such unskilful experiments, these gentlemen did not hesitate, instead of owning their ignorance, to take refuge under the unscrupulous slander, that the observer was a deceiver. They were not ashamed to decorate this bare assertion with stories which bear the stamp of improbability on their very face. Thus Miss Reichel is said to have slipped slyly up to the magnet which one of the doctors held in his hands in the dark, and felt for it with her hand in order to find out where it was. This is clearly false, for it carries its own refutation with it. For if she could not see the odic light, she could not go toward the magnet; and this because it was above the head, under the feet, at the side of, or behind the person who held it, and thus she could not know where to look for it: yet she was sure to catch hold of the body, the head, or the feet of the experimenter, or even to put her hand to his eyes. This accusation is thus evidently nonsensical, and it will be vain to throw dust in the eyes of a thinking reader with such silliness. The girl herself was moved to tears when I told her of this passage in the medical journal, and could not find words to express her pain and indignation at such calumny. The want of accuracy which is here evident cannot be laid to the accused, but to the accusers, and required an earnest correction. People should not set up for judges in a matter when they at the same time exhibit so much ignorance; but to endeavour to cover this ignorance by untruth, at the cost of one who is defenceless, is quite detestable and abominable.—*Author's note.*

fully illuminated. Each particle of the filings appeared luminous to her, and by their arrangement they formed lines of light exactly in the direction of the curves. The whole appearance sparkled at all points at once in every colour of the rainbow, and elicited from her the exclamation that she had never seen anything more charming in her life.

452. Two years later I repeated the experiment with the healthy Josephine Zinkel, in the dark chamber. The results were the same descriptions and the same pleased astonishment at the beauty of the sight. She saw millions of brilliant coloured stars lighting up the plate, all arranged in the curved lines. She evinced the greatest pleasure when I tapped it gently, and the little stars jumped up and danced about. She saw the whole northern half luminous with a bright bluish light; a brilliant red prevailed more on the southern half. She added the further observation, that the entire glass plate was *bounded* all round its circumference by a *seam of light*, which was composed of all the prismatic colours. According to her statements it was but narrow, some one-eighth or one-tenth of an inch broad, and the colours formed parallel streaks in it. Otherwise, neither the sick nor the healthy observer saw any other figures but the magnetic curves already known. Thus nothing observable had occurred beyond the conversion of each filing into an induced magnet emitting odic flame.

453. The discussion of odic flame may be concluded with a little practical application. There is a fable widely spread in Germany, and our poets have depicted it in the most stirring scenes, that spirits, witches, and devils, collect in great numbers at night, to dance on the Blocksberg. Everything has an origin; and now we see that this myth is not without some kind of foundation. It was discovered long ago, that there are rocky points on the Blocksberg which are strongly magnetic, and divert the magnetic needle; more accurate investigations have shown that these rocks

contain fragments of magnetic iron ore,—for instance, the Floenstein, the Snarcher, and others. The necessary deduction from this is, that they emit odic flames, and that these must be visible at night to sensitive eyes. Therefore, when persons of strong odic vision have come to such places on dark nights,—hunters, charcoal burners, poachers, wood-cutters, &c.,—they must have seen delicate flames of various sizes and colours blazing all around, flaring backwards and forwards with currents of air. Who could blame them, if they took this for the devil and all his train of spirits and hags dancing round? The feast of the Walpurgis Night must now, alas! yield to the soberies of physics, which have scattered with their light that fair cloud-picture of fancy.

453. *b.* The compressed retrospect on the odic flame tells us—

a. Very weakly magnetic steel exhibits odic incandescence without flame; as soon as the intensity of the magnetism passes beyond a certain point, emissions of light occur, which display themselves as vaporous, misty, and finally flame-like, especially at the poles of the magnets, and appear not unfrequently as high as a man, even to healthy eyes.

b. Terrestrial magnetism exercises great influence on the size and colouring of the odic flame; and the phenomena of these occur differently according as the magnets are placed with one or other pole towards north, west, south, or east, turned upwards or downwards, in the magnetic dip, or in any other intermediate direction.

c. Iron bars behave like weak magnets in relation to Od, when under the influence of terrestrial magnetism.

d. Banding occurs in the odic flame, just as in the odic incandescence.

e. The direction of the flame exhibits a tendency upwards.

f. Magnet-flames of unlike poles, opposed diametrically

to each other, and gradually approximated, exhibit little or no mutual attraction, do not lift each other up, but repulse one another, accumulate around their own poles, and become introverted. On contact, the introverted flames disappear, and a delicate intermingled flame appears enveloping the opposed poles.

g. Odic flames meeting one another cross-ways, carry one another onward.

h. The flame obeys currents of air.

i. All the manifold effects which one magnet produces upon others, are either directly reflected in accompanying odic phenomena, or give rise to peculiar appearances of the odic light. The rubbing of magnets affords numerous examples of this.

k. The same occurs when the armature is used as an induced magnet, and moved in different directions over the magnet.

l. The divergences between Od and magnetism, which arise here, not unfrequently go on to such a contrast that + Od and - M. co-exist simultaneously in one magnet pole.

m. Electro-magnetism produces the phenomena of odic flame in exactly the same manner.

n. The electrical atmosphere strengthens them, and under certain circumstances reverses the poles.

o. Heat weakens the odic flame.

p. Crystals and animals (human hands) influence the odic flames like magnets, strengthen them, weaken them, reverse or destroy them, both in contact and by mere approximation.

q. The magnetic curves produced with iron filings over bars, present to the eye a multitude of stars of minute odically flaming magnets.

r. Odic flame is a material object, probably a substance rendered luminous, but by no means magnetism.

III.—ODIC THREADS, STREAKS, AND NEBULÆ.

454. It is already known from the accounts of Misses Reichel, Nowotny, and Maix, given in an earlier part of this work, that magnets emit *a light in the form of streaky luminous mist*, in addition to the polar flames of the edges and corners. These observations received confirmation, meanwhile, through repeated perceptions of Baron August von Oberländer, who described the little lateral flames as streaks and brushes; of Miss Atzmannsdorfer, who saw, once between the limbs of a nine-layered, another time of a seven-layered horse-shoe, the whole space filled with threads of flame, and the outer part of the entire magnet enveloped in a delicate fiery mist, both of which she often mentioned in the course of experiments, without my having taken note of it on every occasion; of Miss Zinkel, who found not only the strongest magnets, like seven-layered and nine-layered, but also even a mere single horse-shoe, when rubbed with a five-layered in the dark, covered with a luminous mist two and a half inches broad between the limbs, and two-fifths broad around the outside. She, moreover, saw odic conducting wires, the flames at the ends of wires, also on tinned-plates, disks, and globes of iron, when under induction by a magnet, the first at the edge, the last two over their whole surface, and many other emanations of odic light, appear as streaks, and like a mist; to which I shall recur more circumstantially in their proper places. She perceived these misty luminosities more vividly on open magnets. When closed by the armature, these appearances either vanished altogether, or, as in most cases, merely became dulled and diminished. Farther, through those of Miss Winter, who described a three-layer horse-shoe, as coated all over with delicate fire-mist; of Dr. Nied, who saw a simple horse-shoe, with its armature applied, enveloped to a

thickness of one inch and three-quarters with luminous mist, as also a seven-layer ; of Miss Sophie Pauer, who, like Josephine Zinkel, saw magnetically induced iron disks and globes enclosed in luminous mist-like vapour ; of Miss Weigand, who perceived a small strong horse-shoe magnet lying upon her hand at night, to be enveloped in fire-mist ; of Madame Bauer, who detected fire-mist over all bars and horse-shoes, from the smallest pocket horse-shoe to the nine-layer ; of young Stephen Kollar, old Sebastian Zinkel, and Miss Dorfer, who perceived the lambent fire-mist playing over the sides of all horse-shoes inside and out ; finally, of Madame Kienesberger, who, especially during menstruation, saw all horse-shoes furnished with luminous streaked fire-mist, in such a manner that it was weakest at the curvature, sometimes almost imperceptible, but from here to the poles became continually stronger, exactly as Miss Reichel had described it at first.

455. The emissions of light also exhibited *colours*. Miss Zinkel saw the fire-mist between the limbs of the horse-shoe, red on one side, and blue on the other, the colours playing into each other, so that the interspace had a variegated appearance. This was still stronger with compound horse-shoes, because each limb gave out red and blue mist at once, extending inside and outside as far as the curvature.

456. This luminous mist was very vividly developed along the magnetic bars, which *I exposed to the influence of the electrical atmosphere*. The observer found single bars enclosed all along in fire-mist nearly two inches broad. The interspaces between the limbs of horse-shoes then became completely filled with it, and gave the appearance of masses of luminous threads, variegated with red and blue sometimes even in the prismatic colours.

457. The emissions are always stronger from the *corners and edges* of magnets than from their surfaces. In bar mag-

nets they are symmetrical on the two opposite sides ; almost absent in the axis of the bar, then increasing gradually toward the poles, strongest at the ends of the poles, not at the magnetic foci, which, as is well known, lie about one-seventh of the half-length of the bar below the poles. But on horse-shoe magnets it is unsymmetrical, and was seen by Madame Bauer, Madame Kienesberger, Miss Atzmannsdorfer, and Zinkel, far more vividly inside the limb than outside ; so that the streaked emissions from the limbs in many cases occupied the greatest part of the space between the limbs, and in some filled up the whole with their luminous fiery mist. Mr. Pauer could only detect the fire-mist clearly between the limbs of the magnet.

458. When I *applied the armature* to open horse-shoes which possessed the fire-mist, this instantly diminished considerably, but did not disappear. According to the observations of Miss Atzmannsdorfer and Miss Zinkel, it became rather more than one-half narrower and shorter, but more especially duller, less luminous, and more opaque ; if it had been yellow and red previously, the influence of the armature would make it greyish-yellow, or wholly colourless and grey. This was also the case when I closed the horse-shoe magnet with a second horse-shoe instead of the armature. Dr. Nied, who observed very strong odic mist upon open single magnets, could scarcely see anything of it, detecting only the dull odic incandescence of the steel, as soon as I applied the armature. His sensitiveness is weaker. The conduction through the armature was thus apparently imperfect in all cases, and a portion of the current of the dynamic constituting the magnet continually passed off into the air. These confirmations are more than sufficient to warrant the accuracy of the original statements on this head given by Miss Reichel, as set down in the first part of this work.

459. It is very probable that these envelopes of fire-mist

are constant, spread over the whole of the magnet, weak but interruptedly continuous emanations of Od, only perceptible to the higher sensitive, on account of their slight degree of intensity, and scarcely, or not at all, to those of weaker sensitive vision.

460. Almost all the highly sensitive also described to me *isolated coloured threads, which they perceived in the odic flame.* I have already mentioned this of Miss Atzmannsdorfer and others. Madame Bauer also called my attention to this observation. The Baroness von Augustin saw them rise frequently over the nine-layer, and a five-layer; also from an electro-magnet. I examined this phenomenon most accurately with the healthy girl Zinkel. On nine-layer horse-shoes she saw many separate, strongly luminous, thread-like streaks, rise out from the poles into the odic flame, which were not very slender, but about as thick as a common pin, not taking their origin below immediately from the steel, but first distinctly formed at some height above it in the odic flame. These threads she always found either blue or red. They did not move, but always flowed forth uniformly in the flame, especially in its upper parts. She observed this phenomenon most clearly in the banded alternation of the colours of the odic flame over the layers of the nine-fold horse-shoe, mentioned at § 396. Here she distinguished accurately, that, from the red odically incandescent layers, arose red, and only red streaks of light, from the blue odically incandescent layers blue and only blue in the flames, which were always of just the same colour.

461. I do not think these phenomena are of special kind, but look upon them as equivalent to the rest of the odic flames in general. The cause probably is inequality of the issue from the surface of the magnet at very minute points. Since we know that edges and corners cause stronger emission, I think we have a right to assume that smaller unevennesses may serve as points of emission, and thus cause the

formation of threads, streaks, and mist-like appearances. They are little currents of Od locally concentrated in the general current, blue from the negative, and red from the positive poles.

IV. ODIC SMOKE.

462. The next phenomenon of light attaching itself to the odic flame of the magnet is a peculiar luminous vapour or smoke, which ascends from the magnet, and is seen by the sensitive in the dark. I made little or no mention of it in my earlier treatises ; but as in the further prosecution of my researches it pressed itself upon me unavoidably, and always in the same manner under like circumstances, I have necessarily recognized it as an essential part of the odic luminous phenomena, and turned attention to it.

We will, in the first place, hear and critically compare the statements of the many witnesses I have met with.

463. First, the healthy sensitives :—

Mr. Edward Hütter saw a dim cloudy appearance over a pocket horse-shoe, which, as he moved the magnet in the dark, was carried about with it, and thus doubtless belonged to it. The Baroness Pauline von Natorp saw five- and seven-layer horse-shoe magnets covered with a luminous cloud at the northward pole alone. She perceived slight marks of a misty brightness on the nine-layer. She discerned a grey smoke ascending to the height of one's hand from an electro-magnet. Professor Ragsky saw the northward pole of a single horse-shoe magnet emit, with intermissions, a bluish, weak, and vaporous light. Professor Huss, of Stockholm, the Court Physician, perceived abundance of smoke rising, and passing up in clouds, from a strong electro-magnet. Mr. Demeter Tirka observed that the same nine-layer was enveloped in a cloudy luminosity, which weakly lighted up its entire circumference. Mr. Pauer saw all

largish horse-shoes exhale vapour. He perceived a luminous cloud over each pole of a strong electro-magnet. Mr. Hochstetter discerned a grey smoke ascending forty inches high over the nine-layer magnet: when I placed the horse-shoe in the electrical atmosphere of the conductor, he saw smoke rise to the height of a man over the odic flame, throwing a light upon the ceiling. Mr. Sebastian Zinkel observed smoke produced over the odic flame of a single horse-shoe to three times its height. Mr. Fernolendt saw luminous opake smoke ascend to the ceiling over several horse-shoes in the electrical atmosphere of the positive conductor. Madame Josephine Fenzl, at various times, perceivcd a cloudy light, like thin smoke, almost as high as a man, over the flame of the nine-layer horse-shoe. Madame Isabella von Tessedik and the young Stephan Kollar found all bars, horse-shoes, and electro-magnets, to possess misty lights, either only at the northward or at both poles; the latter saw the smoke whirling up in clouds. Mr. Theodore Kotschy saw a wide-spreading light sweeping like a vapour over the nine-layer, resembling a delicate halo, more than forty inches high; the same was detected by Madame von Varady and Madame von Peichich. The joiner Klaiber observed a luminous smoke above the flame of a three-layer horsc-shoe, gradually losing itsclf in the air above. Mr. Gustav Anschüitz saw a lambent vaporous light appear on a three-layer going and coming, always at the northward pole alone, sometimes paler, sometimes brighter. Another time he saw unipolar misty lights appear over several horse-shoes, but remaining constant. On the nine-layer, in imperfect darkness, at his own house, he saw a misty ball of light wave over one pole alone. Mr. Delhez perceived a column of smoke above the efflux of light from a large electro-magnet ascending vertically to the ceiling of the dark room, and then producing a large illuminated patch, larger than the nine-layer caused. The smoke was diverted there, and flowed visibly along the

ceiling. Miss Ernestine Anschütz perceived the odic vapour over the nine-layer, and over a five-layer, most distinctly when I approximated the friendly poles of the two little magnetic bars to them. Mr. Nicolaus Rabe saw every odic flame that issued from magnetic poles pass gradually into a light vapour; he estimated this at four to five feet high over the nine-layer magnet. He saw a large bar magnet, four feet long, with flame twenty inches long at the northward pole, and twelve inches long at the southward; both flames then passing into smoke, which was light and fine at the northward pole, and dense and duller at the southward. Miss Sophie Pauer perceived a flame twelve to sixteen inches high over the nine-layer, and this passing above into luminous smoke, which ascended almost to the ceiling. But in the electrical atmosphere she saw its smoke strike against the ceiling. Baron von Oberländer detected many of the emissions of odic light as delicate vapour, especially the large column of odic flame of a heavy nine-layer horse-shoe. appeared to him to pass above, when it approached the ceiling, into a kind of thin smoke. Professor Endlicher discerned, over the luminous emissions, forty inches long, of a strong electro-magnet, a column of smoke-like, weakly luminous vapour, which rose vertically to the ceiling of the dark chamber, was turned aside then, and flowed onwards horizontally, lighting it up. Wilhelmine Glaser saw the nine-layer alone, but still more when within the electrical atmosphere, as well as large bars pour out smoke above the odic flame, up to the ceiling; also the electro-magnet. These last observations were repeated on a greater scale with Madame Cecilia Bauer; she saw smoke above the odic flame on all magnets without exception,—on the stronger partially brilliantly coloured, as if iridescent and containing sparks. She always saw it stronger, thicker, and duller over the reddish odic flame; finer, thinner, and lighter, on the blue. Dr. Nied observed vaporous exhalations over every flame-

like emission, both from magnetic bars and horse-shoes. He always found them stronger on the southward pole than on the northward, especially on a single and a seven-layered horse-shoe,—of an arm's length in the latter. He saw a column of vapour ascending from a nine-layer horse-shoe rising to the ceiling, and luminous. The Baroness von Augustin discerned smoke in rolling clouds rising vertically to the ceiling, over the flame-like lights on the nine-layer, and still more over an electro-magnet. Josephine Zinkel, in a series of experiments—to enumerate which would be a wearisome repetition—saw every bar-magnet and every horse-shoe of tolerable strength, change, at the positive pole, from reddish flame into dense, dull, weakly luminous, reddish-yellow smoke ; at the negative, from blue flame into delicate, etherial, grayish-blue vapour. On the smaller or simpler horse-shoes she found these clouds like emanations from four to twelve inches long,—on nine-layered often as long as one's arm, and, when it was strengthened, eighty inches and more in length. She saw magnets of high intensity, especially at her periods of menstruation, covered all over with delicate vapour close to the poles : she saw the smoke emerge to an arm's length from the banded flames of horse-shoes composed of several layers ; during the rubbing, and in the different relative positions the two horse-shoes were thereby made to assume, she saw a rubbed single horse-shoe throw out dense clouds of smoke, especially at the southward pole : in many cases she saw only blue flames at the northward pole, and no flame at the southward, but only dull reddish smoke. When, under such circumstances, the curvature of a single horse-shoe lay upon the poles of a five-layered, whereby—as we have already seen—the flames on the poles of the former were doubled, there was also always a simultaneous marked heightening of the odic smoke at the positive, and of the odic vapour at the negative pole, over the flames of the rubbed magnet.

But when this was so attached to the rubber at two-thirds of its length, that it would no longer support the armature, and its poles thus came into a condition of magnetic indifference, there was a little blue flame visible at the negative pole, but at the positive none whatever; only reddish smoke. A horse-shoe electro-magnet exhibited masses of smoke whirling up violently above both polar flames, and the beholder could here distinguish isolated flocks of smoke continually detaching themselves from each other, like drifting clouds, which was also frequently described to me by the joiner Klaiber, and others. She saw the nine-layer emit dense smoke from the flames when in the atmosphere of the electrically charged conductor (§ 436) : this was the case also when the proximity of the conductor had caused a reversal of the polarity in bars and horse-shoes : these masses of smoke rose up to the ceiling, and sometimes illuminated the painting upon it, so that she was able to distinguish the lines of the pictures here and there. She always saw the smoke rise in greater abundance from the positive pole than from the negative, especially on electro-magnets. Small bars or needles four inches long sometimes appeared without flames at either pole, but the negative pole with grey smoke. She saw bars of twenty-four and forty-eight inches in length, furnished with smoke over the flames of both poles, weaker and bluish-grey at the northward pole, stronger and yellowish-red at the southward. When I placed caps of different forms upon bar magnets, so that the poles terminated in two, three, or four teeth, each tooth delivered its own weaker current of smoke over its flame. When I approximated the friendly poles of two bars eight inches long to the beholder, she observed in the smoke, as in the flame, the tendency to flow out toward each other, and meet ; but when they came near, the union, which seemed imminent, did not come to pass ; for the flowing vapours, retracted together with their flames around

their own poles, and accumulated upon them, were introverted with the flames, as I have already described of certain odic flames. When I approximated two horse-shoes together in a similar manner, the result was similar ; when they lay upon a table (see above, § 394, 405), the ascending smoke was first formed in the middle between the two poles at the ends of their flames. When the poles came so close that the flames were introverted around their own poles, the smoke was no longer produced in front of the poles, but behind, toward the curvature, from the introverted flames ; and when the approximation of the flames together was great enough, from out behind the curvature in the manner already explained above ; to which I refer. The behaviour of the smoke is parallel in all cases, in size and intensity of light, to that of the odic flame.

464. Now the sickly and diseased sensitives :—

Miss Dorfer saw the flames pass off into smoke on various magnets. Miss Winter discerned in the dark, emissions of odic vapour, from a three- and a five-fold magnet, not merely from the poles, but the entire horse-shoes enveloped in it. Miss Weigand saw the nebulous flame of a little pocket horse-shoe wholly enveloped in luminous vapour. Miss von Weigelsberg saw the same horse-shoe emit unsteady clouds, an inch to an inch and a half long at the poles, longer at the one than the other ; they appeared to increase and diminish somewhat, alternately : at another time she found all magnets that were presented to her throw out clouds, especially at the poles. Madame Johanna Anschütz observed luminous vapour rise to the height of a hand from the poles of a five-layer, a foot high from those of a nine-layer horse-shoe ; in like manner luminous clouds waving upon the poles and between the limbs of a large single horse-shoe. Madame Kienesberger saw on all many-layered horse-shoe magnets the polar flames pass into odic vapour above, which became gradually lost further up. She detected this with especial

distinctness over the poles of the nine-layer, where she saw the misty smoke rise to almost the height of a man. Madame Kienesberger also thought she could distinguish between the lower and upper parts of this emanation of light, and believed the former to be more ethereal and misty, the latter more like smoke, becoming more attenuated, and vanishing some distance higher up. She undoubtedly saw the luminous mist below of the negative pole, which all the observers perceived to be shorter, better than the smoke of the positive pole, which reached up beyond the former, and ascended towards the ceiling. Her statements about the odic mist and smoke over a large electro-magnet agreed so completely with those of Zinkel, that there is no necessity to repeat them: she also saw the odic mist rise to the ceiling; but this only happened in such a degree when a rather strong Smee's battery was employed: with a smaller battery the smoke and flame did not rise so high, the flame not above eight to twelve inches. Terrestrial magnetism also sufficed to produce similar effects: a soft steel rod, fastened by the middle in a wooden holder, and placed in the meridian, appeared to her to have little flames and short smokes at both poles, gray at the northward and yellowish at the southward pole. When I brought this rod into the direction of the dip, the remarkable phenomenon again appeared of antagonism of magnetic and odic polarity, and reddish-grey flame was displayed at the lower negative magnetic end, bluish at the upper positive, with odic mist of the corresponding colours at the two sides: in this instance the reddish-grey smoke, being shut out downwards, struck against the floor, at the distance of two feet, and then spread itself out on all sides. Friedrich Weidlich could not at first see various magnets I placed before him; but after he had remained more than an hour in the dark he distinctly perceived the nebulosity next the odic flames which were lost in it above: he described the flame and smoke as passing into one another

in such a manner that in particular places they were indistinguishable. He saw a five-layer smoke particularly strongly ; it was of newly and pretty strongly magnetized steel. He saw dense reddish clouds of smoke rising in confused masses from the flame, as high as a man ; from the nine-layer magnet, ascending to the ceiling, and whirling upwards in constant streaming motion. When I blew it, he saw it driven about and disturbed for a few moments, but soon returning spontaneously into its former position. On another opportunity I made a new series of experiments on the nine-layer magnet with him : he again saw the smoke rising up to the ceiling, as it were in clouds following one another. Johanna Kynast also perceived that the flame, of a man's height, of the nine-layer, possessed luminous odic smoke. Miss Marie Atzmannsdorfer saw the odic smoke over magnets so very many times that I ceased to set down any further notes of it, and shall merely observe, that when her visual power was weakened by any circumstance, or she had not remained long enough in the dark, she always detected the odic smoke before she could see the odic flame ; and that as her vision increased and became more acute, the mists appeared to yield to the flames and took their place upon the latter ; yet if the odic flame by degrees became developed with greater intensity of light, the smoke appeared to become paler than before. She often saw strong odic smoke, from the nine-layer, spread out upon the ceiling, and illuminate the whole of it for several minutes.

* Thus we have here a dozen new testimonies added to the numerous proofs of the accuracy of all Miss Reichel's statements ! It would be quite inconceivable how the Vienna physicians could possibly arrive at the monstrous declaration, that Miss Reichel had never seen any magnetic light whatever, and therefore was an impostor, were it not that the reader of their report sees at a half-glance how their experiments swarm with errors and mistakes. One among these, and not the least, was the collection of ten to fifteen young men in the space of a small

471. That which more than twenty witnesses have here deposed is essentially consistent, not only in itself, but also harmonizes with what we already know concerning the odic flame, with which it is most intimately connected ; it there-

room. Whoever has the least knowledge of this subject knows that human beings exert a very strong reciprocal odic influence upon each other ; and it is explained at length in my treatises, that a human body is a constant source of magnetic, or, more properly speaking, odic force, radiating in all directions. With such reciprocal and universal active influence in action, how could a dozen doctors and professors expect and ask that an ignorant sensitive placed in the midst of them should have any clear ideas of the complicated forces acting in every direction, and give clear and scientifically available answers to the questions which they themselves did not understand how to put correctly ? Every human being is a much stronger source of Od than a steel magnet. The immediate vicinity of a single man, in many cases, on the one hand, destroys the vision of a sensitive ; and, on the other, interferes with the visibility of a magnet. When I make an experiment on light with a sensitive, in the dark, the first thing I do, before putting my questions, is to draw back several paces, first from the person, then from the object of the inquiry, to remove the influence of odic radiations from my own body, which would complicate the results, and render them unavailable for the purposes of science. Instead of observing similar precautions, these gentlemen stationed a doctor on each side of Reichel, who sometimes held her hands,—a condition which no sensitive whatever can endure,—and then placed the magnet opposite her, on some one's knees, &c. It is impossible to help laughing at the idea of such experiments. Reichel, thus put to the torture, was now, on the one side, to corroborate the ignorant declarations of prejudiced persons who placed her in this unsuitable position, and who were exposed to shame by every negative answer she gave ; she was further to answer the strained expectations of the assemblage, who unceasingly irritated her by mockery, and drove her to outbreaks of anger by contemptuous treatment ; in this total disturbance she was to solve with precision the most delicate possible problems that can be offered to touch or sight,—solve them under physical and moral conditions in which they were absolutely insoluble, what else could result, but the miserable confusion with which the pretended report of the butted girl's answers abounds ? Under such circumstances it is not worth the pains to go into the separate statements, whether repeated truly or untruly, understood or

fore bears the stamp of truth so surely that it can only be denied in random, inconsistent talk, which, however, unfortunately is met with in many persons who wish to be called philosophers, but who very often do not possess even a smattering of scientific logic. If we now compare the above scattered perceptions of so large and so varied a series of observers, during a space of more than three years, we come to the following axioms :—

a. All magnets, steel permanent magnets as well as soft steel and iron induced magnets induced by terrestrial magnetism and electro-magnets, exhale in the dark a misty and *smoke-like delicate vapour*, next to the odic flame ; it also flows from the sides of magnets, although much more weakly, and often imperceptibly. The strength of its efflux diminishes from the poles to the magnetic axes ; in the axes it is relatively very small, but not absolutely wanting.

b. *The magnitude of this smoke-like luminous essence* is directly proportioned to the size of the odic flames associated with it. When this amounts to an inch or so, the longitudinal extent of the smoke does not much exceed these dimensions ; when the odic flame rises to a yard or more, the odic smoke ascends to the height of a man, and higher. But its magnitude is also proportionate in the same way

not ; the whole is mingled together in a hopeless complication of mistakes.

Reichel was, in her time, a most excellent sensitive, the best that could be desired for scientific investigation, had extremely delicate sensation and excitable vision, at the same time was willing, persevering, accurate and truthful in her statements, modest in expressing her opinions, and acute in comprehending properly stated questions. But one must not ride rough-shod over such tender instruments of delicate investigation. Neither did these gentlemen know what they wanted, nor did the girl or her helpless guides what to do. Science is not created in this way, but people may thus expose their foolishness, and insolently cloak it by calumny, at the cost of an unprotected women.—*Author's Note.*

to the size as well as to the intensity of the magnet from which it issues. Large magnets of small intensity (like my nine-fold horse-shoe in many cases) gave large odic smoke ; small magnets of greater intensity afforded proportionately long flames, with abundance of vapour. But no pretensions are made at present, in the very beginning of the discoveries, to accurate determinations of dimensions.

c. The odic smoke is *thrown out by magnets* with a certain *force*, which gives it the first direction, but after that it exhibits a constant *tendency to ascend, to flow upwards*. When it reaches the roof of a room it spreads out, flowing away over it, illuminates the painting on it, and displays a certain, though short, permanence. Whatever material substratum may form the basis of its manifestations, it is in any case either lighter than atmospheric air, or it suffers some kind of repulsion from the earth's surface, driving it away ; that is, upwards.

d. It exhibits certain differences, according as it issues from the positive or from the negative poles of the magnets ; the positive, southward pole, gives it out reddish-grey and yellowish-red gray, thicker, inclined to produce cloudy masses ; the negative, northward pole, affords it blue-grey and bluish grey, more delicate, lighter, and more ethereal. When its intensity diminishes, more of green (grey ?), becomes intermingled in both kinds of odic smoke ; at last they become wholly grey. Yet there occur exceptional cases, when the odic smoke of the magnet-poles changes, blue smoke appearing at the positive pole, and red at the negative ; this happens when bars are placed in the direction of the dip, and in a few other cases of special nature,—*e. g.* where there is reversal of the odic pole while the magnetic polarity remains unaltered, &c.

e. Although always present above the odic flame, yet there are also cases when it is visible without it. This

occurs when the magnets possess no great intensity. In such cases the sensitive frequently see a blue, uni-polar flame appear over the northward pole, with no flame on the southward; but instead of this, a thick reddish odic smoke from it. In still weaker examples no flame at all is seen at one pole alone; and, nevertheless, odic smoke is detected over either one or both.

f. The odic smoke so far displays a material nature, that it may be disturbed and broken up by blowing on it, on which it requires a short space of time to recover the original shape in the succeeding waves. It has, to a certain extent, the aspect of the vapour of phosphorus, only with much weaker luminosity.

472. The relation between odic flame and odic smoke is a question we now approach; but it is one very difficult to answer at present. Whether they are really two specifically different, or only one in different modifications, I cannot now decide. All the inquiries I have made on this subject, of those who have had both before their eyes, have been answered by the assurance that the two are quite as different as a common flame, and a luminous smoke issuing from it and losing itself in the air above. Nevertheless, when I reflect that sensitives of weak vision in all cases see only smoke where the more highly sensitive perceive flame with smoke wavering over it; that when the former discern small flames with little smoke, the latter describe much larger flames with much stronger smoke; that the same persons also see the same things diminished when their vision is weaker, which appeared large before; that, moreover, while a blue flame with grey smoke is observed upon a negative pole, on the positive no flame at all, but only reddish grey smoke; that there are magnets which emit only smoke, without flame, from both poles; finally, that sensitives, whom I have kept for a long time—say half a day, in the dark, at first thought all the magnets possessed

only smoke, but after an hour's sojourn perceived flame and smoke on all, and, after several hours, found large columns of flame and vast masses of smoke developed gradually on particular magnets:—by all this I am compelled to conjecture that flame and smoke may perhaps be only one and the same thing,—differing, on the one hand, only in the degree of intensity; and, on the other, detected with different degrees of clearness according to the measure of the visual power of the beholders, or of one and the same beholder according as his or her sense for the perception of odic light is more or less perfectly unfolded, through more exalted sensitive disposition, or more perfect predisposition of the eye resulting from long sojourn in absolute darkness. In this case the first degree of perception would be a faint luminous cloud; a second or more distinct, thicker or brighter mist,—at first grey, then yellowish red-grey on the positive side, and blue-grey on the negative,—then reddish on the former, bluish on the latter. A third or fourth degree, the appearance of flame accompanied by vapour,—first the blue, next the red. Lastly, upon these, especially the latter, the dense rolling upward of clouds of smoke, whirling up to the roof the laboratory. I say “I seem compelled to conjecture,” for I wish to keep every one of my theoretical views in all cases perfectly distinct from the facts of experience, which I here set down from the concordant statements of many sensitives, and which, in any case, are more certain than even the simplest of my speculations. So long as we are ignorant of what these odic luminous phenomena, taken as a whole, are,—and I do not think it looks likely that we shall very soon penetrate into the depths of its essence and origin, in the face of the prejudiced opposition of many physicists,—so long will the whole nature of these beautiful phenomena remain a mystery, so long shall we find it difficult to arrive at a firm judgment as to the identity or intimate difference of their

manifold kinds ; and therefore for the present we must, in our study and nomenclature, keep to the forms of their sensuously perceptible occurrence.

V.—ODIC SPARKS.

473. A fifth has now to be added to the four forms of the luminous phenomena already described, of small compass, but of vivid strength. This consists of the *sparks* which make their appearance in the smoke, and are separately whirled about in it. Miss Reichel first described them, and she saw them frequently, not merely in magnetic smoke, of which alone we shall speak first here, but under many other circumstances, in relating which I shall subsequently recur severally to these. The first characters of these are very faintly indicated in fig. 1 of the first Treatise, most distinctly at the sides. They were seen very distinctly in this form by Baron von Oberländer, who compared them with the flying sparks of glowing pine-charcoal. Several other observers, in particular Miss Atzmannsdorfer and Johann Klaiber, frequently compared them with fire-flies. Miss Girtler called them wee little stars. Miss Winter saw them fly about in abundance, especially rushing upwards with an angular motion near the wall of the room. She had previously seen them very frequently at home during severe nervous attacks. Mr. Delhez saw them darting about separately in the smoke of the electro-magnet, scattered without order. They were seen in abundance over a globular electro-magnet (§ 587) by Professor Huss. Baroness von Augustin saw them rise from the nine-layer, but in still greater numbers from an electro-magnet. Miss Nowotny observed them issue in greatest number from magnets ; and Madame Kernesberger remarked them not only in the smoke of the nine-layer, rising singly, and scattered almost to the ceiling, but also issuing from the electro-mag-

net. Friedrich Weidlich and Miss Sturmann observed them in the smoke of large and small magnets. Dr. Neid and Mr. Rabe saw them stream forth in the misty emanations of the nine-layer, many being extinguished in their passage, but some rising to the ceiling. Miss von Weigelsberg, Mr. Gustav Anschütz, and his sister Miss Ernestine, compared them to fire-flies flying up in the odic vapour, and then wandering here and there. Madame Bauer saw them rise to the ceiling in the smoke of the nine-fold magnet. Professor Endlicher saw them rise singly with the smoke of a strong electro-magnet, ascending to the ceiling; they wandered about separately in the odic smoke, and in part flew out from it, and consisted of larger and smaller, more and less brilliant points. Wilhelmine Glaser observed such abundance of them in the electrical atmosphere, that they rushed up almost in a stream. She also saw them appear in great quantity in the smoke of a large electro-magnet. Josephine Zinkel described them as extremely small luminous points, which moved irregularly upwards, separately, in variable but always small number, with the odic smoke, sometimes also sinking down, and then rising up again in it. Many times they disappeared wholly for the space of a minute; then three, four, another time eight to twelve, appeared again at once in different places, and sometimes several grouped together. It even happened that a single one fell upon the table, upon an arm, or into the bed, and there remained a few moments before it was extinguished. On a bar magnet which had had its negative pole exposed to the electrical atmosphere of the positive conductor, she saw them much increased not only at this but at the opposite positive pole. All these persons expressed lively pleasure at the sight; just such as one hears when a party are returning home through a wood at night, and, meeting with fire-flies, their attention is suddenly diverted from everything else, and fixed wholly upon these.

474. I used the nine-layered horse-shoe in an experiment especially directed to this point with the healthy Josephine Zinkel. I turned the poles upwards and placed them in different positions, sometimes in the meridian, sometimes in the parallel. Under all circumstances she saw the sparks rise, mostly separate, sometimes two or three together, of very remarkably intense luminosity, but in all cases small. She distinguished the two colours here, red and blue. The red flowed in greatest number from the southward pole, the blue from the northward. But blue sometimes came from the former, and also red sometimes from the latter. The reason of this apparent anomaly, which at first was an enigma to me, is very well explained above, § 396. The blue sparks issued from the negative layers, the red from the interposed, which had become positive by reversal; the opposite condition occurring at the other pole. They appeared abundantly when the nine-layer was exposed to the influence of the electrical atmosphere, and all the emanations of odic light were thereby increased; the sparks then presented themselves in greater abundance, and this the greater in proportion as I approached the magnet nearer to the conductor. (Vide § 436.)

475. Miss Zinkel represented this phenomenon as most beautifully developed when I formed a large electro-magnet with a strong Smee's apparatus. Not only did a quantity of separate sparks spirt out on all sides from the large, brilliant odic flame, but they collected into a regular stream, and rose upwards with the smoke to the ceiling. She found the brightness of this so vivid that she could not conceal her astonishment that I saw nothing of it.

476. Finally, something similar was seen when I rapidly pulled off the armature of a horse-shoe, and this the more strongly the more powerful its magnetism was. At the moment of separation, Madame Bauer, Josephine Zinkel, Leopoldine Reichel, Dorfer, and others, saw abundance of

sparks flash up like lightning and disappear again instantly ; immediately after this the odic flame began to appear and unfold itself.

477. The reality of this phenomenon, established concordantly and uniformly through so many healthy and diseased sensitives, and confirmed by innumerable experiments, does not admit of doubt. I do not venture now upon a speculation as to its nature, or even its connection with the other simultaneous magnetic odic luminous phenomena. At present I can only establish the physical fact, as represented in actuality to the sense of vision of the sensitive.

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478. Now that we have made some acquaintance with the *different* kinds of development of light from magnets, we will turn to the *differences of circumstances* in which the magnet may be placed during this development of light, and inquire into the influence they may be able to exert over the same.

ODIC LIGHT IN MODIFIED EXTERNAL CONDITIONS OF THE MAGNET.

In altered media.

479. We know how very differently the phenomena of electrical light present themselves in a vacuum, even under less than the usual pressure of the atmosphere. Since I was ignorant of the share atmospheric air might take, in a similar manner, on the luminous emanations of magnets, I frequently placed magnets under the air-pump in the presence of sensitives in the dark. I employed for this purpose large and small single horse-shoes, which I placed with the poles turned upwards under the bell, in a large glass goblet, so that everything would be seen well on all

sides, and small bars which would lie down horizontally under the receiver.

480. The question was solved even by the blind joiner Tischler. When all was prepared, but before I had begun to exhaust, I led him up to the bell. To be certain that his attention was directed to the right place, I guided his hand to the bell ; but he could not perceive anything, the magnet emitted too little light for him to be affected by it through the glass. I then began to exhaust. Very soon, when the air was about half extracted, he became aware of the light. And as the rarefaction increased the light grew, and attained its greatest strength and extent for his shattered visual powers when the rarefaction was brought to a one or one-and-a-half inch column of mercury. My air-pump was incapable of giving beyond this. When, as a converse test, I let the air suddenly back into the bell without telling him, he expressed himself unpleasantly surprised by the extinction of all light, and the sudden return of darkness. Miss Amalie Krüger detected a little flame only on one pole, the northward, after a certain amount of rarefaction of the air ; the brightness evidently increased as the rarefaction went on, but only so long as the piston was in action ; as soon as it went back, the light became paler, and she soon lost sight of the luminosity. Mr. Demeter Tirka, perfectly healthy, as also Johann Klaiber and Madame Kienesberger, in like manner did not see the magnet at first, but when the air was half pumped out the magnet appeared odically incandescent : on further exhaustion, Klaiber observed the flames over the poles, at first dull, then becoming brighter with each stroke of the piston, so that at last very vivid flame flowed about under the bell. As soon as I let in the air again every trace of light vanished from all three observers, but returned when the pump had been in motion a short time again. Mr. Hochstetter also saw nothing of the magnet at first, under the bell ; but when a

portion of the air was pumped out, the magnetic bar, the bell, and all its contents, became luminous, disappearing again on the re-entrance of the air. Baroness von Augustin did not see the bar magnet under the unexhausted receiver ; but as soon as I had rarefied the air perceptibly, she discerned it, and as the rarefaction increased, the light under the bell also gained strength, till at last this appeared wholly filled with a luminous appearance, with the magnet forming the centre. Miss Dorfer saw little flames arise on the poles after a few strokes of the piston, moving and varying with every rise of the piston. When the rarefaction was carried very far, she saw the polar flames strike against the vault of the receiver, curl round there, and flow downwards again on the glass : she compared the appearance with water flowing in a curve out of an inclined pitcher. The whole contents of the bell became dark again on the opening of the air-cock. Madame Johanna Anschütz, and Mr. Gustav Anschütz, his sister Ernestine Anschütz, and Miss von Weigelsberg, whose degrees of sensitiveness differ but little, saw the magnet, with slight modifications of perfection and intensity of the phenomena, become more brightly incandescent with each rise of the piston ; flames were developed at the poles, stronger at the northward, the latter striking against the vault of the receiver, there curving and turning downwards, and all vanishing again the moment I opened the air-cock ; on the other hand, reappearing, step by step, as the air was, stroke by stroke, pumped out again. Baron von Oberländer described the phenomena in exactly the same way. Friedrich Weidlich's statements agreed accurately with the above in various repetitions of the experiments at distant intervals. Miss Sophie Pauer, Madame Cecilie Bauer, and Wilhelmine Glaser, at first did not see a bar magnet at all under the receiver ; but it became visible, odically incandescent, by the time the rarefaction had been carried to about one-half. On further exhaustion they successively perceived both odic

flames, then odic smoke, completely filling the receiver, the bell itself, and the glass knob at its summit, at last becoming odically incandescent. The last beholders saw the odic flame of the northward pole blue, that of the southward yellowish-red, as in the open air, and flowing obliquely upwards from both poles, on the walls of the glass. As soon as I opened the cork which let in the air, all visible light vanished ; and all this in repeated experiments at various times. Josephine Zinkel added to the previous observations that, when the experiment was continued for some time, the entire empty space became filled with odic mist, and that finally the bell itself became luminous ; even the glass knob which it had on the top acquired white odic incandescence, persisting in this knob for some time after the air had been re-admitted into the bell. As an exceptional case, I first showed the experiment to Miss Atzmannsdorfer while she was in the somnambulistic condition, on which, otherwise, I do not readily incline to make odic experiments. She gave the order of succession of the phenomena in exact agreement with all the other sensitives : after a few strokes of the pump increasing odic incandescence, odic flame rising until it struck against, and was diverted by, the vault of the receiver, luminosity of the glass, and sudden extinction on the opening of the air-cock. She added, that the odically incandescent steel was transparent, almost like glass, a statement which we have already met with before. Two months later, while she was in the waking condition, in which she knew nothing of the previous experiments, I repeated them with her several times. I always obtained the same enumeration of the phenomena of light ; she also, like Josephine Zinkel, saw the bell, and even its knob, become incandescent. She observed delicate flames between the arms of the horse-shoe, occupying the entire interspace ; the fiery mist on the outside filled the whole space as far as the side of the receiver.

The flames were more bluish from the northward pole, more reddish from the southward, but with prismatic colours intermingled. She gave the more minute particulars as to the odic smoke, that at the commencement of the exhaustion it increased in light and fulness, not, however, continuously, but only up to a certain degree of rarefaction ; that it then became duller again, decreased, and when the air was very highly rarefied it almost vanished, while the flame was most beautifully luminous, and flowed brilliantly down the sides of the receiver. The odic smoke was in continual revolution inside the bell as long as it existed. The bell itself, though it became odically luminous throughout, even in its knob, produced no odic smoke externally. These last statements, of which, however, I have not any corroboration from other observers, and, therefore, shall for the present keep back the conclusions to be drawn from them, are evidently of great interest in reference to the judgment of the distinction between odic flame and odic smoke.

481. These observations, collected into a regular form, show :—*The phenomena of odic light of the magnet are modified under varied atmospheric pressure. They increase considerably with rarefaction of the air.* Magnets which, in the open air or under an exhausted receiver, cannot be seen to emit light in the dark, acquire brilliant odic incandescence, and very distinctly visible odic flames on their poles and between their arms, by the time the air is only about half exhausted, and the emanations of light, bluish at the northward pole, reddish at the southward, and intermingled with prismatic colours, continue to increase as long as the rarefaction of the air is carried forward. Then the receiver becomes so charged with Od, that it is rendered luminous, odically incandescent, even to the glass knob at its summit. The odic flame does not penetrate through the glass, but strikes, as it were, against it, and curls round upon it as a common flame would, and as

Miss Reichel had previously described, under other circumstances, when the odic flame curved round on the cover of a Schweigger's multiplier, § 434, and when a glass lens was brought down upon it, § 20, like the fire does when a pan is placed over it. Odic smoke is also formed, and increases, but only up to a certain point of the rarefaction, beyond which it decreases again, and probably wholly disappears on complete exhaustion. The odically incandescent glass bell is not capable of producing odic smoke on the outside.

482. It follows from this that the pressure of the air obstructs the development of odic incandescence and odic flame, and that these are unfolded more strongly and in greater extent when the pressure is lessened or removed. In this respect they both exhibit a certain degree of resemblance to electricity,—but only resemblance, not identity. The development of odic smoke seems only to benefit up to a certain degree by the rarefaction of the air; in the absence of air it appears no longer to exist, and consequently seems to be connected with the presence of air. The sensitives did not indicate any appearance of odic sparks under the air-pump. The glass of the receiver appeared to act as an impediment to the odic lights,—namely, the flame and smoke, which it restrained and repulsed, while the Od itself penetrated it, took possession of it, and rendered it independently odically incandescent.

483. I chose *water* as a medium lying on the opposite side of air, and affording *greater intensity*. A little horse-shoe, which had been freshly magnetized, and from which the polar flames flowed vividly in the dark, was exhibited to the four following sensitives, at various times, alternately in air and in water. Madame Kienesberger saw the flame four-fifths of an inch long in the air. As soon as I dipped the horse-shoe under water both smoke and flame immediately vanished from her sight, but the odic incandescence

persisted, and the steel was luminous as it lay in the water. Moreover, according to her account, a small brightly luminous point remained on one pole, brilliant, but very minute. Friedrich Weidlich saw the polar flames two inches long in the air; I then let him immerse them in water, in a glass dish. He saw the steel continue in unchanged odic incandescence, almost as transparent as the glass itself, but the odic flames vanished instantly the magnet was submerged. At the same time, he assured me that the flame did disappear entirely, but a little point, as if on a corner, was permanent, and remained very bright. As often as the magnet was taken out of the water it again appeared, though still dripping wet, to be furnished with odic flames two inches long, and as often as it was replaced in the water these vanished, leaving only that little brightly luminous residuum. Miss Atzmannsdorfer, in whose presence I went through the same experiment, saw the magnet instantly lose its flame in water, but retain its odic incandescence, weak at the bend, but gradually increasing towards each pole. The healthy girl Zinkel laid a horse-shoe in water, the two flaming poles turned towards the north. Flame and smoke vanished instantly. When she took it out again they returned to both poles without their having been dried. On the other hand, the entire magnet remained odically incandescent in the water, the intensity of its light not being at all weakened. At the same time a strong appearance of light, like a residuum of odic flame, of concentrated brightness, remained upon one of the poles. The fiery point was at an inner corner, that is, one turned towards the other poles; from it issued also an exceedingly delicate fiery streak; when this was accurately felt out it proved to be the inner transverse edge of the same pole; that is, the one lying nearest to the opposite pole. I marked, in the dark, the pole which retained light at the edge and corner under water. When I brought this into the light, it unex-

pectedly proved that this was not the magnetic pole, as I had conjectured, but the *positive*, *the southward*, pole of the magnet. It was doubtless the same on which Madame Kienesberger and Weidlich had perceived a residuum of odic flame in a concentrated condition. In frequent repetitions of the experiment, especially during menstruation, she perceived remains of light also on the southward pole, but less striking and less perceptible, because they were blue and grayish blue, and had less intensity, while the residual light on the southward pole appeared reddish yellow, and sometimes red like glowing charcoal.

484. Thus a denser medium, like water, removes the odic flame and smoke, it may be, by absorbing both, and thus becoming magnetized water; or it may be that it does not allow of the production of either to greater extent than as a luminous point and a luminous thread on the inner corner and edge of the poles of a horse-shoe. Our attention has already been called by Miss Nowotny (§ 3) to such luminous threads on the poles of the magnets, as the smallest degree of magnitude of odic flame.

485. I have not applied media of a third kind of density, namely, solid bodies, as materials for enveloping magnets. It would be an experiment well worth trying to exhibit to a sensitive an induced magnet fused into an envelope of glass of tolerable thickness; I have not hitherto been able to do it. As it would lose its magnetism at the temperature of melting glass, it would be necessary to re-magnetise it from without, which would not be a matter of any difficulty. Experiments approximating to, but yet deviating somewhat from the fundamental idea, I have made with copper wire. I set out with the view of inquiring whether the transfer of Od—which, as we learned formerly at § 45 of the second Treatise, may take place from magnets on to other bodies, and which we made acquaintance with through its influence on the sense of feeling—might not perhaps

also find an expression in the phenomena of light, and thereby be made capable of leading to further conclusions on this profound subject. With this intention I made a loose irregular coil of about ten to fifteen turns of copper wire one-twelfth of an inch thick, so as to form a kind of net, pressed it flat, and laid it upon the northward pole of a nine-layer horse-shoe standing upright, fitting it to this to a certain extent, and allowing the end of the wire to project eight inches free at the side towards the east. When this was done in the darkened chamber, in the presence of Josephine Zinkel, whose eyes had been well prepared, as soon as the wire coil was placed in the middle of the eight inches high blue odic flame this immediately contracted, did not extend beyond the metal coil, but was evidently absorbed by it. On the other hand, the wire rapidly increased in the strength of its odic incandescence, became much more luminous and as if transparent. After a few seconds, this increased so much that it formed a bright atmosphere around it, a delicate, misty luminous envelope, which appeared to coat the wire all along to a thickness of about an inch. Immediately after, a light flame rose from the point of the wire, the luminosity of which was much more intense than that of the blue flame which the pole of the magnet possessed at first, so that it illuminated the neighbouring floor of the room for the space of more than a yard. It was almost eight inches long, and exhibited a streaky composition, like a brush of light, such as has often been observed on the magnet itself, and which therefore appeared to have been transferred from this on to the wire. The magnet itself here lost nothing of its odic incandescence, only its odic flame. I went through a similar experiment, with similar results, with Miss Atzmannsdorfer, but do not find it recorded in the journal I kept with her, and therefore cannot give any of the details of it. On the other hand, the experiments with Madame Kienesberger are accurately reported.

I brought a wire, several yards long, under double doors and carpets, from a room which daylight entered, and where an assistant was placed, into the completely darkened chamber, and I here placed the sensitive before it. I now directed the assistant to apply the negative northward pole of a five-layer horse-shoe to the end of the wire in the light room. After the lapse of about a minute, the portion of the wire which reached into the dark chamber began to increase perceptibly in odic incandescence ; it slowly but continually became brighter, till, after four or five minutes, it attained its maximum of incandescent light, in which it appeared transparent like glass. Along, the wire scattered points of fire-rust were formed here and there, almost like sparks, but larger, duller, and more permanent. They appeared to move backwards and forwards a little, and to increase and diminish in size and intensity of light. When blown upon they were extinguished for a moment, but were immediately reproduced. At the point of the wire appeared a luminous patch, also bluish, somewhat larger than those points, more strongly withstanding currents of air, and more luminous. When I had the southward instead of the northward pole of the magnet applied to the end of the wire in the outer room, the luminous phenomena all gradually appeared in the dark chamber in like manner ; all smaller, however, and with the light duller. These phenomena were evidently completely correspondent to those Josephine Zinkel had observed, and only weaker in proportion as the magnet was smaller, and the length of wire brought in contact with it shorter. The luminous spots here and there on the wire were the rudiments, the first piecemeal appearance of that envelope of light which we have already found Madame Kienesberger perceive. I modified the experiment with Friedrich Weidlich by rolling up the end of the wire in the lighted room, into a coil of several turns, and then having the northward pole of a nine-fold horse-shoe applied

to this. Thus, the surface of contact was increased, and the magnet stronger. In the dark chamber he saw the odic incandescence of the wire increase, and a slender flame, eight inches long, and as thick as one's finger, rise from its extremity; when I had the southward pole applied, a shorter, duller, and rather broader flame appeared on the end of the wire; all agreeing with what has already been reported, and differing only in the greater intensity of cause and effect. With Madame Kienesberger I placed another copper wire, not rolled into a coil, but merely the end of it, on the nine-layer magnet, in the dark chamber. On the northward pole, the copper wire, one-twelfth of an inch thick, and one yard long, became more strongly incandescent than before, diffusing light around; a flame appeared at the other end, which she compared in stillness, size, and aspect, to the flame of a wax candle, slender, rather yellow below, more bluish above, conical, and with smoke ascending more than four inches high above it. When I laid the wire on the southward pole, the phenomena which successively appeared were the same, but rather weaker, smaller, and less luminous; the terminal flame was now red and smoky. The progress of the phenomena was just as before, slowly rising one by one from the source, increasing, and then disappearing again after the wire was removed from the magnet. In a subsequent third experiment I used the coil of wire with her also, and in the same way as with Zinkel, only with the slight modification that I made the projecting free piece of wire a full yard long. When I had applied the coil to the northward pole, the blue flame of this immediately sank down, only a small remnant of it remained playing among the turns of the wire; these had apparently absorbed all the rest, that is to say, absorbed the force which produced the flame. The odic incandescence of the wire consequently increased; it soon acquired an envelope of thin, misty, luminous nature over its whole length, emitting

bluish light, and coating it almost to the thickness of one's finger, without visible motion ; at length, a flame four inches long rose from the end of the wire, pale-yellow below, and blue above, terminating in a stream of delicate luminous vapour. When I took the wire coil away from the northward pole, all this vanished immediately, the flame rose up from the pole to its former height, and all returned to its original condition. Then, bringing the wire coil to the southward pole, similar appearances presented themselves here also : the red polar flame was immediately absorbed by the copper wire, and vanished from the pole ; the pale natural odic incandescence of the wire changed into dull red ; a red, luminous, misty envelope, three-fifths of an inch in thickness, came up over it, and finally an odic flame, two inches long, burst forth from the distant end of the wire, red below and yellow above, pointed, and losing itself in dense and abundant smoke, which rose up above it.

486. These experiments, which I could confirm by the enumeration of many similar ones if it were necessary, all agree in teaching us that the *conduction of odic force through other bodies*, such as we have become acquainted with in many cases in the seventh Treatise, through the *effects on the sense of feeling* produced on the sensitive, *is also accompanied by corresponding luminous phenomena* ; that, like the force which the magnet emits, and with which it impregnates other bodies, so, also, the flames which it sends out can be infused into other bodies and again emitted from them, exactly as from the magnet itself. *The transferable essence of Od, therefore, carries with it, besides its power of affecting the animal nerves also, its luminous force ; and it carries over into other solid media, its incandescence, its flame, its smoke, with their fluidity, their mobility, their light, and their colours*, and, as we already know, in addition, their peculiar sensations of coolness, warmth, uneasiness or refreshment.

487. A retrospect of the various contents of this chapter shows us that the phenomena of light proceeding from the magnet, incandescence and flame, are developed most strongly, in greatest size and luminosity, in highly rarefied air,—perhaps would be still more perfectly unfolded in an absolute vacuum; that odic smoke appears to have its greatest intensity connected with a certain definite density of the air, beneath which it begins to disappear again; that the common density of atmospheric air considerably diminishes the odic luminous phenomena; that the density of water so restrains the odic flame that it almost annihilates it, yet without lessening the odic incandescence; that the density of solid bodies like glass (the bell of the air-pump), absorbs it, and retains it to a certain extent by its coercive power; but of such as metals, especially wires, readily emits the absorbed essence again in luminosity and flame, both along the surface and, more particularly, at points. To comprise this in a word: *that the odic light is subject to different conditions in different media.*

488. So far as we can at present see into the matter, there is some probability that odic smoke is *odized air*, in the same way that the so-called magnetized water is *odized water*, that is, air and water charged with Od. For water also, when odized, whether by the magnet, crystals, hands, chemical action, or any other means, acquires odic incandescence, and becomes visible in the dark, although previously invisible, exactly as odized metals acquire or increase in odic incandescence; which will be more minutely shown hereafter.*

* Clairvoyant persons have repeatedly declared to me, as a fact, the proposition contained in this paragraph, substituting our accepted word *mesmerised* for *odised*. They say, air or water is “thickened” or made cloudy by what they call the *mesmeric fluid*; and sometimes, as it has emanated from different individuals, the colour has been different—from one, deep blue; from another, silvery blue; from a third, green. In

Colours of Odic Light.

489. The phenomena of the colours exhibited by the different kinds of odic light acquire very great consequence as they are more minutely inquired into. From my further researches it proves that they are not accidental and irregular, as they would appear to be from the earlier ones, but that they are subject to ordinary physical laws, and, consequently, that their gradations may thus be used as a measure, on the one hand, of the polar quality and the strength of the development of Od ; and, on the other, of the degree of excitability of the sensitive ; not to speak of the most interesting deductions they afford us respecting magnetism proper and its intimate characteristics. In its

some of Major Buckley's cases, persons wide awake have seen the light produced by his passes to be blue ; some have seen them green. These were delicately sensitive persons, who have in my presence read printed words and sentences on slips of paper previously concealed from them carefully in another apartment, in the innermost of a nest of four silver boxes, all enclosed in a morocco case, or folded up in nutshells.

Such facts would lead us to conclude that the conditions of organization introduce relations into the subject of colour that require much careful investigation. The perceptions of clairvoyants on the colours emanating from metals are so much in accordance with the facts developed in the very careful and curious researches of the Baron, that new views may arise on the theories of colour. Our faculties of perception depend upon our organizations. From these emanate odic or mesmeric forces. Many individuals who can see very well, cannot distinguish colours. The organ of colour is wanting in these persons. No fact in Gall's magnificent discoveries is better established. Colour, then, is dependent on the odic force emanating from Gall's organ of colour. Is colour dependent essentially on further relations of the odic force ? Have we not differences in the perceptions of colour as emanating from chlorine, from iodine, from cobalt, from copper ? May not colour be dependent on a crystalline arrangement of an elementary ponderable with lumine and odine ? The grasp of chemism on other sciences is not yet defined ; and the influence of further researches into molecular forces may yet widely illuminate other spheres of knowledge.

lowest and weakest stage, the odic light appears upon the magnet as a faint grayish cloud, only perceptible after a sojourn for hours in absolute darkness, and the reality of which can only be ascertained by slowly moving the luminous body, the magnet, to and fro in the dark. A pocket horse-shoe of strong magnetic intensity was thus seen by the healthy Mr. Edward Hütter: the luminosity was so faintly grey at the northward pole, in the blackness of night, that for a moment he was in doubt whether what he saw was real or the effect of imagination; but when the magnet was moved backwards and forwards, he saw the grey light traverse the same path, and thus became convinced of the correctness of his observation. This case occurred frequently with many of the less sensitive, always at the commencement of the experiments, especially with the healthy Baroness von Natorp, Madame Josephine Fenzl, Messrs. Tirka, Kotschy, Schuh, Delhez, &c. I omit further instances, since these have been mentioned often enough incidentally elsewhere.

490. This original delicate gray light, at first perceived only at the northward pole, becomes stronger in its ascending stages. In the first place, it becomes more distinctly visible, gradually more dense, more vapourous and concentrated. A cloud also appears at the southward pole. Both gain strength and consistence until they resemble smoke.

491. A period now soon comes in which colour begins to appear, at first only dull and faintly tinging the general gray. Madame Josephine Fenzl saw only a cloudy light over the electro-magnet; but at the northward pole it seemed, in comparison to that over the southward, more of a bluish gray, while the latter was rather yellowish gray. Professor Endlicher gave the same account of some horse-shoes. This is the very commencement of the perception of colour. Proceeding onwards, a portion of the smoke, that which is in contact with the steel, acquires a flame-like continuity;

the other part in which the flame loses itself, remains smoky. Mr. Sebastian Zinkel (77 years old) saw, rising from the northward pole of a single horse-shoe magnet, a bluish appearance, which he was doubtful whether to call flame or smoke ; at the southward pole he discerned a similar smaller but indistinctly smoky emission of light. The smoke is strongest and most dense at that part where it is in contact with the point of the flame, and gradually passes, with diminishing density, at the other end into vapour and mist, and thus, becoming continually weaker, is at last invisible ; this is always in the upward direction. The flame-like lower portion now gains more colour. It is first seen, when the poles are directed upwards, that at the northward pole the gray begins to grow yellowish or bluish, and with increasing strength it passes through blue-gray into yellow or blue. The southward pole frequently only possesses smoke at a time when the northward pole has long shown a blue flame. Finally, the smoke reaches at the southward pole the degree of strength at which it passes into flame ; the gray inclines at first into whitish gray, then into yellowish gray, and rises through yellow and orange into red. The smoke over the red is by this time at a very dense, increasingly densely rolling stage, in which finally scattered sparks, like fire-flies, float about. If, however, the poles are directed, not upward, but downward, or in any other direction, these conditions follow a different course (I shall speak of this immediately). The red flame of the southward pole, though appearing later, possesses the greatest intensity of light ; the blue of the northward pole is always less luminous, and, when the two present themselves side by side in tolerably *equal size*, the blue is always dimmer, the reddish yellow and red brighter : where this, as usually happens with horse-shoe magnets, appears to be reversed, it depends merely on the fact that the northward flame is larger under our latitudes than the southward

flame, and therefore appears relatively more luminous. This course of the phenomena was observed, in all its gradations, by the sickly sensitives, especially by Madame Kienesberger, Misses Winter, Dorfer, Kynart, Weigand, Krüger, Miss von Weigelsberg, Madame Johanna Anschütz, also by Freidrich Weidlich and others, and by the healthy Messrs. Pauer, Gustav Anschütz, Tirka, Schuh, Kotschy, Rabe, Dr. Nied, Stephan Kollar, Baron von Oberländer, Klaiber the joiner, Miss Sophia Pauer, Professor Endlicher, Miss Ernestine Anschütz, the Baroness von Natorp, Mesdames Josephine Fenzl, Isabella von Tessedik, von Varady, von Peichich, Cæcilie Bauer, the Baroness von Augustin, and others. I consider it superfluous to enter upon an enumeration of countless single experiments, of which incidental mention is made everywhere, for the support of these most clear phenomena, which may be repeated and confirmed anywhere with any sensitive person.

491 b. I have already stated, in accordance with the accounts of Misses Nowotny, Reichel, Sturmann, Atzmannsdorfer, and Maix, that in the further progress these two principal colours become associated with others,—in fact, with green, orange, and violet,—and thus the odic flame acquires a variegated, apparently confused, play of colour. Professor Endlicher saw the lights over a strong electro-magnet moving about with an irregular intermixture of different colours. Baroness von Augustin expressed herself in the same way on this point; also Madame Kienesberger, Stephan Kollar, Madame von Varady, Freidrich Weidlich, Dr. Nied, Misses Winter, Girtler, Zinkel, and others; the latter frequently in the cases of bars and horse-shoes. All the more highly sensitive met with it in the first experiments on light, and expressed lively astonishment and delight at it; but, under equal circumstances, they saw it most distinctly beneath the air-pump. Miss Atzmannsdorfer saw the variegated play of colour over a horse-shoe

magnet, which she had perceived but faintly in the open air, become more bright and more vividly coloured under the receiver with every stroke of the pump.

492. There is yet a higher stage of the phenomena of light, and this deserves the most accurate recital of the experiments, and the most circumstantial examination of their details. This is *a perfectly regular iris or prismatic spectrum*, the origin of which astonished me, and will surprise every one who takes the trouble to enter minutely into this remarkable subject. The variegated mobile play of colours is arranged according to certain rules, and is produced in definite forms when all conditions unite to favour its undisturbed development. As early as 1844, Miss Reichel had mentioned to me that she frequently saw a rainbow in the magnet-flame. I took no notice of this, under the idea that she meant merely a variation of colour in the movements of the odic flame, something like what we are accustomed to in the sparks and brushes of the electrical light; but the statements of Miss Reichel have always subsequently proved to be correct.*

* An *avis au lecteur* for the gentlemen of the so-called Vienna Medical Committee. It has occurred to me that it will perhaps not be altogether superfluous to those readers who are unacquainted with the journal of the Vienna Medical Society, to give a small specimen of the contents of the essay launched against my researches: this will place them in a position to judge for themselves what consideration it deserves. At page 50, for example, we find the following passage:—“Dr. von Eisenstein led her (Miss Reichel) in this condition (supposed magnetic sleep) into a large room, where he allowed her to sit down upon a couch, and endeavoured to raise her state to that of *clairvoyance* by passes with his hands and four bar magnets, and at the same time to destroy the influence of the sun, and give the preponderance to that of the magnets. When he brought the magnets to the region of the heart, and Reichel started, as if involuntarily, he cried—“Aha! here is this nasty sun, then! It is on your heart! Wait a moment, and I will drive it out!” And then he made spiral turns over the region of the heart with considerable energy. The same scene followed in the

Then Freidrich Weidlich asserted distinctly that the colours formed a perfect rainbow when the air was still, and

magnetization on the back and the pit of the stomach. The sun was pursued without mercy, and driven out of every lurking-place. In one of these turns, Reichel jumped up and struck at her magnetiser; the latter pressed her into her seat again, and magnetised her lips with little circular passes. When she tried to oppose it, and held her hand before her face, he removed it, and reproached her, that "she would not kiss the magnet, her benefactor, who made her well; the horrid sun must be driven away from her lips, and its place taken by the magnet, &c." Turning over leaf, we find the account of an experiment in which Reichel was to see flames on magnets held before her in a room open to daylight, and when, as an additional means, her eyes were bound with a handkerchief: this ends with the words—"Dr. von Eisenstein (conductor of the experiment) gave no explanation of the tendency of this experiment. Baron von Reichenbach always made his researches on the emanations of light from magnets in darkened places, and found that they were stronger in proportion as the obscurity was more complete. Why Dr. von Eisenstein undertook this experiment in a room brightly illuminated by reflected sun-light,—why he chose the moment when her eyes were bound,—whether he thereby intended to test her gift of divination, or whatever else he wanted to show by it,—we know not: he gave us no explanation of the experiment just related." Nonsense of this kind is met with not unfrequently in the course of the treatise: who could find patience to follow two hundred pages of it?—*Author's Note.*

I must take this opportunity of expressing my admiration of the generous testimony afforded by Professor Gregory in favour of the truths of mesmerism, in his note occurring at page 356 of his translation of the Baron's researches. It is a service of some peril, in these days of literary and scientific ruffianism, to avow a belief in the statements respecting Miss M'Avoy; or in those recorded by Dr. Elliotson in various numbers of the *Zoist*, especially relating to the facts about the Okeys; or even his belief in the genuineness of the phenomena which Professor Gregory had himself observed in the case of Miss Martineau's servant-girl. It is well and nobly asserted by him, that "it is the duty of every lover of truth and of science, to protest energetically against the system of reckless accusations of imposture preferred against persons of blameless character, because their statements appear to us incredible, or, as has often happened, because we are unable, from want of knowledge of the rules of scientific research, to form a

the flame of the magnet was not broken up into fragments by the breath of bystanders. He gave me a rough account

clear distinction in our minds between what is real, and what may be imaginary or delusive, in the results obtained."

In Vienna, the squad of *stupidities* who had undertaken to criticise the Baron von Reichenbach, have had recourse to the same expedients against one of the subjects of his experiments as the opponents of the truth had adopted in England. It is curious to remark the influence which competition exerts in modifying the moral perceptibilities of mankind. The struggle for pelf renders some men, otherwise of fine capacities for generous feelings, sordid and mean. Their organs of acquisitiveness, cunning, and self-esteem, are stimulated into undue action by the leading active minds of the coteries to which they happen to be attached. One man, perhaps, having nothing to recommend him but great activity in gathering gossip, albeit he may be in science, for his ignorance, the laughing-stock of every society of which he is a member; in practice, for his maladroitness, the slaughterer of the women he may be called upon to assist; in friendship, the backbiter of his greatest benefactor; to the poor, a brute and a ruffian; yet, if he can fetch and carry prurient tales, well paid for, and gathered from the lowest haunts of female iniquity, his falsehoods may be listened to and retailed in low whispers among persons *professing* high feeling. Gregarious man is long the victim of the fallacies among which he lazily wades in the struggling sea of life. How strange it would appear to a benevolent being of a higher order, if he were to appear amongst us, that, at hospitals, demonstrations have been given of the power of mesmerism to cure disease, to alleviate suffering, and to render painless the most frightful operations of surgery, and that *thousands* of facts attest these truths, and yet, that the professors of the art and science of medicine have rejected, over and over, again all inquiry into the subject! How strange it would appear to that being, that no sooner had ether and chloroform been proposed to the same professors, than that, without much inquiry, these dangerous and deadly materials were hailed as important acquisitions to the medical knowledge of the age. The one agency, when studied, leads to a knowledge of the highest functions that belong to human beings, to more than a knowledge of the alleviation of suffering by innocent means; to a corroboration of those high scientific truths that tell us of the springs of human action, of the motives of human conduct; and that lead the humble philosopher to the conviction, that large charity is the necessary result of deep reflection on mesmeric facts. The other agency, allied to the nocent

of the arrangement of the colours and their relative extent. He made the observation most distinctly in a three-layer

influences of narcotics on the human brain, leads to the destruction of health, either temporarily or permanently, often to immediate death! sometimes to the encouragement of robbery, even of murder, and of the most abject vices that can degrade the human character. What obliquity of intellect has possessed these professors of science? would be the natural question. Can they witness the deeply interesting facts Dr. Elliotson exhibited to them years ago, and not be stimulated to ardent scientific inquiry? Can the gloating of a few misers on the golden heaps of some of their fellows so obtund all feelings of noble honesty as to leave mesmerism, because it is tabooed by authority, unenquired into? Are fears for the fees and stipends of a few individuals for ever to retard the progress of human knowledge towards a science of mental philosophy? Thanks to Dr. Elliotson, it is not to be so. The silly surgeons who, in their ignorance, so greedily grasped the murderous narcotics, like the savages who prefer the instruments of death and destruction to the quiet influences of progressive civilization, may build monuments of wealth to their destroying angel; may set up their golden calf, and worship their spirit of evil. They cannot succeed in crushing truth! and posterity will regard with pity their weak efforts to darken the world.

As to Dr. von Eisentein, in the Baron's note, he is evidently one of the small fry of those who endeavour to accomplish the impossible feat of arriving at truth, and encompassing it by the force of imagination alone. Such persons are little aware that they call into play a combination of several organs of the brain opposed to the reasoning faculties, and which may lead the individual to conclusions as wide of just results as if they determined at once to judge without knowledge. In all probability, the *stupidities* who have been the slanderers of Miss Reichel, if they have paid any attention to mesmerism, have, to save themselves the trouble of inquiry, attached themselves to the sect who boast of their spiritualism. It will be unnecessary to repeat here the sources of fallacy that belong to ideas which must, in every way, tend to confuse the intellects. There are organs of the brain, which, when over stimulated, leave the individual a victim of ecstasy. The imagination, said to be a mental faculty, but, in reality, the result of a combination of the actions of several organs, if indulged in without regulation and very strict control by the intellectual forces about the forehead, may lead to an ecstasy as incompatible with rational conviction, as the open-mouthed fatuous wonderment of the idiot is with the higher calm reasoning

horse-shoe of great intensity of magnetic charge. He was followed by Baron von Oberländer, who saw a regular iris over the same three-layer magnet. Madame von Varady observed this over the nine-layer. In like manner Dr. Nied, but with intermissions. Miss Atzmannsdorfer frequently described to me the beauty of the rainbows she perceived on the magnet, both on horse-shoes and bars. Madame Bauer gave me the most vivid descriptions of rainbow-like superposition of colours over the poles of all stronger magnets, in which she always found the red at the bottom, then yellow, green, &c. following upwards.

493. One experiment with Josephine Zinkel will serve for all. When in her ordinary healthy condition, she commonly saw the polar flames uniformly bluish or reddish over the poles of the nine-layer horse-shoe. When I showed her the same during menstruation, she saw them not only larger, but perceived the form of an iris in both, in which bluish colour *predominated* at the northward, and reddish at the southward pole. This was the case when the horse-shoe stood upright, with poles directed upwards, and the arms conformable. But when I turned both poles toward the north, while the horse-shoe was laid in the meridian, the iris vanished from the southward pole, only a bluish gray red flame remaining, while on the northward pole the iris is increased to double, and attained a length of twenty inches. When I turned the poles of the horse-shoe to the south, the northward pole entirely lost its iris, retaining only a dull reddish, gray-blue flame, while the southward pole acquired a beautiful iris almost twenty inches long.

494. Even the mere terrestrial magnetism sufficed to

power of the philosopher. Could man be brought to the conclusion that the numerous fallacies, the reiterated falsehoods, which have resulted from his imagination having conquered his reasoning faculties, are the causes of all the evils surrounding him, how ready would he be to abandon his errors! Alas! When is man to be enlightened to this extent?

produce the iris, and render it visible to excitable individuals. Madame Kienesberger, when menstruating, saw an unmagnetic iron bar, twenty-four inches long, lying in the meridian, emit a red flame towards the south and a blue towards the north ; the latter, however, was not totally, but only predominantly, blue ; and she detected, besides this, all the other colours of the rainbow, which possessed less intensity of light. The colours were so distributed that they appeared stratified from below upwards. The lowest stratum was reddish, the next yellow ; then followed green, and the uppermost was chiefly blue with violet.

495. The phenomenon was, however, more beautiful and more clearly marked on electro-magnets. Here I could not only heighten the phenomena, and render them more distinctly perceptible, but I had the advantage of being able to bring a single layer only into the experiment, and to avoid the manifold disturbances which arise from the reciprocal action of the separate layers of a strong compound horseshoe. When I had produced an odic flame of a span high upon an electro-magnet through the influence of a Smee's battery of one-sixth of a square foot, Madame Kienesberger was the first to inform me that the flame which she saw rise from the negative northward pole was not merely blue, but *yellow and blue*, the yellow colour next the iron, the *blue lying horizontally over that*, and passing above into gray mist ; at the positive pole she saw only red flame with dense smoke rising from it. In order to strengthen the electro-magnet, and perfect the experiment, I added another Smee's battery, having about a square foot of surface, to the former. The odic flame of the poles of the electro-magnet was now more than tripled : that on the negative pole was within a few minutes to about twenty inches ; that on the positive to eight. The former now exhibited the interesting phenomenon of becoming a perfect prismatic spectrum, in such a manner that below, when it

touched the horse-shoe, which stood with its poles directed upwards, it displayed to the eyes of the beholder a red layer; this was followed by an orange-coloured, then a yellow, next a green, a bright blue, dark blue, finally an uppermost violet blue, and gray vapour above this. At the same time the positive flame of the southward pole presented a blood-red colour next the iron; then came a light red layer, at the top an orange-red, which lost itself in thick, heavy, and opake smoke rising up to the ceiling. She described the appearance as of extraordinary delicacy and splendour, and was filled with delight and amazement at it, like her predecessors in similar cases. She found the intensity of the colours greater than that of any permanent magnet. Some weeks later I went through the same series of experiments with Josephine Zinkel. She described the phenomena to me all in the same way as Madame Kienesberger, whom she about equals in degree of sensitiveness, and she added the complementary note that the prismatic colours individually are not simple, but that each appears in distinct shades, and thus seems to be composed of several, whereby the entire spectrum is ultimately composed of a great number of superincumbent coloured streaks of light. She also described a *narrow streak of pure red* above the violet-blue, the violet, becoming gradually redder, passing into this above, and this then going off into smoke. She already perceived the iris when the magnet was first induced by one Smee's element of one-sixth of a square foot, but the colours were dull and indistinct, so that she could not give a certain account of their characters at that time: thus she believed she could perceive a light blue between yellow and green; but when I added a battery of six Smee's elements, all the colours became incomparably more luminous, clearer, and perfectly distinct, under which circumstances the imaginary blue was found to be a transition tint between light yellow and light green. This expe-

riment cannot be made successfully with weak electro-magnets: mine measured one foot in the length of the arms, and the iron was an inch thick. This experiment was repeated, with the same results, three months afterwards.

Again, a few months later, I applied a Smee's apparatus having two and a half square feet of surface. The prismatic spectrum was developed splendidly to a height of more than a yard, and with smoke that rose to the ceiling and lighted it up. The appearances at the negative pole were again the same, only on a large scale and more brilliant; but the iris was likewise better developed at the positive pole; blue was now added above to its red and yellow colours. By greater exaltation of the electro-magnet, the green and violet blue would certainly be rendered visible. This experiment was also repeated some months subsequently.

496. The boy Stephan Kollar also saw the coloured appearances in the flame of the electro-magnet. Since he had no idea whatever of what was going to appear when I allowed the powerful voltaic apparatus to act upon the polar wires, he was very much excited by the progress of the phenomena, from the odic incandescence to the prismatic spectrum, and its gradual increase to a variegated flame, appearing to him twenty inches high, with smoke above whirling up to the ceiling.

497. Professor Endlicher did not see a regular steady iris over the electro-magnet, perhaps because time and leisure enough were not afforded in the experiment; but still he detected different colours in the odic flame; below (namely in the seat of the red) it was indistinct and dark; above this he saw yellow, next green, and lastly, above, blue mingled with violet, unsteady certainly, but, on the whole, displaying order of colours of the rainbow to him as to all the other observers, although less perfectly developed.

498. I brought Wilhelmine Glaser, during the cata-

menia, to the same electro-magnet, with the current of two Smee's batteries passing through its coils. She beheld the flame over the negative pole, predominantly blue, about four and a half feet high, that of the positive pole half the height. The smoke from them rose to the ceiling. Both the polar flames again produced the beautiful iris ; the negative with all the prismatic colours, *with a short portion of red succeeding to the blue above*, terminating in smoke, but the positive flame was only red and yellow ; the latter of which lost itself in the dense smoke.

The chlorotic Anka Hetmanck also saw a larger odic flame over the electro-magnet than over the nine-layer horse-shoe, and this was red below upon the magnet, the prismatic colours then following, upward, to blue and blue-red, which merged into smoke and so rose to the ceiling.

499. Madame Cæcilie Bauer (during pregnancy) described the large electro-magnet most brilliantly. She saw nothing over the poles of the horse-shoe before it was connected with the Smee's apparatus ; she stated it to have merely the whitish odic incandescence of all metals. But as soon as I had connected the polar wires of the two batteries with the thick wire coil, she saw the flames rise over both poles, small at first, then increasing, and continuing to ascend till they were half as high as the room. Then they passed into smoke, which came in contact with the ceiling. (Neither of the Smee's batteries worked at all well on the day of experiment ; they were very weak). She saw blue predominate at the northward pole, and red at the southward : but at the same time the flames of both poles were most beautifully prismatic. She even perceived the iridescence on other portions of the arrangement, on the electro-magnet itself, the Smee's elements, and other parts, of which more will be said in its proper place.

499 b. On various occasions I placed a seven-layer horse-

shoc magnet, with the poles turned upwards, in the vicinity of the conductor of the electrical machine, and showed it under these circumstances to Josephine Zinkel. She saw the usual appearance of red and blue flames over the poles. But directly I set the machine in motion, so that the magnet was placed in *the electrical atmosphere*, not only did the flames increase in size and intensity of light, but they each changed into an iris, in which the blue at the northward pole, and the red at the southward, were now only the prevailing and no longer the sole colours. The blue was here found to be the stronger; the red the weaker and duller; the first situated at the top of the iris, the second at the bottom.

500. In all these cases the iris was seen horizontally stratified, *the colours lying one above another in horizontal layers; the red colour was always at the bottom, the violet-blue always at the top.* This relation to the terrestrial magnetism must be kept in view. During the first minutes, while the colours are being developed, they are mingled unsteadily together; they gradually arrange themselves into the form of a floating iris. This does not take place rapidly, but with remarkable slowness; and in the above described experiment, four, five, to six minutes were requisite for the production of the perfect iris over the electromagnet.

501. It results from the above facts, *that the odic flame of the magnet does not consist merely of red and blue, at the two poles, but of an iris or prismatic spectrum at each, in which blue is but the predominant colour at the negative side, and red the like at the positive.* They become visible when magnetism and Od attain a certain strength, and remain invisible, or limited to a single colour, when those forces are weak, or the perceptive power of the sensitive beholder is of low degree.

502. But we have another complicated compound kind of iris to examine, in addition to this simple one.

Here and there in the experiments, as we have already seen several times, a certain *variableness of the odic colour* has announced itself, frequently threatening to render the results uncertain. I was hereby induced to undertake a long special inquiry in this direction, to carry it attentively through a vast number of experiments, and to endeavour to obtain the laws of the phenomenon. I will here merely bring forward the most essential of the results.

503. When I placed a magnetic bar with poles in the direction of the dip, it always emitted different colours from those it gave in the meridian; and when a northward pole was directed towards the north or towards the south, its odic flame displayed at one time more of a blue tint, and at another more of red and gray. Another uncertainty accompanied this: when I turned a northward pole upwards, the beholder generally found it bright blue in the dark, sometimes again gray, and not unfrequently even yellow; with more of the like incongruities.

504. Seeking the causes of all this, I began by setting out from the idea of the possibility of subjective variableness in the perceptions by the sensitive. I placed a magnetic bar two feet long in an upright position, with the northward pole directed upwards. When weakly magnetic, and examined by the girl Zinkel in the dark chamber at a distance of eight inches, it appeared to her opaque, and of an indistinctly grayish-yellow; when she tried at what distance it displayed its colour most clearly, and its general form most distinctly, to her eyes, it proved in every experiment that this was about from seventeen to twenty inches; then it appeared of a pure yellow; going further back she saw this clear yellow soon become indistinct again, a shade of bright gray, not unlike sky-blue, was infused; but on removing

further away this changed into full unequivocal gray, which, on a retreat to a greater distance, grew duller, less perceptible, and from forty inches, and over, vanished.

505. Making the same experiment with Miss Sophie Pauer, I arrived at the same results, with the slight modification only that in her the distance of vision for distinct and yellow odic flame did not amount to twenty inches, but only to about eight, and that she found it become bluish directly the distance of her eyes from the luminous object increased beyond this. Miss Pauer, however, is short-sighted; consequently this peculiarity influenced her odic vision, and showed to what a great extent the apparent variation of the colour of odic flame at different distances is a mere subjective phenomenon.

506. These observations, made in all directions and in the same manner, and repeated at various times with unchanging results, on Josephine Zinkel, furnished the proof that there is only one definitely fixed distance, different for the eyes of each person, at which the colour of the odic flame is seen purely and distinctly; that *it always remains the same, and has no variableness at this distance, for each individual; but that at other distances, less or greater, it strikes the eye with other tints*, dull yellow when nearer, bluish-gray and gray when further off, and that consequently, in order to avoid confusing the appearances, the eye of the observer must always be kept at one particular distance.

507. In fact, I had been every now and then very much puzzled, before I thought of the last investigation, one observation furnishing sky-blue, and another, made under conditions apparently altogether identical, gray or yellow colour of the odic flame. While one is involved in such a complication, the researches, in which the facts cannot be perceived by one's own senses, but must be obtained by questioning in the dark another person who does not un-

derstand the matter, become wearying to an indescribable degree, and it occasionally required all the attractions of so interesting a subject to support my patience.

508. Once master of this, perhaps insignificant looking explanation (but the want of which opposes an inevitable obstacle to further inquiry), a portion of the road was levelled, and I began a wider investigation of the variableness of the colours of odic flame, from the objective point of view. I fixed the same two-feet long magnetic bar by its middle in a Guidino's holder, which had a joint at the top rendering it moveable in all directions. I brought it lengthways into the magnetic meridian, conformably toward the north pole, at first turned to the north, and afterwards inclined at about 95° , in the dip of Vienna. Starting from this, I made the northward pole pass through the complete vertical circle, which could be described around the axis of the magnetic bar in the plane of the meridian.

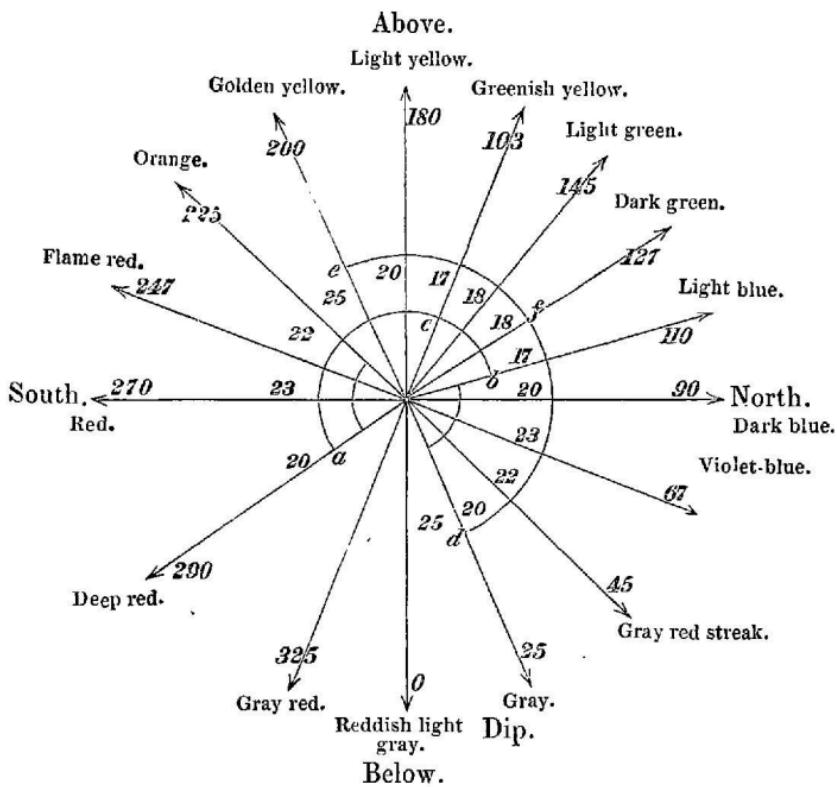
I carried this into effect in the dark chamber,—first in the presence of Josephine Zinkel, who observed the changes developed from the west onward in the progressive motion of the northward pole. From the perpendicular direction downwards at 0° , she saw the odic flame run through the following series of colours :—

At 25° (in the line of the dip)	pure gray.
,, 45° (ascending toward the north) . .	a narrow red streak.
,, 67° ,,	violet-blue.
,, 90° ,,	dark blue.
,, 110° ,,	light blue.
,, 127° ,,	dark green.
,, 145° ,,	light green.
,, 163° ,,	greenish-yellow.
,, 180° ,,	light yellow.
,, 200° ,,	golden yellow.
,, 225° ,,	orange.
,, 247° ,,	flame-red.
,, 270° ,,	red.

- At 290° (ascending toward the north) . deep, intense red.
 „ 325° „ „ grayish-red.
 „ 360° „ „ reddish light-gray.

To make these more distinct, I give a diagram of them collected into a circle (Fig. 20).

FIG. 20.



509. Examining the order of the colours of this circle, we discover a new iris, and in fact one with the colours lying in a circle.

510. It is peculiar that the very direction in which the greatest magnetic intensity occurs, namely, the magnetic dip, or inclination of 65° to the horizon, is exactly that in which all the colours disappear, and nothing but dark gray remains. Is this gray to be taken as white, that is, a compound of all the colours, or as black, the absence of all? Hitherto I have been unable to clear this up with certainty :

new researches will soon decide, but I am inclined to conjecture that the latter will prove to be the case.

511. It is also remarkable that the colours standing diametrically opposite to each other are *not properly complementary colours*: for red here stands opposite blue instead of yellow, and flame-red, instead of green, opposite violet-blue, gray instead of blue opposite yellow, &c. The circle is divided into sections of 90 degrees, the zero of which must be fixed at the dip. Opposite this, at 180° , stands yellow; at each side, both at the distance of 90° , red and blue are situated opposite to each other, so that these again are 180° apart. If we were beneath the magnetic equator, where the polar direction and the dip of the needle coincide, the direction and arrangement of the colours would be different. I hope I may live to hear of this experiment being performed there; it cannot be a matter of great difficulty, for scarcely an European ship can pass the line in which one or other of the crew is not sensitive.

512. Another singularity of a peculiar kind presented itself in the circumstance that the beholder constantly described what she called *a narrow red streak between the gray of the dip and violet-blue*. I had already met with this phenomenon in other cases. Madame Kienesberger frequently assured me that the iris, which presented itself to her with the greatest clearness over the electro-magnet, passed above into a narrow red streak, which then gave place to the smoke. Wilhelmine Glaser, also, Stephen Kollar, Madame Bauer, and Miss Sophie Pauer, gave the same report. It appears, therefore, as if the red was again so fully extricated from the blue or violet as to reappear once more as an independent colour at the other end of the series, and consequently *red closes the spectrum on both sides*, certainly at least the odic.

513. *Those colours which lie in the lower half of the circle*, namely, within 90° on each side of the dip point,

display remarkable difference in intensity of light from those of the other, upper half, occupying 90° on each side of the golden yellow. The upper half, in the arc *a c b*, appeared bright, very luminous, fresh, and brilliant; while the lower was dull, opaque, and emitted little light. *The greatest intensity of light lies in the golden yellow, the greatest obscurity in the gray of the line of dip.* One might call the upper half the *day side*, the lower, where almost all the colours are veiled with gray and overcast, the *night side*. *The yellow colour*, therefore, which we otherwise know to be the most intensely luminous in the spectrum, *represents noon, blue and red the two twilights, gray the night.* *The earth's surface corresponds to the heavens in its influence upon the odic flame of the magnet.* Vide § 536, 356.

514. I expected a great change in the colours of these luminous appearances when I used the southward pole of the same magnetic bar, instead of the northward, in these experiments. But the result did not confirm my anticipation. In the principal points, it was almost indifferent which of the poles of the magnet I made pass through the vertical circle. The distinctions were confined to a few insignificant modifications in the lesser particulars. The colours, which displayed themselves nearly equal in the same direction at the two poles, always appeared rather retarded at the southward pole, in the progress of the pole from the dip point to the north; I was always obliged to move the bar a few degrees further onward, to obtain from the beholder the modification of the same colours which had appeared at any given degree at the northward pole. This retardation of the southward pole occurs in the same way all round the circle, so that even the gray of the dip was at a smaller angle with the horizon than that of the northward pole. Vide § 334.

515. Moreover, the northward and southward poles of

the magnetic bar are again divided into two other principal regions of greater and less purity of colour. *From the dip forward, on the north side, to the golden yellow, upon the arc e, f, d, the colours of the northward pole appeared purer and more distinct ; from the golden yellow forward, on the south side, back to the dip, on the contrary, they were more degraded, indistinct, and overcast.* Exactly the reverse was the case with the southward pole ; from the dip, over north, up to golden yellow, that is in like manner on the arc e, f, d, Josephine Zinkel described the colours as dull and misty ; on the other side, from golden yellow, over south, down again to the dip, as pure and clear. Upwards at the yellow their appearances merged ; they were most strongly manifested in the directions of the terrestrial poles. It is evident that the conformity or nonconformity of the position of the poles exerted their influence here, as everywhere else, and the northward pole, which could act with full force toward the north, was brought into conflict with the opposition of terrestrial magnetism, when turned to the south, and thereby weakened. Its red odic flame was consequently troubled and overcast in the southern direction by a portion of blue produced by its own magnetic but opposite polarity, and intermingled with the red ; hence a red which was described to me sometimes as bluish-red, at others as grayish-red. The same holds good of the southward pole, the direction and the expressions being reversed.

516. *The circle of colours was thus twice divided into halves, through external influences, in respect to intensity of light and purity of colour ; once by a relatively horizontal, the other time by a relatively vertical section ; in the one case principally influenced by terrestrial magnetism, in the other by the polarities of the magnet.*

517. None of the single odic flames ever displayed an iris to Josephine Zinkel, but appeared simply of one colour.

The most important of these researches were repeated with Madame Cæcilie Bauer, and afforded still more complete results. When I showed her the same magnetic bar, free at both poles, and fixed at the axis in the moveable holder, in the meridian, in the dark, she found it to have longer flames than Josephine Zinkel had seen, more than half as long again, and *not now of one colour, but always in the form of an iris, excepting when placed in the direction of the dip.* Here she perceived merely dark colourless gray issue from the northward pole of the magnet. When I began to move it upwards toward the north pole, she soon saw the flame acquire an iris, at first a dull, but gradually becoming more vivid. *But one of the many colours here always displayed very much greater size, strength, and intensity of light, so far as to surpass all the rest, and to predominate so much that unless close attention was paid, the observer only noticed this one prevailing colour.* Without reference to the constant presence of this dull iris, she described the changes of colour in the circuit in the following order: first, when I had moved the northward pole of the bar a little out of the vicinity of the line of dip, upwards towards the north, a short red place, which soon changed into violet-blue, and next with the approach toward the north and the arrival at this direction, first into dark, then into light blue. Between the north and the uppermost point, or zenith, I moved the bar, according to her accounts, through different shades, first of bluish-green, sap-green, and greenish-yellow, and, at the top, came to pure yellow. Golden yellow appeared diametrically opposite to the dip point. Downwards to the south, on the other side, red became intermingled with the yellow, increasing continually to the neighbourhood of the southern direction, when red, with the admixture of a little blue, appeared almost pure. When I passed onwards over this, and inclined the pole further downwards below south,

gray joined the red, increasing as the latter disappeared, till at length, in the dip, this, with all the accessory colours, completely disappeared, and gave place again to the simple and pure gray from which I had set out. This arrangement of the colours evidently agrees with the statements of Josephine Zinkel. The difference between the two beholders lies merely in Josephine Zinkel seeing but one colour in each position, while Madame Bauer perceived everywhere a principal colour associated with all the other prismatic colours, although these were very faint. This distinction is very simply and satisfactorily explained by the different powers of sight of the two observers. The girl Zinkel, with weaker vision, saw only the temporarily prevailing colour; Madame Bauer, with stronger vision, saw this of greater size, and with it the other prismatic colours. (We shall meet with an instance in crystals, when Zinkel stood exactly in the same relation to Wilhelmine Glaser as Madame Bauer does here to Josephine Zinkel.) According to this explanation, Madame Bauer's observations afford the most complete confirmation of those of her predecessor, in numerous and frequently repeated examinations.

518. After Madame Bauer I tried this experiment with the eyes of Wilhelmine Glaser, who saw odic light considerably weaker than Josephine Zinkel. In her usual condition she saw the magnetic emissions only blue, yellowish, or red: but when I introduced her into the dark chamber during the catamenia, she distinctly perceived the changes of colours as I moved the pole of the magnetic bar round in the circle. She hesitated now and then as to the intermediate colours; it was necessary to attend strictly to keeping her eyes at the proper distance from the pole; she sometimes mistook light blue for gray, pale-yellow for pale-reddish, and *vice versa*; but after a few repetitions her definitive assertions always agreed with the colours which Zinkel and Madame Bauer had announced; she was quite

divided, however, as to the gray in the dip, the blue at the north, the yellow above, and the red at the south. She found little distinction between the applications of the northward and southward poles ; there was merely rather more of a bluish tinge in the former case, and of reddish on the other.

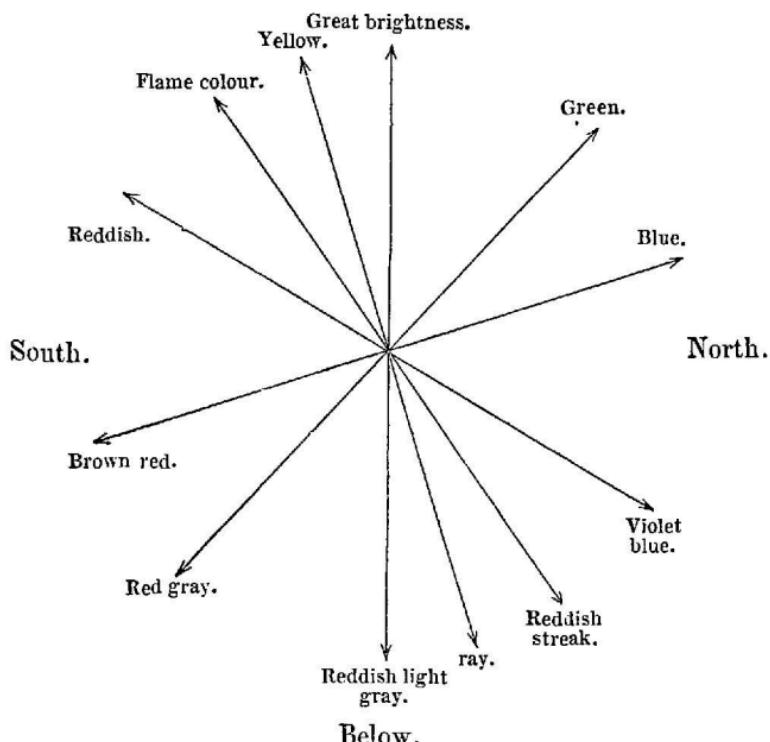
519. Miss Sophie Pauer saw the same magnetic bar emit pure dark gray vapour from its north pole, at the dip, when turned upon its axis in the meridian ; raised a little toward the north, it became, first, somewhat reddish, then red-gray, next violet, dark blue, and pure blue when horizontally pointing to the north ; higher up, light-blue, then blackish-green, next light green, and yellow at the top ; in the declension towards the south, first orange, horizontally towards the south red, and downwards from these reddish gray, decreasing till it became pure gray again at the dip. These trials were made in the morning, while she was still fasting and in an excitable condition ; when I made the same experiments with her in the afternoon, after dinner, her perception of colours was no longer so certain, and she was frequently deceived in the gray tints ; her power of vision was not so acute as before.

520. I was desirous of going through these experiments with much weaker sensitives, to see how far the results would remain the same. Madame Josephine Fenzl had the patience to devote herself to them, and to remain imprisoned with her husband, Dr. Fenzl, and myself, for half a day, in my dark chamber. Made with the same instruments, and in exactly the same way, the experiments furnished the following circle, drawn according to her statements, described by the north pole in the plane of the meridian (fig. 21, next page.)

This agrees entirely with all the preceding ; what is here called the lightest is the pale yellow of the last observers, brown red is their deep gray red, &c. No agreement could have been more complete.

FIG. 21.

Above.



521. In the last place I made the experiment with the still less sensitive Mr. Hochstetter. Under the same circumstances as his predecessor, he saw the northward pole of the magnetic bar, on the meridian, emit dark vapour towards the north ; lighter and stronger above ; densish and duller toward the south ; darkest of all in the dip. His sight was not sufficient to determine colours ; but the various intensities of light which he perceived corresponded accurately with the relative intensity of light of the different colours, which were named by the other witnesses ; lightest above at yellow, darkest at the dip, dark at blue, &c. Even this weakest of the sensitives to whom I submitted this experiment afforded evidence for the accuracy of the observations with the strongest.

522. These results can be controlled by comparing with

the above a single horse-shoe magnet placed in the meridian, with both arms directed one time to the north, the other to the south. When turned to the south, Josephine Zinkel, at a distance of two spans, saw blue flames at the northward pole, and at the southward grayish-violet, and reddish blue with a turbid veil over them. Turned towards the south, she found the southward pole red, the northward bluish or grayish red, likewise obscured ; all four cases, therefore, exhibited agreement with the colours of the flames which are observed on the poles of bars under the same circumstances. Only single horse-shoes can be used for this experiment, because the flames of strong compound horse-shoes pass into visible iridescence with reversed intermediate layers, which alone already complicate the decision, as is shown at § 396.

523. When I made the experiment with the poles of the horse-shoe directed downward and upwards, the results were in great part such as I have already stated, but I must repeat them here in order to collocate and compare them. A horse-shoe with both *poles directed upwards vertically* and conformably, gave gray flame at the northward pole, and reddish light-gray at the southward. In the direction of the dip the northward pole gave darker gray, the southward reddish dark gray. Raised a few degrees upwards towards the north, over the line of dip, the northward pole afforded gray with the entrance of reddish, the southward pole dark gray. The retardation of the southward pole, already mentioned, presented itself here also, in the advance from the dip toward the north : the northward pole, namely, already possessed dark gray flame, while the southward had not completely acquired it, and by the time the latter exhibited it the northward pole had already advanced to reddish gray, to the commencement of the red streak next the violet. When I turned the arms round, in the unconformable position, in the same direction, the results were again different as to the tints ; as follows,

indeed, without further detail, from the many experiments already discussed.

524. Lastly, a single horse-shoe magnet, *vertical and conformable, with the poles directed upwards*, always gave, at the northward pole, a flame which was described by the observer as predominantly gray, bluish or yellowish, according to the distance at which it was examined; at the southward pole a flame predominantly reddish-gray or yellowish-gray. At a distance of the eye of about two spans, and when strict attention was paid to the removal of all other influencing objects which might produce odic effects, Miss Zinkel, and many others, always found the northward pole predominantly blue, at greater distances blue, then gray. Madame Kienesberger, Misses Reichel, Atzmannsdorfer, Sturmann, Klaiber also, Weidlich, Baron von Oberländer, and others, frequently described it to me as pale yellow below and blue above, like the colours of the flame of a wax candle reversed: this was always the commencement of the iris. Under the like circumstances the southward pole appeared reddish-yellow below, and grayish-yellow above. These are all merely confirmations and applications of the facts before collected respecting the magnetic bar passing through the vertical circle in the meridian.

525. In order to see what proportion of all these results was to be placed to the account of the magnetic bar, and what to that of the effect of the terrestrial poles, I performed the same experiment *with an unmagnetized soft iron bar*. Having fastened it by the middle on the wooden holder, I brought it into the meridian, and turned it a quarter of a circle in the dark. In the first instance I showed it to Miss Zinkel. It presented some odic flame at each of its poles, but much shorter than those on the magnetic bar; they were but about a quarter or one-fifth of the length, and at the same time duller, with the colours more difficult to be recognised. Nevertheless, when I com-

pared the result of the iron bar with that of the magnetic bar, I found them essentially identical ; the colours were similar in the order, direction, and succession ; the angles alone under which they appeared varied a few degrees backward or forward. This difference, which, however, was but unimportant, is certainly wholly attributable to imperfections of observation. For although I left the observer to find for herself the point of greatest intensity of each colour, it is impossible, until special instruments have been devised for the purpose, that this should be done so accurately that the statements should not vary a few degrees in so delicate a subject, and with light so exceedingly weak. It is sufficient that the results with the unmagnetic iron bar, produced by terrestrial magnetism alone, coincided perfectly in all essentials with those which had been obtained with the magnetic bar.

I subsequently made the same experiment with Madame Bauer. She perceived the colours quite distinctly and decidedly, but all duller and smaller on the iron bar than on the magnetic bar previously. The arrangement was the same,—grey in the dip, blue in the direction towards the north, yellow above, and red towards the south.

Miss Sophie Pauer also went through this task. She saw the iron bar emit gray vapour in the position of the dip ; the same when turned vertically downwards ; yellow-red toward the south ; upwards pale yellow when near (pale bluish when she was at some distance), and towards the north blue ; all the colours dull, small, and faint, so that she several times had difficulty in detecting the true colour with certainty in the gray regions.

Even Wilhelmine Glaser gave favourable testimony for this less-marked experiment. I held before her in the dark an iron bar supported on the axis merely by the thumb and finger of my left hand. She perceived gray, blue, yellow, and red misty light in the corresponding

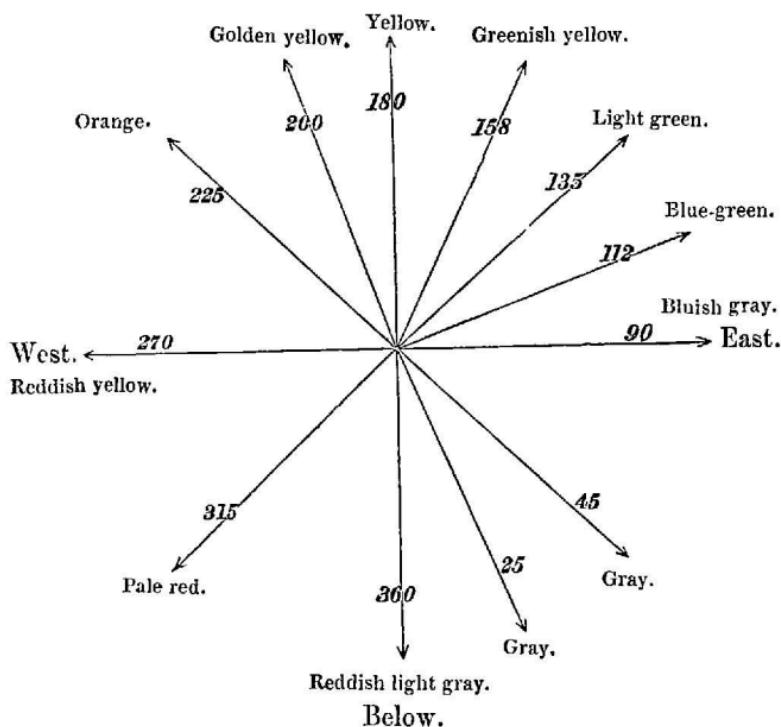
directions, and even drew my attention to green between yellow and blue.

526. It thus appears that the circular iris exhibited by a magnetic bar at its poles and polar flames when made to revolve in its meridian, is also formed in exactly the same way, though more faintly, by a simple unmagnetic iron bar, and consequently it can be produced by the influence of the terrestrial poles alone. This affords an explanation of the results of the unconformable position of the magnet.

527. I now proceeded to investigate the behaviour of the bar-magnet in passing *through a vertical circle in the plane of the magnetic parallel* of my residence, between two and three miles north of Vienna. The arrangements were the same as before, and I directed the attention of the observer, Miss Zinkel, in the first place to the northward pole of the bar. The following diagram (fig. 22.) is derived from numerous repetitions of the trial.

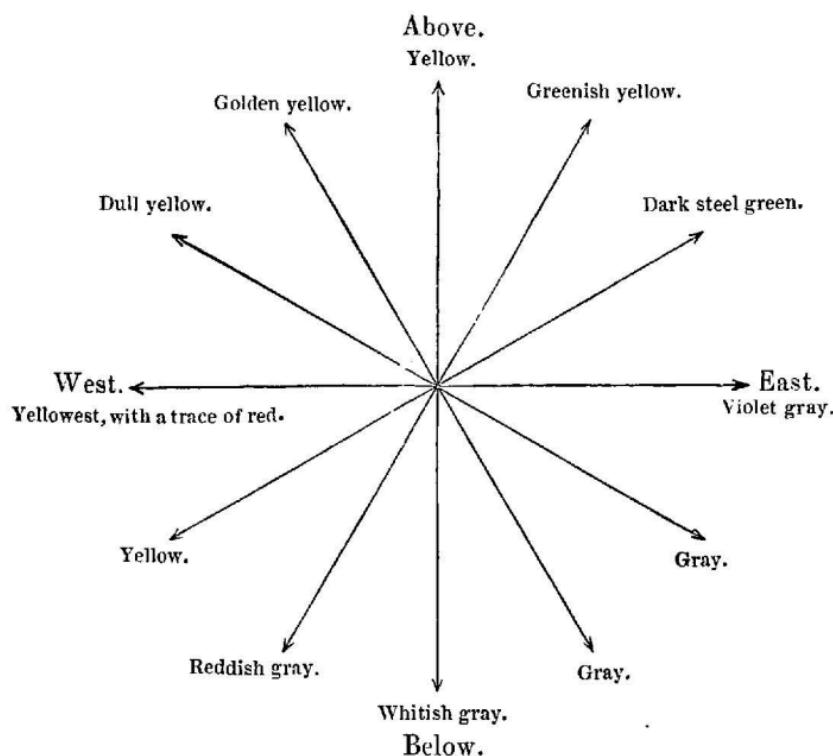
FIG. 22.

Above



528. The southward pole, in several experiments, gave fig. 23.

FIG. 23.



529. The next person with whom this experiment was made was Wilhelmine Glaser. Her statements, after many repetitions, yielded, as a general result, gray in the east ; yellow above ; yellow in the west ; gray again below ; between east and the highest point, traces of green ; between west and the lowest point, traces of red. I tried this soon after with Madame Cäcilie Bauer. The statements of this lady, so exceedingly sensitive, did not differ in any material point ; gray towards the east below, and in the interval between the two ; yellow toward the west, above, and in the arc between them. The slight differences of tint which were obtained in numerous repetitions of the experiment, always proved, on more accurate examination, to depend on slight variations of distance of the beholder, or on deviations

in the position of the magnetic bar with regard to the direction of the magnetic parallel. Miss Sophie Pauer saw the northward pole of the bar gray when pointing downwards, yellow towards the west, yellow also when turned upwards, and gray again towards east. Mr. Hochstetter, under the same circumstances, perceived dark vapour downwards, and towards east, upwards and towards the west lighter vapour, this being the manner in which weakly sensitive vision perceives gray and yellow.

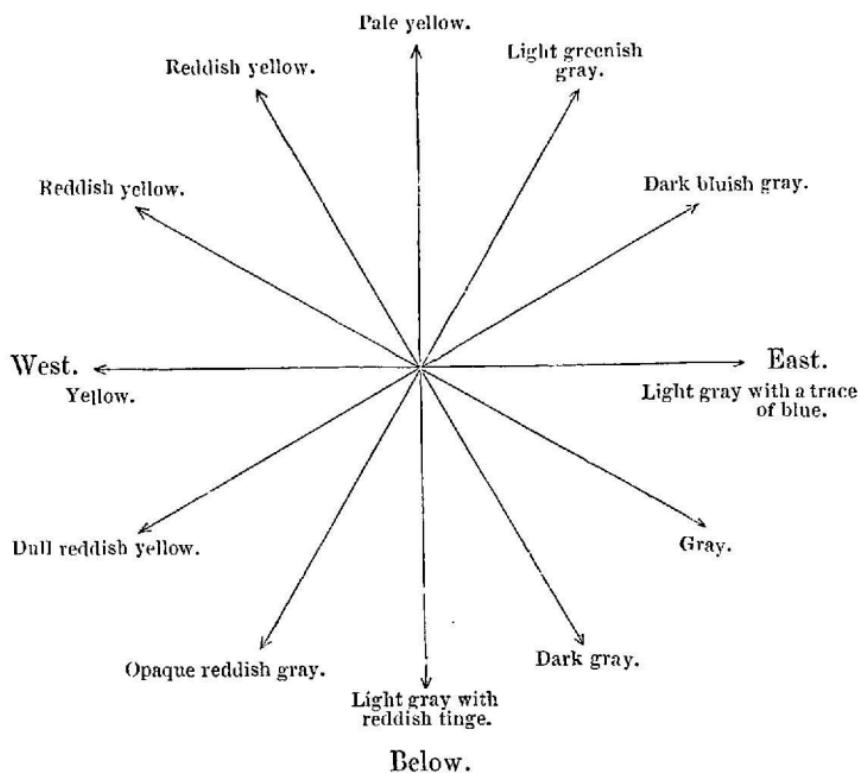
530. It is very evident that the colours of the odic flames of the two poles of the bar differ but little here in the parallels. The general result is that, in both poles, *gray declares itself the prevailing colour when they are directed towards the east, and yellow when towards the west.* East, as essentially gray, corresponds, therefore, with the dip; and west, as essentially yellow, lies diametrically opposite to the dip, there in the meridian circle as here in the parallel circle. The northward pole of the bar appears rather bluish-gray in the east, while its southward pole has more red intermingled, violet-gray in the east. On the other hand, there is more of reddish-yellow at its northward pole in the west, and a purer yellow on its southward pole in the west. These slight variations of colour are, however, difficult to determine accurately, and hence are only approximative.

531. To complete this set of experiments, it was requisite to pass an unmagnetic *soft iron bar* through the vertical circle in the parallel. This afforded the following circle of colours (fig. 24, next page) with Josephine Zinkel, in the dark chamber.

532. All the statements of the colours agree tolerably closely with the result of the magnetic bar in the parallel, and this experiment merely differed in the fact that the polar flames were smaller, fainter, and duller, demanding some effort on the part of the observer to recognise them clearly.

FIG. 24.

Above.

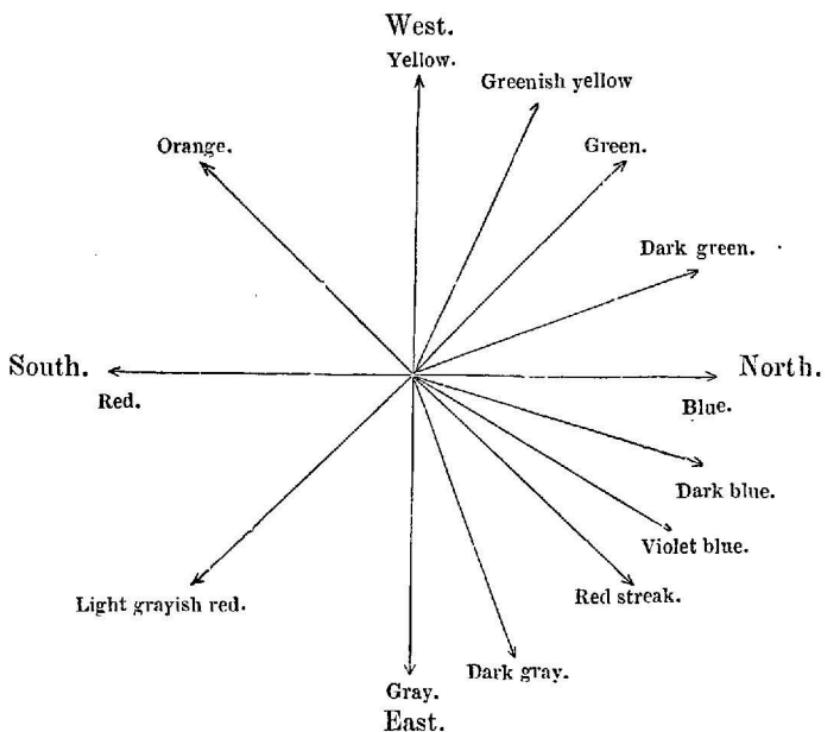


533. Yellow always displayed itself with traces of red on the west side, gray, with traces of blue, on the east side. Gray and yellow are opposed here also, as well as the dawnings of blue, to the first shades of red.

534. *The third direction* requiring to be investigated here,—one which must serve to a certain extent for the control of the two vertical circles already examined, that in the meridian, and that in the parallel—is the *horizontal*. I give the diagram of the *northward pole* of the bar magnet used here, as is furnished by the statements of Josephine Zinkel (fig. 25, next page).

The *southward pole*, when examined in this way, behaved like the northward pole in respect to the emanations of colour, with only very minute deviations; on the former

FIG. 25.



red presented itself among all the colours, in the latter the blue was more predominant, in both cases strengthening and vivifying the colours on the conformable half of the circle, weakening and dulling them on the unconformable. Finally, that retardation of the development of colour at the southward pole, which has been spoken of before (§ 514), again presented itself in this experiment, and was noticed on the advance in the direction from east to west.

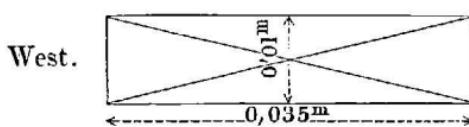
535. That agreement presented itself most satisfactorily here, which one might expect to find *in the points at which the vertical circles intersect the horizontal circle*, and thus, to a certain extent, form nodes. *The coincidence in the direction of north gave blue, that towards south red, east gray, and towards west yellow*, exactly and accurately as we had found at the coincidence in the same positions of the two vertical circles. They thus all serve for form, reciprocal control, and confirmation.

536. The observations are rather more difficult to make in the parallel and horizontal circles than in the vertical ; this arises, in the former, principally from the circumstance that north and south, the more powerful influences upon the magnetic bar, exert continuous equally strong action upon its poles throughout the entire circle ; while east and west, the far weaker odic points of the compass, alternate, and have to bear the whole weight of the conflict above and below. The length of the bar, the strength of its charge, &c., thus all exercise more influence upon those colours which are produced by lesser forces and more feebly sustained. Nevertheless, a little difference does display itself in all cases between the colours of east and west ; for, in the east, the gray of the northward pole approached rather to blue, and that of the southward was slightly intermingled with violet-blue ; in the west, on the other hand, the yellow of the northward pole appeared somewhat tinged with reddish ; that of the southward of the fullest and most brilliant yellow, with a tint of red. The former indicates similarity between the actions of east and north, the latter, similarity between those of west and south. Thus we here arrive, by another path, at that result which we have already once met with above at § 391, namely, that *east is inclined to north, and west to south*, in odic respects generally. And since we have already seen at § 326 and § 513, that east and the downward direction, as well as west and the upward direction, harmonize with one another, we come, altogether, to the comprehensive general result, that *north-east and the earth's surface* (downward direction) *form a general contrast, in odic polarity, to south-west and the heavens* (the direction upwards).

537. Among all the experiments in which the bars were turned round on a circle in this manner in different directions, it seemed, in several cases, as if the end-flames were

not exactly of the same colour on different corners of one and the same pole: for when I used an unmagnetic iron bar of oblong section, namely, twenty inches long, and about one and a third broad, only two-fifths of an inch thick, Josephine Zinkel frequently observed that the polar extremities, under the influence of terrestrial magnetism, gave lateral flames on both sides, which were not exactly alike in colour. This was more observable particularly when the bar was turned round on its axis in the meridian with its broad side, that is, so that its broad face was in the plane of the parallels during the whole revolution. A cross section of the bar in this direction will make this clear. When

FIG. 26.



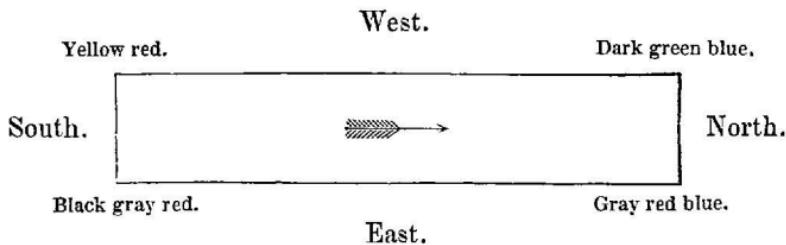
such a bar revolved on its axis on the meridian, it exhibited almost everywhere a rather different coloured side flame on its east from that on its west edge. The colour on the east side had always a darker grayish tint, than on the west more of yellowish, reddish, or frequently grayish tinge. When I used a magnetic bar, the phenomenon was less strongly marked, and, if powerfully magnetic, almost imperceptible; on the other hand, it was most distinct on unmagnetic iron bars.

538. I met with the same in all respects in the researches with Miss Sophie Pauer. When the end of an iron bar was turned upwards, the odic flame on the westward corner alone appeared pure yellow to her in the dark; that on the eastward corner was bluish gray-yellow. The southward side of a bar lying horizontally in the meridian was almost orange in the corner next the west, but greenish red on that next the east. And I found the eastward corner of the magnetic pole directed towards the south duller in all positions, and overcast with gray, while the westward corner

was brighter, clearer, and lighter. When I made the experiment on the west side, with the northward pole in the parallels, the flame always appeared of greener hue on the north corner, and of more of a flame-red tinge on the south corner.

539. I was hence led to conjecture that this might be *the effect of the transverse magnetism of the earth, or an analogous odic phenomenon.* In order to trace this further out, I caused to be prepared a longish, quadrangular, flat iron plate, of full a quarter of an inch thick, twenty inches long, and six inches broad, and I brought this, supported freely in the middle, horizontally into the parallels, and into the meridian, in the dark chamber. The four corners exhibited dull odic flames in both these positions, like an unmagnetized iron bar; but a different colour appeared at each corner. I showed it to Madame Bauer as it lay lengthways in the meridian. She stated that she saw flames at the corners of the following colours:—

FIG. 27.

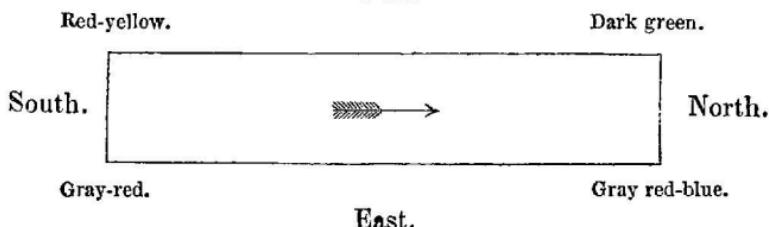


According to this, blue prevailed at both north corners, and red at both the south; but yellow was intermingled with both on the west, and gray on the east. *Thus, yellow and gray, the contrast, appeared as transverse in this experiment.* The dark-green at the north-west looked almost black, and the black grayish-red at the south-east like black greenish-red.

540. I went through the same experiment with Wilhelmine Glaser. The following are the results:—

FIG. 28.

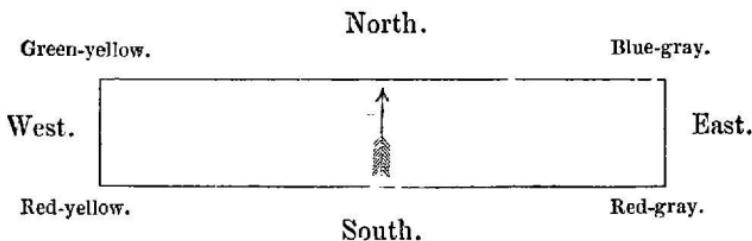
West.



These statements agree essentially with those of Madame Bauer, and harmonize, as to the four predominant colours, with the previous observations.

541. I showed the plate to Wilhelmine Glaser, lying lengthways in the parallel, and she saw—

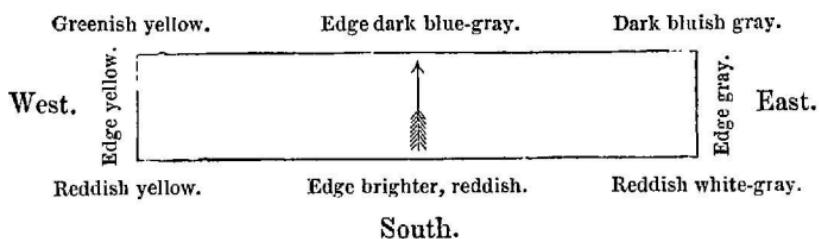
FIG. 29.



542. I repeated the same experiment many times with Miss Zinkel, with every care and accuracy. The results were—

FIG. 30.

North.



543. It was found that the colours, though dull, still decidedly followed the rule, that they appeared gray towards

east, and yellow towards west. And this was not all ; for they became again subdivided in the direction of each of these points of the compass : namely, in the east the flame appeared bluish-gray at the northward corner, reddish-gray on the southward ; and, if we subtract the gray common to both, there remains blue at the former and red at the latter ; in the west, in like manner, the yellow flame appeared greenish yellow, *i. e.* with blue intermixed, at the northward corner, reddish-yellow at the southward ; and, if we again subtract the like gray of both here, we find once more blue on the former and red on the latter. We thus have all four principal colours simultaneously in this longish quadrangle : on the one hand, gray and yellow at the east and west ; on the other, blue and red at the north and south : consequently, when we look close into it, all four primary colours simultaneously on one and the same piece of iron, which is neither more nor less than a broad iron bar under induction by terrestrial magnetism : or, in other words, *the one polar pair of colours, blue and red, make their appearance transversely in the other pair, gray and yellow.*

The figure shows that the edges also agreed with this : of the two longitudinal edges, one of which is directed towards the north, the other to the south, the former is, on the whole, faint grayish-blue ; the latter rather lighter reddish gray, exactly corresponding to their polar directions : of the two cross edges, the one turned to the east is gray ; the other turned to the west yellow, in conformity with their directions.

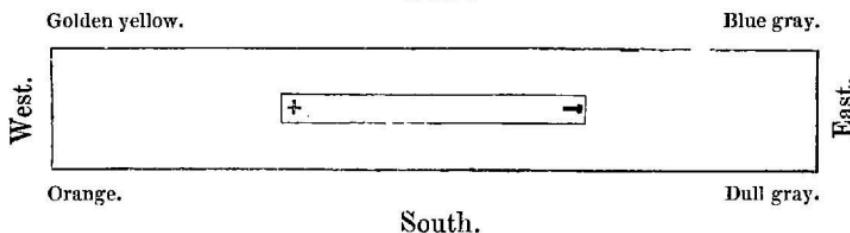
544. For the control of the foregoing in this last experiment with Miss Zinkel, I laid a bluntly pointed iron rod lengthways on the iron plate, and moved it forward so as to project about a hand's length beyond one of the cross edges. When so placed as to form a prolongation of any of the four corners, it absorbed their odic flames, and emitted

them from its own point, unchanged, but strengthened by concentration. But when I moved it sideways along the cross edge, from one corner to the other, it assumed in its passage mixed colours, compounded of those of the two corner flames between which it moved ; when moved in this way between greenish yellow and orange on the west side, it passed step by step through all the intermediate tints, while the colours at the corners shrank to a confused residue. The flame on the pointed bar was therefore composed of two adjacent colours, into which it became decomposed transversely when it had sufficient space.

545. In order to render these appearances stronger, I tried the effect of laying lengthways on the plate of the last figure a magnetic bar half its own length, and placed in the middle, so that its poles were at equal distances from the two ends of the plate. The intensity of light and distinct-

FIG. 31.

North.



ness of colour were at once both increased and diminished. The northward pole, directed toward the east, converted the bluish gray of the north-east corner of the plate to blue-gray, the reddish light gray to dull gray ; the southward pole, the greenish yellow to golden yellow, and the reddish yellow to orange, on the west side. Thus the northward pole strengthened the blue tints on the plate, and weakened the red ; the southward pole, on the other hand, rendered the red tints more vivid and the blue fainter. Exactly similar effects were produced by laying the bar magnet the

reverse way on the plate, with its northward pole to the west, and its southward to the east. Under these circumstances the blue-gray was changed to violet-gray, and the reddish light-gray into red-gray, at the east end of the plate, while on the west side the greenish-yellow gave place to dark green-yellow, and the reddish gray to dull gray-yellow; all corresponding to the effect and intermixture, on the one side of red, on the other of blue, from the magnet, upon the colours given to the iron plate by terrestrial magnetism.

546. One experiment still remained, which I was unwilling to neglect, that of placing the plate vertically in the meridian with the cross edges upright, and the long edges running from north to south at the top and bottom. Thus arranged, I showed it to Josephine Zinkel in the dark, and was informed that the north edges were darker, since they were bluish; the south edges lighter, because reddish; the lower edges darker, being grayish; the upper edges lighter, because yellowish; the lower south corner darker, since it was grayish; the upper south corner lighter, because yellowish; the upper north corner darker, because verging to dark blue; the lower north corner lighter, as it approached to light gray;—all clearly corresponding closely and completely with the principles already many times laid down. I availed myself of Madame Cæcilie Bauer's aid for further confirmation of this. She, capable of seeing better, found the two northward corners to have bluish corner flames, the two southward yellowish red flames. In the case of the two former the upper was dulled with dark green, the lower with reddish gray; this because there was a slight admixture above of yellow, and below of gray, and the often-mentioned red streak: of the two latter, the upper was bright yellow, the lower dark gray-red, also because yellow had become intermixed above, and gray below. Though it was hardly requisite, I tested both the observer and the

observation by turning the plate over several times, bringing the edge which was the lower in one instance to the top in the next trial. Madame Bauer assured me that nothing was changed but the position of the plate, the relative situations of the coloured flames remaining unaltered. This was necessarily the case. Such a result produced through the short vertical in the long horizontal could not be other than most pleasing to me, since it confirmed in the most delightful manner the accuracy of the preceding observations.

547. When I next turned the plate thus arranged, a quarter of a circle horizontally, so that it stood in the magnetic parallel, Miss Zinkel gave me the following account :—

Above and below, as in the preceding experiment.

The west edges lighter, because on the yellow side.

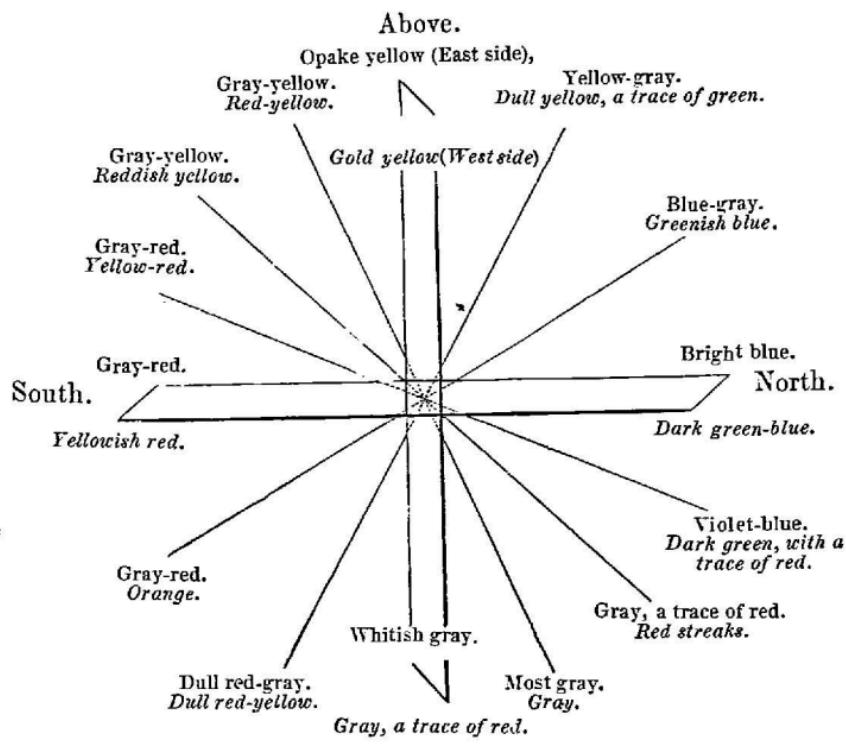
The east edges darker, because on the gray side,—thus all four sides agreeing with the results already obtained on the bars.

During these observations the entire mass of the plates was odically incandescent, and the brightness of this increased from the shorter axis outwards towards the two cross edges (or ends). The maximum intensity of light here was not situated at the extreme ends, but at some distance within these, as in magnetic bars. At this point, also, the down-like odic flame, which coats all the borders like a delicate fleece, was strongest and of greatest length.

548. I combined all these different observations into a single more comprehensive experiment. I had a supporting apparatus made on purpose, capable of holding a plate weighing upwards of 15 lbs., freely moving on its centre, and also arranged so as to turn round in a circle on its short axis. I laid this with the long edges on the magnetic meridian, while the cross edges ran from east to west; thus, in such a position that the plate could be turned

round in a meridional circle in the direction of its length, while the cross edges always remained in the parallel during the movement. In this way I obtained the results shown in Fig. 32.

FIG. 32.



Below.

The Roman letters denote the colours of the odic flame of the eastern corners, the italics the western corners, of the short edges in each position.

549. On examination of this diagram we find all the colours closely corresponding, *in general*, all round with the laws already discovered; blue is found predominating in the north, red in the south, gray below, and yellow above; but when we look to the *particulars*, we see, in all the positions, the prevailing colours of any given pair of corners, somewhat modified, in obedience to a transversality, at each

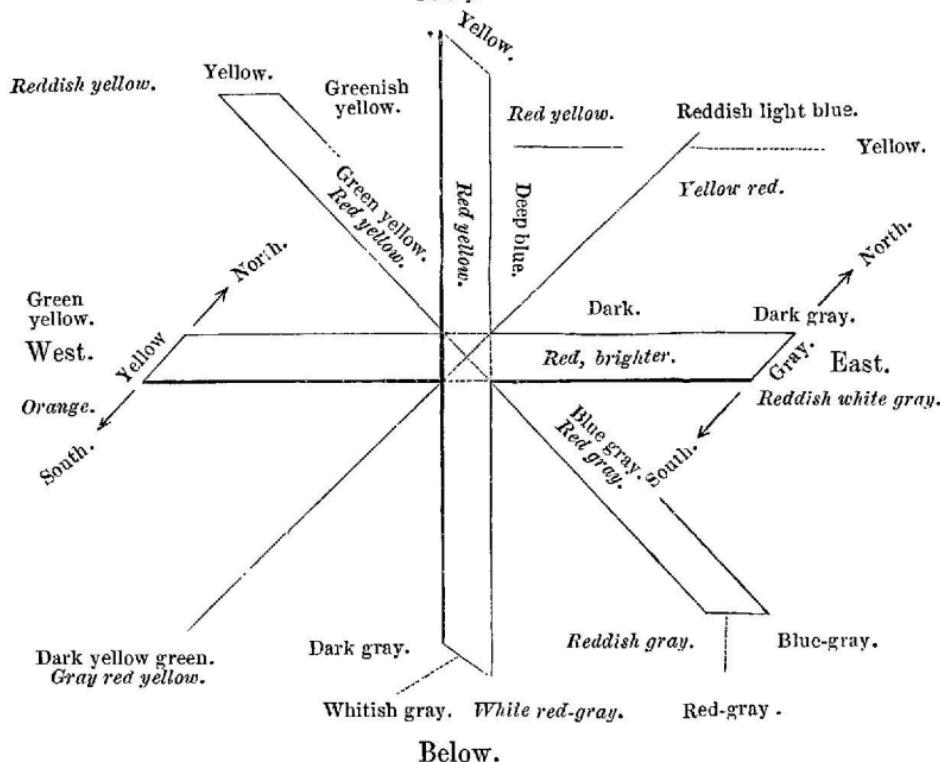
corner, and this always arising from an approach to the colour produced by east or west side to which the corner is directed : that is to say, we see all the corners tinged gray on the east side, and all those on the west side affected by yellow ; both intermixtures being manifest all round the circle.

556. I made the same experiment in the parallel, curtailing it somewhat. The following figure gives the results :—

FIG. 33.

Above.

Gold yellow.



The words in Roman letters refer to the odic flames of the northern corners, those in italics to the southern.

551. Here, again, as in all the previously-described experiments with iron bars (§ 513 and 536), the general characters

of all at the top and to the west is yellow, of all below and to the east, gray ; but we find red making good its presence in a mixed tint all round on the south side, and blue upon the north side, the latter sometimes passing into dark gray, at others producing tinges of green.

552. The long edges of the plates correspond to all this throughout their whole length on both sides ; nay, even their two halves become oppositely polarized, especially in the direction of the dip,—*e. g.*

Below	$\left\{ \begin{array}{l} \text{Blue-gray.} \\ \text{Red-gray.} \end{array} \right.$	$\left\{ \begin{array}{l} \text{Green-yellow.} \\ \text{Red-yellow.} \end{array} \right.$
-------	--	---

It is impossible that these contrasts should display themselves and divide and subdivide more beautifully than they do in these numerous experiments, with the most delightful consistency. They make manifest the most inviolable constancy in the action of the all-ruling natural forces, which are in operation here, and which come clearly to light as everywhere identical throughout the modifications of the experiments.

553. And thus we have *established beyond doubt the existence of transversality in the odic phenomena*, as was long since done in magnetic by M. Precht's earliest investigations. The principal distinction between the two, so far as my researches have gone at present, is, as may be seen from the experiments, that *the magnetic transversality has more independence, while the odic is more dependent* upon the triple polar conditions of the earth.

554. After I had thus made out, under conditions very variously modified, that certain fixed points of the compass correspond invariably to particular odic colours, the iris itself, in which the whole of the colours always appear simultaneously toward each point of the compass, was still more puzzling. In this abstruse subject it is, indeed, out

of the question at present to attempt solving enigmas, for here everything is enigmatical ; but it is possible to collect facts, to arrange them according to their resemblances, and to bring the homologous temporarily into abstract groups. With this view I was now desirous of examining whether the iris, which presented itself over the poles of stronger magnets, had an independent existence, not subject to or liable to modification, by the influence of the points of the compass beyond a certain limit, or whether it might not perhaps be possible to separate its colours, and exhibit each independently. From the foregoing observations we know that the iris always appears horizontally stratified, in such a manner that the red colour is always below, the yellow in the middle, and then the blue above, over which a further streak of red occurs—succeeded, however, by gray smoke ; we know, moreover, that when the iris is directed towards any of the points of the compass, a different but always a fixed and particular colour becomes predominant over the rest, in size and brilliancy, in each position. I now wished to see whether, if I made the points of issue for the flaming emanations at the poles of different shapes, the iris, corresponding to the position and direction of the apparatus at the time, would be developed from all of these in one and the same way.

555. For this purpose I had a number of different iron caps made, fitting upon the pole of a large magnetic bar. They were so constructed that the lower part of all consisted of a short four-cornered ferule, which could be slipped on to the end of the pole ; the upper portions were made in various shapes, just such as it seemed worth while to test the emanations of odic light with. I was thus enabled to make the pole of the magnetic bar terminate in all kinds of points. I now fixed my strongest bar-magnet in a vertical position, and exhibited it, with the various caps applied in succession upon the upwardly directed pole, to

Miss Zinkel, and some months subsequently to the less sensitive Baroness von Augustin and Dr. Nied.

556. The first was a *hemisphere*, attached on the north pole. It was rather more than an inch in diameter. When the bar terminated in a rounded surface like this, Josephine Zinkel observed a dull iris, on which two colours—yellow and blue—predominated, the yellow below, the blue above; the rest of the colours were opaque and indistinct. In this case the usual form of the emanation was not much altered, and the odic flame was rather more than four inches long, as it was without the cap.

557. I took this off, and applied a cap *which was hollowed out in the centre, and a sharp rim all round*. It formed a cup, into which the hemisphere of the first cap fitted exactly, and they were consequently the reverse of each other. The raised margin alone emitted all the odic light here, and the observer saw nothing come from the cavity it bounded. The flaming rim again formed an iris, but no longer, as in the last experiment, with the colours horizontally stratified, but arranged *side by side*, and forming a horizontal wreath, which was but about two inches high. This was seen both by Josephine Zinkel and Dr. Nied.

558. When I put on a *ring-cap* like this, with the addition of a *free point* projecting from its centre, the wreath of colours remained unchanged, and no coloured odic flame flowed from the central point, but exclusively *gray smoke*. Dr. Nied detected merely a bright luminous point in the middle.

559. Substituting a cap forming a *four-sided pyramid*, consequently terminating in a single point, I obtained an elongated narrow flame, displaying an *iris*, in which the colours were again horizontally stratified, and which only differed from that of the hemisphere in having more colours, and being more drawn out, so that it rose higher.

560. With a cap having a simple *straight edge* running transversely across the pole, I again obtained an imperfect iris, with the colours horizontally stratified. Placing the edge so as to coincide with the meridian, the colouring on the northward corner was violet and blue; on the southward, red. The rest of the colours existed in a duller condition between these. When I placed the edge in the direction of the magnetic parallel, the corner on the east side exhibited gray, that on the west yellow, colouring of the odic flame; the remaining colours being irregularly intermingled along the edge between the corners.

561. With a cap having *two points* in a line, I obtained an odic flame from each. When one was on the north, the other on the south, the flame at the former was blue, at the latter red. This was stated by Dr. Nied, as well as by Baroness von Augustin. When placed east and west, Josephine Zinkel saw the former gray, the latter yellow. Turning them north-west and south-east, I obtained green and dark muddy red flames; from north-east and south-west, reddish violet and orange.

Finally, I applied a cap with *four points* arranged on a quadrangle, and so placed that each was directed to one of the four points of the compass. Differently coloured odic lights now arose from all four points. Baroness von Augustin saw the flames of the east point gray, of the south point red, of the north point blue, and those of the west lightest of all and doubtful in colour, sometimes light blue, at other times whitish. The statements of Dr. Nied were to the same effect, with the addition that he observed decided yellow flame at the west point. Miss Zinkel distinctly perceived a blue flame on the north point, a yellow on the west, a red on the south, and a gray on the east.

563. When I applied the caps to the magnetic bar reversed, so that the *southward pole was uppermost*, I obtained from the observations of Josephine Zinkel the same

appearances in all cases, only all duller and fainter than when the northward pole was at the top.

564. I thus had the pleasure of finding the flame both of the northward and southward poles of a bar magnet, which had independently formed an iris with colours of unequal intensity, *decomposed (separated) by the application of a four-pointed cap into their four primary colours, displayed in flames of equal size*, and in this experiment to attain with a single magnet-pole all that I had acquired previously with much more complex experiments—namely, the proof that every magnetic flame contained all the conditions necessary for the production of all the prismatic colours; and these may be called out simply and clearly in each case from the corresponding part of the compass, provided only that such an arrangement of the apparatus be hit upon that the colours can separate from each other, and each unobstructedly develope itself free from the rest. We might say, indeed, in other words, that a kind of double odic transversality is thus demonstrated in each pole of the magnet dependent upon terrestrial polarity.

565. From these results I proceeded to the examination of a *circular plate*. I had a disc of iron plate, rather more than a foot in diameter, well flattened and bored by folding the edge over an iron wire, so as to obtain a smoother and truer edge of about one-eighth of an inch thick. A little iron hook was fixed in the middle, so that it might be suspended with its surface in the horizontal position. By means of a chandelier-hook in the ceiling, I could suspend the disc freely by a silk cord, and place it at any height I pleased. I placed my strongest bar magnet upright beneath it, the northward pole upwards, and lowered the iron disc down upon it. In this manner it formed a kind of widely expanded flat cap to the pole of the magnet, or, what amounts to the same thing, an induced magnet only as long as the

thickness of the flat iron plate, but with a thickness of the whole diameter of the disc.

566. I first showed the disc alone to Wilhelmine Glaser : she saw it palely incandescent, of a light gray, but could not detect colours. I then lowered it on the northward pole of the bar. She immediately beheld coloured odic light upon it. A blue patch was formed in the centre ; above, the surface became brighter, and the border coloured all round, gray towards the east, blue to the north, yellow to the west, and red to the south, and these colours darkly blended together where they were in contact.

567. Madame Cæcilie Bauer saw the same appearance of the iron disc under the same circumstances ; not, however, merely a gray surface and prismatic colours on the circumference, but with the latter running inwards a considerable portion of the distance towards the centre. When I reversed the magnetic bar, and placed the disc in contact with the southward pole, she found the arrangement of colours on the plate unchanged, but they were fainter and obscured.

568. I showed the disc, similarly arranged, with the northward pole of the bar upwards, to Miss Sophie Pauer. She saw it immediately become incandescent throughout. The colouring of this was such as might have been expected : at the centre of the upper surface, turned away from the northward pole of the magnetic bar, a blue spot was formed ; on the centre of the under face, which was in contact with the magnetic bar, a red one. She described the size of both as about half that of her hand, *i. e.* more than two inches in diameter. They merged into a yellowish ring surrounding them, the lower of which had a reddish tinge, the upper a greenish, and these were lost in gray light, which extended nearly up to the edge of the iron disc : here it was surrounded by a kind of thickened border

of down-like flame rather more than half an inch thick ("as thick as her finger," she said), and again coloured. Toward the east it displayed gray, toward north blue, toward west yellow, and toward south red; the north-west was green, south-west orange, south-east gray-red, and the north-east violet-blue, with a short redder piece. These colours altogether formed round the edge a continuous wreath of colours shaded into one another, and thus a kind of circular rainbow.

569. Miss Pauer saw a stream of blue light, an inch and a half high, like a common magnet flame, run out of the centre of the upper face: at its very summit it passed into sulphur-yellow, and then into gray; this was absent beneath, because the disc was applied immediately upon the magnetic bar. The entire disc was enveloped in a luminous mist, of a downy character, only distinctly visible in profile, appearing bluish above and reddish-gray beneath. It exhibited throughout a kind of slowly undulating motion, and both on the upper and under surface flowed gently inwards from the circumference towards the centre of the disc. It projected about half an inch beyond the edge. She could disturb it by blowing, which caused it to become more luminous for the moment, but it soon returned to its original state.

570 I made a modified experiment of a similar kind with Josephine Zinkel. I connected the iron disc, suspended by its silken cord, with the poles of a zinc and silver battery of about two and a half square feet of surface, bringing two copper polar wires in contact with the centre of the disk, so that they were merely separated to the extent of the thickness of the iron plate of which the disk was made, amounting only to about the twenty-fifth of an inch; which at the same time forms a metallic connection.

The beholder immediately saw a blue luminous patch of odic incandescence, two inches in diameter, formed on the

centre of the upper surface of the disc when the silver pole of the voltaic battery joined : a red patch was simultaneously produced on the under face, when the wire of the zinc end touched the iron plate. No odic flame was visible over these places ; but the entire plate acquired coloured odic incandescence, not merely at its borders, but over the whole of both surfaces. The colours were so distributed that blue presented itself towards north, yellow towards west, red towards south, and gray towards east, also green towards the north-west, &c. The blue and red central patches formed star-like appearances, with innumerable points, or rather radiating prolongations, which ran from the centre towards the circumference of the disc, and throughout exhibited those colours which corresponded to the points of the compass toward which they ran. The colours were so arranged upon the surface that each occupied a segment of a circle, and the whole formed a kind of circular rainbow. The edge of the disc was again enveloped in a luminous thickened border of delicate down-like odic light, such as is seen on horse-shoe magnets when the armatures are in place. This downy flame extended over the whole disc, in a thickness of about one-fifth of an inch ("hardly as thick as a quill"), and flowed in weak undulations from the edge to the middle, where it was rather thicker. It was thick enough there to veil the brilliancy of the light of the disc like a kind of mist.

571. In order, if possible, to add the key-stone to the result of the foregoing experiments, I had a hollow globe of sheet iron made, without any projections whatever. It was rather more than a foot in diameter, and composed of two hemispheres fitted smoothly and closely, so that when one was slipped over the other the junction could scarcely be seen. A little hole was made through this joint, in which was attached a silken cord, and the globe thereby freely suspended in the air.

Weighing all the preceding discoveries, I indulged the hope of being able, with this arrangement, to produce something which might, perhaps, in some degree, approach to an artificial aurora,—a northern and southern polar light. It appeared to me that an electro-magnet would be the fitting means of giving my globe, like the earth, two magnetic poles of equal strength, the intensity of which I could have under my control. I coiled a round iron bar of nearly an inch in diameter, with silk-covered copper wire, about one-twelfth of an inch thick, and fixed it diametrically in the globe; it was made just the length of the internal diameter, so that it remained in its place without special fastening, so long as the two halves of the globe were applied together. I placed it upright within the iron ball, and it was thus in immediate contact with the highest and lowest points of this. The two ends of the wire were brought through two little holes, lined with pieces of quill, at the top and bottom of the globe, and were connected with a Smees battery of two and a half square feet of active silver surface. Thus arranged, the globe was shown in the dark to Professor Huss of Stockholm, Mr. Hochstetter, Baroness von Augustin, Miss Sophie Pauer, Wilhelmine Glaser, Madame Cæcilie Bauer, and Miss Zinkel; persons, therefore, undoubtedly quite healthy and vigorous.

572. Dr. Huss, the least sensitive of the number, only discerned the suspended globe during a few moments, and this at first, when the voltaic battery was in strongest action; but it now disappeared from his sight, either from loss of strength in the inducing current, or through an intermission of his sensitive powers.

573. Mr. Hochstetter saw a bright round patch arise on the top and bottom of the globe, about two inches in diameter, without visible colour, and situated at the two points of the surface of the globe which corresponded to the

ends of the electro-magnet touching the inside. He detected nothing else.

574. Baroness von Augustin saw the globe alone feebly luminous : when connected with the voltaic current, she saw the light increase and become enveloped in vapour. She discerned expanded clearer portions of light above and below, at the poles, which produced dull but visibly brighter patches on the ceiling and floor of the room. On the surface of the globe, from the upper pole down to the lower, she detected differences of colour, weak indeed, but distinctly blue upon the north side, gray and dark on the east side, a reddish condition on the south side ; she found the west side the lightest, but could not declare with certainty the nature of its colour.

Anka Hetmanek saw the large globe in a whitish odic glow, before it was connected with a Smee's battery. When the electro-magnet was put in action she found the globe much more luminous, and covered with broad, coloured streaks from pole to pole. She saw them blue on the north side, yellow towards the west, red towards south, darker green (gray?) towards east ; she observed green on the north-west. The poles were more strongly luminous, the upper blue, and the lower red.

Madame Josephine Fenzl saw the globe become luminous directly I had effected its connexion with the Smee's battery. She perceived the south-west side to be incomparably brighter than the north-east, yet could not distinguish colours. But both at the top and bottom of the globe she discerned flames, two or three inches broad, radiating from the polar points, and then, to use her own expression, spreading like an open parasol over the globe, concentric with it, both above and below, but a little distance from its surface.

575. The appearances were much better developed to the

eyes of Miss Pauer. Even before the connection of the iron bar inside the globe with the voltaic battery, she discerned the form of the globe, as a ball of pale light floating in the air. When I completed the electric circuit, and thus converted the iron bar into a strong electro-magnet, the balloon became highly incandescent. Colours soon appeared in the incandescence. The beholder saw the north side become blue from above downwards, the west side yellow, the south side red, and the east side gray. She detected green between north and west, orange between west and south, violet between east and north. The light was most intense upon the west side, least upon the east. The colours merged gradually and imperceptibly into each other. But the light was developed most strongly at the top and bottom, at the parts of the outer surface corresponding to the internal points of contact of the poles of the enclosed electro-magnet, which were at the same time the poles of the globe itself: the upper pole had a blue patch, the lower a red; the former being connected with the silver pole of the battery, the latter with the zinc. Each polar patch was nearly four inches in diameter. Both passed into a yellowish colour at the edge, which gradually became paler outwards and lost itself in gray. Odic flame ran from the surface at both poles, blue at the upper and red at the lower, which the observer estimated at a height of nearly four inches. She also saw a delicate gray misty envelope all over the ball, most distinctly to be discerned in profile, and rising about two-fifths of an inch above the surface; it appeared to be flowing from the equator to the poles, and was disturbed when she blew upon it. She perceived a more luminous, narrow and whitish-yellow ring running all round at the equator.

576. Madame Cæcilie Bauer perceived the globe in a faint yellow light before the bar within it was rendered magnetic. Directly the voltaic current began to pass

through the wire coil, a splendid variegation of prismatic colours appeared upon the globe. The greatest intensity of light displayed itself at the poles; blue above, when the electric current was derived from the silver; red below, when it was in connexion with the zinc. Both colours formed brightly luminous patches of odic incandescence, six inches in diameter, at the polar regions, dividing externally into innumerable narrow, coloured meridians, which ran straight over the surface of the ball, perpendicular to the equator. On the side turned towards the north they were blue; on the west, yellow; on the south, red; and on the east, gray; and the mixed colours appeared between these in every intermediate shade. The globe was darker on the east side, lighter and with the colours more brilliant on the west. The intensity of the light of the colours diminished from the poles towards the equator, and near this they were lost; but in their place occurred another phenomenon,—the equator itself formed a narrow, rather brighter band round the globe.

577. I was able to examine these phenomena most accurately and circumstantially through Josephine Zinkel. The period of menstruation was chosen for the trial. She saw the globe in a white light before the voltaic current was completed. When the connection was made, and the internal iron bar converted into an electro-magnet, it displayed a bright light, decorated with the most beautiful colours, which always drew expressions of admiration from the beholders. Josephine Zinkel detected all the same phenomena as her predecessors:—the pole of the globe towards the silver side of the battery, blue; that towards the zinc, red; the light most intense at the poles, forming from them great stars, with apparently innumerable points, or rather radiant thread-like prolongations, running over the globe, towards the equator, in various colours,—blue on the north, yellow on the west, red on the south, and

gray on the east, and thus following the order so often observed ; the whole of the east side was darker, the entire west side brighter, &c.

578. She also perceived the band which runs round the globe at the equator. She described it as a luminous streak, passing horizontally round at the greatest circumference, and thus dividing the globe into two halves, upper and lower. According to her descriptions, it is only about one-fifth of an inch broad, of pale whitish-yellow light, so that persons of a lower degree of sensitiveness cannot discern it ; and hence it was not perceived at all by Mr. Hochstetter, only indistinctly by Miss Pauer, and first detected by Madame Bauer and Miss Zinkel. It is not sharply defined at the two edges, but has countless strong short teeth, like a fine comb, at right angles to the equator, and therefore pointing to the poles.

579. The luminosity of the surface of the globe, its odic incandescence, appeared to Madame Bauer continuous, but at the same time composed of innumerable clearly distinguishable filaments, which seemed to her about one-twenty-fifth of an inch thick (the size of a knitting needle), and ran from the blue and red patches of the upper and lower poles perpendicularly towards the equatorial band. She described these filaments as not so much independent isolated streaks, as rather merely lines of greater intensity of light, alternating with fainter lines, so as to give a streaked appearance to the whole as if it were made up of threads running down from the poles. They were all of the colours corresponding to the points of the compass toward which they were directed,—thus, blue on the northward side of the globe, both above and below the equator, yellow on the west, and so on.

She saw the blue and red patches as much as six inches in diameter ("a hand's length") ; that is, with a radius of three inches ("a finger's length") from the poles. Beyond

this distance they became subdivided, and changed into filaments running downwards over the succeeding zones, which gave the polar patches a star-like aspect, and this the more since the different colours were of different degrees of brightness ; and the lighter and darker exhibited repeated alternations, whence arose apparent projections and hollows, presenting to the eye the form of a kind of star.

580. The intensity of the light of these phenomena of odic incandescence, which was greatest at the poles, decreased in regular gradation from there to the equator, so that they at length became dull in the tropical zones, and vanished wholly when they came very near to the luminous girdle.

581. The colours thus collectively forming a spherical iris around the globe were shaded off into one another in all parts ; thus, blue through green into yellow, yellow through orange into red, &c. These transitions were so formed that every single filament running down as a kind of meridian over the globe, was slightly deficient in colour, from there on each side of it ; no two were exactly of the same colour, and the difference was sufficiently marked for the observer to detect it clearly. This made the globe look as if it were composed of thousands of coloured lines, which gave it such a charming appearance that Madame Bauer and Josephine Zinkel declared that they had never seen anything more beautiful.

582. The primary colours were again subdivided into several mixed tints, in their own special regions, so that collections of filaments, all differing to a certain extent from each other, formed bundles according to their resemblance. Thus there was a bundle of dark blue luminous filaments, and one of sky-blue. The green, as it became extricated from the sky-blue, formed first a bundle of blackish green, then one of grass-green threads ; the yellow also, the red, and the gray, were subdivided in shades of this kind. The

last formed in the middle a bundle of dark gray filaments, four-fifths of an inch broad, near the equator; on each side of this lay a bundle of whitish light gray, an inch and one-fifth to an inch and three-fifths broad. Between the violet and the gray, towards the north, appeared the often-mentioned striking phenomenon of a red streak. It was sharply defined on the side towards the dark gray, not more than one-fifth of an inch broad at the equator, (or, as she expressed it, about twice or three times as broad as the back of a knife,) and then merged rather suddenly into dark violet-blue. This remarkable red streak was particularly luminous and of a bright red, the intensity of its light being much greater than that of the rest of the red on the south side of the globe. Thus there was *red at both sides of the spectrum, beginning and ending the series of colours*, produced on the one side out of yellow, on the other out of blue, and from this we distinctly see *the condition of the violet, generally, in the spectrum; namely, that it is not a peculiar colour, but, in reality, merely a mixture of blue with adjacent pure and independent red*. The fact that this red is so wholly merged into the blue, in the common spectrum, as only to declare itself in the violet, while in the odic spectrum it is developed independently, depends on causes which remain to be disclosed by future researches in other directions.

583. Besides the general distinction which is evident in the intensities of the light between the eastern and western surfaces of the globe, a second, not less comprehensive, was detected between the upper and lower hemispheres. The upper, with the blue pole, displayed incomparably stronger light upon its red and yellow portions, and was duller upon its blue and green; the lower, on the other hand, when the pole was red, was more vividly luminous on its blue and gray parts, and was opaque at the red and yellow; that is to say, that the red and yellow issued dull from the red pole,

and acquired brilliancy as they approached the blue pole on the further side of the equator ; while, conversely, the blue and gray were sent off in dull threads from the star of the blue pole, but gained power and brilliancy beyond the equator, on the hemisphere of the red pole. Therefore identical colours, occurring at the poles and in the luminous streaks, displayed opposition ; unlike colours were in agreement.

584. The preceding were merely the characters of the *odic incandescence* of the globe ; we have now to examine those of the *odic flame*. A flame flowed out from each pole, perpendicularly to the surface of the globe, upwards of two inches in height and about an inch and a half thick, which *then expanded and overspread all sides of the globe parallel to its surface*, became broken up into rays and streaks, and flowed out at once into the air in filaments of odic flame, like the filaments of the odic incandescence on the globe, and parallel to them, but only to a distance of a radius of about three inches from the poles. The entire diameter of the flaming appearance over each pole was thus rather more than six inches, beyond which distance it was lost in the air. The observer compared the whole flame to a loosely-bound sheaf of corn, standing upright on the ground with the ears and stalks hanging over in curves all round, so as to lie horizontally upon one another over the band. The streaks of flame were not steady, but flickered and scintillated constantly backwards and forwards, becoming shorter and longer, and shooting out in rays like the electric flash on the positive electrified conductor. *The resemblance of this phenomenon to the polar light of the earth* is too manifest to any one who may take the trouble to read these lines. The iron sphere became in this way a *terrelle*, analogous to Barlow's.

585. A second phenomenon connected with the odic flame of the globe is a *thin envelope of luminous vapour*,

a kind of delicate *photosphere*, or atmosphere of light, surrounding it. This consists of an opaque veil of light, not in contact with the surface, but at a little distance from it, and floating freely in the air above it, like a spherical shell. The distance from the surface amounts to about two-fifths of an inch (the thickness of the little finger was the expression), and the misty envelope itself was only about one-twelfth of an inch thick. This luminous envelope is probably similar to that which this observer and many others have described as existing over a ball or an electrified conductor, which I shall give an account of in a future treatise. It differs, however, from this in the circumstance, that while the latter completely envelopes the electrified ball, our *terrelle* is principally clothed with it when the blue and red streaks of light prevail, while over the yellow and gray regions it becomes fainter, and in one part almost entirely vanishes. This envelope, therefore, follows more especially the direction of the terrestrial meridian in which the iron globe is placed, abiding in the northern and southern directions, and retreating from the east and west. The density of the shell of vapour was not altogether inconsiderable there, for it was sufficient to obscure the filaments of light beneath it perceptibly, and to affect the distinctness of their outlines.

586. *Odic smoke* rose in abundance from the globe above its polar flames. From the upper blue flame it ascended vertically to the ceiling, enveloping the silken cord by which the globe was suspended. Both this cord and a small weight that was fastened to it some distance up, became luminous in a golden yellow colour. On the ceiling above it formed a large light patch more than twenty-six inches (an ell, she said) in diameter, so light that she could dimly discern the painting on the ceiling; it then turned outwards and extended over it visibly for a distance of about a yard.

The silken cord was also visible in faint odic incandescence for a certain distance along the ceiling.

587. Six months afterwards I had another much larger globe made of sheet iron. This was about twenty-one inches in diameter; the iron bar placed inside, one inch thick, with a triple coil of covered copper wire one-eighth of an inch thick. The zinc and silver battery connected with it was powerful enough to make this wire hot. The globe was observed by Baroness von Augustin and Miss Wilhelmine Glaser. The former saw the coloured meridians running from pole to pole, as already described, § 574, in speaking of the odic incandescence of the globe. In addition to these, she discerned short luminous columns flowing out as a kind of vapour from both poles, reddish at the positive and blue at the negative. The columns or stalks of light, as she called them, spread out above and turned over. She compared them with the form of a palm-tree, when the leaves spread out in all directions at right angles to the stem. Wilhelmine Glaser perceived the globe to be streaked all over, from top to bottom, gray on the east, red on the south, yellow on the west, and blue on the north; also green at the north-west, and so on. The coloured streaks were about of a hand's breadth where they passed over the equator, and were separated from each other by opaque, indistinct, transitional streaks of the same breadth, in which the colours were blended together. She saw a mass of light above, which she also described as resembling a tree with the stem ascending from the pole, and the branches separating each other, and overhanging on all sides. This is the very same condition as that which Josephine Zinkel compared to an overhanging wheat-sheaf, and also to a tassel turned the wrong way upwards. She perceived a similar appearance, of a red colour, below, but this was less distinct. Anka Hetmanck also saw streams of

light issuing from the top and bottom ; that is, the two poles of the globe, spreading out on all sides like the branches of a tree. Josephine Zinkel observed everything the same on the large as on the small globe, with the exception of the girdle around the equator, and the filaments into which each colour was subdivided on the surface of the smaller globe. The larger globe probably possessed a somewhat less intense development of the odic force ; hence these variations.

588. We see the statements of Josephine Zinkel controlled in all essential particulars by those of Madame Bauer ; of which, indeed, they are merely an extended and detailed amplification. The statements of Madame Bauer, again, are confirmed by those of Miss Sophie Pauer and Wilhelmine Glaser, and the observations of Baroness von Augustin and Mr. Hochstetter form a basis for these. All these sensitives report the perceptions merely in greater detail in proportion to the higher degree of their power of seeing odic phenomena. Madame Bauer, it is true, is more sensitive than Miss Zinkel in her ordinary condition ; but the last experiments with the latter were made during the presence of the catamenia, at which periods she not only equalled Madame Bauer, but even somnambulists such as Misses Reichel, Atzmannsdorfer, &c., in sensitiveness of vision. The reason why Madame Bauer did not report some of the characters of the globe, and described others less perfectly than was done by Josephine Zinkel in the subsequent researches, is most probably to be found in the short time which the former could stay with me, and, on the other hand, in the tranquillity and leisure with which I was enabled to experiment with the latter, to repeat the investigations on different days, and carry them out in detail.

589. Such explanations, indeed, are unnecessary to any one who has attentively marked the course of these experi-

ments ; the researches continued now for more than three years demonstrate on every page that throughout the whole of some sixty persons with whom I have pursued my inquiries, the same threads of physical laws run on, and that every succeeding ramification affords but new testimony to their accuracy, and new evidence of the consistency of their connection. Thus, in the most recent researches, we have seen a yellow odic flame flow out from the point of a vertical bar of unmagnetized iron (§ 525), but from a magnetic bar (§ 517) an iris with horizontally stratified colours, exhibiting red a second time over the violet. When the upper end of a vertical magnetic bar had the form of a horizontal line (§ 560), it afforded an iris with the colours side by side. Bars (§ 517) displayed coloured odic flames at both ends, certain predominant colours always in contrast, those of one contrast in the meridian, those of the other in the parallels. Quadrangular iron surfaces (§ 539 *et seq.*) exhibited both the contrasts of colours at once, predominant colours being situated at the four corners. It was even possible to separate and isolate the colours of the odic spectrum on one single pole ; a cap with two points placed on the pole (§ 561) gave both the contrasts of odic colours,—one when placed on the line of the meridian, the other when arranged in the parallels, as a bar does at its two ends when placed in the same lines ; and a four-pointed summit (§ 562) actually afforded all four primary colours at once ; it displayed to the eye, simultaneously, a double, crossing, transversality, most beautifully defined. A circular surface (§ 565) acquired in the horizontal position all the primary colours of the pole at once, producing at the same time the intermediate mixed shades. Finally, proceeding from the circle to the globe (§ 571 *et seq.*), we arrive at a combination of all these phenomena, each independently marked, but all collected on one focus of activity, the surface of the sphere, on which they might be seen in all their mutual relations in one

view. The arrangement by which these demonstrations were effected was different in different cases ; sometimes I made use of the terrestrial magnetism, sometimes of a magnetic steel bar, or of an electro-magnet, but all came to one and the same ultimate principle, as will be readily understood. In this section we have seen, in innumerable modifications, that, (*en résumé*,)

590. *a.* The light which the magnet visibly emits in the dark, is seen, by the sensitive, of different colours at different distances ; but always of the same colour to each particular eye at a fixed distance.

b. This light not only appears in a variety of outward forms, but assumes every known kind of colour.

c. These kinds include all the primitive colours, all their intermediate shades, and white and black mixed in every gradation of gray.

d. In many cases they appear singly to the sensitive eye ; in such instances they are gray at both poles, or blue at the southward, and red at the southward pole.

e. Most frequently, however, and always when of a certain degree of intensity, several occur together ; they often all appear at once.

f. When they occur together, and arrange themselves freely, they take the relative positions of the colours of the rainbow.

g. The red end of the iris is then below, the blue above.

h. Above the blue, the intermediate shade violet being interposed, a pure red appears a second time, so that the odic spectrum, which commences with red, running through orange, yellow, green, blue, and violet-blue, terminates in red again.

i. The phenomena of coloured light are produced according to the same laws by the magnetism of steel, electro-magnetism, and terrestrial magnetism.

k. The last, since it is motionless relatively to us,

impresses certain rules upon them, causing different results at each particular point of the earth's surface.

l. Terrestrial magnetism produces them in unmagnetized iron bars.

m. In all the observed cases, and probably universally, the phenomena of odic light consist of an iris, except, perhaps, in certain directions in which they appear gray.

n. As a rule, one, or more rarely two colours, predominate in size and intensity in this iris. In many instances only this prevailing colour is perceived by the sensitive; the others, being fainter, escape them.

o. In general, they are gray when directed towards the point of the magnetic dip; blue towards the north, yellow above, red towards the south; they also appear gray in the east, and yellow in the west. Mixed colours, such as green, orange, violet-blue, &c., lie between them. This holds good in all its details in the meridional circle, in the horizontal, and in that of the parallels.

p. If the magnetism of steel or electro-magnetism come into conflict with terrestrial magnetism, through unconformable position, the colours of the odic light are weakened and changed. In the conformable position they are strengthened and rendered more vivid. Intermediate positions afford intermediate tints.

q. Crystallod, Biod, and Od, from any other source, act upon the odic light of another body in the same way as terrestrial magnetism, when brought into conflict with it.

r. A magnetic bar, turned round on its axis, and flaming at both ends, does not exhibit at its poles, either in the vertical circle, in the meridian, or in the parallels, in the horizontal circle, or in any position whatever, odic flames displaying complementary colours, although they stand in polar opposition.

s. But the colours of the upper half of the circle display more brilliant light than those of the lower. All colours

produced by the northward pole of a magnetic bar are more brilliant in the half of the circle turned towards the north, and duller on that turned to the south ; the converse holds, with regard to the intensity of the light, in the colours produced by the southward pole.

t. These coloured odic flames may be conveyed from magnets on to other conductors of Od.

u. Magnetic bars, terminating in several points, have the colours distributed among these, so that each bears a different colour, corresponding to its point of the compass, and the iris of every flame may be decomposed, or subdivided into its elementary colours.

v. A four-cornered iron plate in this manner shows both magnetism and Od not merely as longitudinal, but transverse, so as to present two directions, at right angles to each other.

x. A circular surface of iron, and still better and more perfectly an iron sphere with a strong electro-magnet passing through it, exhibits all these appearances combined, and possesses, in addition, a number of new ones, so as finally to acquire every resemblance to the terrestrial globe with the polar lights playing over it.

x. The odic nature of the positively magnetic north pole of the earth, the odic nature of the east and of the earth's surface (the *nadir*, or that *below*, in all cases) bear a certain character of agreement, in which they stand in opposition to the negatively magnetic south pole of the earth, the west and the heavens (the *zenith*, or that *above*).

ODIC LIGHT, IN THE MORE RESTRICTED SENSE OF THE WORD.

591. It is scarcely necessary to explain that *odic light* must be carefully *distinguished* from odic incandescence,

flames, streaks, sparks, and smoke, and that the latter are to be regarded as sources of the former. This is involved in the circumstance that we see all these phenomena ; for, from the structure of our eyes we are only capable of seeing that which emits light ; that is, whenever we see anything, that something is emitting luminous rays. I have already clearly expressed myself on this subject in § 20 of the first treatise. The statement of Miss Reichel there reported, that she saw the odic flame of the nine-layer horse-shoe magnet diffuse light for twenty inches round over the tube, as well as that of Miss Sturmann at § 55, I have found confirmed, in the meantime, by numerous fresh observers. I will only name some of the more important here. The blind joiner, Bollmann, discerned that the flame of the nine-layer magnet diffused a brightness to the distance of an arm's length around, which he compared to a large light cloud. Josephine Zinkel saw a magnetic bar throw light upon the armature lying near it ; when she placed her finger and other objects between them she saw the light intercepted and shadows thrown on the corresponding parts of the armature ; moreover, she saw a light issue from two horse-shoes which I brought near together upon a table (§ 405 *c*), rendering the surface of the table visible for twelve to sixteen inches. Miss Atzmannsdorfer saw not merely the immediate vicinity, but the whole room, lighted to a certain degree by the five or six feet high flame of the nine-layer magnet, so that she could distinguish all the larger objects, as in twilight. I have already mentioned, on many occasions, the fact of several other sensitives seeing the ceiling of the room so much illuminated by the odic flames and odic smoke of magnets, that they could distinguish the lines of the painting on it ; in particular, Dr. Nied and Mr. Delhez saw a lighted space, as large as a common round table, upon the ceiling of the darkened chamber, over the nine-layer magnet four or five yards

distant below. Professor Endlicher and Baroness von Augustin saw the ceiling illuminated over the same large compound magnet, and to a still greater extent over a strong electro-magnet. Baroness von Augustin saw the larger *terrelle* throw large lights, more than forty inches in diameter, both on the ceiling and the floor. Mr. Hochstetter, standing in front of a nine-layer magnet in the electrical atmosphere, saw the table illuminated to the diameter of forty inches by its flame; and he discerned a round spot on the ceiling directly over it. Both the *terrelles* afforded a remarkable case, and one which is the more worthy of notice, that it stands isolated, without connection with any of my other observations. Besides throwing a patch of light some twenty-six inches in diameter upon the ceiling, sufficiently bright to allow the painting to be made out, the globes also cast a separate, half-moon-shaped patch of light laterally to the north-east, or perhaps the north part of the ceiling, and this moveable backwards and forwards with the globe. This phenomenon is one which must lead to important results when followed out.

592. On one occasion, when Josephine Zinkel was in the dark chamber, she noticed a little spot of light, which she detected at some height on the opposite side of the room. We went towards it to seek the cause, and, on coming near, it was found that the spot of light was on the ceiling, and that a slender ray of light was running upwards to it. On searching we found a magnetic bar twenty inches long, and about one inch square, standing with its southward pole upwards on a support. From this the streak of light ran up vertically, and produced a spot of light upon the ceiling, the size of which the observer compared to that of the bottom of a common wine-glass. Whenever the magnetic bar was moved the bright spot on the roof moved with it; when I interposed my hand it immediately disappeared. This demonstrates the remarkable fact that the cause which

produced the odic light *remained closely aggregated, at a distance of more than four yards, without having suffered dispersion*, for the cross section of the magnetic bar and the spot of light on the ceiling were pretty nearly equal in size.

593. I turned a seven-layer horse-shoe magnet towards one of the solid walls of the dark chamber, at the short distance of two feet. Two spots were formed, side by side, one dullish, corresponding to the northward pole, the other very luminous and reddish, opposite the southward pole. According to Miss Zinkel's statement, both the spots were about the size of an egg. I must reserve the explanation of this interesting phenomenon for a future treatise; here I confine myself simply to the fact, that the flaming phenomena of horse-shoe magnets throw light, which does not suffer dispersion, on the side walls also of rooms.

594. Josephine Zinkel observed a still further stage of these phenomena: when I had coiled a copper wire one-twelfth of an inch thick round the northward pole of the nine-layer magnet, she saw a beautiful stream of odic flame, eight inches long, issue from the outer end of the wire, so exceedingly luminous that it lighted up the floor at a distance of more than a yard. The experiments immediately following will confirm still more the contents of this paragraph.

CONCENTRATION OF THE ODIC LIGHT.

595. I have since repeated on many sensitives the experiment described at § 18 of the first treatise, in which I endeavoured to concentrate the magnetic light by means of a glass lens, in the presence of Miss Reichel. For this purpose I obtained from Paris a large lens a foot in dia-

meter, with a focal length of about eleven inches. I had this heavy glass so mounted as to be easily moveable in any direction. I laid down a large nine-layer horse-shoe magnet at a distance of forty inches from the lens, with both poles directed towards it. I could not well place the magnet further off, since I should then have lost too much of the always sparing amount of light; on the other hand, the flame of the magnet was itself ten or twelve inches broad, and thus I could at all events reckon, in spite of the proximity of the source, upon a sufficient quantity of parallel rays of light falling upon the lens to admit of their being concentrated into one principal focus. This arrangement was submitted in the dark room, at different times, to the sickly Miss Atzmannsdorfer, Madame Kienesberger, Miss Dorfer, and Friedrich Weidlich, to the healthy Messrs. Kotschy and Tirka, the joiner Klaiber, and the blind Bollmann; also to Miss Zinkel and Wilhelmine Glaser. Even the blind man could distinguish light at these different points; and when I made him feel his way to them, he placed his hands, successively, on the magnet, which he stated to have pale yellowish light; on the glass lens, which were reddish; and, lastly, on the screen, which he stated to be white, and the smallest but strongest of the lights. With a distance of from twelve to sixteen inches between the screen and the lens, all the other persons perceived a round spot of light upon the former from four-fifths, one and three-fifths, to more than three inches in diameter; the most accurate observers stated twelve inches to be the distance, between the lens and screen, at which the focus appeared smallest and brightest; in particular, Madame Kienesberger, Wilhelmine Glaser, and Josephine Zinkel. At the same time they all saw the glass lens in reddish odic incandescence, just as they saw the bell of the air-pump when the magnet was beneath it; but the light in the focus was white. Mr. Kotschy and Miss Atzmannsdorfer called my

attention especially to a distinct cone of light which they saw with its base resting against the lens, the apex converging into the focus. When I moved the screen a little nearer or farther off the lens, in the presence of Josephine Zinkel and Wilhelmine Glaser, they saw the size of the spot of light upon the former increase every time. Madame Kienesberger made the same statement, with the addition that every time I removed the screen a little further off, the enlarged image assumed the *prismatic colours*, arranged in the following order: a dark red spot in the middle, around this a yellow ring, which was encompassed by a broader ring of blue. Wilhelmine Glaser, whom I allowed to move the screen backwards and forwards herself, in the dark, until she hit the focus, sometimes saw a blue ring appear outside the yellow circle, sometimes a blue spot arose in the middle of it. Josephine Zinkel gave me similar accounts many times. Thus, an iris had begun to develope itself here also. Although I had entertained some hope of being able to observe the phenomena myself when the light was concentrated, I could not, unfortunately, perceive the slightest trace. I laid two magnets, a nine-fold and a seven-fold, one upon the other, in the presence of Baroness von Augustin, with the view of rendering the effects of the light more powerful. She saw upon the screen a round patch of light, about six inches in diameter. She detected in the middle of this an inner round place, about an inch in diameter, much more strongly illuminated. This was evidently the focus of the parallel rays that fell upon the lens. The Baroness was kind enough to make an oil-painting representing this phenomenon as she saw it, thus making it quite clear to every one. I went through the same experiments, pretty nearly in the same way, with two superimposed magnets, in the presence of Madame Josephine Fenzl. As she about equals Baroness von Augustin in the degree of sensitiveness, it was interesting to obtain from them both

exactly similar descriptions of the size and intensity of the luminous appearances on the screen. I tested the sensitive beholders by making various alterations in the dark, which they could neither perceive nor understand; I moved the screen backwards, forwards, and sideways, pushed the magnet to the right or to the left, and turned the lens upwards and downwards; in every case they all told me of alterations in the position of the focal image, corresponding to those it should suffer according to the known laws of dioptrics, and which it would be quite superfluous to enumerate here. The foregoing confirms the experiment with Miss Reichel, formerly made known by the testimony of four sick and eight healthy new witnesses, and I can only desire that other conscientious observers will soon repeat them, and establish the facts I have recorded.*

* Towards the close of the proceedings of the so-called Committee of the Vienna Physicians, a division arose in its own bosom. Some of them, particularly Drs. Wotzel and Steiner, felt the uncertainty of the plan of investigation, and the want of credible foundation for the conclusions drawn. The latter took the precaution, before the publication of the reports of the physicians, to inquire of some of the sensitive persons whom I had experimented with as to the methods I pursued, and their results. As he received from the most trustworthy persons nothing but confirmation of the experience of sensations of feeling and sight exactly such as I had described in my publications, he expressed a desire to witness some of my experiments for his own conviction. Perfectly ready to accede to this, I invited him to a trial with a new sensitive person, whom I had never seen before. Dr. Steiner could not but be convinced, from his own inspection, of the accuracy with which my investigations were made; and he necessarily felt a misgiving that the superficial labours of the committee might be refuted with proofs by me, and the participators in the affair be sooner or later exposed. This determined him to address the meeting of the Medical Society on the 16th of November, 1846, urgently opposing the publication of the report of the committee against Miss Reichel, and indirectly against me. In his address, which appeared publicly in the printed report of that day's sitting, he says, among other things, "from *such results*" (as those obtained by the labours of the committee) no absolute proofs

596. Another observation, made by Professor Endlicher, also refers here. Commonly wearing spectacles, he kept them on in the dark chamber. As I was showing him magnets, which he did not see so distinctly as I expected from what I knew of the degree of his sensitiveness, it struck Dr. Fenzl, who was present, that the spectacles might interfere. Professor Endlicher removed them. He immediately saw the emanations of light from the magnets very distinctly, and just as I had presupposed from his sensitive excitability. The glasses had thus certainly reflected one portion of the light, and absorbed another, and what remained was so small a residuum that there was scarcely enough to be perceived even faintly by the sensitive eye, while the collective amount given out by the magnet was very clearly visible, and displayed a flame four inches long.

597. When I had thus established that the magnetic light penetrates glass, and, in its passage, undergoes ab-

against the matter could be drawn. For his own part, he was compelled to declare that opportunity had been afforded him of seeing Baron von Reichenbach experiment with persons for whose honour, truthfulness, and impartiality, he could vouch as for his own, and that he had been astonished at the agreement of the statements of these with the assertions contained in Baron von Reichenbach's pamphlets. And other persons, well known to him, and of the greatest respectability, had assured him that they had found Reichenbach's experiments confirmed in their own persons." He therefore gave it as his opinion that the report of the committee would only compromise the Society, and that it would be much better not to publish it at all, or at all events only within the circle of their own members, which limits, as a private matter, it should not be allowed to pass. A violent discussion arose on the subject on the general meeting of the Society, and it was decided by a large majority that the report of the committee *should not be published* in the name of the Society. How far this resolution was carried out by the officers of the Society is seen on looking at the title-page of the Part of the Journal in which the report appeared.—*Author's Note.*

sorption, reflexion, and refraction, uniform with those of common light, it remained to test the first two by reflecting surfaces, and compare their behaviour with that of ordinary light. It was quite possible that odic light might be absorbed, and be incapable of producing catoptric phenomena, in so far, at least, that the Od, from which it is derived, is readily absorbed by all bodies.

598. I made use of a common quicksilvered mirror in my experiments in this direction. I placed one in front of Miss Atzmannsdorfer's bed, and opposite to it, in a suitable position, a nine-layer magnet, standing with its poles upright. She saw in the mirror the image of the odic incandescence of the metal, but she did not discern odic flame, not even a trace, during careful search on different dark nights. I repeated the same experiment a year after with Miss Zinkel; she also saw the odic incandescence of the horse-shoe reflected from the mirror, but could not distinguish a flame, or any other kind of emanation, from the magnet. The light of the flame of the nine-layer magnet was therefore so weak that after the usual absorption by the glass there did not remain enough for reflexion to be detected by these two sensitives in their conditions at those periods.

599. I had given up hope of finding these emanations detected in the rays reflected from a mirror, when, in an experiment for confirmation, made some time after with Wilhelmine Glaser, she not only corroborated the statements of seeing the reflection of the odic incandescence, but declared she saw a faint appearance of the flame in the mirror; weak, it is true, but yet a real representation. I then repeated the experiment with Josephine Zinkel during the catamenia. She also now saw a reflexion of the magnetic flames very distinctly, although unable to detect it before. In the last place, I tested it with the very sensitive eyes of Madame Cæcilie Bauer. She immediately saw

a number of incandescent objects in the mirror with tolerable clearness. She perceived the odic flame of magnets sufficiently well to distinguish pretty accurately between the blue and red of the two poles. But she declared that the image in the mirror was far duller and fainter than the direct light of the flame. In the original flames of the two poles of a seven-layer horse-shoe, she could detect even a portion of an iris, yellow and violet, as well as some smoke ; they were certainly weak, but in the reflected image they had vanished altogether from her eyes.

600. In particular cases odic light is also capable of penetrating *semi-transparent bodies*. This is shown by the fact that it is still detected in the dark *through closed eyelids*. I owe this observation to Madame Josephine Fenzl, who first observed that she could to a certain extent perceive the odic luminosity in the dark chamber, even when she had closed her eyes. I repeated the experiment with Madame Cæcilie Bauer and Misses Zinkel and Atzsmannsdorfer. They all perceived odic flame and incandescence with closed eyes. It is true they lost the form and shape of objects, but they could detect the presence of any body which emitted odic light, without doubt, when it was brought near them. They could point out the direction from which the brightness came, could state whether it was derived from one or several detached points, and they perceived distinctly odic incandescence as well as flame ; not, indeed, distinguishing the two, but recognizing the character of emitting light common to both.

601. The cyclid, however, is very transparent. When a person is in the dark, with the eyes closed, and a lighted candle is brought near, the approach of the light is instantly and very strongly perceived ; indeed, this transparency is so great that no one can bear to keep even the closed eyes turned towards the brightly shining sun. *The odic light, then, weak as it is, is still strong enough to*

penetrate through closed eyelids, and become visible to the sensitive. We shall hereafter find that this circumstance, by itself insignificant, becomes of some importance when it comes to be applied to the elucidation of other rather striking phenomena of sensitiveness.

THE NORTHERN LIGHT.

602. And now I must beg the reader to cast a retrospective glance back to § 21 of the first of these treatises; thus to the very beginning of my labours. I already expressed the opinion there, at a time when I was in possession of far less experience of the odic light, that it was the same thing which, on a large scale, constitutes the northern light, and polar light generally. In the long interval that has elapsed, which I have uninterruptedly devoted to the study of this subject, this opinion has not merely remained unshaken, but has had confirmation and support forced upon it on every side. The observations which I have made on the behaviour of the odic light under the air-pump, its development of colours, the motions which the odic light may be made to exhibit at will, the discovery that it is visible to great numbers of perfectly healthy persons,—these things are all weighty considerations, not, in any case, opposed to my original view, but evidently new and powerful supports to it. Sir Humphry Davy's idea, that the northern light is not so much a magnetic as an electrical phenomenon, a tranquil and slow neutralization of the electricity of the air at great heights, when the air, much rarefied, taking the place of the rapid stormy discharges of the thunderstorms, occurring at less attitude in our latitudes, is mainly opposed by the following facts: that in the temperate zone also, as well as in the arctic, the meteoric changes of rain and snow proceed without thunderstorms through

the whole winter, and yet no phenomenon resembling the polar light is produced by an accumulation of the electricity of the air; that from the numerous recorded observations made since Davy's time, it is found that the polar lights do not appear more frequently in winter than in summer; that so universal an accumulation of electricity in the atmosphere as would be necessary to half fill often one quarter of the globe with electric light, through half the night, is, from the rest of our experience of the laws of electricity, inconceivable under the constant movement existing in the air; lastly, that there is no apparent reason why such an accumulation of electrified air, supposing it to exist, should occur in preference at the magnetic poles. Davy's hypothesis was favourably received as an ingenious idea, but has not proved to have foundation in the settled laws of science; it does not give sufficient account of the relations of cause and effect. But now that we know from our more recent researches *that flaming lights exist over the poles of the magnets, which are larger than magnets themselves*; since we have seen that *this flaming appearance occurs mobile, undulating, frequently serpentine, like rolls of riband blown about by the wind*; often varying in size from larger to smaller, shooting out rays, scintillating, variegated in colour, and also in the form of *vapour*; since we perceive it to be capable of being made to *flare backwards and forwards by our breath*; finally, when we now hear that it increases in vast proportions in size, as well as intensity and brilliancy of light, *in rarified air*; when we see how the play of *colour of the rainbow* follows it every step, &c.,—there is actually scarcely a single essential character of distinction between magneticodic light and the northern light left, for it would be from the difference of intensity that the latter is visible to ordinary eyes, while the former can only be seen by the sensitive. The undulations and serpentine movements some-

times exhibited by the northern light are thus explained simply by the motion of the wind, which drives the odic flames about over one another, in the more or less rarified higher regions of the atmosphere, as our breath does the odic flame over the poles of magnets ; the constant change by increase and decrease of size correspond exactly with the unsteadiness which the magnitude of the flame exhibits in our laboratories ; and the vast flames at great and undetermined altitudes which have been observed by particular travellers above the *cirrus* or most elevated clouds (*Lämmervolken*), agree most beautifully with our observations under the air-pump, § 481, where the odic light increased remarkably in size and intensity of light under the diminished pressure of half an atmosphere. And the equally well-attested observations of other travellers, who have observed abundance of auroras with the most scrupulous attention in the polar regions, where the altitudes appear to be very much less, and the light often in the form of luminous clouds, harmonize perfectly with the nature of the magnetic light. In the foregoing researches, we have frequently met with the odic luminous vapour, flame-like smoke, or whatever we may please to call this appearance. It also increased under the air-pump. This produces the luminous cloud-like phenomena, always ascending from below and completing the parallel between odic light and the northern light or aurora. The vaporous, cloud-like, luminous nature of the polar lights has been accounted for by supposing the appearance to be produced by illuminated clouds. These may have occurred in many cases ; but it is clear, from my investigations, that there is no necessity for such clouds, and that accumulations of Od develope independently in the air smoke-like, that is, cloud-like luminous appearances, which in some of my experiments illuminated the whole room up to the ceiling. The higher the odic emanations of the terrestrial magnetic poles ascend in or

above the atmosphere, the larger, more luminous, and brilliant must be the emissions that unfold themselves, from the same cause which makes them increase so greatly under the air-pump, even with moderate rarefaction of the air. As healthy persons who are not sensitive perceive nothing of the motions of magnetism and Od, it is easy to explain why travellers could perceive no unusual sensations, even at the very poles of the earth. And the often-mentioned observation, that the aurora has been seen to the south in high latitudes, is no longer puzzling; the odic light, wherever developed, shines from its localities with equal strength in every direction.

603. Finally, looking at the rich combination of odic luminous phenomena displayed by the iron globe (§ 571, *et seq.*), we recognise in it a kind of *terrelle*, or miniature earth, *exhibiting artificial northern and southern lights on a small scale*. As the earth is a large magnet, my globe, by reason of the electro-magnet passing through its axis, is a magnet of the same form in miniature. *Their poles emit, in the former on a great scale, in the latter on a small, delicate light visible only in the darkness of night. High above both poles it turns over and flows on all sides towards the tropical zones*, broken up into filaments and rays on the great terrestrial globe as on the little *terrelle*; iridescent with all the prismatic colours, on the former as upon the latter. If we may venture to add, that the difference of the intensity of light in the two cases may probably be proportionate, in some degree, to the difference of size of the two globes, in which the mass, of course, increases as the cube of the diameter, while the surface only enlarges as the square of the same, whereby, consequently, the odic light, emitted by the mass but only poured over the surface, must become more concentrated on the earth, in a degree corresponding to this difference of size, than at the poles of the *terrelle*,—the greater luminosity of the aurora, which surpasses the

light of the terrelle under common pressures of the atmosphere, becomes in some measure incomprehensible. A second cause of the *difference of intensity of the two polar lights, is to be sought in the odic influence exercised by the sun and moon upon the earth.* In the fourth treatise (§ 95 *et seq.* and § 118 *et seq.*) I gave an account of some experiments which demonstrated that the two heavenly bodies strongly charge with Od all bodies exposed to their rays. The surface of the earth, on which they constantly shine, receives accordingly an uninterrupted supply of Od, in the same way as of light and heat. Thus it is not merely the inherent Od, proper to the earth and its magnetism, that appears concentrated at its poles, but this is continually receiving accessions through the vast contributions poured out upon the earth by the sun and moon. In accordance with their own laws, when these reach the surface of the earth they not only flow to the regions which possess a weaker charge, but at once become polarized, that is to say, the current goes towards the terrestrial poles, and increases the intensity of the odic phenomena there. The want of uniformity in the condition of the earth's surface, according as it is or is not covered with clouds, since in the former case the odic radiations are absorbed by the atmosphere, while in the latter they reach the solid substance of the globe,—moreover, the differences of position of the sun and moon in relation to the earth, the co-operation or antagonism of these,—all these things necessarily cause irregularities in the appearance of the northern light, as they do in the weather generally; and this explains the differences between the intensity of the odic light of the *terrelle* and that of the terrestrial poles, and to a certain extent shows their necessity.

604. If it should be objected that there is no magnet passing through the earth as through my *terrelle*, I think I can give this a sufficient answer; for it does not set aside

the demonstrated and established fact that the earth really possesses magnetic poles, whether these depend on the surface and its irradiation by the sun, as the modern physicists think there is reason to assume, or are derived from the internal conditions of the entire planet. In regard to the latter supposition, however, there is a point in its favour, which, so far as I know, has not yet been taken account of in physics: I shall take the liberty to explain it here. It is now pretty generally agreed that meteorites are of planetary origin, that they are minute stars, which have originated under the same laws, and follow their paths around the sun, in the same way as the larger and smaller planets. And in reality the difference is not much greater between the vast Jupiter and the little Vesta or Astræa, which are scarcely larger than the Island of Ceylon, than between an asteroid such as these and the enormous meteorites lying in Senegal, stated to form small mountains of iron. And from these, again, through those of Bahia, Durango, and Zacatecas, which are masses of iron weighing many tons, to our ordinary meteorites of a few pounds, there is every step of gradation. Thus, from Jupiter down to the smallest meteorite, we have an uninterrupted series, so that apparently size alone affords distinction between a planet and a meteoric stone. If this be admitted, and, indeed, it cannot now be avoided, the structure of the meteorite places in our hands a key of extreme value, opening the way to the examination and study of the probable internal condition of the earth. The law which gave the rule for the composition of the meteorite, gave it, consequently, for the construction of our globe. Now, meteorites are composed chiefly either of metallic masses, mostly iron with a portion of nickel, or of stony masses, almost always containing a great intermixture of this metallic nickeliferous iron. This is universally known; but it is not known—and this is of essential importance here—that in the majority of meteoric stones the

abundant proportion of iron does not occur in irregular, accidental, and isolated fragments, but the form of a *connected cellular network*, traversing the whole mass. This may be seen with the naked eye in the meteorites of Krasnojarsk, of Atacama, in the original mass of iron at Bittburg, and in the meteorites from unknown localities, resembling these, in the collection at Gotha, &c. And in such also as are more minutely intermixed, like those from Smolensk, Seres, Blansko, Tabor, Barbotan, &c., and have the same structure, the stony portion may be extracted, leaving a connected cellular network of iron. The specific gravity of these stones is from three to four and five. That of the earth, as is well known, is about 4.7, and all this renders it probable that it is constructed internally like a meteorite, of a congeries of iron cells, that its entire stony mass is interpenetrated by cellular metallic iron, exactly as in the majority of meteoric stones. *And in this iron would the magnetism of the earth dwell.* The irregularity of its distribution, as seen in every meteoric stone, and therefore to be assumed in the earth, renders the four-fold polarity of the terrestrial globe readily comprehensible.

605. This view of the constitution of our planet, of which geologists have not yet made any use, but which, as is seen, rests on a foundation of facts in natural history, is not contradictory to the now generally adopted hypothesis, that strata of molten matter in igneous fusion may still exist beneath the lowest of our geological formations. That such strata do exist is as certain as that meteorites arrive at the surface of our earth, still hot and coated with recently-molten clay. The remarkable meteorite of Clairborn, Alabama, was enveloped by a crust of slag one-fifth to one-third of an inch thick, when I received it. I received a mass of meteoric iron from Caryfort, Decalb County, U.S.

with a crust one-sixth of an inch thick. I possess aerolites from Nanjemoy, Maryland, covered in places with a porous slag one-seventh of an inch thick. But there is a wide interval between such a coating, and a melting and a state of igneous fusion *throughout the entire mass*. The earth has really an incandescent or still fluid coating some inches thick, analogous to the slag crust of the meteorites; the abundant proofs are too strong and too consistent to admit of a doubt of it; but it by no means follows from this, that it must be in a state of incandescent fusion throughout its whole mass, as is commonly much too hastily assumed. It is beyond all comparison more probable that its internal structure is like that of a meteorite, and, indeed, of a meteoric stone containing iron, perhaps of several united together, since we see new ones becoming united to it daily before our eyes.

606. Certain physicists, in particular Mr. Faraday, have asserted that it is impossible for the earth to be magnetic throughout its mass, if it be in igneous fusion in its interior, as we know from experiment that great heat is incompatible with the presence of magnetism in bodies. This objection is only important so long as we regard the *whole* contents of the planet as a lava. There is not only no strict reason for so doing, but a number of circumstances are directly opposed to it, none of which I shall bring forward here, except those I have just developed from the analogy with meteors. All these are melted merely on the surface, and in their interior consist of crystalline structures produced by a force which can be proved to have operated wholly and exclusively in the cold. Meteorites have been placed in circumstances in which excessive heat has acted upon them externally, melted their surface, and produced lava upon it, but this only for a short period, sufficient to melt down but a very limited portion of the surface. The earth has also

once passed through such a period, in the same way, only a crust of the substance composing it could be melted, now represented by that incandescent fluid stratum beneath our cooled surface, by which geologists satisfactorily explain our volcanoes, our basalts, trachytes, porphyries, and the heat increasing with the depth in every shaft and boring; the hypothetical basis on which all this rests having received general recognition. But such a mere crust of glowing matter, even if miles thick, cannot annihilate or even essentially affect the operations of the magnetism of the enormous cold, iron-traversed, globular mass more than 8000 miles thick.

These considerations, therefore, go to prove that the terrestrial globe is traversed by a magnet just in the way I have, in imitation, placed one in the *terrelle*, and thereby sought to bring the latter into condition, which should to a certain extent resemble those of the earth.

607. But *this iron*, assumed, as it must be, to be interwoven through the globe, *is also crystallized throughout*. When meteoric stones are ground and polished, and then very slowly corroded by diluted nitric acid, crystalline characters, which become distinctly visible under the microscope, make their appearance in all the portions of iron, however small they may be. There have been demonstrated to be markings identical with those called Widmanstetten's figures, on masses of meteoric iron, and they are nothing else than crystalline structures of the metallic constituents. I have investigated a great many in my own collection, and have found they contained metallic iron, everywhere crystallized, exactly in like manner, and according to the same laws and figures, as in the large masses of iron. I have dug out of the metcoric stones of Blansko little particles of iron, which, when polished and corroded, small as they were, exhibited not only planes of cleavage, but also pyrites en-

closed in the iron, exactly like the large masses of meteoric iron. The masses of meteoric metal, therefore, have magnetic and odic polarity from two causes : the one that they partially consist of a *mass of iron which is continuous throughout*, although cellular ; the other, that *this metallic mass is crystallized*, perhaps composed of one single vast crystal, irregularly formed, certainly, on the surface, but cohering intimately according to the laws of crystallization. But we know, from § 55 of my second treatise, that all crystals unceasingly emit concentrated odic light from their poles. The contained iron, therefore, and crystallization, act in conjunction to produce magnetic odic poles upon the terrestrial globe, and they afford the grounds which render it probable, in my eyes, that the magnetism and Od of the earth are not simply external and due to the sun's rays, but are in great part, if not chiefly, to be ascribed to internal causes ; in following out which, the otherwise singular fact that the astronomical and magnetic poles of the earth do not coincide,—that we have, not two, but four, magnetic terrestrial poles, &c.,—loses its strangeness, and becomes readily explicable. Thus the polar light of the terrestrial globe, like the odic luminous phenomena of my *terrelle*, may, on magnetic and odic grounds, be confidently attributed for the most part to internal action. We may regard both as diametrically traversed by actively magnetic and odic axes. The analogy between the entire planet and the miniature artificial imitation of it, is, therefore, quite complete on this side of the question.

608. An old observation made in Sweden by Wilke may also deserve to be recalled to recollection,—that *the appearance and the movements of the northern lights are always preceded by disturbances of the magnetic needle.** This,

* Gehler's physisch-Wörterbuch (Physiological Dictionary), i. 161.

as is seen, agrees most exactly with the odic phenomena : the latter always occur later and more tardily than the magnetic and electrical movements complicated with them, an observable pause always intervening before the commencement of the odic effects. Thus the same things which I have made out as above described, in the investigations in my dark chamber, were observed by others many years ago in the open sky.

609. Finally, I have to refer to Wargentin's observation that *the northern lights weaken the magnetic needle*. This is now explained without difficulty. The northern light is an odic magnetic emanation, material or immaterial, whichever we please to assume. When it issues from the north pole it is of positive magnetic nature. But the northward pole of the needle is negative. When +M passes over the needle from north to south, as the northern light does, it amounts to the same thing as if the southward pole of a very weak magnetic bar were passing uninterruptedly over the needle from north to south, for a length of time equal to the duration of the northern light. The effect of this must be like that of a weak ordinary rubbing ; and every one knows that a needle loses strength, or, as Wargentin expresses it, becomes dulled, when so treated, if rubbed in a direction contrary to its polarity. The northern light makes, over the needle, a weak but not the less real reversed pass, which, from its nature, tends to carry the south polarity of the north point of the needle to its south end,—that is, to reverse it ; and, since it does not possess intensity sufficient for this, it merely weakens the needle, thus dulls it, and so, as Wargentin adds, renders it less sensitive to subsequent northern lights.

610. Thus everything, without exception, that has been made out, in the endeavour to extend our knowledge of Od, has contributed to increase the harmony with which all the

facts agree to mark *the northern light as an enormous manifestation of magnetic odic flame, odic vapour, and odic light*; a miniature representation of which was afforded by the *terrelle*.

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